Cook Islands Government

Office of the Minister for Islands Administration (OMIA)

Palmerston Island Cyclone Management Project Feasibility Report

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Palmerston Island Cyclone Management Project
Feasibility Report

Contents

List of Abbreviations

ACCG	AC Consulting Group Limited
CIGov	Cook Islands Government
CIIC	Cook Islands Investment Corporation
CMC	Cyclone Management Centre
DM	Disaster Management
EIA	Environmental Impact Assessment
IF	Island Friends Ltd
NZAID	New Zealand Agency for International Development
NZHC	New Zealand High Commission
OIDP	Outer Island Development Projects
OMIA	Office of the Minister for Island Administration
PI	Palmerston Island
PID	Project Implementation Document
PIA	Palmerston Island Administration
PIC	Palmerston Island Council
TCI	Telecom Cook Islands

Finding your way around this Document

This is the Feasibility Report for the Palmerston Island Cyclone Management Project. The following should assist the reader to find their way around the primary information contained within this document. This report should be read in conjunction with the Shelter Options Report W1828/0/5/SO Rev 1 dated May 2003.

Why Provide Palmerston Island with Cyclone Shelter?

The Rationale and Justification for providing Cyclone Shelter is discussed in Section 3. The issues considered in identifying Palmerston's shelter requirements are discussed in Section 4.

What is recommended?

There is clearly a need for some form of shelter on Palmerston. Four options have been presented for consideration. The shelter options are generally discussed in Section 5, with a brief description of each option, their costs, and their pros and cons included as Attachment 7. The design of each shelter takes into consideration the improvements identified by NZAID during their evaluation of the Manihiki Project.

What Needs to be Taken into Consideration?

The implementation of the Project would be challenging and considerable planning will be required to ensure the construction programme is achieved on time and to budget. The construction issues that need consideration are discussed in Section 6, with the preliminary risks identified, and a means of mitigating them included in the Risk Management Matrix found in Section 11.

What would it Cost?

The estimated costs associated with achieving each of the shelter option are summarised in Section 5.

Option Two has been identified as the preferred Option and a breakdown of the preliminary construction costs is provided in Attachment 8. An Economic Evaluation based on Option Two is included as Section 10, with the detailed analysis provided in Attachment 9.

When would it be done?

Section 11 details the work plan and implementation schedule, with a preliminary construction programme appended as Attachment 10.

1. Palmerston Island

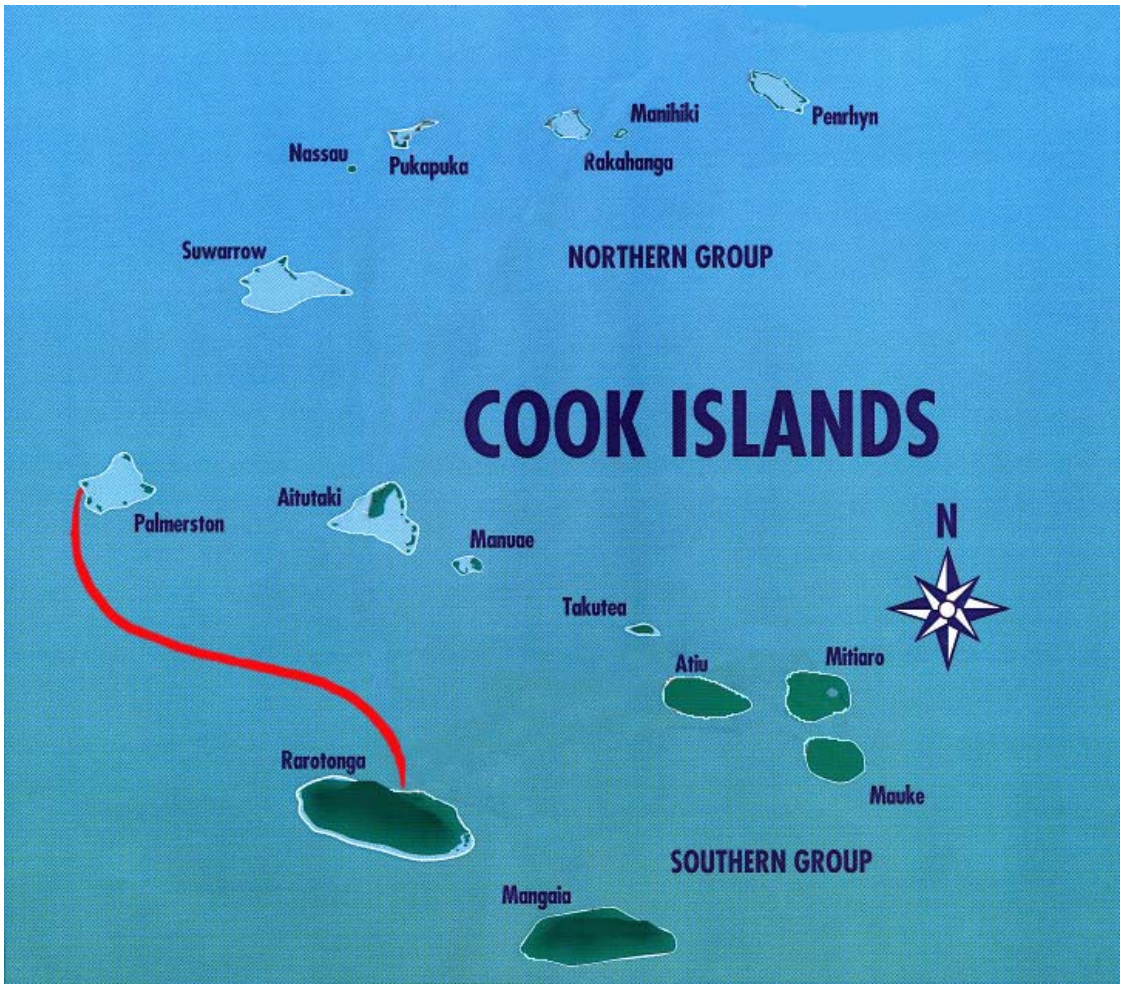
Palmerston Island is a low-lying atoll with a land area of 2.6 km^2 lying 18.07^o S and 163.17^o W, 500km (270 nautical miles) northwest of Rarotonga. It consists of six sandy motu (islets) scattered around a coral reef covering 14.6 km^2 and surrounding a lagoon of approximately 11km across. The only inhabited islet is Home Island, which has a land area of 0.39km^2 and is approximately 2.5 m above mean sea level (AMSL).

Access to Palmerston is by boat only, with a trip from Rarotonga to Palmerston taking approximately 24 hours depending on the vessel and sea conditions.

Palmerston has an everyday population of approximately 57 within three family groups, namely Matavia, Akakaingaro, and Tepou. The population can swell to 100 people during the Christmas Period when overseas family members return home for the holiday.

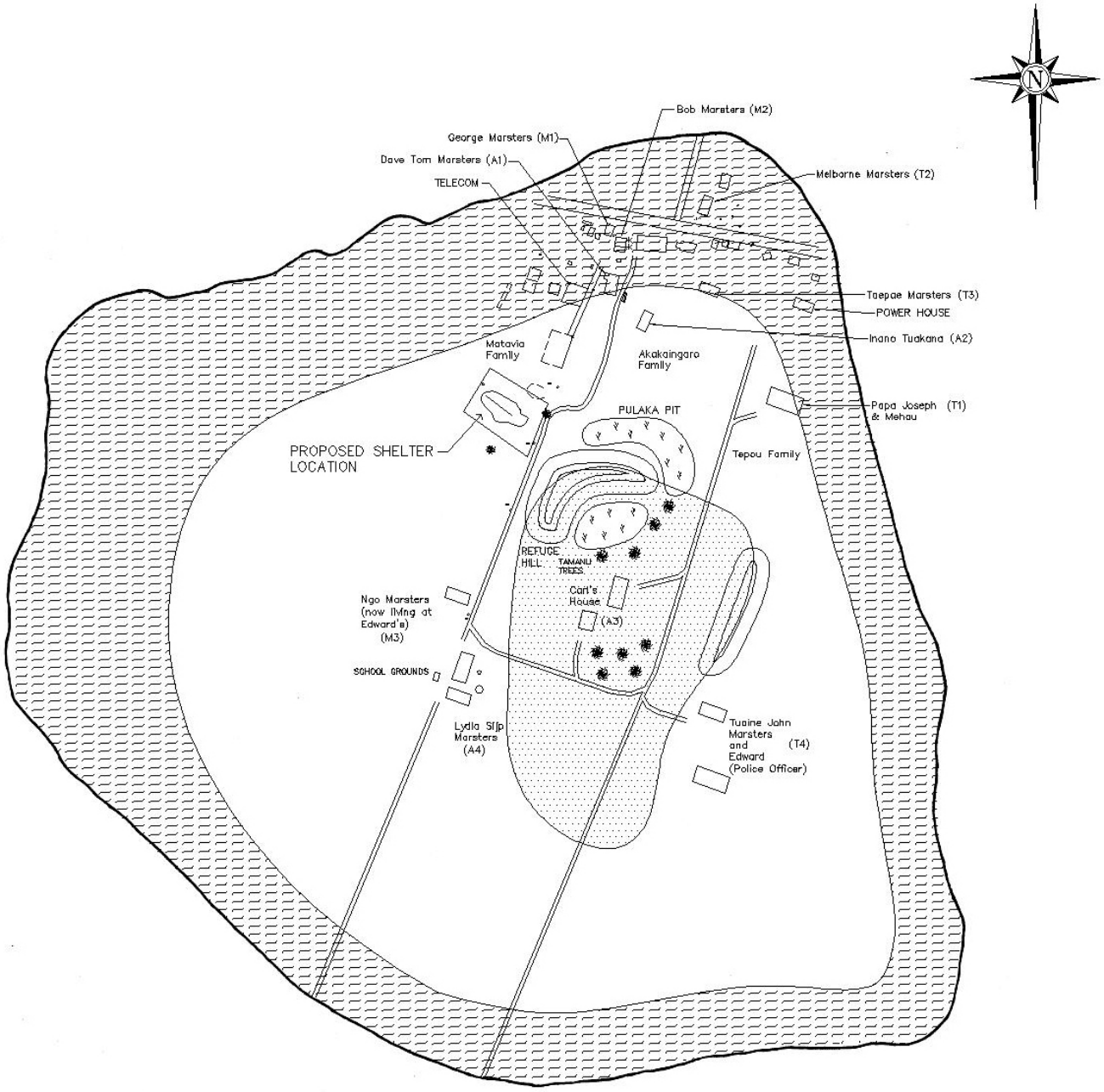
Refer to Maps 1, 2 and 3 below.

Map 1, The Cook Islands



Map 2, Palmerston Island

Map 3, Home Island



PALMERSTON – HOME ISLAND HAZARD PLAN

Not to Scale

(SKETCH OF ISLAND BASED ON OBSERVATION TAKEN DURING 7–11 APRIL 2003 SITE VISIT)

HAZARD LEGEND

- HIGH HAZARD
- MEDUIM HAZARD
- LOW HAZARD

FAMILY IDENTIFICATION LEGEND

(A1) AKAKAINGARO FAMILY

(M1) MATAVIA FAMILY

(T1) TEPOU FAMILY

2. Background

2.1 Project Origin

One of the primary focuses of the Palmerston Island 2000-2005 Strategic Plan was to "…provide improved services in all areas of the community…" To achieve this long-term goal, the Island Council and Island Administration developed concept plans for a multi-purpose administration building incorporating:

- Cyclone Shelter
- Medical Clinic
- Administration facilities including:
  - Council Chambers
  - Local Government Offices
  - Library
  - Tourist Office
  - Telecom / Bank Facilities
  - Police /Justice
  - Trading Store
  - Accommodation Unit

Following a request by the Palmerston Island Administration (PIA) for assistance, the Office of the Minister for Island Administration (OMIA) engaged AC Consulting Group (ACCG) to undertake a feasibility study for the Design and Construction of a Cyclone Shelter on Palmerston Island.

The Intention of the Feasibility Study was to:

"...address the proper scoping of the Project, to confirm design requirements, to confirm effluent disposal issues, to undertake an EIA report using the Cook Islands Environment Services, and confirm the overall budget and practicability of the Project."[1]

2.2 Design Brief

The Project's Design Brief called for a structure that addressed the following functional requirements:

- The principal function of the building will be to provide safe shelter from cyclone storms for the entire population of Palmerston Island. For design purposes, the population on Palmerston can be assumed to be 60. *This figure has since been revised to 70.*
- The secondary function of the building will be to provide accommodation for vital post-cyclone services for health and communications.

[1] Design Build Brief for Contract C02/04

- The building will be designed to allow for future annexed office accommodation for other Local and National Government functions, and also banking services, tourism office and retail outlets for example.

- The building shall also have toilet/shower facilities, and rainwater catchment and storage facilities.

- The building is to be two stories. The upper floor area will be the location for the emergency shelter. The future annexed office accommodation occupying the ground floor will be designed not to compromise the overall tidal wave survival capability of the emergency shelter.

A full copy of the Project Brief is included as Attachment 1.

2.3 Preparation Path

This study has been prepared in close consultation and collaboration with key project stakeholders including OMIA, the Palmerston Island Council and Island Administration and the Community of Palmerston. This feasibility study takes into consideration the outcomes of the:

- Site assessment visit to Palmerston Island over the period 7 April 2003 to 13 April 2003.

  The Feasibility Team comprised:

  - *AC Consulting Group Limited,*
    Graeme Campbell and Neil Robertson

  - *Island Friends Ltd (Environmental Impact Specialists),*
    Teariki Rongo and Julia Rongo

  - *Office of the Minister for Island Administration (OMIA),*
    Ken Munro

  - *Cook Islands Investment Corporation (CIIC),*
    Reboama (Rebo) Samuel

  The Team was also accompanied to Palmerston Island by:

  - *Palmerston Island Mayor,* George Marsters

  - *Palmerston Island Secretary,* Lydia Sijp-Marsters

  - *ERLA Trading,* Eric Sijp

- Meetings with Island Representatives in Rarotonga including the Mayor and Island Secretary;

- Stakeholder meetings in Rarotonga and New Zealand such as OMIA, the NZHC and NZAID

A Work Diary is included as Attachment 2, and a Record of People Consulted is included as Attachment 3. Questionnaires were also developed by AC Consulting Group (refer Attachment 4) to assist with the data capture, copies of which were provided to the Island Friends Team for their information.

It was clear during the feasibility site visit, and after discussion with key stakeholders, that more consideration of the various options for providing shelter was required, specifically by taking into account the long-term development goals of the Palmerston Administration, before finalising on a structure for detailed design.

An Options Report was prepared to address this issue with four options presented for consideration. R*efer Shelter Options Report W1828/0/5/SO Rev 1 dated May 2003.* For each of the four options, the report provided:

- A description of the key elements of the design;

- Drawings including floor plans, an elevation and a typical cross section;

- Preliminary costings;

- Discussion of the pros / cons of each option in relation to Option One;

The intention of the Options Report was to provide information on a range of shelter options from a basic core structure that meets the immediate cyclone shelter needs through to a larger structure that would cater for more of the community's future aspirations. The report also assessed the pros and cons of each option and provided a ranking from the consultant's knowledge and experience.

3. Rationale for Providing Cyclone Shelter

3.1 Project Goal and Objective

The *Goal of this Project* will be to provide cyclone shelter to the Community on Palmerston that minimises lose from a cyclone.

The *Objectives* will be to design and construct a shelter that:

- Provides shelter for the Palmerston Island Community and some of their possessions;
- Improves social and economic recovery following a cyclone;
- Provides basic water and sanitation facilities;
- Provides for post–cyclone recovery including the provision of space for a medical clinic and emergency communications;
- Allows for the long term development goals of the Island
- Maximises the use of local resources and skills during the construction of the cyclone shelter.

3.2 Justification

Palmerston Island's specific location makes the community very vulnerable to damage from a cyclone. Home Island itself is on the weather side of the atoll in the event of an approaching cyclone. It has a land area of approximately 0.39km^2 and is generally no more than 2.5 - 2.7 m above mean sea level. The only high ground (Refuge Hill) is man made as a result of excavating Pulaka Pits. In addition to this, Palmerston Island has no airport, and the communication facilities and the medical clinic are all located in the medium to high hazard areas making it very likely that there will be no communications or ready access to Palmerston following a major cyclone event. In addition, the paths of cyclones are such that those that affect Palmerston have a high probability of hitting Rarotonga and the other islands in the southern group, which means that the national emergency services will likely be deployed to address the immediate needs of Rarotonga, and adjacent islands.

The Palmerston Community will therefore have to be totally self sufficient for several days if not weeks after the event. It was three years before the outside world became aware of the plight of the Palmerston Island community following the 1926 cyclone *(David Tom Masters 2003).*

Currently, there are no buildings on Palmerston that are considered secure during a cyclone. The new telecom facility has been located in a high hazard area and will almost certainly be inoperable during a major cyclone. All communications will therefore have to rely on private VHF radios scattered around the village.

In addition to Palmerston Island's specific situation discussed above, previous work contained in "The 10-Year Plan for Improving Cyclone Shelter in the Outer Islands", prepared by ACCG on behalf of the Cook Islands Government, noted that:

Reducing the impact of cyclones will greatly enhance the ability of the Palmerston Community to participate in the national economy. This will be achieved by reducing the impact of cyclones on the economic and social activities by speeding the recovery following a cyclone event.

In particular, the provision of cyclone shelter will:

- Save Lives;
- Reduce the sociological impacts of cyclones on the community;
- Reduce the value of damages from a cyclone event;
- Speed up recovery times;
- Reduce the cost of recovery programmes.

Women and children are two groups who are considered to particularly benefit from the provision of cyclone shelter. In Manihiki following Cyclone Martin, for example, the majority of the people evacuated from the Island were women and children. Separating the family groups a few days after they had experienced what would have been, in many instances, the most traumatic event in their lives caused even further distress. In most cases, it was months, and some years, before the family groups were reunited. If shelter can be provided that avoids the need for such a mass evacuation, then the social losses would be reduced, and ideally, recovery times shortened.

Cyclone shelter provision helps to keep individuals, businesses and communities safe, as well as protecting assets and avoiding the disruption and trauma caused by cyclone events. For Central Government, deciding what cyclone protection should be offered to each Outer Island means balancing the benefits to those at risk against the benefits and costs to the whole nation.

'Our people are our greatest natural resource. Putting people first is the cornerstone of a philosophy, which acknowledges the family unit as the building block of the community, of the village, of each island, and of our nation. When the people in these units are well off, the country as a whole is well off. When they suffer, the whole country suffers…'*Central Government Budget Policy Statement April 2000*

Further, part of Central Governments' long-term strategic direction is to minimise migration and to encourage communities back to the Outer Islands. Offering safe shelter during the Cyclone Season is one of the first steps towards this objective.

4. Cyclone Shelter Requirements

The cyclone shelter requirements for Palmerston were made considering:

- Topography and Hazard Category
- Location of the Shelter
- Land Tenure
- Population
- Historical Records
- Existing Cyclone Shelter
- Existing Disaster Management Capabilities

4.1.1 Topography and Hazard Categories

Our assessment of Home Island, including talking to nearly all residents on the island and our own observations collated during our site visit, indicates that the whole of Home Island is at some risk from cyclones. Referring to Map 3, we have categorised this risk into three hazard zones being High, Medium, and Low.

- ***High Hazard***

The seaward edge around the entire periphery of Home Island should be regarded as a High Hazard Area, where storm surges and tidal waves are expected to break. The entire shoreline and up to a minimum of 50m inland is considered to be a high hazard zone. This high hazard zone extends further inland on the north and west shore, as this is the predominant direction from which the cyclones will come. The part of the village to the north of, and including the telecom site and water catchments, is in this high hazard zone.

Areas of the island in the High Hazard Zone would present extreme danger to people during a major cyclone with the potential for loss of life. The water and wind velocities would be such that people would be unable to maintain their footing and there would be significant amounts of flying debris.

High Hazard Areas should be treated as a conservation reserve with planting of trees and shrubs encouraged, providing a natural buffer between the sea and permanent buildings.

- ***Medium Hazard***

The balance of the island, apart from the area around Refuge Hill falls into a medium hazard zone. Although out of the wave break zone, wave wash is expected to flow through this area, with debris from the wave break expected to flow and accumulate.

During Cyclone Val, which is considered only a once in 10-year event, water flowed through the village past the Medical Officers House (Taepae Marsters), up the main road and past the telecom site, towards the site for the proposed shelter. This cyclone also flooded the eastern side of the island, through the lagoon, reaching past Edward's house (the Police Officer). An adult taking extreme care may be able to move through a medium hazard zone, for short periods during a cyclone event.

- ***Low Hazard***

A low hazard area should offer reasonable protection to people during a major cyclone. Able-bodied adults would be able to move within a low hazard area during a major cyclone but may still have to take reasonable precautions such as tying themselves to the tamanu trees during the peak of a cyclone.

The centre of the island is at lowest risk, with the area around the mounds adjacent to the Pulaka Pits known as Refuge Hill. Refuge Hill offers safe ground of up to 4.0m AMSL. There are also a number of large tamanu trees that the community tie themselves to during extreme cyclone events. These mounds are just behind the houses in the main part of the village and extend to the southeast past the road adjacent to Carl's house. Most houses in the village have ready access to this area.

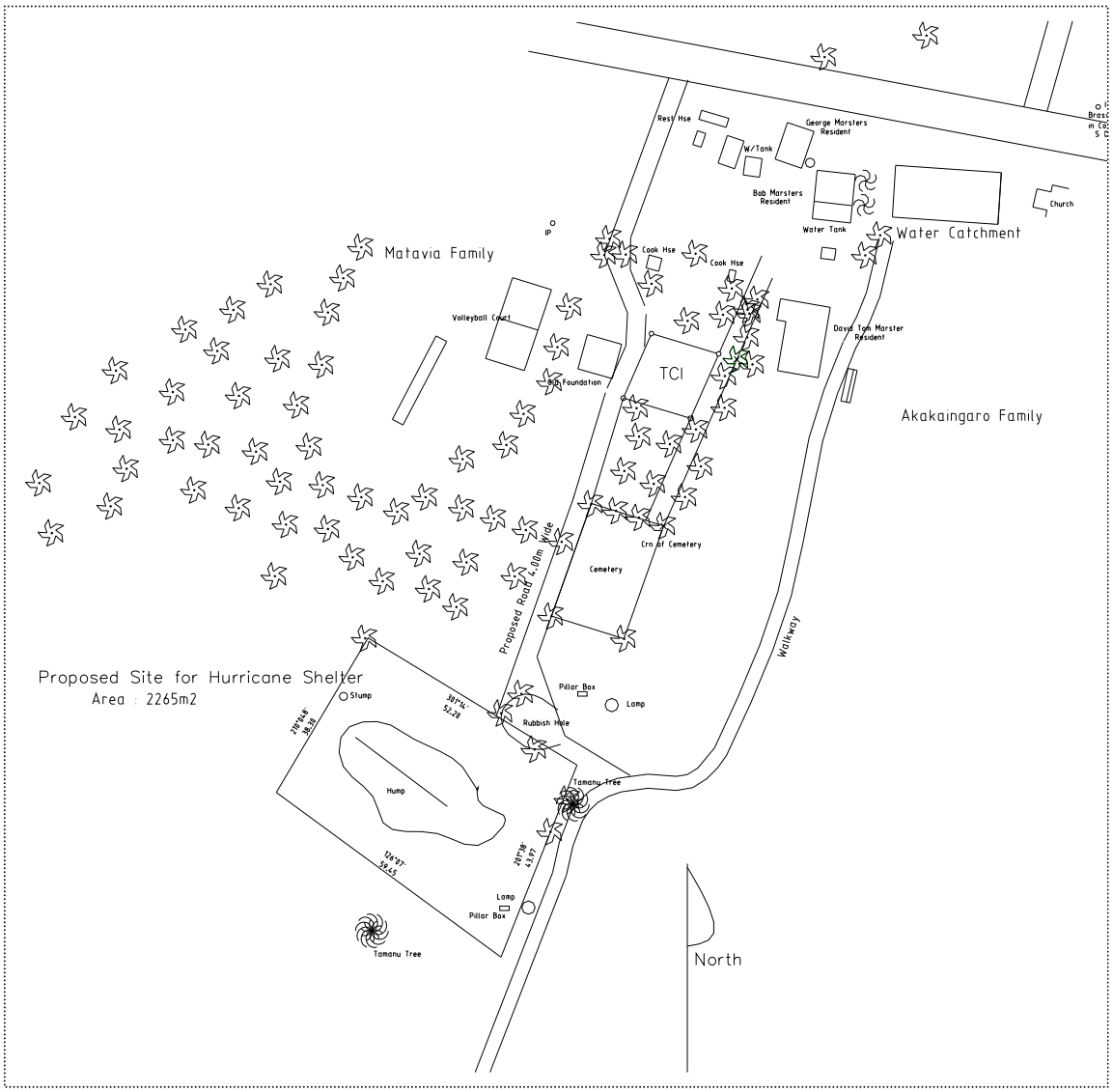
4.1.2 Location of the Shelter

Referring to Map 4, the site for the proposed shelter is in the north-western sector of the Island, approximately 150m back from the shoreline. This puts the site in a medium hazard zone. The site is also slightly raised, with a ground level of approximately 3.0m. There is a significant band of trees between the site and the sea, which would provide reasonable protection from breaking waves. These trees would need to be retained to provide protection to the shelter.

Access to the site is available from all parts of the island, over land that is out of the High Hazard Zone. No individual would have to cross a higher hazard area, than that in which they are currently living, to get to the site. The families on the south-eastern side of the island would use the back road; past Carl's House and the school, to get to the site.

Consideration should be given to the ability of the elder community to get to the site. Specifically the members of the Tepou family, Papa Joseph, Mehau and Tuaine John Marsters, who are more isolated from the shelter and reside on the eastern shore of the Home Island. When the issue of isolation from the shelter was raised, the community assured us that come what may, the elders would be taken to the shelter,…"even if it meant carting them in a wheel barrow!!"

Map 4, Village Plan, Courtesy of CIIC



4.1.3 Land Tenure

Palmerston Island was leased from the British Government on 23 May 1891, and replaced by the Cook Islands Administration lease granted in 1913. In 1954, NZ Parliament Act vested the land to the Native inhabitants of Palmerston and their descendants, apart from 10 acres, which would be deemed to remain as Crown Property. This 10-acres has yet to be demarked

In conjunction with the Feasibility Site Visit, Rebo Samuels, a surveyor, was requested by the Cook Islands Investment Corporation (CIIC), to locate and demark the proposed site for the cyclone shelter and those assets which have been designated as Crown Property and which form part of the 10-acre allocation. These assets include the:

- Easement of roads for access around the Island;
- Old radio section;

- Community Water tank;
- School;
- Island Administration Storage Sheds;
- Power-Energy Station

The location of the proposed shelter is on land owned by the Matavia Family. The site, with a land area of 2265m^2, is located approximately 200 meters south-east of the main village, and approximately 150 meters inland from the shoreline. The site, is nominally 2.7 metres above mean sea level (AMSL) with a raised mound of +0.3 meters formed from sandy material deposited during the excavation of a Pulaka pit (which is now being used as a rubbish pit) to the north-east of the site.

Acknowledging that the site is defined as *Medium Risk*, and taking into consideration the:

- availability of land in general;
- willingness of the Matavia family to allocate the site for the specific purpose of constructing a community shelter;
- proposed integration of the site into the community for administration and social purposes, as a venue for public meetings and social functions;

the site allocated for the shelter is the most reasonable. It does not present any construction difficulties that cannot be reasonably accommodated.

The land tenure agreement has been based around the Island Council's long-term development plan for a multi-purpose administration building. This was to ensure that the footprint of the final building could be accommodated on the site. Two proposals for land size were identified.

The first proposal was for the bare minimum requirements of the building footprint, based on a ½ acre parcel, and allowed nominally for a 15m easement around the building to protect the building from falling coconut trees. The second proposal was for a larger site of approximately ¾ of an acre that allocated land for a contractor's yard (i.e. for storage and construction purposes). Both proposals were presented to the head of family, George Marsters, to look at and evaluate before endorsing the land transfer deeds.

We understand that the Matavia Family has decided to gift the smaller parcel of land for the purposes of constructing a shelter and that the legal documents have since been drafted for ratification. *Including the ½-acre allocated for the shelter, 4 acres of the 10-acre allocation has now been demarked as crown property.*

4.1.4 Population

The initial design brief for the shelter identified the requirement to provide shelter for up to 60 people. This was subsequently revised to 70 following discussion with the Island Council and Island Administration.

Also, and in discussion with members of the community, AC Consulting Group took a snap shot of the population on Palmerston during the Feasibility Visit, provided as Attachment 5. Excluding the Feasibility Team itself, the number of family members on Home Island were 57. Taking into consideration the anticipated return of George Marsters' family from Rarotonga, and Taepae Marsters (Medical Officer who was evacuated to Rarotonga with a broken leg) the population could increase to 65. Over the Christmas Period, which is in the middle of the Cyclone Season, the population can swell to 90-100 as family members from overseas return home for the Christmas Break.

4.1.5 Historical Records

Whenever a Tropical Cyclone threatens the Cook Islands, Cyclone Warnings are issued to allow the communities to take the necessary precautions. These warnings are issued 24-48 hours before the Cook Islands are affected. On Palmerston, the warnings are notified through Telecom Cook Islands (currently by Melbourne Marsters) and through radio broadcasts. *The majority of households have VHF radio facilities powered by solar panels.* The three main categories of intensity are:

1. ***Hurricane Intensity***:
   Average surface wind of 64 knots (118km/hr)
   State of the sea: phenomenal over 14m (45 feet)
   Damage very rarely experienced on land but if so wide spread damage.
   Hurricane Warning Issued 3-hours before the expected occurrence of Hurricane force winds

2. ***Storm Intensity:***
   Average surface wind speed of 48 to 63knots (88 to 117km/hr)
   State of the sea: Very high 9 to 13m (30 to 45 ft)
   Extensive damage to any obstacle.
   Warning issued 3 hours before the expected occurrence

3. ***Gale Intensity****:*
   Average surface wind speed of 34 to 47knots (63 to 87km/hr)
   State of sea: Moderate to high and rough seas. 4 to 6m (13 to 20 ft)
   Damage: Slight structural damage.
   Warnings issued 6-hours before expected occurrence of gale force winds.

Attachment 6 provides a summary record of the Cyclones affecting the Cook Islands.

The Village Elders recall, with some clarity, the 1926 and 1935 events. These cyclones, which devastated Palmerston Island, could be considered to be once in a lifetime event. It took the community and the island ecology years to recover following these storms.

4.1.6 Existing cyclone shelter

There is clearly a need for cyclone shelter on Palmerston as there are no buildings or areas on the islands that could be considered safe during a cyclone. Given Palmerston's isolated location, and vulnerability to inundation during a major cyclone, this puts the whole community at risk in terms of both lives and possessions.

No point on Palmerston is more than 400m from the sea and there is no natural ground (other than Refuge Hill) more than 2.7m above mean sea level.

4.1.7 Existing disaster management capabilities

When Cyclone Warnings are received, the community rally together, pull the boats off the beach, and store them in the lee of their homes. Building roofs are tied down, and shutters placed over windows. The community traditionally take shelter in their own family homes, and it is only when water begins to flow through the village do they evacuate and head for the higher ground around Refuge Hill.

There are a number of tamanu trees on Refuge Hill that people have tended to tie their children to during the height of a storm.

5. Shelter Options

As a component of the Feasibility Study, an Options Report was prepared and presented to key stakeholders for their consideration. This report, refer 'Shelter Options Report W1828/0/5/SO Rev 1 dated May 2003' presented four different options for providing shelter to the Palmerston Community. A brief description of each of the four options has been included as Attachment 7.

The four options considered cover a range of shelter options from a "bare bones" shelter which meets the immediate cyclone shelter needs of Palmerston, through to a more substantial shelter / administration building (along similar lines, but on a smaller scale than that originally proposed by the Palmerston Island Council) that caters more for the community's future aspirations.

The pros and cons of each option are again discussed in Attachment 7. A comparison of key elements for each of the options is summarised in Table 1 below.

Table 1, Key Elements

Features	Comparison			
	Option 1	Option 2	Option 3	Option 4
Preliminary Estimate of Costs	1,496,500	1,583,000	1,752,000	1,875,500
No. Of Bays	3	3 + mezzanine	4 + dbl mezzanine	5
Upper floor area available for shelter and storage of possessions during a Cyclone (m^2)	81	100	140	112
Ranking	4	1	2	3

Option 2 is currently considered as the preferred option because it is the lowest cost option that meets the project brief and has the support of the Palmerston Island Council.

The economic analysis in Section 9 of this report is based on Option 2.

5.2 Are there Other Options?

It has been suggested that Palmerston does not need a large community shelter and that three smaller shelters (similar to the microshelters constructed on Manihiki) would suffice.

However, it would appear that the community is trying to move away from the traditional 'three three three' scenario; the future aspirations of most members of the family (especially those members of the younger generation who we talked with) is to become a more integrated community, working and living together and not be defined by boundaries or traditional family splits. As a move towards this, when the project initially suggested supplying three individual microshelters, it was rejected by the Island Council. The Island Council is looking for one building, protected as a Crown Asset, a building that was integrated into the community and one that recognises the future long-term aspirations of the community.

A microshelter, similar to that constructed on Manihiki should comfortably accommodate upto 12 people with minimum possessions during a cyclone event. Six microshelters would therefore be required to provide sufficient shelter for all the community.

The costs of six shelters would be in the order of $1.1M or 30% cheaper than the preferred option. The microshelters however are not as secure as the Cyclone Management Centre because of their lighter construction and would not provide for the broader goals of the Palmerston island Council, namely a single community asset for all to use.

For these reasons, we have not recommended pursuing the microshelter option.

5.3 Other Donor Opportunities

The estimate of costs for the shelter options considered is for the basic building only. However, one of the recommendations from the Manihiki Reconstruction Project Evaluation is that the CMC should be resourced "to properly fulfil a civil defence purpose e.g. provision of emergency medical supplies, an emergency medical station, basic search and rescue equipment and telecommunications equipment (short wave radios), and emergency power facilities.

No costs have been allowed for these items. However, they should be considered in order to service the primary function of the building. The Island Council has indicated that they will prepare separate proposals for funding of these additional items.

6. Construction Issues and Implementation Methodology

In general, all materials, plant, and labour would be imported for the construction of the shelter. While potentially more expensive, it means the project is able to proceed in a relatively self-sufficient manner. Where possible however, local resources would be used if they are made available. Contracts for construction would be set up in such a way that any 'savings' from using local resources would be passed back to the overall project budget.

Some of the specific matters considered are dealt with below.

6.1 Materials

- ***Aggregate***

Approximately 150m^3 of graded aggregate (kirikiri) is required for concrete production. The material and shipping costs allocated to the shelter include for importing the aggregate mix to Palmerston. Offloading 150m^3 of aggregate will take approximately ten trips on the barge (assuming 15m^3 per load). Assuming a two-hour turn around per trip, via Big Passage, five trips could be achieved per day. Offloading the aggregate, excluding the use of local lighterage, would therefore take two days.

No suitable sources of aggregate were found on Home Island. Inconsistent quantities were located on some of the adjacent motu. The logistics, environmental issues and resourcing (both in plant and in personnel) for winning aggregate locally and transporting it to Home Island make it an extremely difficult exercise and therefore negate the practicality. Notwithstanding this, the quality of the aggregate on the motu does not offer the preferred grading for concrete production. It is also estimated that for concrete requirements alone, it would take between four and six weeks to hand win and stockpile on site upto 150m^3 of material. A very labour intensive exercise for the community.

For in-filling around the site and within the building foundations, approximately 100m^3 of general non-organic fill material would be required. The Project would win this material locally, either through the process of constructing the water well (s) or from other inland sources determined with landowner approval. The Matavia Family has granted permission for pits to be dug locally to provide this additional in-fill material; the pits would be turned into Pulaka Pits upon completion of the Project.

- ***Sand***

Approximately 15m^3 of sand is required for construction purposes, specifically during concrete production. This quantity of sand can be won locally, nominally from the wide sandbanks on the west to southwest quadrant of Home Island. 15m^3 equates to approximately 10 trailer loads of sand, which is equivalent to working along a 20-meter stretch of beach, within 10 meters of the foreshore, and removing upto 100mm of sand.

The Mayor has agreed that, prior to construction activities commencing, and subject to adequate notice being provided, he would arrange for the community to win the sand and have it stockpiled adjacent to the shelter site. Winning of the sand would be done manually using shovels, loading the material onto the tractor-trailer

- ***Water***

Cumulatively, approximately 94,000 litres of water would be required for this project, comprising:

  - 54,000 litres allocated to the construction team for general consumption and for washing and cleaning etc (based on a team of six people using 50 litres per person per day for 180 days).

  - 40,000 for concrete production.

It is expected that the community water tanks would be used to meet the construction team's personal needs, up until such time additional catchments can be established. Each of the community water tanks holds about 45,000 litres. With three main tanks on the island, two beneath the water catchment and one located at the school, the community storage is approximately 135,000 litres.

The project would be importing between four and six 5,000-litre tanks. Therefore, to efficiently utilise the available catchments and minimise the time spent constructing new catchments, water could be transferred from the main community tanks to the project's storage tanks to meet the construction team's needs. The community tanks would then have residual capacity, to contain the maximum amount of rain run-off, without loss, in times of heavy rainfall (between February and April).

For construction purposes, water would be sourced from the fresh water lens via a well constructed adjacent to the shelter site. A pump of sufficient capacity would need to be installed to transfer the ground water at a sustainable rate to storage tanks on site. Again, the Head of the Matavia Family, George Marsters, has agreed to the construction of a well adjacent to the site.

- ***Trees***

Coconut trees would be used for the construction of the temporary wharf and for the construction of lean-tos for material storage. The trees would be sourced during the clearing of the site for the storage yard and the contractor's working area. We understand that there would be no costs associated with using the trees.

- ***Pre-casting of Materials***

Appreciating that there is a significant amount of concrete work in the foundations, one option to save time and resources on island is to look at the options of pre-casting as much of the material as possible (such as the foundation beams and the concrete columns). This would potentially save time, both in terms of:

- Offloading of materials. It is estimated that the aggregates would take three days to offload and then potentially another week of time to stockpile them on site.

- Construction of the foundations as there would be significantly less time spent on manufacturing formwork, tying the reinforcing, placing concrete, curing and stripping the formwork.

Pre-casting of materials would minimise the need for construction supervision during the foundation phase (refer 6.15 below). However, additional time would need to be spent in NZ working with the pre-caster, to ensure that tolerances and quality are achieved.

The pre-cast materials would present a challenge during offloading due to the weight and bulk of the beams and columns. The plant for lifting and transporting would need to be sized accordingly. In addition, extreme care would need to be taken during offloading, as the consequence of losing one of the beams overboard would be major. Additional beams may need to be manufactured to minimise exposure or stock lengths of reinforcing and aggregate/cement supplied as a fall back.

We are unsure at this stage what the cost-savings for pre-casting the foundation beams would be as there are a number of items that would need to be taken into consideration. This would need to be worked through with the Contractor.

6.2 Labour

The preliminary costs allow for a totally independent workforce, nominally NZ or Rarotongan based. However, the Project would need to allow sufficient time for the Island Administration to approach members of the local community who may want to be involved in the construction; and also allow sufficient time for those family members in Rarotonga to return to Palmerston should they wish to become involved.

- ***Advance Party***

We see great benefit to the project in sending an advance party to site before the main construction team arrives with the materials and plant items. Not only could they get the temporary wharf constructed in time to facilitate the offloading of plant and materials, they would also be able to undertake the on-site establishment (including refurbishing accommodation and setting out the work site and construction yard).

One other major benefit would be to have a small presence on the island so that the community become fully aware of what is required of them (in terms of offloading), and for the team to identify who, from the community, would be willing to work for the project. This would help to maximise the community input by providing more of a lead up time, prior to the main construction team arriving. It will also give the contractor time to assess the labour resources on island and evaluate the true potential to make sure that the team and resources brought on island are optimised.

The preliminary costs allow for the advance party to travel to site on the Te Kukupa four weeks before the arrival of the main construction team.

- ***Accommodation***

The issue of accommodation still needs to be resolved. For the extended duration of the Project, a construction team of between six and eight people would be looking to have two to three houses available for their use.

An $ 18,000 allowance has been allocated either for the renting of accommodation or for the basic refurbishment of houses in lieu of rent. On a worst-case scenario, the project would have to temporarily construct their own accommodation at potentially a higher cost.

The option of billeting the team with families was raised but we do not think that this is the preferred option as it does not provide the construction team with their own space after a hard days work and avoid any potential friction between the team member and the individual families. Obviously, this issue would need to be considered further should three houses not be available. A campsite (tents) is another option that may be a feasible option depending on the requirements of the preferred contractor.

- ***Site Supervision***

Supervision of the construction works would be difficult primarily due to restricted shipping services, which prevent regular site inspections. Supervision is essential for on-going liaison with the community and to ensure that the building is constructed properly and that quality procedures are being adhered to, especially in the foundations, as there is little opportunity to correct any deficiencies once the concrete is in place.

Options for on-going site supervision would need to be considered. However, the preliminary estimate of costs has allowed for three visits of three weeks each during the construction phase.

- ***Community Labour***

We acknowledge that there are a number of people who would be willing to work on the project, and effort would be taken to identify the various opportunities available. However, whilst the Project would be hoping to maximise community involvement, we would still need to ensure a totally independent workforce to ensure that the Project is completed on time and without the reliance of external input.

There would be significant exposure to the project if there were a reliance on community input. Experience has shown that it exposes the client to claims for extensions of time (from the Contractor) if the agreed community input does not eventuate. It can also result in a feeling of negativity between the project team and the community.

With the issue of providing an independent workforce, and the willingness of the community to provide assistance, careful consideration would need to be given to the type of construction contract entered in to, to ensure that the project gets some financial benefit from the community input. i.e. community input would potentially benefit the contractor by reducing his establishment time on island, with no reduction in the overall contract value. This is discussed further in 6.10 below.

- ***Communications***

Palmerston Island is serviced by one community public telephone and facsimile service, located at the Telecom building approximately 100m north of the site. The public telephone is located outside the Telecom building and requires a prepaid Kia Orana Calling Card for all outgoing calls. The facsimile service is located inside the telecom building and although it is a 24-hour service, access to the facsimile machine is only during working hours.

Whilst the facilities appear to be realistic, the project would need continuous access to phone/fax and e-mail facilities especially during the initial phase of the project when there are potentially a number of difficulties to overcome such as sorting out construction details, resourcing, to ordering of materials etc. The Project would be hoping to have in place a dedicated phone line and have had some preliminary discussions with Telecom Cook Islands with the view of installing another phone line direct to the shelter site. However, the initial feedback from TCI suggests that it is cost prohibitive. We will continue to liaise with TCI. However, we have allowed nominally $1,000/ week for communications, which we believe as sufficient to cover nominal satellite communication costs.

- ***Banking Facilities***

There are no banking facilities on the Island, which will prove difficult when it comes to employing members of the local community and paying their wages. The Project may need to adopt the Island Administration's current practice of crediting wages direct to the workers' bank accounts in Rarotonga. This is not the ideal scenario, as people tend to like receiving money in their hand at the end of a week and would therefore need to have some faith that the money is being paid.

The other alternative is to arrange with the Island Administration to employ the workers on behalf of the Project, as all the systems of payment and PAYE are in place. The Project would in turn credit the Island Administration. This item needs to be discussed further.

6.3 Plant

All plant would be brought on to Palmerston and would be taken off at the end of the Project. The costs allow for the disestablishment costs and return shipping of plant.

We assume that the island administration tractor-trailer would be made available especially during the offloading of materials.

6.4 Shipping of Materials and Storage

- ***Shipping***

At this stage, it is anticipated that the materials will be shipped to Palmerston direct from Auckland on the MV Miss Mataroa. This would minimise the risk of delays and loss or damage to materials as a result of transhipping the cargo at Rarotonga.

Of the ships servicing the Outer Islands, the Mataroa offers the best facilities for the Project due to its size and cargo carrying capacity, the deck space for storing plant and the barge and the derrick crane (although rated for 5 tonnes SWL, it can lift upto 8 tonnes) and the deck hiab (rated for 1 to 1.5 tonnes) for offloading. The hiab can work independently of the derrick crane to offload onto the lighters, speeding the offloading.

If the Mataroa were not available, the Project would need to tranship its cargo to the only other local shipping line, (potentially at a higher cost to the project due to varying freight rates etc). The freight rates adopted for the preliminary costings take into consideration the higher costs for trans-shipping the freight in Rarotonga.

The project would have to look closely at the options available, including potentially the negotiation of the lease of another ship to freight plant and materials specifically for this project.

Customs Clearances for the Project Supplies will be the responsibility of OMIA. All customs documentation including Bills of Lading and Export Entry Documentation will be provided to OMIA to facilitate this. We understand that OMIA will pass this information on to the Aid Management Division (AMD) who will certify the exemption of levies and then send the information onto Customs via the Ministry of Finance.

- ***Offloading***

Approximately 500m^3 of plant and materials (depending on which building design is chosen) would be shipped to Palmerston. This comprises approximately 125m^3 of plant and approximately 375m^3 of materials. On completion of the works, the plant and minor establishment items would need to be shipped off Palmerston.

We understand that the community would assist the project in offloading the cargo, making available upto six boats (both council owned and private). The project would meet all fuel costs for running the lighters, and have allowed for these costs. However, we have yet to be advised whether the community would be looking to be compensated for their time, but it is anticipated that the community contribution would be provided free of charge.

From discussions with the Palmerston Community, we understand that from experience it takes one day to offload approximately 80 tonnes of personal cargo (including foodstuffs and minor building materials). With this in mind, and taking into consideration the availability of a barge and the size and weight of the project materials, we estimate that it would still take six or seven days to offload 500m^3 of plant and materials. Packages would be limited to 1.5 tonnes, where possible, to allow them to be carried by the small lighters and to assist with lifting and handling at the landing site.

The project would utilise both Small Passage (for the lighters) and the Big Passage for the barge. The turnaround for the lighters is estimated at 45 minutes (including waiting time); with the turnaround for the barge estimated at 2-hours.

- ***Construction of a Temporary Landing***

A temporary landing would need to be constructed on the beach foreshore. The landing would need to be tide independent. The landing would need to be in the order of 20 meters long to allow sufficient depth, nominally 1.5m, to ensure sufficient freeboard for the barge.

The temporary landing would be constructed primarily from coconut logs (cut to approximately 4m long) tied together, with gabion baskets forming the head of the wharf.

It is envisaged that the barge and lighters would tie up to the landing, with the project excavator working off the landing. The excavator would offload the materials and transfer them to the beach, above the high tide mark. The materials would then be loaded onto one of the 4WD trucks of the Island Administrations tractor-trailer for transferring to the designated storage area.

- ***Storage of Materials***

The provision of secure storage facilities (for building consumables and small plant) still needs to be addressed. The Island Administration has a storage shed located just south of Carl's House, on Akakaingaro Land. This shed is empty and would provide ideal storage for the project, but due to an apparent family dispute, the shed has been locked and the Island Administration is unable to gain access to it.

However, we understand that the land the shed is constructed on is to be demarked as Crown Land, and the family would therefore have no claim over it. If this were so, then the Island Administration would make it available for Project use. We assume that this would be free of charge. The other alternative is for the project to construct its own secure storage shed on site.

7. Plan for Period 1 July 2003 to 30 June 2004

7.1 Strategy for Implementation

The immediate strategy would be to secure support and funding for the project. Once this funding is secured, the detailed design can progress, together with the preparation of construction specifications for tendering the construction works.

On completion of the detailed design, specification, and confirmation of costings, the Project Implementation Document (PID) would be produced for Government Approval.

Following approval to proceed, tenders would be released for the construction phase. Notification should also be sent to the Island Administration to allow them time to identify those members of the community who would be looking to be employed on the Project.

- ***Tendering and Material Procurement***

A number of suppliers would be approached (both in the Cook Islands and New Zealand) to ensure competitive costs are obtained for the various materials. Following this, orders for the material supply would be placed with the intention of consolidating and shipping materials ex. Port of Auckland.

- ***Advance Party***

As discussed in 6.13, an Advance Party could be sent to site to establish the construction team's facilities, set out the site and storage area, and construct the temporary wharf. This would ensure that all preparatory work is complete before the establishment of the main team. The timing of the advance party could be one month before the first shipment of plant and materials. The Project would need to hire the Cook Island Police Patrol Vehicle (Te Kukupa) to transport the team and limited materials to site (we understand the Te Kukupa can carry approximately 15-20m^3 of materials in its hold).

- ***Shipping***

Due to Palmerston's remote isolation and lack of regular shipping, meticulous planning will be required to ensure that all materials, down to the smallest consumables, are delivered on set shipments. Depending on shipping schedules, the intention would be to use two main shipments to deliver the materials and plant to Palmerston. This will ensure that if there were anything forgotten then there is a back up shipment available and it would also help to minimise the logistics of offloading, handling, and storing all the construction material at the one time. The first shipment would comprise the establishment items, plant, and materials for the foundations and blockwork for the toilet/shower area. The second shipment following some six to eight weeks later will comprise the material for the structure above ground.

It would take at least two months to plan, procure, and package the materials for the first shipment. Allowing an additional month for shipping delays, the Christmas Break, and delivery of the materials, the first shipment of materials could be landed on site by mid to late January 2004 if approval to proceed was given in September 2003.

The duration of the project is such that it will either have to take the risk and work through the cyclone season or accept the costs of disestablishing and re-establishing the Project out of the cyclone season. Our recommendation would be to continue with the project and accept that, should a cyclone occur, there would potentially be loss of materials or damage to the building. It is unlikely that insurance would be available to cover this risk at a reasonable cost and therefore the CIGov would need to accept this risk.

- ***Establishment and Construction***

The construction team would nominally comprise:

- 1 x Site Foreman / Builder
- 3 x Carpenters (One with electrical experience)
- 1 x Blocklayer / Plumber
- Community labourers, as required.

Building a shelter will require a number of different trades such as carpenters, a blocklayer, a plumber and an electrician and ideally the Contractor would be able to source personnel with combined skills to minimise the number of people on site, or the need to get other trades people onto the island midway through the Contract which would be an issue due to the irregular shipping.

The advance party comprising say the foreman and one carpenter would travel to Palmerston on the Te Kukupa approximately one month before the expected arrival of the first shipment. The remainder of the construction team would fly into Rarotonga and would travel to Palmerston with the first shipment of materials.

The total construction period is estimated to be 26-weeks. A preliminary construction programme is included as Attachment 10.

8. Environmental and Social Analysis

An Environmental and Social Analysis has been undertaken by Island Friends Ltd (IFT) on behalf of the Cook Islands Environment Service (CIES). Their Report *"Proposed Palmerston Cyclone Management Project Environmental Impact Study (Feasibility Study Phase)"* provides a detailed summary of the IFT findings during the Feasibility Site Visit.

There are a number of Environmental and Social Issues that have been identified and which need to be addressed during the construction phase of the Project and a means of minimising their effect has been proposed by the IFT.

Our understanding of the main points includes:

- ***Aggregate***

  Aggregate will be imported to Palmerston. Suppliers would be approached in both the Cook Islands and NZ

- ***Excavation of Sand***

  Sand would be won locally by the island community. The sand would be carefully removed from the top half of the beach using shovels.

- ***Well Water for Construction***

  The project would construct a well adjacent to the site for use during the production of concrete.

- ***Community Input***

  Enough time must be given to the Palmerston Community so that those people off island have sufficient opportunity to return to Palmerston and seek short-term employment. Effort must be made to get the community involved in the building. Whether it is in the actual construction works or in the finishing and landscaping. This will ensure the community, as a whole, take ownership of the new shelter.

- ***Choice of Contractors***

  The contracting team must be screened to ensure that suitable people are sent to Palmerston. The team must be made fully aware of the living conditions, the isolation, environment and local customs and traditions of the Palmerston Community. This will ensure that the workers know exactly what to expect and what is expected of them prior to them establishing on-island.

9. Project Expenditure

This section summarises the understanding between the Government of New Zealand and the Cook Islands Government concerning their responsibilities and contributions with respects to this Project. It includes a forecast of estimated expenditure by NZAID in the current financial year and the forecast estimated expenditure to Project Completion. Furthermore, it summarises the expected contribution from the Cook Islands Government and that from the Palmerston Island Community.

9.1 Inputs

9.1.1 Government of New Zealand

NZAID's estimated contribution to the Project is scheduled below.

Table 2, NZAID Estimated Contribution – Assuming Option 2

Financial Year	Funding NZ$
2002 - 2003	100,000
2003 - 2004	1,000,000*
2004 - 2005	Nil
Total	**1,100,000**

* Subject to Final Approval

The contribution of the Government of New Zealand in relation to this Project includes:

- Feasibility Study (allocated in the 2002 – 2003 Financial Year)
- On-going Project Management;
- Supply of Materials;
- Shipping costs from the supplier to site;
- Construction and Supervision Costs;

A detailed estimate of expenditure is included as Attachment 8.

9.1.2 Cook Islands Government

The Cook Islands Government's estimated contribution to the Project is based on approximately 40% of the financial costs towards construction, as scheduled below.

Table 3, CIGov Estimated Contribution - Assuming Option 2

Financial Year	Funding NZ$
2002 - 2003	200,000**
2003 - 2004	400,000***
2004 - 2005	Nil
Total	**600,000**

** Funds would be carried over to the 2003 – 2004 Financial Year. Total funding available 2003 – 2004 would be 600,000

*** To be confirmed through the Budget Appropriation.

The contribution of the CIGov in relation to this Project is described below. Without limitation it includes:

- Financial contribution towards material procurement, shipping and the construction and supervision costs;
- Nominating appropriately qualified personnel to work closely with the Project Team to ensure that each activity takes into account the local conditions and to develop realistic and achievable work plans;
- Ensuring that suitable accommodation is available for the Contracted Program Personnel for the duration of the Project;
- Facilitating the clearance of project supplies at the point of entry to the Cook Islands;
- Waiving customs duties and wharfage fees payable for the importation of project supplies;

9.1.3 Palmerston Island Community

At the community level,

- Assist with offloading Project Supplies;
- Landowner approval for the:
  - Construction of the temporary wharf
  - Landowner approval for the winning of sand;
  - Access to land for constructing the shelter
  - Access to land for winning fill material in and around the shelter
  - Access to land for stockpiling of sand and gravel and for storage of construction materials adjacent to the site
  - Access to land for digging a well for construction purposes
- Use of community freshwater supplies for drinking, cooking and washing, as required for the construction team, until their own catchments have been established;
- Identification of people who would like to be employed during the construction period. This would require a commitment to work in the order of 55 hours per week, Monday through to Saturday (10 hours Mon to Fri and 5 hours Sat). *Note, the project would have an independent workforce and would not be relying on any local input.*
- Identify three houses that are available for the construction team to rent for the duration of the project (nominally six-months)
- Make available the Island Administration storage shed for providing secure storage facilities

9.2 Forecast Expenditure

The forecast expenditure for the Project is appended as Attachment 8. The forecast expenditure is based on Option 2 proceeding. The Project costs are based on a provisional estimate of the labour, materials and plant required to complete the works, and can only be confirmed upon competitive tendering.

10. Economic Evaluation

10.1 Appraisal Approach

The principal concepts used in the evaluation are:

- The evaluation has been based on a "with" minus "without" shelter approach. That is, the evaluation has considered the differences in both costs and benefits for Palmerston without the proposed cyclone shelter, compared to Palmerston with the shelter.
- A timeframe of 50 years has been considered, based on the nominal design life of the cyclone shelter, assuming it is properly maintained.
- A discount rate of 7.5% has been adopted.
- All costs and benefits are reflected in New Zealand dollars.

The results of the evaluation have primarily been presented as a

- **Benefit/Cost Ratio (BCR)**.

We have also presented the results as:

- **Net Present Value (NPV)**
- **Internal Rate of Return (IRR)**.

A sensitivity analysis is also presented changing values for major input variables.

10.2 Costs

Based on Option 2 being the preferred option, the preliminary costs for the construction works is approximately $1,583,000. Maintenance costs are based on 10% of the initial value of the structure over 50 years, or approximately $15,000 every 5-years. The maintenance cost assumes that representatives of the local people would carry out day to day maintenance, and that tradesmen will be contracted for major works every five years.

10.3 Cyclone Data

As discussed in section 4.1.5, cyclones have been divided into three categories: Very Severe (Hurricane Intensity), Severe (Storm Intensity) and Moderate (Gale Intensity) based on the amount of damage that could be expected.

Tropical Cyclone Martin (TCM), in November 1997, was considered a very severe event. Nineteen people lost their lives and the damage assessment was estimated at $ 14,196,000.

Historical (mainly anecdotal) records of cyclones in the Cook Islands were obtained and analysed to obtain the annual probability of each category of cyclone reaching each island. Refer attachment 6.

10.4 Benefits

Three distinct classes of benefits are considered to be derived from cyclone shelters:

- Lives saved;
- Damages saved;
- Loss of productivity saved.

10.4.1 Lives Saved

To consider the potential loss of life in a very severe cyclone, we have made a pro-rata assessment of lives lost on Manihiki during TCM, on a population basis. For Palmerston, with a design population of seventy, the potential loss of life in a similar event would be two; or put in a more positive light, by having a shelter these two lives would potentially be saved.

Numbers have been reduced for lesser cyclones, and for the presence of a cyclone shelter i.e. the benefit calculated from the number of lives likely to be saved with a cyclone shelter.

The only data readily available for estimating the value of life is $2,000,000 based on Transit New Zealand (TNZ) practice for calculating the value of life for road improvements. This figure has been widely adopted throughout New Zealand. While not ideal, it provides a reasonable figure which to work with. A more reasonable figure would have to be derived for Palmerston, which would need to be the subject of a specific study. The costs are likely to be higher than these used by TNZ because of the high search and rescue costs and medical evacuation costs associated with remote atolls.

The alternative value of $700,000, used in the sensitivity analysis, was derived from multiplying $2,000,000 by the ratio of the GDP per capita for the Cook Islands ($10,156) [2]and New Zealand ($28,500).

10.4.2 Damages Saved

We have assumed that 100% of existing infrastructure will be destroyed (no shelter) and 75% (with shelter) in a Very Severe Cyclone. With a cyclone shelter in place, people will be able to safely store many of their valuable possessions, and take greater steps to protect their infrastructure. Further, the cyclone shelter is likely to remain relatively unscathed.

The corresponding figures used are:

- Severe Cyclone 50% (no shelter), 35% (with shelter)
- Moderate Cyclone 20% (no shelter), 10% (with shelter)

The estimates of damage to infrastructure and the loss of business (measured through GDP) have been based on observations at Manihiki since Cyclone Martin, pro rated as above.

10.4.3 Loss of Productivity Saved

It has been assumed that in a Very Severe Cyclone (no shelter) 90% of one year's annual GDP will be lost. Although it would be spread over two or three years, for analysis purposes it has been assumed it would all occur in the first year. Similarly, in a Very Severe Cyclone (with shelter), it has been assumed that 40% of one year's GDP will be lost mainly due to the population staying on the island and protecting assets, rather than evacuating.

The corresponding figures used are:

- Severe Cyclone (60% no shelter, 10% with shelter)
- Moderate Cyclone (10% no shelter, 0% with shelter)

[2] Cook Islands Annual Statistical Bulletin, December 2002

10.4.4 Intangible Benefits

There are a number of intangible benefits related to the provision of Cyclone Shelter that are difficult to assess and put a monetary value on. For the purposes of this exercise, the evaluation has been undertaken both with and without an allowance for intangibles. Studies undertaken overseas have indicated that intangible benefits account for approximately half the total benefits.

The intangible benefits considered include:

- The stress and anxiety on the community as a result of a cyclone event.
- The impact on local businesses and community groups.
- The disruption of services in the area.
- The loss of items of personal value.

10.5 Discussion

Referring to Attachment 9, the economic analysis shows that for a total investment of approximately $ 1,583,000, over a 50-year period, this results in:

- **A Benefit/Cost Ratio of 2.05**
- A net present value of $ 1,701,000.
- An internal rate of return of 16%.
- Six lives saved.

There is no doubt going to be lengthy debate in justifying spending $ 1,583,000 on only 70 people. However, the economics suggest that it is still worthwhile with $2 of long-term benefit resulting from every dollar spent.

Notwithstanding the economics, if we only look at the number of lives potentially saved by having a shelter (i.e. not taking into consideration the loss of infrastructure or GDP), the Benefit/Cost Ratio is still 1.77. The Benefits clearly outweigh the Costs.

10.6 Sensitivity Analysis

A sensitivity analysis has been undertaken on the single entity approach and the results of this are summarised in Table 4 below.

Table 4, Sensitivity Analysis

Discount Rate	Cost of Life	Intangibles	BCR
5 %	$2,000,000	Nil	2.86
7.5 %	**$2,000,000**	**Nil**	**2.05**
10%	$2,000,000	Nil	1.58
7.5 %	$2,000,000	Nil	**2.05**
7.5 %	$ 700,000	Nil	0.95
7.5 %	$2,000,000	Nil	**2.05**
7.5 %	$2,000,000	50% of Losses	2.15

Although the benefit cost ratio alters with some of the input variables, it does not alter the conclusion that proceeding with the cyclone shelter construction project is well worthwhile, providing benefits in excess of the costs.

11. Work Plan

The Milestone Timeframes are summarised in Table 5 below. The milestones are based on the provisional programme included as Attachment 10.

Table 5, Milestone Schedule

Item	Project Milestone	Planned Date	Actual Date
1.	Completion of Feasibility Study and Confirmation of Design Outputs	6 June 2003	
2.	Submit Detailed Design, Specification and Costings	4 July 2003	
3.	Preparation of the PID	18 July 2003	
4.	Approval of PID	31 July 2003	
5.	Approval to proceed with Construction	1 September 2003	
6.	Order Materials	Plus two Month	
7.	Shipping to Palmerston (based on three months from approval to proceed)	Plus three Month	
8.	Establishment on Site	Per item 10.	
9.	Complete Construction (based on six months construction)	Plus nine months	
10.	Final Inspection	Per item 12.	
11.	Opening Ceremony and Official Handover	Per item 12.	
12.	Disestablish	Per item 12.	
13.	Project Completion	Plus 10 months	

Note, plus times are in relation to date of approval of PID

We have assumed that approval for construction will be given in September 2003 and have based the construction programme around this. However, the detailed design, specification, costings and preparation of the PID will only proceed when Project Funding has been agreed.

11.1 Risk Monitoring and Management

There are a number of risks associated with a project such as this, which are typically borne by the Tenderers, at significant costs to the Client. Cyclone Insurance cover for example, costs of extended establishment as a result of shipping delays, loss of materials during unloading and lack of community support during unloading. These issues will need to be addressed during the tender / construction phase.

Those risks that are considered to have a significant impact on the Project, should they eventuate, have been identified in the table below. A method of mitigating those risks has been proposed.

Risk Management Matrix

Source of Risk (how it can happen)	Risk Event (what can happen?)	Impact on Project (why is this a risk?)	Risk Analysis			Risk Treatment	Responsibility	Timing
			L	C	R			
Institutional Risks								
Change in the Government position.	Political and social changes	Change in "development" priorities de-emphasising the importance of all round participation. Decision not to support CIGov input to the Project. Failure to provide long-term support	3	4	4	Increased capacity strengthening support	CIGov NZAID	Project Duration and beyond
Establishing communication between village may be slow	Community unable to carry out necessary preparatory tasks	Potential delay in offloading materials No accommodation available Water resources unavailable Potential Land Issues	3	4	4	Encourage Communication Liaise closely with villages Send in an Advance Party	OMIA The Project	Project Duration
Weather								
Construction in the Cyclone Season	Cyclone Event	Delays in Implementation. Difficulty in offloading Cargo Potential for the loss of life, equipment and materials.	2	5	4	Avoid constructing in the cyclone season where possible.	OMIA The Project	Between Nov – Apr.
Drought	Lack of water for the preparation of concrete	Delays associated with the construction of the shelter	3	3	3	Establish own Catchments. Dig a well Repair water catchments, guttering and downspouts.		Between May - Sept
Extreme Weather	Shipping Delays	Increased Establishment Period resulting in additional costs to the Project.	3	3	3	Liaise closely with the shipping agencies.	Shipping Line	Project Duration
Materials								
MV Mataroa not available for project use.	Trans- shipping of materials at Rarotonga delaying the project, incl. loss or damage to materials. Difficulty in transporting plant	Shipping costs could increase significantly due to constraints in availability of appropriate vessel to transport materials	3	5	4	Liaise closely with the shipping agencies. Possibility of sourcing another vessel	GOT OMIA	During establishment and disestablishment

Risk Management Matrix

Source of Risk (how it can happen)	Risk Event (what can happen?)	Impact on Project (why is this a risk?)	Risk Analysis			Risk Treatment	Responsibility	Timing
			L	C	R			
Inadequate care of equipment during loading and offloading of cargo.	Loss or Damage to Project Freight.	Delays associated with the lead-time for delivery of the replacement item.	3	4	4	Liaise closely with the shipping agencies.	Contractor Shipping Line	Project Duration
Inadequate quality assurance checks.	Delivery of Incorrect or Defective Equipment	Delays associated with the lead-time for delivery of the replacement item.	3	4	4	Liaise closely with the supplier. Purchase from reputable suppliers.	Contractor The Project	Project Duration
Inadequate quality checks. Loss or misappropriation of materials.	Shortage of Materials	Delays associated with the lead-time for delivery of additional materials.	3	4	4	Undertake site survey. Secure project supplies.	Contractor The Project	Project Duration
Materials lost overboard due to sea condition, out of balance loads or lack of care.	Precast beams or columns lost overboard during offloading	Delay in constructing the building due to lack of appropriate materials. Long lead time for the delivery of replacement pre-cast materials.	3	5	4	Extreme care during offloading. Possibility of manufacturing additional beams to minimise exposure or provide stock lengths of steel and cement / aggregate	Contractor Shipping Line	During Offloading
Land Disputes								
Access to land is hindered for winning sand and creating well	No Landowner Approval	Delays in Implementation. Increased Establishment	3	5	4	Consultation with the landowners. Ensure agreements are in place before establishing.	GOT OMIA Local Community	Project Duration
No agreement reached for use of land for shelter.	Family Land Dispute.	Delays in Implementation until agreement reached with landowner Increased Establishment	2	4	3	Consultation with the landowners. Ensure that the Land Tenure Agreements have been ratified	GOT CIIC OMIA PIC/ PIA/Family	Stage 1 , Feasibility

Risk Management Matrix

Source of Risk (how it can happen)	Risk Event (what can happen?)	Impact on Project (why is this a risk?)	Risk Analysis			Risk Treatment	Responsibility	Timing
			L	C	R			
Labour Resources								
Mechanical Breakdown	Shipping Delays	Increased Establishment Period resulting in additional costs to the Project. Delay costs could be charged at around $400/person/day plus direct establishment costs for extension of time claims.	3	3	3	Liaise closely with the shipping agencies.	Shipping Line	Project Duration
Poor living and working conditions	Low team morale	Affect the relationship between team and community. Low productivity.	3	3	3	Ensure proper establishment. Advise staff of living conditions.	The Project Island Community	Project Duration
Project Reliance on Community labour	Community Labour does not show up Claims by Contractor for Extension of Time	Negative Sentiment between the community and the construction Team Increase to project Costs	2	2	1	Ensure Project totally independent in plant and labour resources whilst encouraging community assistance	OMIA Project Community	Tendering Stage and through Construction

Key: L = Likelihood (5 = Almost Certain, 4 = Likely, 3 = Possible, 2 = Unlikely, 1 = Rare)
C = Consequence (5 = Severe, 4 = Major, 3 = Moderate, 2 = Minor, 1 = Negligible)
R = Risk Level (4 = Extreme, 3 = High, 2 = Medium, 1 = Low)

Attachments

Attachment 1, Project Brief

TURNKEY CONTRACT C02\04

PALMERSTON ISLAND CYCLONE MANAGEMENT PROJECT

DESIGN & BUILD SUPPLIER BRIEF – FEB. 2003

Proposals are requested from suitably experienced and qualified Contractors and/or Consultants (the Supplier) to provide an offer of service for a turn-key project for the design and on-site construction of an appropriate building on Palmerston Island, Cook Islands to provide emergency shelter during cyclones, together with accommodation for the island's administrative services and also some private enterprises.

There is a budget of NZD475,000 in the 2002-03 financial year for this project, which is being jointly funded by NZAID and the Cook Islands Government.

The executing agency for the Project will be OMIA. The Principal in the proposed Turnkey Contract will be the CEO, OMIA. The Principal will nominate the Technical Services Manager, OMIA, as the Project Manager for the project. The selection of the preferred Supplier will be entirely at the discretion of the Principal, on the recommendation from the Project Manager.

Proposals should be in writing and addressed to the Technical Services Manager, OMIA, PO Box 383, Rarotonga, Cook Islands, and delivered by 3pm Friday 14 March 2003. The Proposal should be clearly marked as a tender submission. Facsimiled Proposals will not be accepted. The contact email address is tmana@moid.gov.ck

Each Proposal shall contain attribute information on the Supplier's capabilities on projects of this nature such that the Project Manager can make an informed decision as to the adequacy of the experience and qualifications of the Supplier. Each Proposal should also provide concept designs, project milestone timeframes and project expenditure schedules offered for the delivery of the completed Project. Each proposal should nominate the principal personnel to be involved with the Project. More information may be requested on any Proposal submitted for consideration.

The following indicative timetable is offered for the implementation of the Project:

1. Proposals submitted to OMIA – 14 March 2003.
2. Preferred Supplier selected by OMIA – 21 March 2003.
3. Supplier completes Feasibility Study and confirms design outputs – 15 May 2003.
4. Supplier submits detailed designs, specifications and costings – 15 June 2003
5. OMIA confirms designs and specifications meet intent of Project – 30 June 2003.
6. Supplier commences construction on Palmerston Island – 01 September 2003.
7. Supplier completes construction work - 30 November 2003.

The functional requirements of the completed Project are as outlined below:

1. The principal function of the building will be to provide safe shelter from cyclone storms for the entire population of Palmerston Island. For design purposes the population on Palmerston can be assumed to be 60.
2. The secondary function of the building will be to provide accommodation for vital post-cyclone services for health and communications.
3. The building will be designed to allow for future annexed office accommodation for other Local and National Government functions, and also banking services, tourism office and retail outlets for example.
4. The building shall also have toilet/shower facilities, and rain-water catchment and storage facilities.
5. The building is to be two stories. The upper floor area will be the location for the emergency shelter. The future annexed office accommodation occupying the ground floor will be designed not to compromise the overall tidal wave survival capability of the emergency shelter.

The Supplier's Proposal should break down the Project into sub-projects to make up two distinct phases of the Project. These phases are to be firstly a Feasibility Study, and secondly the Construction Phase.

The Feasibility Study phase is intended to address the proper scoping of the Project, to confirm design requirements, to confirm effluent disposal issues, to undertake an EIA report using the Cook Islands Environment Services, and confirm the overall budget and practicability of the Project. This phase will include a site visit to Palmerston by the Supplier's design and construct team, and also the nominated personnel by Environment Services. As part of the Feasibility Study, the Supplier will also prepare a Project Implementation Document (PID) for the Project. This PID will require approval of the funding agencies before the Construction Phase can be implemented.

Each phase of the Project is to be stand-alone in terms of the price offered by the Supplier, and there can be no guarantee given that the Project will proceed to the Construction Phase under the proposed contract. The Supplier is therefore to arrange their cash-flows accordingly, and in an itemised basis.

The Supplier shall prepare a FIDIC 'Design and Build' contract document or equivalent for execution.

The Principal reserves the right to change any requirement of the project, and to enter into negotiations with any individual Supplier at any time. Each Proposal will be treated in confidence. Except as required by Law, no discussions on the reasons for the award of the contract will be entered into with any Supplier. The lowest cost or any Proposal will not necessarily be accepted. The Principal will assume ownership of any drawings, specifications and any other intellectual property provided by the Supplier under the Project.

Attachment 2, Work Diary

Following is a brief summary of the tasks undertaken by the team in the compilation of this report

DATE	ACTIVITY
Friday 4 April 2003	▪ Travel to Rarotonga via Auckland. ▪ Prepare Project Plan.
Saturday 5 April 2003	▪ Arrive Rarotonga 5:30 A.M. ▪ Meeting with Ken Munro 10:15 ▪ Informal meeting with the Hon. Dr Robert Woonton PM ▪ Meeting at Vaine Wichman's Office at 10:30. Present, Ken Munro, Graeme Campbell, Neil Robertson, Vaine Wichman, Lydia Sijp Marsters (Palmerston Island Secretary) and Eric Sijp (Lydia's Husband) ▪ Visited Avaitu Harbour to look at progress on the new harbour development ▪ Met with Lydia, Eric, their Aunty (??) and an Ex-Government Surveyor (??) at the Sailing Club.
Sunday 6 April 2003	▪ Planning for the Site Visit to Palmerston ▪ Began structuring out the Feasibility Report
Monday 7 April 2003	▪ Meeting with Ken Munro and Nandi Glassi at 8:00 A.M. ▪ Bought food and provisions for the Palmerston Community ▪ Met up with the Feasibility Team at 9:00 A.M. General introductions. ▪ Te Kukupa Departed for Palmerston at 11:00AM
Tuesday 8 April 2003	▪ Arrived Palmerston at 11:00 A.M ▪ Introductions to Island Council ▪ Site Familiarisation ▪ Meeting with Bob and Tepou Marsters
Wednesday 9 April 2003	• Meeting with Island Council • Walkover of CMC Site • Survey Site and develop plans • Meeting with Edward and Tuaine John Marsters • Look at Dukes' Pool • Meeting with Island Council
Thursday 10 April 2003	▪ Meeting with Carl Marsters regarding Energy, Fishing and Personal aspects. ▪ Visit to Tom's Island and Cooks Island to look for sources of gravel and the proposed site for developing an airport ▪ Trip through Big Passage ▪ Meeting with Dave Marsters, Deputy Mayor ▪ Discussed and marked out the Shelter Site, both minimum requirements and Optimum size with Stakeholders ▪ Checked sources of aggregate ad sand on Home Island

DATE	ACTIVITY
Friday 11 April 2003	▪ Discussion with School Children regarding cyclone awareness ▪ Dug Trial Pits at CMC Site ▪ Discussion with Melbourne Marsters re Telecom. Trialled E-mail facilities. ▪ Design discussion with Ken Munro. ▪ Meeting with Mary Marsters ▪ Discussion with Rebo, CIIC Surveyor, to check site survey has identified both larger and smaller parcels of land ▪ De-brief with Teariki and Julia Rongo at 3 AM to ensure that they have captured sufficient information re Environmental and Social Analysis ▪ De-brief with Island Government
Saturday 12 April 2003	▪ Meeting with Melbourne Marsters, Government Representative and Head of Household. ▪ Departed Palmerston for Rarotonga at 9 AM on the Te Kukupa
Sunday 13 April 2003	▪ Boat Arrived Rarotonga at 9 AM ▪ Update site notes and sort through photographic record of visit ▪ Prepare Schematic Drawings of various design options for discussion
Monday 14 April 2003	▪ Meeting with Telecom to discuss possibility of installing additional telecom lines and providing connection to CMC ▪ Visit to Met Service to source Historical Cyclone Data for Palmerston ▪ Visit to MOW to try and source Aerial Photographs of Palmerston ▪ Meeting with Ken Munro at 9:30AM to discuss the various design options ▪ Brief meeting with Otheniel Tangianau, OIDP, to get background on Palmerston Island Devolution. ▪ Meeting with Palmerston Island Administration at 11 AM to present various design options to seek comment ▪ Meeting with Kurt Myer NZ High Commissioner to debrief. ▪ Meeting with Aid Management Division
Tuesday 15 April 2003	▪ Travel to NZ ▪ Meeting with Architect at Auckland Airport to discuss feasibility design options.

Attachment 3, Record of People Consulted

Name	Title
In New Zealand	
Stephenie Knight	NZAID Programme Manager, Cook Islands
Roger Cornforth	DEV DEAP Division, MFAT
In Rarotonga	
Hon. Dr Robert Woonton PM	Prime Minister *(Informal Discussion Only)*
Vaine Wichman	Arama and Associates Ltd
Nandi Glassie	CEO OMIA
Ken Munro	OMIA
Otheniel Tangianau	OIDP
Kurt Myer	New Zealand High Commissioner
On Palmerston	
George Marsters	Mayor and Island Council Representative
Lydia Sijp- Marsters	Island Secretary
David Tom Marsters	Deputy Mayor and Island Council Representative
Gran Tom	Wife to Dave Tom
Bob Marsters	Brother of George Marsters
Tupou Marsters	Bob's Wife
Ngu Marsters	Brother of George Marsters
Jimmy Marsters	David Tom's Grandson
Carl Marsters	Power Supervisor
Eric Sijp	ERLA Trading and Lydia's Husband
Inano Marsters	Head of Household
Melbourne Marsters	Government Representative and Telecom Supervisor.
Haua Marsters	School Teacher
Mary Marsters	Head of Household
Tuaine Marsters	Edward's Mother. Head of Household
Edward Marsters	Police Office

Attachment 4, Questionnaire Used During Community Consultation

Palmerston Island Cyclone Management Project
Feasibility Study

Stakeholder Questionnaire

Date and Time :	
Stakeholder Group :	
Location :	
Interviewer :	
Those in Attendance :	

AC Consulting Group Limited
Consulting Engineers

Palmerston Island Cyclone Management Project Questionnaire

A. CYCLONE PREPARDNESS

1. How do you currently get cyclone warnings?

2. What do you do when you receive a cyclone warning?

3. When was the last time you and your family were affected by a cyclone?

4. How often is Palmerston hit by cyclones? Specifically, do you recall when?

5. When was the biggest cyclone that you can recall hitting Palmerston?

6. What buildings have been damaged during a cyclone?

    a) Last 5 years

    b) Last 50 years

7. Which areas of the village are prone to flooding during a cyclone?

    a) Last 5 years

    b) Last 50 years

8. How deep does the water get?

    a) Last 5 years

    b) Last 50 years

9. Have waves ever washed over the village?

    a) Last 5 years

    b) Last 50 years

10. If you had a Cyclone Shelter, at what stage of the storm would you go to it?

11. What possessions would you take with you to a cyclone shelter?

Palmerston Island Cyclone Management Project
Questionnaire

B. Building Design

1. What are your minimum requirements for cyclone protection?

2. What help or facilities do you require following a cyclone?

3. What do you think the basic requirements are for the proposed shelter?

4. Are there any additional items that you would like to see in the shelter? If so, please rate them in order of preference

5. Are there any social or cultural issues that we should be aware of when designing a shelter?

6. Do you think that access will be suitable for all people – all families, old and young? If not, what improvements would you suggest?

7. How do you think everyone would like

   a) sanitation and food preparation areas to be organized

   b) sleeping areas to be organized?

8 Are there any special arrangements that need to be made for:

   a) Women

   b) Any other groups

Palmerston Island Cyclone Management Project
Questionnaire

C. Land

1 Where is the safest site on the island?

2 How do you feel about the site that has been chosen for building the proposed shelter?

3 What is your preferred location for the shelter? Why?

4 How was the current site chosen? Who was involved in the decision-making?

5 Will the chosen site equally suit all residents?

6 Who is the current land owner? Where do they live?

7 Are there any cultural or traditional reasons why this area might not be suitable?

8 What is the process for arranging land transfer?

9 Who should own the land on which the building is built? Why?

Palmerston Island Cyclone Management Project
Questionnaire

D. Maintenance and Management

1 Who will look after the building once it is finished? i.e. cleaning, doing repairs etc

2 How will the community pay for the materials to do repairs on the building?

3 How will the community pay for the wage costs for someone to clean the shelter or do repairs? If so, how?

4 Is it likely that the community would want to build onto the shelter?

a) If so, for what purpose?

b) How would they arrange money for materials?

c) When would you predict this happening?

5 Would the community want to put partitions inside the building?

a) If so where?

b) How would they arrange money for materials?

c) When would you predict this happening?

Palmerston Island Cyclone Management Project Questionnaire

E. Island Resources

1. What basic services are available on Palmerston. i.e. shops, banks, health centre, post office, telecom, guest accommodation etc

2. There would be a team of eight builders. Is there any accommodation available for rent? (the project would need to rent three houses).

3. What would be a fair rental rate?

4. If three houses are available, where will the existing owners live?

5. Is there any local plant that would be available for use?

6. The project would need approximately 15m^3 of sand for making concrete. Where do you think this should be taken from?

7. Why do you choose this place to take sand from?

8. Are there any concerns with the project using this much sand from the beach?

9. Are there any special animals or birds, shell fish that use this area?

10. Is this the main feeding or breeding place for any of these animals

11. Are these animals also found else where in the atoll?

12. What would be the process for getting landowner approval for using sand?

13. The project would need approximately 150m^3 of kirikiri for making concrete and for filling beneath the floor. Where would you suggest this is taken from? Why this place?

14. Are there any concerns with the project using this much kirikiri?

Palmerston Island Cyclone Management Project
Questionnaire

15. What would be the process for getting landowner approval for using kirikiri?

16. We would need approximately 50,000 litres of water for making concrete. Are there communal water supplies that can be used for construction (i.e. to make concrete)? How big are the community water tanks.

17. When is the dry season? Do you normally have water supply problems during the dry season?

18. If we took this water, would if cause problems during the dry season?

19. Are there storage facilities available for storing materials and tools etc. If so where?

20. Are there any members of the community who would be willing to help on the project as paid employees?. The work would be for 4 to 5 months, 6-days a week (10hrs each day Monday to Friday and 5 hrs Saturday)

21. If so, what skills have they got?

22. Are there any examples of people working long hours like this, for such a long period?

23. What is the hourly rate paid to islanders for construction work in the past?

24. Would there be members of the community who would be willing to help look after the Construction Team, as paid employees, by doing cleaning, washing and cooking?

25. Is the community willing to assist with offloading the boat which would deliver the materials?

26. There would be approximately 500m^3 of plant and materials to offload. How many people would be able to commit to the offloading, 10-hrs per day for three days?.

27. How many private boats would be available to assist with the offloading?

28. Is the community likely to organise a celebration (blessing, feast, party) at any stage in the construction (unloading , grouped breaking, completion)? If so, how would the project contribute? (i.e. arrange for supplies to be shipped)?

29. How does the community organise a Ground Breaking Ceremony?

30. Construction work would be six days a week. What would the construction team be allowed to do after work, and especially on Sundays?

31. Would the community be willing to provide unpaid “Community Assistance” during key construction activities such as pouring concrete?

Palmerston Island Cyclone Management Project
Questionnaire

F. Establishment and Construction

1. Navy boat. Travel time, No. of berths, Cargo capacity, Crane/hiab, Lifting capacity

2. Anchorage Palmerston. Distance from boat passage? Sea state, Rough/Med/Light? Distance from boat to landing site? How wide is boat passage through reef (note barge will be 4-5m wide)?

3. Landing site. Access to island proper? Sand base/coral (rough) hard and firm? Road from beach to site? Distance from building site. (Require good access from beach to site so boat can be unloaded quickly or we leave on or near beach and move later)

4. Building Site. Level or extra fill excavation required? Trees or scrub to be removed No?, Type? Type of ground, able to be used as hard fill? If not how far is suitable hard fill? How far to take and dump excavation material?

5. Storage of plant and material at site or near, 400msq m 20 x 20m Is there space for sheds 4 or 5 with lean to between, taupalins for shade

6. Temporary power. Is it available? Distance from site? How to meter power for CMC? Distance from supply connection?

7. Communications. How reliable? 24hr/day? Phone / fax / email? Are spare lines available for fax

8. Accommodation. House 1, for supervisor also supervisors office, storage, bedroom. This house could be where meals are cooked and crew eats

   House 2, minimum 2 bedrooms 3 preferable for construction crew

   Alternative accommodation. What 'tourist' facilities are available?

   2nd alternative. 5 x 4800 x 2400 portable huts or army style tents, local hall

9. Security. Need secure storage maybe 2 x portable sheds

Attachment 5, Family Members On-island

The following records the family members who were on–island during the feasibility site visit and those members who were expected to return to Home Island in the immediate period.

This is list has been compiled by ACCG as snapshot, following our discussion with members of the community, and should not be treated as a definitive list.

Matavia Family				
Family #**	**Name**	**Relationship**	**Position**	**On the Island**
M1.	George Marsters	Head of Household	Mayor and Family Head	Yes
	Tutai Marsters	George's Wife		In Raro
	Jed Marsters	Eldest Son		In Raro
	Less Marsters	2nd Son		In Raro
	Tepou marsters	Eldest daughter		In Raro
	Lehi Marsters	3rd Son		In Raro
	Pearl Marsters	2nd Daughter		In Raro
	George Marsters Jnr	4th Son		In Raro
M2.	Robert (Bob) Marsters	George's Brother, Head of Household		Yes
	Tepou Marsters	Bob's Wife		Yes
	Taia Marsters	Eldest Daughter		Yes
	Munokoa Marsters	2nd Daughter		Yes
	Bury	Son		Yes
	Mehau Marsters	3rd Daughter		Yes
M3.	Ngu Marsters	George's Brother, Head of Household		Yes
	Kai Marsters	Ngu's Wife		Yes
	John Marsters	Eldest Son		Yes
	Marion Marsters	Eldest daughter		Yes
	Alfred Marsters	2nd Son		Yes
	Nga Marsters	2nd Daughter		Yes
	Simon Marsters	3rd Son		Yes
	Ann Marsters	3rd Daughter		Yes

Akakaingaro Family				
Family #**	**Name**	**Relationship**	**Position**	**On the Island**
A1.	David Tom Marsters	Head of Household	Council Rep and Deputy Mayor	Yes
	Gran Tom Marsters	David's Wife		Yes
	Jimmy Marsters	David's Grandson		Yes
	Raineer Marsters	Jimmy's Daughter		Yes
	Nga Marsters	Jimmy's Son		Yes
A2.	Inano Tuakana Marsters	Head of Household		Yes
	Alex Marsters	Inano's Grandson		In Raro
A3.	Carl Marsters	Head of Household	Power Supervisor	Yes
	Mata Marsters	Carl's Wife		Yes
	Temarama Marsters	Eldest Daughter		Yes
	Linku Marsters	2nd Daughter		Yes
A4.	Lydia Sijp-Marsters		Island Secretary	Yes
	Eric Sijp	Lydia's Husband		Yes
	Jan Marsters	Lydia's Grandson		Yes

Tepou Family				
Family #**	**Name**	**Relationship**	**Position**	**On the Island**
T1	Joseph Marsters	Head Of Household	Council Rep	Yes
	Mehau Marsters	Joseph's Wife	Council Rep	Yes
	Joseph Marsters Jnr	Joseph's Grandson	Energy Operator	Yes
	Mary Marsters	Joseph Jnr's Wife		Yes
	Rutera Marsters	Eldest Daughter		Yes
	Mehau Marsters	2nd Daughter		Yes
	Marconi Marsters	Eldest Son		Yes
	William Marsters	2nd Son		Yes
	Hamish Marsters	3rd Son		Yes
	Joseph Marsters	4th Son		Yes
	Andrew Marsters	Joseph Snr Nephew		Yes
T2	Melbourne Marsters	Head Of Household	Government Rep & TCI	Yes
	Haua Marsters	Melbourne's Wife	School Teacher	Yes
	Michi Marsters	Eldest Daughter		Yes
	Darling Marsters	2nd Daughter		Yes
	Ramal Marsters	Grandson		Yes
	Vaevae Marsters	Granddaughter		Yes
	Akarotoua Marsters	Melbourne's Mother		In Raro
	Sare Marsters	Melboune's Sister		In Raro
	Tekaroa Marsters	Akarotoua's Grandson		In Raro
	Nooroa Marsters	Tekaroa's Wife		In Raro
	Jayjay Marsters	Tekaroa's Eldest Son		In Raro
	Rimaata Marsters	Tekaroa's Eldest Daughter		In Raro

Tepou Family				
Family #**	**Name**	**Relationship**	**Position**	**On the Island**
	Mary Marsters	2nd Daughter		In Raro
	Jock Marsters	Akarotoua's Granddaughter		In Raro
	Serena Marsters	Jock's Eledest daughter		In Raro
	Thomas Marsters	Jock's Eldest Son		In Raro
	Tuakana Marsters	2nd Son		In Raro
	Julia Marsters	2nd Daughter		In Raro
T3.	Taepae Marsters	Head of Household	Agriculture officer	In Raro
	Mary Marsters	Taepae's Wife		Yes
	Jimmy Marsters	Eldest Son		In Australia
	Korenakoa Marsters	2nd Son		In Raro
	Marama Marsters	Eldest Daughter		Yes
	Teenano Marsters	2nd Daughter		Yes
	Ned Marsters	Son of Teenano		Yes
T4.	Tuaine John Marsters	Head of Household		Yes
	Edward Marsters	Tuaine's Eldest Son	Police Officer	Yes
	Shirley Marsters	Edward's Wife		Yes
	David Marsters	Edward's Eldest Son		Yes
	John Marsters	2nd Son		Yes
	Mary Sue Marsters	Eldest Daughter		Yes
	Terangi Marsters	3rd Son		Yes
	Simon Marsters	Tuaine's 2nd Son		Yes

Total number of family members on island was 57.
**Refer to Map 3 for the location of each family.

Attachment 6, Historical Record of Cyclones

Information compiled courtesy of Cook Islands Meteorological Services

1904
Hit Aitutaki, Mangaia & Mauke inflicting little damage but causing the sea to rise 10m at Mangaia.

1906
Gales, almost of hurricane force battered **Penrhyn**, **Manihiki** and **Rakahanga** for nearly 5 weeks between 15/01/06 and 20/02/06. Coconuts lost but otherwise little damage.

1914
8-10 January, **Suwarrow**, **Rakahanga**, **Manihiki**, Atiu and Aitutaki struck by hurricane force winds when huge seas overwhelmed the first three islands. At Aitutaki and Atiu nearly all the houses were demolished or unroofed. Coconut and orange plantations were completely devastated. In no case was there an immediate shortage of food supplies although support through public works was considered necessary to tide over until replacement food crops were produced.

1925
16-21 December, Severe, Southern Cooks

1926
29-30 March, Severe blow. Described as worst for 30 years. Quick action to save oranges. 12 months for the people to recover. Assistance of provisions to **Palmerston** Atoll for building materials and relief provisions – island would not be productive for 18 months or so. Repairs required to Aitutaki wharf and to Government boatshed, damaged foreshore, seawall and telephone system on Rarotonga.

1930
24 December, Minor.

1935
7-11 February, Most disastrous in living memory. Twin hurricanes one behind the other with Rarotonga and Palmerston taking the full brunt. On Rarotonga 4000 tonnes of rocks and debris subsequently shifted from roads and private property, very few people injured by many minor injuries. On **Palmerston,** everyone fled their homes to hastily built shelters in the lee of a hill, with memories of the 1926 hurricane sweeping the sea completely over the atoll. Practically all plant life was destroyed. Islanders were running short of food and water when relief arrived on 8 March. Northern group islands not affected.

1941
13 January, Northern Cooks, minor.

1-4 March, Southern Cooks, moderate-severe.

25-27 November, southern Cooks, minor.

1942
19-23 February, Northern and southern groups, minor, **Palmerston Island** severe.

1943
9-11 March, Southern Cooks, severe. Exceptionally heavy damage inflicted on Rarotonga and the Southern Islands. Mitiaro required food relief. On Rarotonga, damage to administration buildings, road and wharfs less than in 1935. Food available but building materials required. For the first time growers expected compensation from the (NZ) Government.

25 December, Moderate.

1944
30-31 January, Southern Cooks, moderate-severe.

1946
13-14 January, Southern Cooks, moderate.

1955
2-3 January, Southern Cooks, minor.

1956
1 January, Southern Cooks, minor.

1959
13 February, Southern Cooks, moderate.

1962
14-15 February, Southern Cooks, moderate.

1963
8-14 March, Southern Cooks moderate-severe.

1966
28-29 January, Southern Cooks, minor. Severest hurricane to effect Samoa and Tokelau Islands. Largely by-passed Cook Islands but still caused damage.

1967
16-18 December, Northern and Southern groups. Very severe beating, wiping out the newly constructed wharf at Avarua and the airport, leaving the runway intact. European style homes unroofed and some collapsed. Damage to administration buildings, roads, electricity and telephone in the southern groups.

1970
17-13 February, Southern Cooks.

18 February – 2 March, Northern Cooks.

1972
22-28 March, Northern and Southern Cooks.

1973
14-18 January, Southern Cooks.

31 January – 1 February, Southern Cooks.

1974
25-28 April, Southern Cooks.

1976
10-12 December, Southern Cooks.

1977
20-21 February, Southern Cooks.

1978
15-27 February, Southern and Northern Cooks.

1981
20-24 February, Southern Cooks.

10-13 March, Northern And Southern Cooks.

20-23 March, Southern Cooks.

1982
10-15 December, Cyclone Northern and Southern Cooks. Followed by extended drought throughout the group. Water flown to **Penrhyn.** Led to development of improved reticulation on Rarotonga and a programme of water tank construction for individual homes throughout the group.

1983
26-28 February, Northern Cooks.

29 March – 3 April, Northern Cooks.

1985
26-28 January, Southern Cooks Hurricane Freda

1986
5-14 February, Severe. Hurricane Ima

26 December – 3 January, Northern and Southern groups, moderate-severe. Hurricane Sally

1987
15-27 January, Southern group, minor.

1-7 March, Southern group, minor.

1988
28 February – 3 March, Southern Cooks, minor.

1989
23-28 February, Southern especially Mangaia, minor. Hurricane Judy

8- 10 November, Southern Cooks, minor

14 – 17 December, Southern cooks, minor

1990
12 – 19 February, Southern Cooks, severe. Cyclone Peni caused significant damage to some of the islands in the Northern and Southern Cooks, while others escaped with only minor damage. In the Northern Cooks, only **Rakahanga** reported major damage to buildings, crops and trees. In the Southern Cooks, damage to varying degrees was reported. In **Autitaki,** the island's resort was damaged, the airport was flooded and damage occurred to some buildings. In Atiu, the school assembly hall collapsed and some houses were damaged. **Mauke** reported severe damage to its airport while some warehouses were destroyed and crops damaged.

1991
5 – 13 December, Northern Cooks, severe

1992
25 – 29 March, Northern and Southern Cooks, minor

1993
12 – 16 February, Southern Cooks, moderate. Cyclone Nisha

1995
1 – 3 January, Southern Cook, moderate. Cyclone William

1997
31 October – 5 November, Northern Cooks, severe. Tropical Cyclone Martin (TCM) On 1 November 1997, TCM struck Manihiki. Enormous waves, reported to be higher than coconut trees, washed over this low-lying atoll. Nineteen people lost their lives. Cyclone Martin caused extensive damage to 95% of the existing infrastructure, with the costs of the damaged estimated to be $ 14,196,000 Public and privately owned buildings, the power system and the telecommunication facilities were destroyed or damaged beyond repair; the airport runway and wharves were inundated, causing extensive damaged. Damage to the vegetation of the islands was considerable. Most of the pearl farming buildings located within the lagoon, and around the foreshore were destroyed

24 – 28 November, Northern Cooks, severe.

6 – 11 December, Northern Cooks, severe, Hurricane Pam

1998
30 January – 5 February, Northern Cooks, moderate

1999
11– 19 March, Southern Cooks, moderate to severe. Hurricane Hali.

2001 OMA
20 February, Cyclone OMA, Gale Force, Southern Cooks

2003
04-06 February, Hurricane Dovi, Southern Cooks

Attachment 7, Shelter Options

From the Shelter Options Report W1828/0/5/SO Rev 1 dated May 2003

2.1 Option One. Basic Three Bay Structure (Toilet Block One End Only)

2.1.1 Description

Option One is, in essence, a similar structure to that constructed on Manihiki. However, it has been reduced to a three bay structure with a toilet / shower block at one end only, gravity fed by a 22,000 litre water tank located above the toilets.

One of the bays at the bottom could be closed in, and used as a kitchen and storeroom area. The actual usage of the enclosed area can be changed to better match the specific requirements of the community. The remaining two lower bays have been kept as an open concourse. A verandah, to provide additional protection from the elements, has been incorporated along the lower floor.

The upstairs area is fully open, providing 81m^2 of open floor area. However, it could be partitioned in a range of ways to meet emergency centre and /or island community day to day needs. Access to the upper floors is by two external staircases.

Figure 1: Artists Impression of Option One

2.1.2 Pros and Cons

Pros

- Cheapest Option to meet the principal function of the building, which is to provide safe shelter to the community from cyclone storms
- Fully open upper floor area to maximise space utilisation during a cyclone

Cons

- Does not meet the communities preferences for usable floor area and functionality
- No specific space allocated for a medical clinic or emergency communications
- No specific space allocated for the storage of food, and limited space for personal possessions on the upper floor
- External access to the toilet block
- External access to the kitchen and lower floor storage area
- Toilet Block has external doors which, based on the Manihiki scenario, are susceptible to warping due to weather exposure

2.1.3 Costings

Table 2, Option One Preliminary Cost Estimates

Item	Description	Cost, NZ$
1.	**Supply of Materials and Shipping**	
	Material Costs	280,000
	Shipping Costs (refer Note 4)	201,000
	Temporary Wharf	15,000
	Supply of Barge (excl Shipping)	66,000
2.	**Project Management, Design and Documentation**	
	Detailed Design	14,000
	Specifications	5,000
	Cost Estimates	3,500
	PID	6,500
	Competitive Tendering	19,000
	Construction Supervision	74,000
	Reporting and Off-site Management	41,500
3.	**Construction**	
	Preliminary and General	155,000
	Labour Resources	240,000
	Tools and Equipment	40,000
	Plant (Hire based on 6-months)	130,000
	Fuel Costs	17,500
	Contractor Management Costs	38,500
	Contingency	150,000
Preliminary Cost Estimates		**1,496,500**

Notes:

1. *To be read in conjunction with Option One Schematic Drawings*

2. *Costs are essentially Preliminary Cost Estimates based on confirmation through tendering of Material Supply, Shipping and Labour.*

3. *Shipping costs based nominally on a $300/m^3 for Materials and $350/m^3(Incl return shipping) for Plant*

4. *Contractor Duration Based on twenty week construction period*

2.2 Option Two. Three Bay Structure with Sheltered Access to Toilet Annex.

2.2.1 Description

Option Two is essentially the same as Option One but has had some modifications made to the design following consultation with the Palmerston Island Council, Island Administration, Island Community and OMIA. The main visual change is that the toilet block has been moved away from the shelter in order to allow for possible future expansion, integrating the long term development of the islands' proposed administration building.

The toilet block has been re-orientated to open towards the core building and a screen wall / roof added to allow for sheltered access to the toilet block during a cyclone event. The access is described as "sheltered" because it will protect people from the wind and flying debris but will not prevent them from getting wet. It is not expected that people will wish to use the toilets during a wave wash situation; however, the screens will greatly reduce water velocities should people find themselves in the situation where they need to use the toilet while waves are washing over the site.

Consideration was given to locating a single toilet upstairs within the main structure but this was not considered a prudent option as there would be significant costs involved, as well as taking up valuable space in normal times and during a cyclone event. There are also cultural, social and hygiene issue that would need to be taken into consideration; with sleeping, food preparation and storage of possessions within the close proximity.

Other modifications include:

- Moving the kitchen and store to the eastern end of the building as requested by the Island Administration.
- Addition of a mezzanine floor to provide extra storage space (at minimum costs) without having to add to the building footprint;
- Partitioning for a medical clinic (No fixtures or fittings have been allowed for. We understand that the Island Administration will approach other donor agencies for possible funding of these items);
- Cabinets for medical supplies and emergency radio communications
- Enclosed / screened staircases. The roofline of the main structure has been extended to provide a roof over the staircase.

Modifications incorporated as a result of the Manihiki Review (*these have been carried through to all options)*:

- Septic tank situated away from the toilet block;
- Ridge vent removed and replaced with additional vents in the gable end walls;
- Waste pipes from the hand basins and showers piped to gulley traps;
- Exterior door design modified to make them less susceptible to warping and sticking (not from Option 1)
- Water tank modifications to minimise the potential for leakage.
- Use of stainless steel fixtures and fittings such as bolts, nails and strapping.

2.2.2 Pros and Cons

Compared with Option One,

Pros

- Addresses the Palmerston Island Administrations' (PIA) requirements for functionality and usage including space for:
  - Communications/ Emergency Radio Equipment
  - Medical Clinic (Note costs do not allow for furnishing the clinic)
  - Provision of a mezzanine floor area above the clinic, providing an additional 27m^2 of storage area for food supplies and limited personal possessions.
- Ability to expand the building in the future to meet the PIA long term goals without compromising the structural integrity of the main building
- Greater extended lower floor area. Ground floor slab extended to the annexed toilet block

- Generally takes into consideration the design outcomes of the Manihiki Project Evaluation by providing for:
    - More direct access to the toilet area (though access is not internal, a debris shelter has been provided for);
    - Toilet block re-arranged to minimise warping / sticking of doors from sun exposure;
    - Underground septic tank moved away from toilet block and core building;
    - Piped wastes within toilet block (i.e. open drain for grey water removed);
    - Covered Staircase (one end only)
    - Deletion of main roof vent with additional gable wall vents added
    - Stainless Steel Fixtures and Fittings such as bolts, nails and strapping

Cons

- Additional Cost
- Reduced Open Floor Area (upper floor)
- Still does not provide covered access to the kitchen and lower storage area

2.2.3 Costings

Table 3, Option Two Preliminary Cost Estimates

Item	Description	Cost, NZ$
1.	**Supply of Materials and Shipping**	
	Material Costs	300,000
	Shipping Costs (refer Note 4)	207,000
	Temporary Wharf	15,000
	Supply of Barge (excl Shipping)	66,000
2.	**Project Management, Design and Documentation**	
	Detailed Design	25,000
	Specifications	5,000
	Cost Estimates	3,500
	PID	6,500
	Competitive Tendering	19,000
	Construction Supervision	74,000
	Reporting and Off-site Management	41,500
3.	**Construction**	
	Preliminary and General	167,000
	Labour Resources	276,000
	Tools and Equipment	40,000
	Plant (Hire based on 6-months)	130,000
	Fuel Costs	19,000
	Contractor Management Costs	38,500
	Contingency	150,000
Preliminary Cost Estimates		**1,583,000**

Notes:

1 To be read in conjunction with Option Two Schematic Drawings

2 Costs are essentially Preliminary Cost Estimates based on confirmation through tendering of Material Supply, Shipping and Labour.

3 Shipping costs based nominally on $300/m^3 for Materials and $350/m^3(including for return shipping of Plant

4 Contractor Duration Based on a twenty-three week construction period

5 Costs do not include for the furnishings of the medical clinic

2.3 Option Three. Four Bay Structure

2.3.1 Description

Option three has been extended to a four bay structure. This allows for the incorporation of a covered stair at one end of the building. It does not provide fully internal access to the toilet block, but is a more secure option compared with option two. The internal staircase is protected by a screened wall over the full length of the bay.

The additional bay provides an additional 15m^2 (at each level) for storage or office space. It does not increase the useable floor area by the full 27m^2 (on each level) expected for a one full bay extension because a considerable amount of space is taken up with the staircase and upper and lower access ways. However, the size of the mezzanine floor is able to be doubled from 27m^2 to 54m^2. Easy access from the first floor is also able to be provided to the tank roof deck area for use during everyday situations.

The clear floor height beneath the mezzanine floor will be kept to 2.1m (as opposed to 2.4m) to maximise the height within the mezzanine area. However, the floor joists for the mezzanine area will be left exposed but painted white (i.e. no ceiling will be installed within the surgery, access way or upper storeroom), creating the feeling of space beneath the mezzanine.

All of the modifications allowed for in option two have also been allowed for in option three including:

- Moving the kitchen and store to the eastern end of the building;
- Addition of a double mezzanine floor;
- Partitioning for a medical clinic including a storage cupboard for medical equipment
- Partitioning for a communications room or additional storage area
- Enclosed internal staircase
- Additional space for a future office adjacent to the lower floor stairwell

2.3.2 Pros and Cons

Compared with Option One,

Pros

- Addresses the Palmerston Island Administrations' (PIA) requirements for functionality and usage including space for:
  - Communications/ Emergency Radio Equipment
  - Medical Clinic (Note costs do not allow for furnishing the clinic)
  - Provision of a double mezzanine floor area providing an additional 54m^2 of storage area for food supplies and limited personal possessions and shelter.
- Generally takes into consideration the design outcomes of the Manihiki Project Evaluation by providing for:
  - Direct Access to the toilet area
  - Toilet Block re-arranged. No external access doors
  - Under Floor Septic Tank removed away from Toilet block and core building
  - Piped Wastes within Toilet Block (i.e. open drain for grey water removed)
  - Internal Staircase
  - Deletion of main roof vent with additional gable wall vents added
  - Stainless Steel Fixtures and Fittings
- Increased useable upper floor area
- Allows access to the water tank roof deck in everyday situations

Cons

- Additional Cost
- Does not allow for future expansion of the building

2.3.3 Costings

Table 4, Option Three Preliminary Cost Estimates

Item	Description	Cost, NZ$
1.	**Supply of Materials and Shipping**	
	Material Costs	340,000
	Shipping Costs (refer Note 4)	222,000
	Temporary Wharf	15,000
	Supply of Barge (excl Shipping)	66,000
2.	**Project Management, Design and Documentation**	
	Detailed Design	25,000
	Specifications	5,000
	Cost Estimates	3,500
	PID	6,500
	Competitive Tendering	19,000
	Construction Supervision	74,000
	Reporting and Off-site Management	41,500
3.	**Construction**	
	Preliminary and General	193,000
	Labour Resources	336,000
	Tools and Equipment	40,000
	Plant (Hire based on 7-months)	150,000
	Fuel Costs	20,000
	Contractor Management Costs	45,500
	Contingency	150,000
Preliminary Cost Estimates		**1,752,000**

Notes:

1 To be read in conjunction with Option Three Schematic Drawings

2 Costs are essentially Preliminary Cost Estimates based on confirmation through tendering of Material Supply, Shipping and Labour.

3 Shipping costs based nominally on $300/m^3 for Materials and $350/m^3 for Plant

4 Contractor Duration Based on a twenty-eight week construction period

5 *Costs do not include for the furnishings of the medical clinic*

2.4 Option Four. Five Bay Structure

2.4.1 Description

In this option, the core structure is extended to a full five bay building, the same size as that constructed on Manihiki, although only one toilet block has been allowed for. Space for a bank and office facility has also been added in the end bay and a radio communications / telecom office has been added on the upper floor. The size of the building is such that no mezzanine floor has been allowed for as there should be sufficient storage space for the Palmerston community. All of the design modifications allowed for in the previous options have been included, where applicable.

2.4.2 Pros and Cons

Compared with Option One,

Pros

- Addresses the Palmerston Island Administrations' (PIA) requirements for functionality and usage including space for:
  - Communications/ Emergency Radio Equipment
  - Medical Clinic (Note costs do not allow for furnishing the clinic)
- Direct Access to the toilet area
- Fully enclosed internal staircase
- Increased useable upper floor area
- Allows access to the water tank roof deck in everyday situations

Cons

- Additional Cost

2.4.3 Costings

Table 5, Option Four Preliminary Cost Estimates

Item	Description	Cost, NZ$
1.	**Supply of Materials and Shipping**	
	Material Costs	390,000
	Shipping Costs (refer Note 4)	231,000
	Temporary Wharf	15,000
	Supply of Barge (excl Shipping)	66,000
2.	**Project Management, Design and Documentation**	
	Detailed Design	14,000
	Specifications	5,000
	Cost Estimates	3,500
	PID	6,500
	Competitive Tendering	19,000
	Construction Supervision	74,000
	Reporting and Off-site Management	41,500
3.	**Construction**	
	Preliminary and General	203,000
	Labour Resources	360,000
	Tools and Equipment	40,000
	Plant (Hire based on 8-months)	170,000
	Fuel Costs	24,000
	Contractor Management Costs	63,000
	Contingency	150,000
Preliminary Cost Estimates		**1,875,500**

Notes:

1 To be read in conjunction with Option Four Schematic Drawings

2 Costs are essentially Preliminary Cost Estimates based on confirmation through tendering of Material Supply, Shipping and Labour.

3 Shipping costs based nominally on $300/m^3 for Materials and $350/m^3 for Plant

4 Contractor Duration Based on a thirty week construction period

5 Costs do not include for the furnishings of the medical clinic

3. Summary of Options and Ranking

3.1 Summary Tables

Tables 6 and 7 below provide a quick reference comparison of the key elements of each option.

Table 6, Comparison of Floor Area

Item	Description	Floor Area (m^2)			
		Option 1	**Option 2**	**Option 3**	**Option 4**
	Lower Floor				
1.	Open Concourse	54	54	65	81
2.	Assigned for Use (i.e. Kitchen / Store etc)	27	27	27	43
3.	Verandah	94	94 + 25*	112	130
4.	Access (i.e. Stairs, Hallway)	18	23	25	20
	Upper Floor				
5.	Open Floor Area	81	51	54	81
6.	Assigned for Use (Medical and Communications)	0	22+3**	32	31
7.	Mezzanine Floor	0	27	54***	0
8.	Access (i.e. Stairs, Hallway)	0	5	22	23
	Toilet Block				
9.	Toilet Area Lower	19	19	19	19
10.	Water Tank Top	19	0	19	19
Total Assigned for Use - Upper and Lower (items 2, 4, 6, 8 and 9)		**64**	**99**	**125**	**136**
Total Open Area - Upper and Lower (items 1, 3, 5, 7 and 10)		**248**	**251**	**304**	**311**
Upper Floor Area Available for Storage and Shelter during a Cyclone (5, 6 and 7, excluding access)		**81**	**100**	**140**	**112**

* Sheltered Access to Toilet Area
** Storage Cupboards (Radio and Medical)
*** Option Three has a double Mezzanine Area

Table 7, Comparison of Options

Item	Description	Comparison			
		Option 1	Option 2	Option 3	Option 4
1.	Preliminary Cost Estimates	1,496,500	1,583,000	1,752,000	1,875,500
2.	Upper Floor Area Available for Storage and Shelter during a Cyclone (m^2)	81	100	140	112
3.	Kitchen	✓	✓	✓	✓
4.	Storage	✓	✓	✓	✓
5.	Verandah	✓	✓	✓	✓
6.	Open Staircase	✓			
7.	Sheltered Staircase		✓		
8.	Enclosed Staircase			✓	✓
9.	External Access to Toilet	✓			
10.	External Sheltered Access to Toilet Block		✓		
11.	Internal Access to Toilet			✓	✓
12.	Mezzanine		✓	✓ (dbl)	
13.	Space for Medical Clinic		✓	✓	✓
14.	Space for Communications		Cupboard provided	✓	✓

3.2 Ranking of Options

Our work has identified a number of key features about each option that has enabled a rough order ranking. *A robust system for ranking each of the options has not been able to be developed within the context of this report.* The rankings are based on:

- Cost;
- Community support;
- Meeting the project brief;
- Environmental Impact;
- Ability to meet future community needs;
- Storage space for possessions during a cyclone.

A simple system of ranking has been prepared to summarise these results. Refer to table 8 below.

Table 8, Rough Order Ranking

Item	Description	Comparison			
		Option 1	Option 2	Option 3	Option 4
1.	Cost	1	2	3	4
2.	Community Support	4	1	2	3
3.	Meeting the Project Brief	4	1	2	3
4.	Environmental Impact	1	2	3	4
5.	Ability to meet future community needs	4	3	2	1
6.	Storage space for possessions during a cyclone	4	3	2	1
	Points Total	18	12	14	16
	Rough Order Ranking	4	1	2	3

Option Two is the option that stands out as being the most preferred option for two reasons.

1. It is the cheapest option that fully meets the brief. Option One is cheaper overall but does not allow for future expansion, nor does it provide as much space for the storage of possessions required for post-cyclone recovery.

2. Option Two has the full support of the Palmerston Island Council. *Having the council and community support is vital if the project is going to be successful.* The PIC has aspirations for a larger building but they have acknowledged that budget and resource constraints make option two the best compromise.

Option Three is then considered the next best option primarily because it is more expensive that Option Two for only a marginal increase in benefits.

Option Four is considered the third ranked option. The primary reason for this is that it is the highest cost option primarily as a result of putting in place infrastructure now for the expected future needs of the community. Our understanding of the situation is that it may be some time before these future needs arise and that the passage of time may change the requirements. Our assessment has therefore been that putting in place infrastructure now, for some uncertain future needs is not warranted. If these future needs were certain and likely to arise within the near future then Option Four is an efficient way of putting the infrastructure in place.

Option One is the lowest ranked option for two reasons:

1. The option does not have the full support of the PI Council

2. The space provided by Option One is barely sufficient for the current cyclone shelter requirements of the community. If the cyclone happened at a time when there were additional visitors on the island (for example, over the Christmas period the population can swell to 90-100 people as overseas family members return home) or the cyclone was of an extended duration then the facility would not be able to adequately cope with the community needs. Given the cost of establishing on Palmerston Island it is considered more cost efficient to build a structure that has some ability to provide additional space rather than limiting it to precisely what is currently required.

Attachment 8, Breakdown of Preliminary Costings for Option 2

Attachment 9, Economic Evaluation

Attachment 10, Preliminary Construction Programme

Attachment 11, Photographs