Environmental Assessment Report

Project Number: 48192
June 2014

Tonga: Cyclone Ian Recovery Project

Initial Environmental Examination – Disaster Relief Funding - School Reconstruction Projects

Contents

Acronyms and Abbreviations

ASS	Acid Sulfate Soils
ADB	Asian Development Bank
ASL	Above Sea Level
CEMP	Construction Environmental Management Plan
CEO	Chief Executive Officer
DRM	Disaster Response Management
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
GDP	Gross Domestic Product
GNI	Gross National Income
GNDI	Gross National Disposable Income
GoNZ	Government of New Zealand
IEE	Initial Environmental Examination
JNAP	Joint National Action Plan on Climate Change Adaptation and Disaster Risk Management
GoT	Government of Tonga
Ha	Hectares
MLECCNR	Ministry of Land, Environment, Climate Change and Natural Resources
MoET	Ministry of Education and Training
PASS	Potential Acid Sulfate Soils
PPCR	Pilot Program for Climate Resilience
PPTA	Project Preparatory Technical Assistance
SLR	Sea Level Rise
SPCR	Strategic Program for Climate Resilience
TDOS	Tongan Department of Statistics
TMO	Tongan Meteorological Office

Executive Summary

On 11 January 2014, Tropical Cyclone Ian, a Category Five Cyclone lashed the Ha'apai Island Group in the Kingdom of Tonga. This was the first Category Five Cyclone to ever affect Tonga. While only a small cyclone in diameter, Tropical Cyclone Ian had wind gusts up to 287km/h (155 knots). Tropical Cyclone Ian caused extensive damage across a number of the island and the loss of one life. The main islands affected by Cyclone Ian included Foa, Ha'ano, Lifuka, Lofanga, Mo'unga'one, 'Uiha and Uoleva.

The Ministry of Education and Training (MoET) has identified that sixteen of the 31 primary and secondary schools that were damaged or destroyed by Tropical Cyclone Ian. Six of the damaged schools were non-government schools. A total of 1,346 students were affected. The extent of the damage ranged from broken windows and doors to torn roofs and buildings being totally destroyed. While temporary learning spaces in the form of tents and education supplies have been provided, there is an urgent need to ensure students can return to a safe and clean learning environment as soon as possible.

The Government of Tonga (GoT) has received emergency assistance funding from the Asian Development Bank (ADB - $2.47 million USD) and the Government of New Zealand (GoNZ - $5 million NZD) following Cyclone Ian that caused extensive damage in the Ha'apai Island Group on 11 January 2014. The ADB funding has been provided for the rebuilding of Government Primary Schools (GPS), while the GoNZ funding is for the provision of rebuilding other schools including both Government and Non-Government (Church) High/Secondary Schools.

This report presents the Initial Environmental Examination (IEE) for the proposed works at the sixteen schools in the Ha'apai Island Group. The works include small repairs to schools that did not sustain extensive damage to full reconstruction of schools where significant damage resulted due to Cyclone Ian. The work also includes the removal of asbestos from one school.

All sixteen school projects are categorized as Environmental Category B and Category C for Involuntary Resettlement and Indigenous Peoples consistent with the ADB *Safeguards Policy Statement* (2009) (SPS). Category B projects require the production of an IEE as the sixteen school projects will have minor impacts on the environment as a whole. This IEE prepared under the guidelines provided by the ADB's SPS includes a grievance redress mechanism and public consultation. The IEE will be submitted to the MoET to comply with its environmental requirements in consultation with other Tongan Government Ministries.

A range of potential construction impacts have been identified for all school projects. These impacts are confined mostly to short construction periods and, as long as proper clean-up and site rehabilitation measures are implemented; can be classed as temporary impacts with very minor impacts. Further, the removal of asbestos as part of the work will have significant beneficial impacts on human health for people associated with buildings that potentially contain asbestos including Mata'aho Government Primary School.

With the avoidance and mitigation measures proposed in this IEE; plus the compliance with the annexed Construction Environmental Management Plan (CEMP), the school projects will not result in any significant deleterious impacts on the environment and can proceed. All bidding documents and contracts for works on the school projects will contain provisions that require contractors to comply with the CEMP based on detailed design. The final CEMP will be specific to the construction methods that the contractor intends to use and will comply with the measures relevant to the contractor set forth in this IEE.

Introduction and Background

1. The Kingdom of Tonga is an archipelago of 172 coral and volcanic islands, of which only 36 are inhabited. The total land area is 747 km^2 spread over 347, 282 km^2 of sea. There are 17 main islands forming three major groups namely the Vava'u group to the north, the central Ha'apai group and the southern Tongatapu group (including 'Eua).

2. The islands of the Kingdom of Tonga and particularly Ha'apai are very susceptible to climatic events such as cyclone and associated storm events and subsequent flooding. Further, the islands are also very susceptible to associated impacts of earthquakes including tsunamis that may impact the nation. The nation has already observed the impacts of sea level rise (SLR) as a result of the impacts of climate change particularly in Ha'apai.

3. On 11 January 2014, Tropical Cyclone Ian, a Category Five Cyclone lashed the Ha'apai Island Group in the Kingdom of Tonga. This was the first Category Five Cyclone to ever affect Tonga. While only a small cyclone in diameter, Cyclone Ian had wind gusts up to 287km/h (155 knots). Tropical Cyclone Ian caused extensive damage across a number of the island and the loss of one life. The main islands affected by Tropical Cyclone Ian included Foa, Ha'ano, Lifuka, Lofanga, Mo'unga'one, 'Uiha and Uoleva.

4. Tropical Cyclone Ian struck the Ha'apai Island Group at low tide which would have limited any impact from flash flooding including sea flooding. There was no formal information at the time of writing this IEE that indicated that flash flooding including sea flooding occurred during the Cyclone. The evidence suggests that the storm surge was as little as 0.6 meters, which is very low for many Category Five cyclones.

5. An estimated 5,500 people of the local population of the Ha'apai Island Group (6,616) were directly affected. The Prime Minister of Tonga declared a state of emergency for Ha'apai on the day of Tropical Cyclone Ian, and the Government of Tonga (GoT) formally requested international assistance on 23 January once the extent of damage was clearer.

6. At the GoT's request, Asian Development Bank (ADB) and the World Bank fielded a joint post disaster scoping mission from 30 January to 4 February 2014. Based on a rapid assessment and review of the damage assessment conducted by the GoT with support from the United Nations Pacific Humanitarian Team, the scoping mission concluded that total preliminary estimates of damage and losses amounted to $50 million, equivalent to some 12.1% of gross domestic product (GDP). Most of the damage was to housing, followed by businesses, agriculture, power, infrastructure and education (4%).

Figure 1 Long Distance shot showing damage at Niu'ui Hospital post Tropical Cyclone Ian (Jan 2014) - Photographs courtesy of the New Zealand Air Force

Figure 2 Damage at Pangai Port post Tropical Cyclone Ian (Jan 2014) - Photographs courtesy of the New Zealand Air Force

Figure 3 Damage at Pangai Government School post Tropical Cyclone Ian (Jan 2014) - Photographs courtesy of the New Zealand Air Force

Figure 4 Long Distance shot showing damage in Pangai post Tropical Cyclone Ian (Jan 2014) - Photographs courtesy of the New Zealand Air Force

7. Category One Tropical Cyclone Kofi impacted the Kingdom of Tonga on 1 through 4 March 2014. Winds of up to 100km/h (54 knots) were experienced. A number of coastal land based impacts resulted from Tropical Cyclone Kofi. This included the impacts of flash flooding including sea flooding in the low lying areas, particularly during the extreme high tide on the evening of 2 March 2014. Anecdotal evidence from school staff in Pangai indicated that sea flooding/storm surge resulted in coastal roads and school properties being inundated and water remaining in school properties (School Principal, Catholic Church, St Joseph Community High School, April 2014).

Figure 5 Storm Surge and Sea Flooding associated with Cyclone Kofi

Figure 6 Storm Surge and Sea Flooding associated with Cyclone Kofi

Figure 7 Storm Surge and Sea Flooding associated with Cyclone Kofi

Figure 8 Storm Surge and Sea Flooding associated with Cyclone Kofi

8. As a result of the impacts of Tropical Cyclone Ian, the GoT has received emergency assistance funding from the ADB ($2.47 million USD) and the Government of New Zealand (GoNZ - $5 million NZD – approximately $4.25 million USD) following Cyclone Ian that caused extensive damage in the Ha'apai Island Group on 11 January 2014.

9. The ADB funding has been provided for the reconstruction and climate and disaster proofing of ten Government Primary Schools (GPS) that were damaged in Ha'apai and the provision of furniture such as blackboards, desks and chairs.[1] The funding does not include the reconstruction of teacher's residents at GPS schools. GPS were selected on the basis that they are government-owned, were severely damaged, and together they cater for half the affected student population. The reconstruction and climate and disaster proofing of these primary schools will allow classes to resume in a safe and conducive learning environment and will reduce the number of days that schools are closed during extreme weather events in the future. The GoNZ funding is for the provision of rebuilding other schools including both Government and Non-Government (Church) High/Secondary Schools.

10. Consistent with ADB requirements contained within the *Safeguards Policy Statement* (2009) (SPS), projects are classified as Category A,[2] Category B,[3] Category C,[4] or Category FI.[5] Following an assessment of the projects consistent with the Rapid Environmental Assessment and Project Categorization Forms, all sixteen school projects were considered to be Category B projects and Category C for Involuntary Resettlement and Indigenous

---

[1] The identified damaged Government Primary Schools include Fakakai, Faleloa, Fotua, Ha'ano, Koulo, Lofanga, Mata'aho, Mo'unga'one, Pangai and Tongoleleka GPS.

[2] Asian Development Bank (2009) *Safeguards Policy Statement*: Category A (OM 20): Projects with potential for significant adverse environmental impacts. An environmental impact assessment (EIA) is required to address significant impacts.

[3] Asian Development Bank (2009) *Safeguards Policy Statement*: Category B (OM 20): Projects judged to have some adverse environmental impacts, but of lesser degree and/or significance than those for category A projects. An initial environmental examination (IEE) is required to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

[4] Asian Development Bank (2009) *Safeguards Policy Statement*: Category C (OM 20): Projects unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are still reviewed.

[5] Asian Development Bank (2009) *Safeguards Policy Statement*: Category FI (OM 20): Projects are classified as category FI if they involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all subprojects will result in insignificant impacts.

Peoples. As such, an Initial Environment Examination (IEE) is required to be prepared for each project (cumulatively in this IEE).

11. This IEE relates to sixteen schools in Ha'apai. Figure 9 shows the whole Kingdom of Tonga, while Figure 10 shows the location of the islands in the Ha'apai Island Group.

12. The IEE is presented in the following format. The report initially provides an overview of each school project, the condition of the existing infrastructure, the damage sustained as a result of Tropical Cyclone Ian and the proposed improvement works. The general existing environment is then discussed followed by an assessment of the potential impacts of the projects on the existing environment both directly and indirectly. The IEE then provides background on the annexed Construction Environmental Management Plan (CEMP) and subsequently considers public consultation related to the projects. Finally the IEE provides recommendations for the upgrading of the schools with variations within the CEMP due to the location of each school.

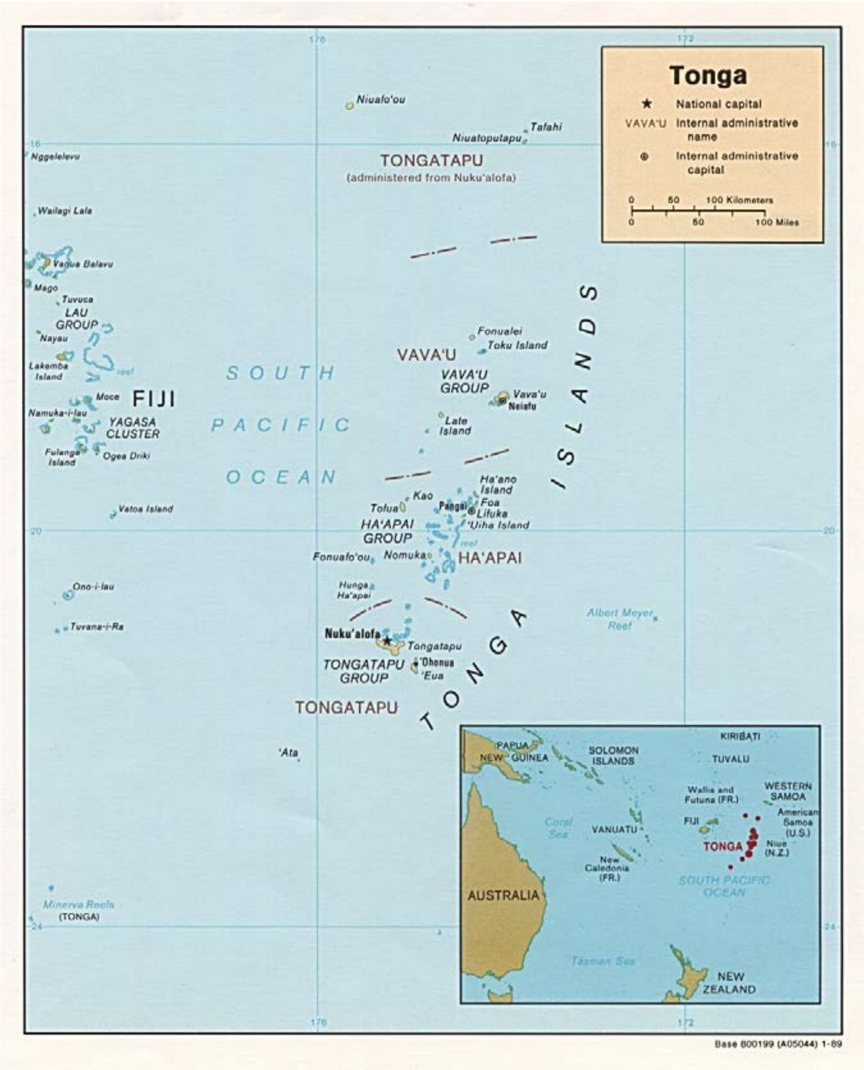

Figure 9 Map of Tonga

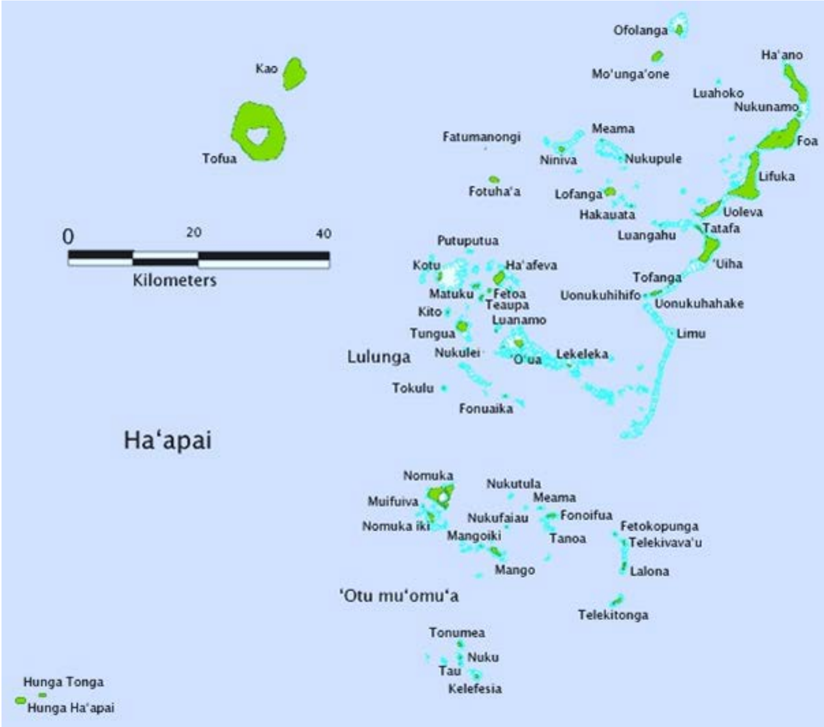

Figure 10 Map of Ha'apai Island Group

Description of Projects

13. The following section provides an overview of the sixteen schools that require assistance following Tropical Cyclone Ian. The description of each school includes an overview of the number of students that attend each school based on United Nations Children's Fund's (UNICEF) February 2014 enrollment data, the condition of school buildings and the damage sustained as a result of Cyclone Ian and the suggested reconstruction work that will be needed to repair the schools back to a condition that is acceptable for students.

14. The description of the school projects is predicated on the fact that many areas of the Ha'apai Island Group have very low elevations above sea level. The impacts of cyclones, storm surge/sea flooding and tsunamis are considered. The condition of the school in relation to its effectiveness to be resilient to earth quakes is also discussed with further detail being provided on this in the Infrastructure Specialists report of April 2014.

15. With respect to schools on Lifuka, in 2013, the Secretariat of the Pacific Community's Applied Geoscience and Technology Division (SOPAC) conducted scientific modelling of the potential inundation in Lifuka from storm surge and run-up associated with a severe (one in a 100 years) tropical cyclone event. Coupled with projected scenarios for SLR and rainfall, the SOPAC study found that flooding of up to five meters above current average sea-level might be expected. This would potentially impact 79% of existing infrastructure and homes on Lifuka, as well as groundwater resources. The results of the model, together with the implications for possible school reconstruction options such as elevated school buildings and relocation of infrastructure to higher ground, were presented to the community, along with the associated benefits and costs for each option.

16. The modeling splits the western coast of Lifuka into three zones, these being

    a. Long Term Coastal Erosion Zone (Red Zone) - This is the zone subject to erosion as well as the most intense natural forces from tropical cyclones and extreme storms with high-velocity wave action from damaging waves of 1 m or greater;

    b. Coastal High Hazard Area (Yellow Zone) - This area is subject to inundation from tropical cyclones and extreme storms with high-velocity wave action from waves of 1 m or greater; and

c. Coastal Hazard Zone (Blue Zone) - This area is subject to inundation from tropical cyclones with wave characteristics that are sufficient to damage structures on shallow or solid wall foundations.

17. The report makes a number of recommendations with respect to each zone as follows:

a. Long Term Coastal Erosion Zone (Red Zone) - Any construction in this zone is to be avoided. All buildings must be located landward of the reach of the zone. Critical infrastructure in this zone should be considered for relocation. Removing sand or vegetation may increase potential flood damage and erosion. Instead, this zone should be vegetated and allowed to maintain its natural integrity;

b. Coastal High Hazard Area (Yellow Zone) - Building in this area is to be avoided for critical facilities. All other buildings must be constructed on an open foundation (e.g. posts or columns) and the top of the lowest floor must be above the depth of inundation. Consider extra freeboard to add a margin of safety. Enclosed space below the lowest floor must be free of obstructions; and

c. Coastal Hazard Zone (Blue Zone) - Building in this area is to be avoided for critical facilities. All other buildings must be constructed on an open foundation (e.g. posts or columns) and the top of the lowest floor must be above the depth of inundation. Enclosed space below the lowest floor of buildings* may be used only for storage or parking and the walls must be of open design to allow entry and exit of water.

18. A Building/Buildings refer to new construction, substantial improvement, and repair of substantially damaged building. This could have implications for the reconstruction of some schools both on Lifuka and other affected islands. A graphical representation of the model outputs is included at Figure 11.

19. The models demonstrate that a number of schools on Lifuka in their present location are within the hazard zone (Figure 12). Discussion on these issues is included for each school as appropriate. For schools on islands other than Lifuka, discussion is provided given the height above sea level (high tide) obtained from the use of a GPS when undertaking the assessment and an analysis based on the experience with mapping and the SOPAC modeling.

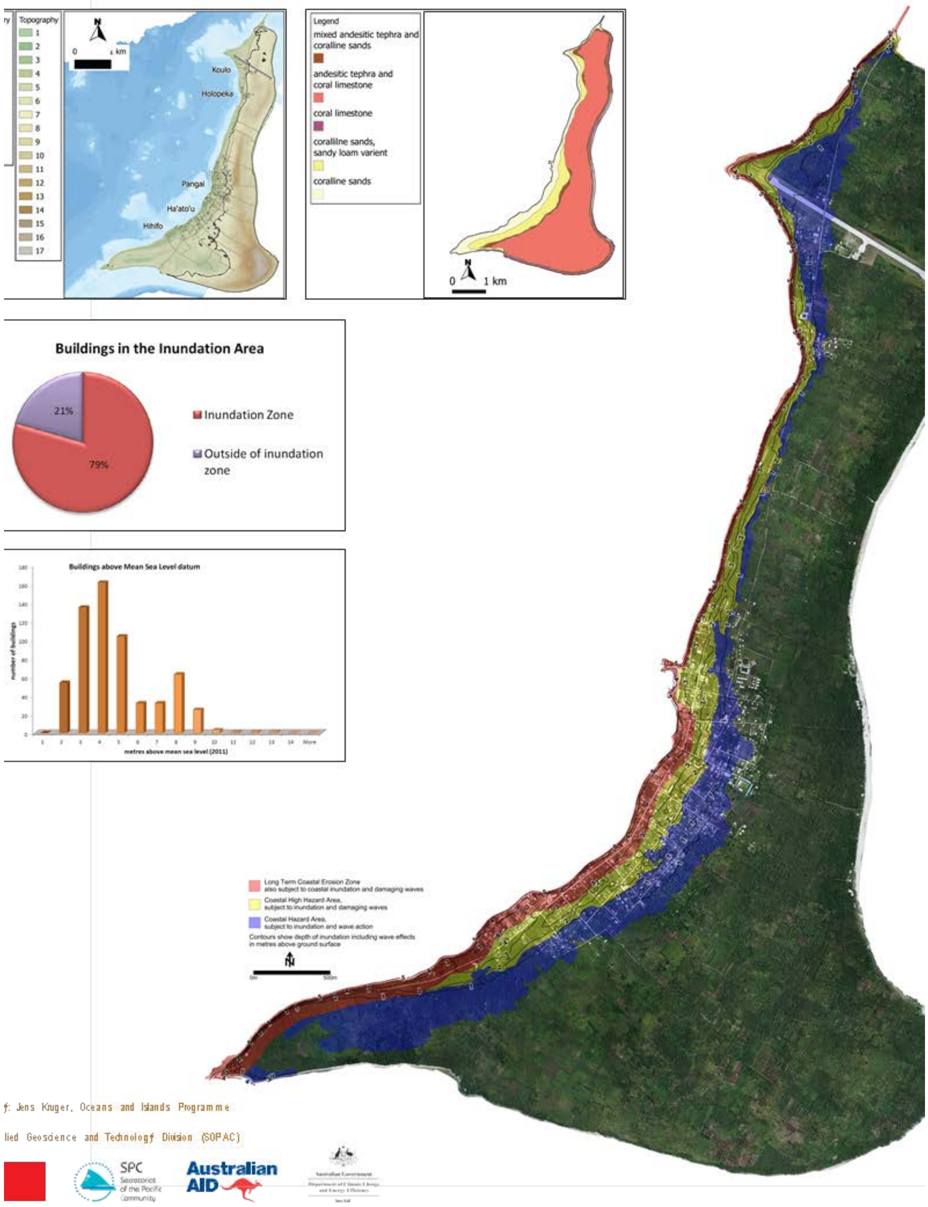

Figure 11 Lifuka Hazard Mapping, Ha'apai Island Group

Figure 12 Lifuka Hazard Mapping, Ha'apai Island Group with Lifuka Schools overlaid

Lifuka Government Primary Schools

Koulo Government Primary School

School Attributes

20. Koulo GPS is located adjacent to Salote Pilolevu Airport (Ha'apai Airport). The school provides educational facilities for 42 students and three teachers. The school is located in the blue zone consistent with the SOPAC modeling. An overview of the school if provided in Figure 13.

Condition of Existing Infrastructure

21. Prior to Tropical Cyclone Ian, Koulo GPS had three buildings designated for classrooms plus an additional building, the purpose of which was unknown. Two of the buildings, these being the main classrooms are a three classroom design, built with block bricks on a concrete slab (Figure 14). The newer classrooms were funded by and built consistent with Japanese standards in about 2012. The older classroom appears to be of a similar design; however there was no identification as to the funder, builder and/or year of construction.

22. The two buildings are relatively undamaged and there appears to be no earthquake or cyclone structural weaknesses. The main damage to the two buildings was to the fascia, gutters and about 50% of the eaves and ceilings in the older of the two classrooms have been damaged (Figure 15 and Figure 16). The roof has been repaired for any damage and lost sheeting that may have been sustained although there has been no work undertaken to the fascia and gutters.

23. The third classroom block was a timber framed classroom of approximately 30 meters long by 10 meter wide which it is understood was a kindergarten. This building only has the sub-frame remaining and therefore is totally destroyed (Figure 17). The sub frame and footings

appear to be in a satisfactory condition with the concrete stubs not showing any sign of rust or corrosion. As can be observed in Figure 17, 90% of the building has been destroyed.

24. Adjacent to this building was a smaller building (Figure 18). The roof and walls have been totally destroyed. The timber frames appear to still be in satisfactory condition although all the cyclonic ties are rusted and no longer has strength. This building could be rebuilt.

25. The toilet block contained four toilets. The building is built from block bricks and has only lost about 50% of its guttering. There appears to be no earthquake or cyclone structural weaknesses as a result of Tropical Cyclone Ian.

26. There is significant building debris within the school grounds from the damaged buildings that requires removal. This is currently a safety hazard should the students venture into this area. The debris includes glass, iron and nails as an example.

Proposed Works

27. The proposed work at the school includes the replacement of gutters and fascia to the two main classrooms and toilets. Where ceiling damage has been sustained in the older of the two classroom blocks, this will be replaced as needed. Further, all debris should be removed from the school compound to a waste facility for recycling and reuse where possible. This work should provide safe schooling facilities for the 43 children that attend Koulo GPS.

Figure 13 Koulo Government Primary School - Overview from Google Earth

Figure 14 Koulo Government Primary School – newer Japanese Designed Classroom

Figure 15 Koulo Government Primary School – Older Japanese Designed Classroom with gutters missing

Figure 16 Internal Ceiling Damage to older Japanese Designed Classroom at Koulo Government Primary School

Figure 17 Koulo Government Primary School Kindergarten destroyed by Tropical Cyclone Ian

Figure 18 Koulo Government Primary School - building destroyed by Tropical Cyclone Ian

Pangai Government Primary School

School Attributes

28. Pangai GPS is located in the main section of the town of Pangai. The school provides educational facilities for 126 students and fourteen teachers. The students from Pangai GPS are currently being educated in Ha'apai High School Hall. The school is located in the yellow zone consistent with the SOPAC modeling. An overview of the school if provided in Figure 19.

Condition of Existing Infrastructure

29. Prior to Tropical Cyclone Ian, Pangai GPS had three buildings designated for classrooms plus an additional building, which appears to have been an office along with two toilet blocks. Two of the buildings, these being the main classrooms are a six classroom design, built with block bricks on a concrete slab (Figure 20). These buildings were built pre 1974.

30. The first of these classrooms lost its roof during Tropical Cyclone Ian although this has been replaced with new sheeting. The roof trusses are currently exposed as the ceiling was also lost (Figure 21). The internal dividing doors are made up of movable partitions although the fixtures have rusted significantly overtime and were unmovable during the assessment. The internal and external walls of this building have suffered overtime with extensive concrete rot, corrosion and cracking.

31. The second of these classrooms lost its roof and timber frame during Tropical Cyclone Ian (Figure 22). There are no longer any internal dividing walls and as with the other main classroom, the internal and external walls of this building have suffered overtime with extensive concrete rot, corrosion and cracking.

32. The school office library lost its roof and suffered extensive damage although the walls appear to have withstood the main force of the cyclone (Figure 23). A building adjacent to the school office was totally destroyed with the sub-frame being the only remaining component of the building (Figure 24). The footings of this building are unsound.

33. Tow toilet blocks were observed on site. One block appeared to survive the impact of Tropical Cyclone Ian although it lost one of its doors. A second smaller toilet block was destroyed and the debris remains on site.

Proposed Works

34. All classrooms show a minor to higher degree of structural damage in that the post and beams have significant cracks and corrosion. Previous attempts to patch the columns as an example; have been unsuccessful. The two main classrooms, based on a rapid assessment,

are structurally unsound particularly given its age. This leaves these buildings in an unstable condition with requires replacement immediately.

35. It is recommend that all existing structures left from the cyclone damages be demolished and the school be rebuilt consistent with earthquake and cyclone design. Based on conversations with Pangai GPS staff during a visit to Ha'apai High School, the would be pleased to retain dividing classrooms as it gave them flexibility with class sizes.

36. Considerations should also be given to the specific design and potential location of new buildings given Pangai GPS's location within the Coastal High Hazard Area based on the SOPAC modeling.

Figure 19 Pangai Government Primary School - Overview from Google Earth

Figure 20 Pangai Government Primary School – Main Classroom Building

Figure 21 Pangai Government Primary School – Internal Roofing of Main Classroom Building

Figure 22 Pangai Government Primary School – Second Classroom Block that has been totally destroyed

Figure 23 School Office at Pangai Government Primary School

Figure 24 Destroyed Small Classroom at Pangai Government Primary School

Tongoleleka Government Primary School

School Attributes

37. Tongoleleka GPS is located south of the main section of the town of Pangai. The school provides educational facilities for 128 students and ten teachers. The school is located on the edge of the red and yellow zones consistent with the SOPAC modeling. An overview of the school if provided in Figure 25.

Condition of Existing Infrastructure

38. Tongoleleka GPS has two buildings designated for classrooms plus a toilet block between the two classroom blocks. The main classrooms are a three classroom design, built with block bricks on a concrete slab (Figure 26). The classrooms were funded by and built consistent with Japanese standards although there were no details of the year of construction.

39. The two buildings are relatively undamaged and there appears to be no earthquake or cyclone structural weaknesses. The main damage to the two buildings was to the loss of fascia, gutters and about 50% of the eaves and ceilings have also been damaged (Figure 27). The roof has been repaired for any damage and lost sheeting that may have been sustained although there has been no work undertaken to the fascia and gutters. A number of louvers will also lost and additional strapping is required to make the buildings cyclone proof.

40. Damage was only found on the inside walls of the most northern classroom where water has leaked through the block brickwork. This water has lifted the vinyl floor tiles and damaged the children work pasted on walls of this room. Water flooding into the classroom also damage classroom furniture. Low quality concrete blocks and unfilled cavities contributed to this leaking problem.

41. A small toilet block located between the two classroom buildings suffered minor damage to the roof and all the guttering and down pipes being blown off. Two residential houses also suffered minor damages from the Tropical Cyclone Ian which included the loss of part of the roof; ceiling and exterior walls.

Proposed Works

42. The proposed work at the school includes the replacement of gutters and fascia to the two main classrooms and toilets. The walls inside the classroom inside the classrooms will also be painted with water proof paint to reduce the future impacts on intrusion. All debris should be removed from the school compound to a waste facility for recycling and reuse where possible. This work should provide safe schooling facilities for the 128 children that attend Tongoleleka GPS.

Figure 25 Tongoleleka Government Primary School - Overview from Google Earth

Figure 26: Tongoleleka Government Primary School - Japanese Designed Classroom

Figure 27 Tongoleleka Government Primary School – Lost fascia and guttering

Figure 28 Water damage in northern classroom at Tongoleleka Government Primary School

Foa Government Primary Schools

Faleloa Government Primary School

School Attributes

43. Faleloa GPS is located at the northern end of Foa. The school provides educational facilities for 95 students and six teachers. The school is located at an elevation of about 13 meters on the top of a hill and therefore would not fall within any of the hazard zones. An overview of the school if provided in Figure 29.

Condition of Existing Infrastructure

44. Faleloa GPS has one main classroom building with five classrooms (Figure 30) along with a separate classroom building that was destroyed by Tropical Cyclone Ian. There is a separate toilet block with 10 toilets. The school itself was built in about 1980 although an exact date was not available.

45. The main classroom is a wooden structure constructed on block bricks that have cracked significantly. A full engineering investigation is required; however conservatively, it is suggested that the classroom's resistance to earthquakes and cyclones is suspect. The roof was torn off by the cyclone due to a lack of strapping and insufficient fixings which resulted in the ceiling being destroyed with the roof trusses being exposed (Figure 31). Numerous window louvers were also missing. The guttering on the majority of the building is adequate

although there is need for repairs to some sections of the roof on the northern side of the building.

46. The classroom building for Grade Six was completely destroyed and a UNICEF tent has been placed on the concrete slab where the building previously existed (Figure 32). The concrete slab is in good condition and could be used for any future building that was to be constructed on the site.

47. The toilet block which contains eight toilets is in a state of disrepair (Figure 33). The roof was damaged and doors ripped off. The concrete slab on which the toilet block was built appears to be in good condition.

48. There are two large piles of cyclone debris within the school compound. These include all the material that has been stacked on the western side of the existing toilets from the destroyed Grade Six classroom as well as another large pile of roofing iron placed on the northern side behind the large classroom block (Figure 34).

Proposed Works

49. Given the nature and extent of the damage; and in that, the existing five room classroom building is not earthquake and cyclone proof, it is recommended that the whole school be demolished and a new school be constructed on the site. There is significant land available that would allow for temporary repairs to the existing large classroom building while constructing new buildings adjacent to the current buildings that could accommodate all the students within either a single structure, or something similar to Koulo GPS.

50. The site will also need to be cleaned and all the cyclone debris removed. Where possible, recycling and reuse should occur. Any contaminated material should be taken to Tapuhia landfill in Nuku'alofa, Tongatapu.

Figure 29 Faleloa Government Primary School - Overview from Google Earth

Figure 30 Main Classroom at Faleloa Government Primary School

Figure 31 Missing Ceiling in the Classrooms of Faleloa Government Primary School

Figure 32 Temporary Teaching Tent at Faleloa Government Primary School

Figure 33 Toilet Block at Faleloa Government Primary School

Figure 34 Debris from destroyed building at Faleloa Government Primary School

Fotua Government Primary School

School Attributes

51. Fotua GPS is located at the southern end of Foa. The school provides educational facilities for 106 students and five teachers. The school is located at an elevation of about 10 meters on the eastern side of a small hill and therefore would not fall within any of the hazard zones. An overview of the school if provided in Figure 35.

Condition of Existing Infrastructure

52. Fotua GPS comprises of four classroom blocks with one totally destroyed by Tropical Cyclone Ian. The main classroom building is a Japan standard three-classroom block with no significant structural issues (Figure 36). As a result of the loss of the roof (which has already been repaired), the ceiling in one classroom suffered damage some damage (Figure 37). Further, the end cable wall was destroyed by Tropical Cyclone Ian and has been fixed temporally by the Defense Force.

53. There are two other classroom structures at Fotua GPS. Both are in a state of disrepair but did not suffer significant cyclone damage. The first is a three classroom building that is constructed on a concrete slab that has been poorly laid and has numerous cracks through it, which are likely to be a result of poor workmanship (Figure 38). The classroom building shows extensive signs of timber rotting and has significant termite damage. The classroom has a very old steel roof that has numerous small holes in it which has resulted in water damage within the building which has damaged sections of the internal walls that are made of particle board. The internal walls are exposed and there are numerous window louvers missing.

54. Building three is an abandoned classroom that has not been used for many years (Figure 39). The building has no windows and a large area of the roof is open to the environment. The building has no internal walls or doors.

55. Building four was a small classroom that was totally destroyed by Tropical Cyclone Ian. The building has a wooden sub-frame with three concrete steps leading up to the building. The sub-frame exhibits sign of wood rot and therefore is not salvageable.

56. A small toilet block (three toilets) is built on a concrete slab. The walls are constructed of brick with an steel roof. The building was relatively undamaged by Tropical Cyclone Ian.

Proposed Works

57. Repairs will be undertaken on the main classroom block. This will include the repair of the ceiling, the end cable wall and small repairs to the guttering. Further, strapping will be undertaken to better secure the roof. This will result in the building being in good working order.

58. The second main classroom block requires significant repairs including to the concrete slab, internal cladding and replacing the roof. This will allow the building to be used into the future.

59. The third and fourth classroom building should be demolished and replaced as necessary. Given that the third building has not been used for many years, it is unlikely that an additional classroom block will be required; however, the building is a safety issue. As to building four, this should be rebuilt as required. Investigations should be undertaken to build a new structure to accommodate both students and a school office which did not previously exist on site.

60. The site will also need to be cleaned and all the cyclone debris removed. Where possible, recycling and reuse should occur. Any contaminated material should be taken to Tapuhia landfill in Nuku'alofa, Tongatapu.

Figure 35 Fotua Government Primary School - Overview from Google Earth

Figure 36 Japanese Designed Classroom at Fotua Government Primary School

Figure 37 Lost Ceiling in main classroom block at Fotua Government Primary School

Figure 38 Second Classroom Building Fotua Government Primary School

Figure 39 Abandoned Classroom Block at Fotua Government Primary School

Figure 40 Small Classroom that was destroyed at Fotua Government Primary School

Outer Island Government Primary Schools

Fakakai Government Primary School

School Attributes

61. Fakakai GPS is located at the eastern end of Ha’ano. The school provides educational facilities for 61 students and three teachers. The school is located at an elevation of about 1.5 meters immediately adjacent to the coast and therefore would fall within the red hazard zones of the Lifuka modeling. An overview of the school if provided in Figure 41.

Condition of Existing Infrastructure

62. Fakakai GPS consisted of one large five classroom building; one residential building and a toilet block. The classroom building that was built with Japanese funding in about 2005. The school suffered significant damage as a result of Tropical Cyclone Ian (Figure 42). The classrooms were constructed with concrete block walls. A section of the walls collapsed as a result of Tropical Cyclone Ian which suggests that the structural stability and quality of the construction should be evaluated prior to any repairs being carried out (Figure 43). It was noted that the building was missing reinforcing ties and poor concrete infill. The classroom block also lost its roof and structural trusses during the cyclone. Most of the doors and windows are missing.

63. UNICEF has erected a number of tents to allow the students to continue learning (Figure 44).

64. The residential building at Fakakai GPS was also destroyed by Tropical Cyclone Ian (Figure 45). The building had a wooden frame with the sub-frame being the only remaining component of the structure. The floor has been extensively damaged and therefore, the whole building is no longer viable.

65. A four stall toilet building is built of concrete block work on a concrete slab. The roof has been replaced by qualified persons and is well built although areas of the toilet block roof require re-strapping to ensure it will not be damaged in the future.

66. Figure 46 shows a seawall that is immediately adjacent to the school buildings. The location of the school is within three meters of the high tide mark and as indicated, at a level of about one meter above sea level. The seawall is broken in numerous locations and has suffered subsidence on the landward side of the wall as a result of wave action and sea flooding. There is also significant erosion on the ocean side of the wall which suggests that the wall is totally unstable.

Proposed Works

67. Prior to a final decision being reached on any proposed work, a risk assessment is required and consideration as to the merits of rebuilding the school in its current location. Further, the risk assessment should also investigate whether the school should be repaired or demolished and rebuilt. The Lifuka Hazard Mapping would suggest the school is located within the red zone. A quick evaluation of the area adjacent to Fakakai GPS suggested that alternative land maybe available without the need for any resettlement of local people.

68. It is recommended that in the short terms, the students from Fakakai GPS utilize the school facilities at Ha’ano GPS given the numbers of students currently attending that school and the facilities available (see Ha’ano Government Primary School).

Figure 41 Fakakai Government Primary School - Overview from Google Earth

Figure 42 Classroom Block at Fakakai Government Primary School

Figure 43 Collapsed wall in the classroom block at Fakakai Government Primary School

Figure 44 UNICEF Tents at Fakakai Government Primary School

Figure 45 Destroyed Residential Building at Fakakai Government Primary School

Figure 46 Seawall at Fakakai Government Primary School

Ha'ano Government Primary School

School Attributes

69. Ha'ano GPS is located at the western end of Ha'ano. The school provides educational facilities for sixteen students and two teachers. The school is located at an elevation of about 5 meters and therefore would likely fall within the blue hazard zones of the Lifuka modeling. An overview of the school if provided in Figure 47.

Condition of Existing Infrastructure

70. Ha'ano GPS consisted of two classroom building; one residential building and a split toilet block. The main classroom building is a Japan standard three-classroom block with no evidence of any structural issues (Figure 48). During Tropical Cyclone Ian, the roof sheets was taken away and as a result of the loss of the roof (which has already been repaired), the ceiling in one classroom suffered damage (Figure 49). Further, the northern end cable wall was damaged. Some louvers were also missing.

71. A second classroom building (two classrooms) is currently being used for storage and as a residence for one of the teachers. The building is constructed of concrete block work on a concrete slab (Figure 50 and Figure 51). The block work demonstrates extensive cracking which suggests that the concrete block walls are unstable and unsafe for uses in the classroom. The roof suffered minor damage including the loss of guttering in places. The roof itself is corroded in places

72. A third building, which it is understood was a residence was destroyed by Tropical Cyclone Ian (Figure 52).

73. A four stall toilet building and a separate two stall toilet building have been built of concrete block work on a concrete slab. The roof of the two toilet blocks is badly corroded; however the wooden trusses are in reasonable condition. There are small brick vents in the stalls which act as windows; however no glass was observed.

74. There are two large piles of cyclone debris within the school compound. These include all the material that has been stacked in the destroyed building as well as another large pile of roofing iron and wood that has been placed on the eastern side behind the sea wall.

Proposed Works

75. Repairs will be undertaken on the main existing classroom block. This will include the repair of the ceiling, the end cable wall and small repairs to the guttering. Further, strapping will be undertaken to better secure the roof. This will result in the building being in good working order.

76. The second main classroom block will be demolished and replaced as necessary. Given that Ha'ano GPS only has sixteen students, it is unlikely that additional teaching facilities above the three classrooms are required; however, the demolition of the building is required as it is a safety issue.

77. As highlighted above in relation to students that current attend Fakakai GPS, an investigation should be undertaken to consider the use of Ha'ano GPS for those students.

78. The site will also need to be cleaned and all the cyclone debris removed. Where possible, recycling and reuse should occur. Any contaminated material should be taken to Tapuhia landfill in Nuku'alofa, Tongatapu.

Figure 47 Ha'ano Government Primary School - Overview from Google Earth

Figure 48 Main Classroom Building Ha'ano Government Primary School

Figure 49 Internal Damage to main classroom building at Ha'ano Government Primary School

Figure 50 Second Classroom Building at Ha'ano Government Primary School

Figure 51 Second Classroom Building at Ha'ano Government Primary School

Figure 52 Destroyed Building at Ha'ano Government Primary School

Lofanga Government Primary School

School Attributes

79. Lofanga GPS is located in the main township. The school provides educational facilities for 25 students and two teachers. The school is located at an elevation above 10 meters and well inland; and therefore would not fall within any of the hazard zones of the Lifuka modeling. An overview of the school if provided in Figure 53.

Condition of Existing Infrastructure

80. Lofanga GPS consisted of a single three classroom building. The building is constructed of concrete block work on a concrete slab (Figure 54 and Figure 55). The block work demonstrates extensive cracking which suggests that the concrete block walls are possibly unstable and unsafe for uses in the classrooms. The roofing consists of recycled roofing iron which has many holes in it, thus resulting in water intrusion into the classrooms (Figure 56 and Figure 57). Further, many of the window louvers are missing (some sections of the windows have been covered with roofing iron) and along with the intrusion from the holes in the roofing iron, this has resulted in damage to the internal walls and fixtures in the classrooms (Figure 58). Large areas of guttering were also damaged.

81. There is a small pit latrine toilet block that is located in a galvanized iron shed.

82. Pigs have dug up the current electricity cable and it is now exposed, creating an unsafe environment.

Proposed Works

83. The classroom building requires buttressing or rebuilding as the block work is unsafe due to cracking. The rebuilding should be undertaken in consideration of both cyclones and earthquakes. The roofing iron and window louvers will be replaced to restrict water intrusion into the building and the roof trusses should be strapped and re-nailed. The gutters will be replaced where missing.

84. A new two stall toilet will also be constructed on site.

85. Work will be undertaken to securely bury the electricity power connection into the school and install a new electricity box.

Figure 53 Lofanga Government Primary School - Overview from Google Earth

Figure 54 Classroom Building at Lofanga Government Primary School

Figure 55 Classroom Building at Lofanga Government Primary School

Figure 56 Recycled Roofing Iron with holes at Lofanga Government Primary School

Figure 57 Internal Trusses at Lofanga Government Primary School

Figure 58 Water Damage to a classroom at Lofanga Government Primary School

Mata’aho Government Primary School

School Attributes

86. Mata’aho GPS is located in the middle of the island of ‘Uiha. The school provides educational facilities for 77 students and four teachers. The school is located at an elevation of about 2 meters immediately adjacent to the coast and therefore would fall within the red hazard zones of the Lifuka modeling. An overview of the school if provided in Figure 59.

Condition of Existing Infrastructure

87. Mata’aho GPS consisted of three classroom building; one residential building and two toilet blocks, with the original toilet block no longer being used.

88. The main classroom building is a Japan standard three-classroom block with no evidence of any structural issues (Figure 60). It would appear given carvings in one of the toilets that the buildings were constructed in about 1985. During Tropical Cyclone Ian, the roof sheets was damages and as a result of the loss of the roof (which has already been repaired), the ceiling in all three classrooms suffered damage and has been removed, leaving exposed roof trusses both inside and outside the classrooms. Some the guttering were also damaged. Some louvers were missing and water has entered the classrooms through both the roof and windows causing minor damages to furniture.

89. A second building acts as a classroom/hall and has a library at the southern end (Figure 61 and Figure 62). This building suffered minor damage and requires roof frame strapping, gutter replacement and minor fascia repairs.

90. The third classroom building is a historical 7.5 x 23m hardwood timber school building with an asbestos cement roof (Figure 63). It is proposed to be used as a kindergarten. The building did not suffer any damage as a result of Tropical Cyclone Ian. The classroom building shows extensive signs of timber rotting due to its age including the edge floor beams and flooring (Figure 64). There is severe degradation of timber around windows. The external foundation concrete stub columns are degraded and show signs of cracking and corrosion. The building has a sentimental value to the school but will require substantial renovation to upgrade this building so that it can be used as a kindergarten.

91. There are two toilet blocks contained within the school, with the second no longer operational. The condition of the toilets is very satisfactory and they suffered no damage as a result of Tropical Cyclone Ian.

Proposed Works

92. Repairs will be undertaken on the main existing classroom block and the classroom/hall/library. This will include the repairs to the ceiling and guttering. Further, strapping will be undertaken to better secure the roof. This will result in the building being in good working order.

93. The third building will be demolished and removed from the site. The asbestos roof will be removed by trained professionals and transported to the special cell within Tapuhia landfill in Nuku’alofa, Tongatapu. All other debris will be removed off site.

Figure 59 Mata'aho Government Primary School - Overview from Google Earth

Figure 60 Main Classroom Block at Mata'aho Government Primary School

Figure 61 Second Classroom/Hall/Library Building at Mata'aho Government Primary School

Figure 62 Second Classroom/Hall/Library Building at Mata'aho Government Primary School

Figure 63 Proposed Kindergarten with Asbestos Roof at Mata'aho Government Primary School

Figure 64 Proposed Kindergarten at Mata'aho Government Primary School

Mo'unga'one Government Primary School

School Attributes

94. Mo'unga'one GPS is located on the island of Mo'unga'one. The school provides educational facilities for 12 students and two teachers. The school is located at an elevation of about 10 meters on the western side of the island and therefore would not fall within any of the hazard zones. An overview of the school if provided in Figure 65.

Condition of Existing Infrastructure

95. Mo'unga'one GPS consisted of a three classroom building; one residential building and a toilet block.

96. The school suffered significant damage as a result of Tropical Cyclone Ian (Figure 66, Figure 67 and Figure 68). The classrooms were constructed with concrete block walls. A section of the walls collapsed as a result of Tropical Cyclone Ian which suggests that the structural stability and quality of the construction should be evaluated prior to any repairs being carried out. It was noted that the building was missing reinforcing ties and poor concrete infill. The northern half of the classroom block lost its roof and structural trusses during the cyclone (Figure 69 and Figure 70). Most of the doors and wooden shutters are missing/damaged. The southern end of the classroom building appears to have withstood the main impacts of Tropical Cyclone Ian; however the rest of the building is unsafe. This area is used as both and office and for the second teacher's accommodation.

97. UNICEF has erected a number of tents to allow the students to continue learning.

98. The main residential building at Mo'unga'one GPS survived Tropical Cyclone Ian.

99. There is a small pit latrine toilet block that is located in a galvanized iron shed.

Proposed Works

100. Given the damage sustained to the existing building and that is considered unsafe, the school will be demolished and replaced with a new school building to cater for the small number of students that attend the school.

101. The site will also need to be cleaned and all the cyclone debris removed. Where possible, recycling and reuse should occur. Any contaminated material should be taken to Tapuhia landfill in Nuku'alofa, Tongatapu.

Figure 65 Mo'unga'one Government Primary School - Overview from Google Earth

Figure 66 Destroyed Classroom Building at Mo'unga'one Government Primary School

Figure 67 Destroyed Classroom Building at Mo'unga'one Government Primary School

Figure 68 Destroyed Classroom Building at Mo'unga'one Government Primary School

Figure 69 Destroyed Classroom Building at Mo'unga'one Government Primary School

Figure 70 Usable Classroom at Mo'unga'one Government Primary School

Lifuka Government Secondary Schools

Ha'apai High School

School Attributes

102. Ha'apai High School is the major Government high school is the Ha'apai Group. The school has an enrolment of 277 students and 25 staff, many of whom live within the school grounds. Students attend Ha'apai High School from a number of islands within the Ha'apai Group. The school is located at approximately 13 meters and therefore is not within any of the hazard zones from the Lifuka modeling. An overview of the school is shown in Figure 71.

Condition of Existing Infrastructure

103. The original High School is now a Catholic High School. The current Ha'apai High School was built in about 2001. The school has seven classroom buildings plus a large hall that was constructed by the Chinese Government (Figure 72). The school came through Tropical Cyclone Ian relatively unscathed. A number of the classroom buildings lost guttering and a number of the staff quarters lost their roofs (Figure 73).

104. Primarily the work required at Ha'apai High School is routine maintenance given the annual MoET budget for maintenance is only 5% of the annual budget. There is extensive maintenance required to the internal ceilings of buildings, the replacement of louvers and framing and the electrical and plumbing fixtures. For example, many of the internal corridors and classrooms are missing ceiling panels (Figure 74). Further, the electrical components both within classrooms and at mains boards are rusted and/or damage and this has resulted in a potential safety issue for both staff and students (Figure 75).

105. The fire equipment within Ha'apai High School also requires servicing (Figure 76) as it is broken in many places throughout the school.

106. The main damage sustained at Ha'apai High School was the destruction of a three bay car garage on the northern side of the school compound. Based on discussions with the Principal, it is not planned to replace this structure.

Proposed Works

107. The proposed works will include the repair of guttering around the school and linking with existing water tanks. Further, all electrical equipment will be upgraded to current standards. Louvers and ceilings will be replaced as required.

108. Following the upgrading, the fire equipment at Ha'apai High School will also be repaired to ensure the safety of staff and students alike.

109. The main hall at Ha'apai High School is part of the climate proofing of schools project funded through the Strategic Program for Climate Resilience under the Pilot Program for Climate Resilience. The funding is being provided by the Climate Investment Fund. The proposed upgrading of the gutters and linking with the storage of water tanks will assist the students of Ha'apai High School to be provided with high quality drinking water as well as linking the proposed works at the school with the new hospital located on the current rugby oval at the school. This work will make Ha'apai High School an ideal evacuation center prior, during and post emergency incidents such as cyclones and tsunamis.

Figure 71 Ha'apai High School - Overview of Site from Google Earth

Figure 72 Main Classroom Buildings at Ha'apai High School

Figure 73 Lost Gutters on Classroom Building at Ha'apai High School Hall

Figure 74 Damage Ceiling at Ha'apai High School

Figure 75 Rusted Electrical Switch Board at Ha'apai High School Hall

Figure 76 Damaged Fire Hose at Ha'apai High School

Lifuka Church Secondary Schools

Ofamo’oni Primary and Secondary School

School Attributes

110. Ofamo’oni Primary and Secondary School is located north of the main section of Pangai. The school provides educational facilities for a total of 66 students (34 primary and 32 secondary students) and eight teachers. The school is located is just outside the blue zone consistent with the SOPAC modeling. An overview of the school is shown in Figure 77

Condition of Existing Infrastructure

111. Ofamo’oni Primary and Secondary School has two main classroom blocks, one for the primary and one for secondary students along a small toilet block and teacher’s residence. The school was built in 2002.

112. The first building contains three classrooms and an office. This building is constructed of rendered block work on a concrete slab (Figure 78). The roof has been replaced on this building although the gutters were also lost but are yet to be replaced. There are numerous window frames and louvers missing in the classrooms which require replacing (Figure 79). Overall the building itself is in good condition.

113. The second building contains three classrooms like the main building (Figure 80). This building is constructed of rendered block work on a concrete slab. The roof has been replaced on this building although the gutters were also lost but are yet to be replaced. Significant damage has been sustained to the particle board ceiling both inside and outside the classrooms (Figure 81and Figure 82). The loss of the ceiling allowed water to damage fixtures within the classroom.

114. A third smaller classroom building is currently being used as a teacher’s residence. This building, like the two main classroom blocks is constructed of rendered block work on a concrete slab. The frame of the roof is made of light timber and ceiling were lost during Tropical Cyclone Ian and is unlikely to withstand a future event (the roofing iron itself is satisfactory). Approximately 30% of the window louvers and door were damaged during the cyclone.

115. A five stall toilet block is constructed of rendered block work on a concrete slab (Figure 80). The building has a timber frame roof and the roofing iron is in good condition. The location of the toilets between the two main classroom buildings would have provided some resistance and protection during Tropical Cyclone Ian.

Proposed Works

116. The proposed work includes the replacement of the ceiling in the second classroom block and the replacement of gutters, window frames and louvers in all three buildings. Further, strapping will be undertaken to better secure the roof. This will result in the building being in good working order.

Figure 77 Ofamo'oni Primary and Secondary School - Overview from Google Earth

Figure 78 Primary Classroom Block at Ofamo'oni Primary and Secondary School

Figure 79 Damaged windows in the Primary Classroom Block at Ofamo'oni Primary and Secondary School

Figure 80 Secondary Classroom Block with toilet block in foreground at Ofamo'oni Primary and Secondary School

Figure 81 Damaged Ceiling in the Secondary Classroom Block at Ofamo'oni Primary and Secondary School

Figure 82 Damaged Internal Ceiling in the Secondary Classroom Block at Ofamo'oni Primary and Secondary School

Petani Bilingual Free Wesley Church School

School Attributes

117. Petani Bilingual Free Wesley Church School is located north of the main section of Pangai. The school provides educational facilities for a total of 22 students and five teachers. The school is located just outside the blue zone consistent with the SOPAC modeling. An overview of the school is shown in Figure 83.

Condition of Existing Infrastructure

118. Ofamo'oni Primary and Secondary School has two main classroom blocks, one for the primary and one for secondary students along a small toilet block and teacher's residence. The school was built in 2002.

119. The first classroom block is an older building containing two large classrooms. This building is constructed of wood with steal posts on a concrete slab (Figure 84. The building is in a dilapidated state with the wood cladding exhibiting rot and near the end of its life. The roof trusses are wooden with some strapping. The fascia has been damaged and the gutters were torn off by Tropical Cyclone Ian (Figure 85 and Figure 86). The roof has been replaced although there is no ceiling within the two classrooms (Figure 87). There are numerous window frames and louvers missing in the classrooms which require replacing. Overall the building itself is in poor condition.

120. The second classroom building is a Japan standard four-classroom block with no evidence of any structural issues (Figure 88). This building is constructed of rendered block work on a concrete slab and was built in circa 2005. The roof appears in good condition although some guttering was removed as a result of Tropical Cyclone Ian.

121. A seven stall toilet block is constructed of rendered block work on a concrete slab. Only three of the toilets are operational. The building has a timber frame roof and the roofing iron is reused from past work. The windows have been boarded up and there are no doors on some of the toilets and those that do have doors, the doors themselves are in a poor condition.

Proposed Works

122. Repair work is currently underway following Tropical Cyclone Ian. The main repair work is in the form of maintenance including but not limited to the repair of the wooden cladding on the older building as well as the replacement of gutters on both buildings.

123. Guttering and the ceilings will be replaced/repaired as part of the proposed works.

Figure 83 Petani Bilingual Free Wesley Church School - Overview from Google Earth

Figure 84 Main Classroom Building at Petani Bilingual Free Wesley Church School

Figure 85 Back of Main Classroom at Petani Bilingual Free Wesley Church School

Figure 86 Missing Gutter on Main Classroom at Petani Bilingual Free Wesley Church School

Figure 87 Damaged Ceiling in Main Classroom Building at Petani Bilingual Free Wesley Church School

Figure 88 Second Classroom at Petani Bilingual Free Wesley Church School

St Joseph's Roman Catholic Church School

School Attributes

124. St Joseph's Roman Catholic Church School is located just south of the main section of Pangai. The school provides educational facilities for 76 students and twelve teachers. The school is located in the yellow zone consistent with the SOPAC modeling (elevation of about 3 meters above sea level). The School Principal advised that during Tropical Cyclone Kofi in March 2014, sea flooding/storm surge occurred resulting in the school grounds being inundated and water remaining in school properties (School Principal, Catholic Church, St Joseph Community High School, April 2014). An overview of the school is shown in Figure 89.

Condition of Existing Infrastructure

125. St Josephs was the original High School in Ha'apai. It was constructed in 1976 and granted to the Catholic Church when the new Ha'apai High School was constructed in 2001. There are three main buildings at St Josephs, these being the main classroom block, a second classroom block and office and a third machinery room that was destroyed by Tropical Cyclone Ian (Figure 90)

126. The main school building is a very large three story structure made of concrete on a concrete slab. The building includes a science laboratory, library and teacher's apartments. The building has extensive spalling and corrosion of the concrete (Figure 91). The building shows previous unsuccessful repairs have been undertaken across the entire building.

Significant repair work was undertaken post an earthquake in 2006. The concrete columns have many examples of exposed corroded reinforcing. There are only three exits from the upper levels with the previous staircase on the south eastern side being closed off and a concrete wall built. There are also numerous locations on the upper levels with no railings leaving gaps where students could fall. The staircases at either end are in a state of disrepair. There are a number of toilet blocks on each level for both gender of students and a number of the stalls are not operational.

127. The roof structure is made of wood with a galvanized steel roof. Some of this was replaced following Tropical Cyclone Ian. The gutters on either side of the building were torn off by the cyclone and these have been replaced on the western side of the building only. Numerous louvers where observed to be missing and many of the frames were corroded (Figure 92).

128. Based on engineering considerations, the building is not considered safe and/or structurally sound to withstanding a future event including an earthquake. The structure is considered too far deteriorated to bring it up to a satisfactory earthquake proof standard.

129. A second classroom block is locates south west of the main building (Figure 93). This building is a two story structure constructed of rendered block work on a concrete slab and is a newer building that the three story structure. The two buildings are joined by a suspended walkway. Many of the rooms were observed to unused during the mission in April 2014. Some rooms were used as offices.

130. The roof structure is made of wood with a galvanized steel roof. Some of this was replaced following Tropical Cyclone Ian. The gutters on either side of the building were torn off by the cyclone and these were in the process of being replaced. Minor window and louver damage was also observed.

131. While not in the same condition as the main classroom block, the building is not considered safe to withstand both an earthquake and future cyclones.

132. A third building on the site was previously used as a training workshop. This building was destroyed by Tropical Cyclone Ian (Figure 94). The building is made of concrete block with a timber frame containing many windows on a cracked concrete slab. The cracking in the concrete slab suggests that the foundations are inadequate. The roof and trusses were destroyed by the cyclone along with approximately 20% of the windows.

Proposed Works

133. Given the current condition of the buildings, it is recommended that the buildings be demolished and rebuilt consistent with recommendations from the Lifuka modeling. The main classroom building should be demolished first allow students to utilize the predominantly empty second classroom block. Temporary repairs will be undertaken to this building in the interim to allow for its use. All new buildings should be constructed within the SOPAC modeling in mind.

134. With respect to the workshop, while this building could be repaired, it is actually located within the red hazard zone. Accordingly, a risk assessment is required and consideration as to the merits of rebuilding the school in its current location. Further, the risk assessment should also investigate whether the school should be repaired or demolished and rebuilt.


Figure 89 St Joseph's Roman Catholic Church School - Overview from Google Earth


Figure 90 St Three Classroom Blocks at Joseph's Roman Catholic Church School


Figure 91 Exterior of Main Classroom Block at St Joseph's Roman Catholic Church School


Figure 92 Missing Louvers in Main Classroom Block at St Joseph's Roman Catholic Church School


Figure 93 Second Classroom Block at St Joseph's Roman Catholic Church School


Figure 94 Destroyed Machinery Workshop at St Joseph's Roman Catholic Church School

Tailulu College Free Church of Tonga School

School Attributes

135. Tailulu College Free Church of Tonga School is located just south of the main section of Pangai and immediately across the coast road from St Joseph's Roman Catholic Church School. The school provides educational facilities for 45 students and thirteen teachers. The school is located at an elevation of about one meter immediately adjacent to the coast and is

located within the red hazard zones of the Lifuka modeling. An overview of the school if provided in Figure 95.

Condition of Existing Infrastructure

136. Tailulu College consisted of one large classroom building which includes six classrooms, a library and office; two smaller classroom buildings and a toilet block.

137. The main classroom building was built in circa 1986. The main classroom suffered significant damage as a result of Tropical Cyclone Ian (Figure 96). The classrooms are constructed with concrete block walls on a concrete slab that exhibits both cracking and sagging. The concrete black work also exhibits substantial cracking, extensive spalling and corrosion. The entire roof structure of the building was torn away from the building as a result of Tropical Cyclone Ian which mounting points cracked (Figure 97). While the roof and concrete ceiling has been destroyed in some sections of the classroom building, the main internal classrooms are still covered with a concrete ceiling. The classroom has both wooden windows and louvers and many of these were either damaged by the cyclone of in a state of disrepair already. A large internal area appears to have issues with drainage as water had collected within this area during the mission. The above suggested that the classrooms are not cyclone and earthquake proof.

138. A second classroom is located immediately adjacent to the coastal road. The three classrooms are constructed with concrete block walls on a concrete slab which appear to be in a stable condition. The timber roof and roofing iron are in good condition although additional strapping is required to improve cyclone resistance. A small section of the gutters were damaged.

139. A third classroom was destroyed by Tropical Cyclone Ian. This building was made of wood construction on a concrete slab. Only the northern wall of the structure remained standing following the cyclone (Figure 98).

140. UNICEF has erected a number of tents to allow the students to continue learning (Figure 99).

141. A four stall toilet building is built of concrete block work on a concrete slab. The slab is broken in places. The structure has a timber roof covered with previously used corrugated iron. The toilets are located on the seaward side of the school within 3 meters of the high tide mark.

142. Figure 100 shows a corrugated iron steel seawall that is immediately adjacent to the school buildings. The location of the school is within 5 meters of the high tide mark and as indicated, at a level of about one meter above sea level. Significant debris has been placed on the seaward side of the corrugated iron. Erosion around the corrugated iron sheeting is visible. Given that sea flooding occurred in St Josephs during Tropical Cyclone Kofi, it is anticipated that this areas was also impacted.

Proposed Works

143. It is considered likely that the main classroom will be demolished given that is it not cyclone or earthquake proof. Prior to a final decision being reached on any proposed work, a risk assessment is required and consideration as to the merits of rebuilding the school in its current location. Further, the risk assessment should also investigate whether the school should be repaired or demolished and rebuilt. The Lifuka Hazard Mapping would suggest the school is located within the red zone.

144. Repairs can easily be undertaken on the second classroom building to make it usable. The main repairs include strapping and guttering replacement. The third classroom should be demolished and rebuilt as required

145. The site will also need to be cleaned and all the cyclone debris removed. Where possible, recycling and reuse should occur. Any contaminated material should be taken to Tapuhia landfill in Nuku’alofa, Tongatapu.

Figure 95 Tailulu College Free Church of Tonga School - Overview from Google Earth

Figure 96 Main Classroom Block at Tailulu College Free Church of Tonga School

Figure 97 Main Classroom Block with no roof at Tailulu College Free Church of Tonga School

Figure 98 Destroyed Third Classroom Block at Tailulu College Free Church of Tonga School

Figure 99 UNICEF Tents established at Tailulu College Free Church of Tonga School

Figure 100 Cyclone Debris placed within the coastal zone at Tailulu College Free Church of Tonga School

Taufa'ahau Pilolevu Free Wesley Church School

School Attributes

146. Taufa'ahau Pilolevu Free Wesley Church School is located east of the main section of Pangai. The school provides educational facilities for 172 students and eighteen teachers. The school and its associated buildings are located across four sites. The school proper is located at an elevation of about 10 meters meter and outside any hazard mapping zone, the kindergarten and girl's dormitory block is located at 9 meters, the school hall is located at seven meters and is within the blue zone and the boy's dormitory block is located at 4 meters and within the blue zone and immediately across an area of open space from Petani Bilingual Free Wesley Church School. An overview of the school, kindergarten, hall and girl's quarters is provided in Figure 101.

Condition of Existing Infrastructure

147. Taufa'ahau Pilolevu School has twelve buildings as described below.

148. The first classroom block contains three classrooms, an office, computer room, staff room and gymnasium. This building is constructed of rendered block work on a concrete slab (Figure 102). Some sections of the roof have been replaced on this building although the gutters were also lost; however at the time of the mission, new guttering had been delivered and staff were organizing for installation. The roof trusses were of timber construction and in good condition, although no strapping was visible. There are numerous window frames and louvers missing in the classrooms which require replacing and again these items had just been delivered. Overall the building itself is in good condition.

149. The second classroom block contains nine classrooms and a library. This building is constructed of rendered block work on a concrete slab (Figure 103). Some sections of the gutters were lost. The roof trusses were not visible; however it is anticipated that they would be of a similar construction to the first classroom given the similar ages of the buildings. No strapping was visible. There are numerous window frames and louvers missing in the classrooms which require replacing. Overall the building itself is in good condition.

150. Building Three was a classroom and workshop complex, including practical rooms for home economics, industrial arts and an additional two rooms. This building is constructed of block brick work with concrete columns on a concrete slab. The concrete columns and brick work have cracked and have been previously patched in locations. The roof is a flat steel roof with almost all gutters lost. The windows include louvers and in some rooms, fly screen has been fitted. Some assessment of the concrete would be required prior to deciding on any substantial repair work.

151. Building Four is a library (Figure 104). The building is constructed on a concrete slab with a concrete frame in concrete filling of the block bricks. The slab exhibits spalling and has shagged in a number of locations which has resulted in a number of the floor tiles lifting and have been lost. The timber roof trusses arte bolted to the concrete block work and the steel roof is in good condition. All the gutters were lost from this building. Further, approximately 40% of the louvers have been broken and require replacement.

152. There are a number of toilet blocks associated with the school (classified as two buildings in the total number of buildings). The female toilet block contained six stall, of which only four were operation. The toilet building is built of concrete block work on a concrete slab which requires repair. The structure has a timber roof covered with good quality corrugated iron, although additional strapping is required to ensure the building will survive a future cyclone. The male toilets are made of four stalls, all in working order. This building is part of the library structure.

153. Building Five was an engineering shed for machinery. The shed was built on steel tube stanchions but was totally destroyed during Tropical Cyclone Ian. All that remains is the bent stanchion posts that in some cases have been pulled out of the ground with the force of the cyclone.

154. Building Six if the School Hall. The hall is an open structure of about 65 meters long by 30 meters wide. The hall has previously been used as an evacuation center during a tsunami warning. The hall is built from brick pillars and rendered block work and is braced by a steel frame at either end of the structure. The current roof is very rusted and will require replacement. There were not gutters on the roof (observations in May 2013). The main damage to the hall was fourteen sets of louvers that were destroyed.

155. Building Seven is a small kindergarten located between the school and the hall. The building is constructed of timber frame, cladding and trusses on a concrete slab. The roof is steel and is in reasonable condition. The minor damage sustained to the building included the loss of fascia and guttering, with the latter already being replaced. Overall, the building is in good condition.

156. Buildings Eight and Nine is the girl's dormitory block and the canteen building. The dormitory is constructed of rendered block work on a concrete slab. Approximately 20% of the steel roofing and 10% of the fascia needs to be replaced. The majority of the guttering was destroyed by Tropical Cyclone Ian. During the site visit, the building was locked and therefore it was not possible to provide an accurate assessment of the internal sections of the building except where windows were open. Of importance, the canteen was totally destroyed during the cyclone and the students have been forced to convert a section of the dormitory into a canteen (Figure 105). The only remaining component of the canteen is the concrete slab which is in a satisfactory condition.

157. Building Ten is the boy's dormitory building (Figure 106). This building is some distance away from the main school and is located within the blue zone consistent with the flood mapping. The building is constructed of block brick work with concrete columns on a concrete slab. Some cracking was observed in the concrete wall. The building provides accommodation for up to 44 boys. A twelve stall toilet building is located behind this main building. The building suffered extensive damage to approximately 50% of the roof trusses and lost about 75% of the steel roof. All the gutter was destroyed as were about 10% of the louvers. During the mission, the main section of the building was covered in tarpaulins and the students were living in approximately 20% of the building. The remaining roof requires re-strapping.

Proposed Works

158. During the April 2014 mission, work had already commenced at the school itself to install replacement guttering and louvers. The Free Wesley Church appears to have this under control and the majority of the repairs have been commenced. However rebuilding is required particularly in relation to the girl's canteen and the boy's dormitory and associated infrastructure. Specifically with respect to the boy's dormitory, this will require the relocation of the students during the construction period and therefore alternative accommodation will be required

159. Based on discussions with the Principal, it is unlikely that Building Five will be rebuilt as it is not an essential component of the School.

Figure 101 Taufa'ahau Pilolevu Free Wesley Church School - Overview from Google Earth

Figure 102 First Classroom Block at Taufa'ahau Pilolevu Free Wesley Church School

Figure 103 Second Classroom Block at Taufa'ahau Pilolevu Free Wesley Church School

Figure 104 Library and Hall at Taufa'ahau Pilolevu Free Wesley Church School

Figure 105 Destroyed Canteen at the Girl's Dormitory at Taufa'ahau Pilolevu Free Wesley Church School

Figure 106 Boy's Dormitory at Taufa'ahau Pilolevu Free Wesley Church School

Project Alternatives

160. The following provides an overview of project alternatives. It is noted that this IEE is in response to disaster management response and accordingly, it is unlike most "normal" IEEs.

Do-Nothing Alternative

161. The no-construction alternative is to maintain the present situation at the sixteen schools. The current works proposed will allow for students to resume their normal education patters particularly in terms of the health and safety for school students. The "do nothing" alternative would result in the continuation of unsafe conditions for students attending the sixteen schools and moreover would continue to impact on their learning capacity. Importantly, based on the outcomes of this IEE, the works proposed will increase health and safety and therefore the "do nothing" alternative is not appropriate.

Alternative Location

162. The schools are currently located on land owned by MoET or by the relevant church. Based on the existing infrastructure and the proposed works, the only real alternative in a number of cases where would be to build new schools in new locations where the schools are currently located in areas that could be considered as being within the red, yellow and blue hazard zones. This is particularly important for schools in the red zone.

163. The impact of needing to build in an alternative location is both time consuming with respect to obtaining the new land and then the delay in building the new schools unless alternative land is owned by MoET and by the relevant church. It could also potentially require MoET or the church to involuntary resettle people associated with the land although in a number of cases, it is recommended that investigations and risk analysis be undertaken as to alternative sites given the location of the schools to identified hazard zones. During detailed design, risk assessments should be undertaken to determine the appropriate response.

Description of Existing Environment – Whole of Tonga

Physical Environment

Seismic Activity

164. Tonga is located near the world's longest deep oceanic trench, the Tonga Trench. The area is an extremely active seismic zone (approximately 150 earthquakes in the last year to 3 July 2013) due to friction caused by the occasional movement of the Pacific Plate, diving (subduction) under the Australian plate (Tonga-Kermadec Subduction Zone) along the Tonga Trench.

165. A tremor of magnitude 7.9 occurred on 20 March 2009, 200km north east of Nukualofa. An accompanying tsunami with a height of 0.8 meters resulted from this earthquake prompting seismologist in the Pacific Tsunami Warning Centre to issue tsunami warnings for Tonga, Samoa and Fiji. No damage was recorded. Prior to this earthquake, an underwater volcanic eruption took place 10km north east Nukualofa on 18th March 2009.

166. On 24 May 2013, while the PPTA team was in Tonga, three earthquakes were felt between 0500 and 1100. A 7.4-magnitude earthquake, followed by another tremor with a 6.3-magnitude shook Tonga. A 5.0-magnitude earthquake occurred at about 1100. There were no immediate tsunami alerts or reports of damage. The 7.4-magnitude earthquake occurred at a depth of 170km approximately 285km southwest of Nukualofa. The 6.3-magnitude earthquake occurred at a depth of 152km, 85km southwest of Nukualofa. No damage was reported and no tsunami warning was issued following the three earthquakes.

Severe Tropical Storms

167. The cyclone season in Tonga occurs during the months of January to April. Damaging cyclone normally have an eight to ten year cycle. From 1960 to 2006, there were 58 severe weather events within the Kingdom of Tonga. The Tongan Meteorological Service categorizes cyclonic events to include gales (average winds of 34 to 47 knots = 63km/h to 87km/h); storm (average winds of 48 to 63 knots = 88km/h to 117km/h); hurricane (average winds of 64 to 100 knots = 118km/h to 185km/h) and severe hurricane (average winds of >100 knots = >185km/hour) (conversion 1 knot = 1.852km/h). Of the 58, 28 have impacted the central region of Tonga which includes Ha'apai and Vava'u.

168. In December 2012, Tropical Cyclone Evan missed the northern region of Tonga as a Category 3 cyclone (killed two people in Samoa). In January 2012, Cyclone Jasmine caused damage to Tonga which resulted in minor damages such as fallen trees and power lines, uprooted root crops and vegetables.

169. Importantly, on 11 January 2014, Tropical Cyclone Ian, a Category Five cyclone directly impacted the Ha'apai Islands. This was the first Category 5 system to directly affect Tonga. Cyclone Ian it claimed one life and left significant destruction to buildings in the Ha'apai Island group. Following Cyclone Ian, Tonga was also impacted by Cyclone Kofi, a Category One cyclone. Winds of up to 50 knots were experienced across Tonga. A number of coastal land based impacts resulted from Cyclone Kofi including the impacts of flash flooding including sea flooding in the low lying areas, particularly during the extreme high tide on the evening of 2 March 2014.

Economic Development - Tongan Economy

170. The Tongan economy had a Gross Domestic Product (GDP) in Tongan Pa'Anga (TOP) of $799.3 million (about $470.7 million USD – exchange rate of 0.589) for the 2011-2012 financial year. This was based on market GDP of $523.5 million TOP; non market GDP of $187.4 million TOP; imputed bank service charges of $12.7 million TOP and taxes (less subsidies) on products $101.1 million TOP. For the 2011-2012 financial year, Tonga received $23.3 million TOP in income from overseas. Overall, Tonga had a Gross National Income (GDI) of $822.6 million TOP and when accruing current transfers ($181.5 million

TOP), Tonga had a Gross National Disposable Income (GNDI) of $1,004.2 million TOP ($591.3 million USD).

171. The Tongan GDP is made up of $133.8 million TOP from the agricultural sector ($109.1 mill TOP from agriculture, $4 million TOP from forestry and $20.8 million TOP from fisheries); $150.1 million TOP from industry ($8.4 million TOP from mining and quarrying; $44.9 million TOP from manufacturing; $22.4 million TOP from electricity and water supply and $74.4 million TOP from construction). The vast majority of GDP come from the service sector ($427 million TOP) which includes among others, $80.4 million TOP from wholesale and retail trade; $93.9 million TOP from public administration and $72.4 million TOP from the ownership of dwellings.

Schooling

172. The 2011 Census indicated that 33,344 individuals were currently attending school or some other educations institution. The Census Data provides two tables although the age breakdown is slightly different.[6] For the purposes of inclusion, both sets of data are included.

173. Data in Table G31 provided information on students attending school from the following age groups: 5; 6 to 9; 10 to 12; 13 to 14 and 15-19. There was a large number of five year old students not attending school (35%) although that number significantly reduced in the 6-9 year age bracket (1.5%). Overall, there was a high attendance rate from the 6-9 year bracket to the 10-12 year bracket. Census data on school attendance is shown in Table 1.

Table 1 2011 Census Data – School Attendance and Non Attendance

School Age	Total Students	Attending School	Not Attending School
5	2,597	1,690	907
6-9	10,273	10,115	158
10-12	7,497	7,379	118
13-14	4,584	4,363	221
15-19	10,965	7,817	3,148

174. Data in Table G31 also provides information on the split of female and male students attending school in the same age groups as above. The rate of school non-attendance is slightly higher in males not attending school above females; although the difference is not extreme except for the 15-19 year old bracket (32% of females were not attending school in comparison to 49% in males). Census data on school attendance by sex is shown in Table 2.

Table 2 2011 Census Data – School Attendance and Non Attendance by Sex

School Age	Females Attending School	Females not Attending School	Males Attending School	Males not Attending School
5	796	429	894	478
6-9	4,900	74	5,215	84
10-12	3,509	55	3,870	63
13-14	2,081	76	2,282	145
15-19	4,010	1,281	3,807	1,867

[6] See Tables G31 and G32

175. Of those attending school across Tonga from Table G31, in the five year old bracket, 70% (1,191) attended a Government or Public Schools while the remainder (499) attended a Private or Church Schools. In the 6-9 year age bracket, 89% (8,974) attended a Government or Public Schools while the remainder (1,141) attended a Private or Church Schools. In the 10-12 year bracket, 75% (5,555) attended Government or Public Schools while the remainder attended Private or Church Schools (1,822). There was a significant shift in the type of school attendance in the 13-14 age bracket, with 59% (2,592) attending Private or Church Schools while the remainder (1,771) attended Government or Public Schools. Similar results were observed in the 15-19 age bracket with 64% (4,991) attending Private or Church Schools while the remainder (2,826) attended Government or Public Schools. From this age group, 29% were not attending school or other educational facility.

176. With respect to the differences between females and males attending different schools, Table 3 provides an overview of school attendance for the difference school types by sex. The data across the early years is a fairly consistent split between attendances at the two school types by sex. However, there are a higher number of females attending private school by percentage than males in the 13-14 and 15-19 age groups, with 63% of 13-14 year old females attending Private and Church Schools in comparison to 57% of males attending the same school type. In the 15-19 year bracket, 68% of females attended Private and Church Schools in comparison to 60% of males attending the same school type.

Table 3 2011 Census Data – School Type by Sex

School Age	Females – Government Schools	Females – Private Schools	Males – Government Schools	Males – Private Schools
5	559	237	632	262
6-9	4,321	579	4,653	562
10-12	2,586	921	2,969	901
13-14	780	1,301	991	1,291
15-19	1,299	2,711	1,527	2,280

177. The level of education in an important aspect in the development of schools. Across Tonga, of the 64, 135 people who are 15 years or older (31,495 males and 32,640 females), 36,050 (18,303 males and 17,747 females) had no qualification; 19,923 (9,141 males and 10,782 females) had completed their secondary school certificate; 6,136 (2,923 males and 3,213 females) had passed a technical vocational and professional qualification; 1,462 (792 males and 670 females) had attained a undergraduate degree; and 501 (300 males and 201 females) had some form of postgraduate qualification. An additional 63 (36 males and 27 females) had some other qualification. Higher education levels were higher in urban areas compared to rural areas.

178. Literacy, it is measured by a person's ability to read and write a simple sentence. The literacy rate for those aged five years and older in the usually resident population was 98.2% in 2011. Of those who are literate, 86% were literate in both Tongan and English or other languages, while 11% were literate in Tongan only. Literacy in the Tongan language is over 98% for all age groups; however, literacy in both Tongan and English languages decline with age. Approximately 94% of those aged 10-19 years are literate in both Tongan and English, compared to only 56% of those aged 75 years and over.

179. Specific data for each island group and district is included in the relevant section of the IEE below.

Indigenous People

180. There are no indigenous peoples in the Kingdom of Tonga.

Description of Existing Environment – Ha’apai

Physical Environment

181. The following section provides background on the existing physical environment both in the immediate area of the sixteen schools and within a broader context across the Ha’apai Island Group.

Topography, Geology and Soils

182. The Ha'apai Island Group is a chain of 62 volcanic islands. The islands include barrier reefs, shallow marine lagoons, coral shoals and active volcanoes including Kao, the highest point in the Kingdom standing at 1,046 meters. All the larger islands are in the eastern Lifuka group, including the most densely populated islands of Lifuka and Foa. The majority of the islands are small low-lying coral atolls with the smallest island being less than 1 hectare. Tofua is the largest island in the Ha’apai Group at approximately 46.6km^2. The total land mass of the Ha'apai Islands group is 109.3km^2.

183. The Ha’apai Group lies along the crest of the mostly submerged Tonga ridge and includes the Tofua Volcanic Arc. The Tofua Arc separates the shallow Tonga Ridge from the deep Lau Basin formed during the Cenozoic. The majority of the islands are flat although due to plate movement, have now locally tilted slopes. The windward islands, especially Lifuka and Foa have marked sea cliffs of limestone that have retreated following coastal erosion from wave action.

184. The soils are made up of a relatively young to moderately weathered reddish brown soil of about 1.5 meter thick. The underlying older tephra layer is more strongly weathered with yellowish brown tints.

185. Along these coastlines, inshore fringing reefs cover erosional impacted ancient coral reefs. On the leeward and protected shorelines, beeches have been formed from carbonate sand. The uplifted reef flats that form the uplands of Lifuka are tilted downwards to the west to northwest and this result in elevations of slightly in excess of 15 meters (Dickinson, Burley and Shutler, 1994).

Climate

186. The mean temperature during the entire period (2000-2012 data from Ha’apai) was 25.3^{o}C (minimum mean = 21.1^{o}C; maximum mean = 30.2^{o}C). The warmest temperatures are observed in December through March (warmest temperature observed from 2000 to 2012 was 31.5^{o}C in March; coldest minimum during these months was 24.2^{o}C), while the coolest months were June through August (warmest temperature observed from 2000 to 2012 was 27.1^{o}C in July; minimum during these months was 19.8^{o}C). Figure 107provides a graphical representation of monthly mean minimum, mean and mean maximum temperatures from Ha’apai from 2000-2012.

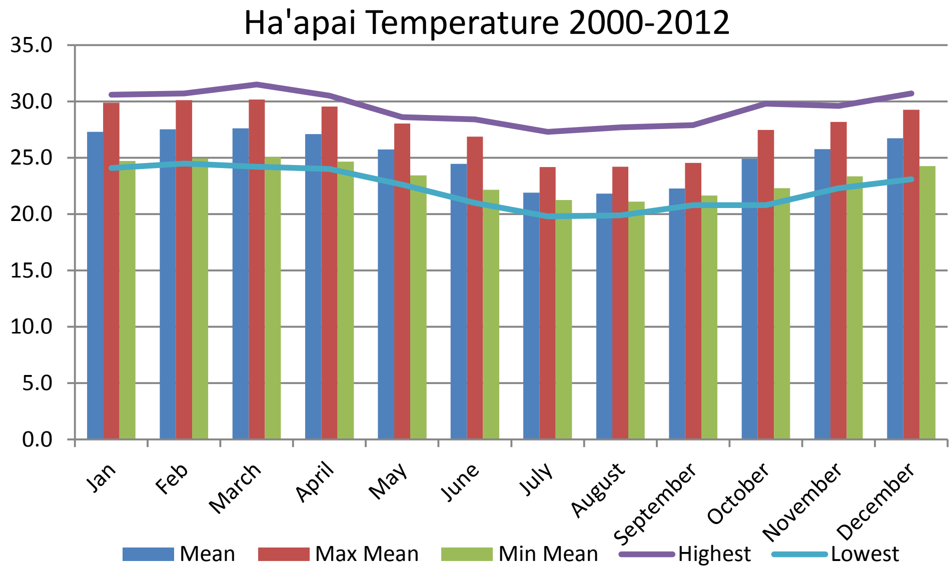

Figure 107 Air Temperature recorded at Ha'apai - 2000 to 2012 (Date from Tonga Met Office)

187. While Fuaʻamotu Airport has the most comprehensive atmospheric data, rainfall data is collected in Ha'apai. Between 2000 and 2012, the mean annual rainfall recorded at Ha'apai weather station was 1,846mm (about 300mm less than Fuaʻamotu Airport for the same period). The highest rainfall is observed in the summer months of December through March although there is good rainfall recorded across the year (highest mean rainfall observed in January (277mm) and lowest mean rainfall in August (83.5mm). The highest rainfall monthly rainfall observed during the months of 2000 to 2012 was in January 2012 (788.1mm), April 2000 (496.7mm) and March 2003 (461.9mm). The lowest rainfall within each month was always below 66mm, with July 20120 only receiving 2.4mm. Figure 108 provides a graphical representation of monthly mean minimum, mean and mean maximum temperatures from Ha'apai from 2000-2012.

188. Wind data has been recorded at both Ha'apai and Fuaʻamotu Airport approximately seven times a day since 2000, although there is some missing data for Ha'apai. For Ha'apai specifically, the majority of the winds are recorded from the east (56.8% in total). The wind speed was recorded in meters/second (one meter/second = 3.6 km/hour or 1.94 knots). Approximately 1.5% of the time, the wind speed is less that 10km/hour. Almost half the time (45.5%), the wind speed is between 10km/hour and 20km/hour (5.4 knots to 10.8 knots). About 34% of the time the wind velocity is between 20km/hour and 30km/hour (10.8 knots to 16 knots). Approximately 0.7% of the time, the wind is above 40km/hour. This would suggest that Tonga is not impacted by significant ocean breezes. Stronger winds are predominantly recorded between November and April and come from the east and south east directions. Table 4 provides an overview of the percentage of time the wind comes from a particular direction with the maximum wind velocities from Ha'apai from 2000-2012.

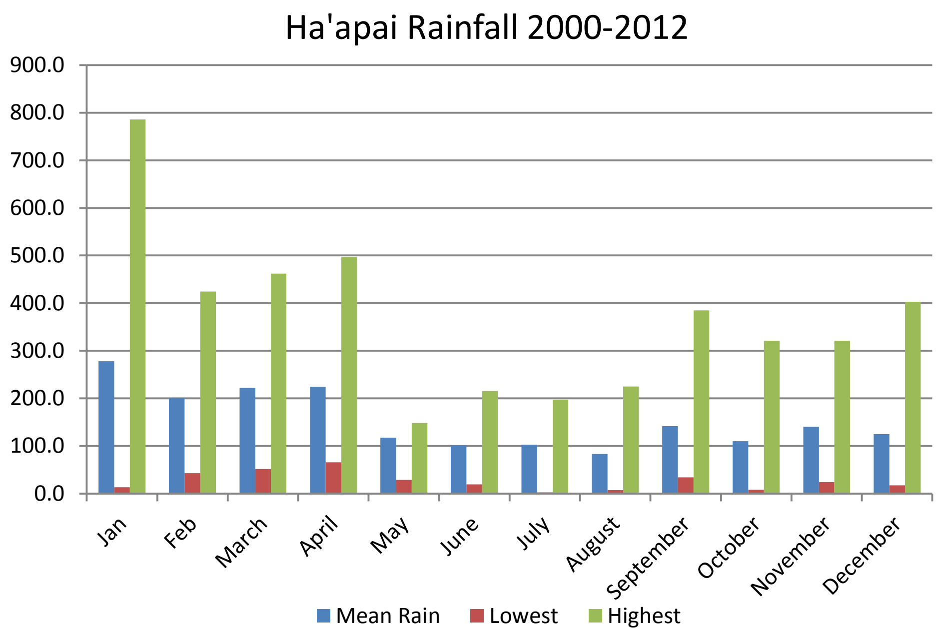

Figure 108 Rainfall recorded at Ha'apai - 2000 to 2012 (Date from Tonga Meteorological Office)

Table 4 Wind Direction and Maximum Speed at Ha'apai - 2000 to 2012 (Data from Tonga Meteorological Office)

Wind Direction	Percentage of Time	Max Wind Speed (m/s)	Max Wind Speed (km/h)
North	7.2%	24.7	89
North East	6.4%	12.9	46.5
East	56.8%	72	259
South East	18.4%	56.6	204
South	2.4%	41.2	148
South West	2.3%	11.8	42.5
West	3.5%	12.9	46.5
North West	3%	15.4	55.5

189. The highest winds recorded were 210.9 meters/second (759km/hour; 409 knots) in July 2002 and 101.9 meters/second (367km/hour; 198 knots) in May 2005. However both would appear to be outliers and an incorrect reading, as the wind speeds recorded within the day either side of the event were less than 20km/h.

Water Resources – Surface and Groundwater

190. The majority of Ha'apai gets its water supply from the Island's groundwater. The water is first discharged into reservoirs for treatment with calcium hypochlorite before it is conveyed and delivered through pipelines to the residents of the islands. The other form of water supply is through rainwater roof top harvest that are stored in rainwater tanks as there are no available surface water on the island. Wells are also used by residents with an elevated communal tank (see Socio-economic Conditions). Many of these were impacted as a result of Cyclone Ian.

191. During the site visit, the Principal of Ha'apai High School indicated that the groundwater drunk by the students, while less than palatable in nature, may fall within World Health Organisation Standards although no tests were undertaken. This could be potentially an issue across all schools utilizing ground water for drinking.

192. There are no streams or rivers in proximity to any of the schools.

Air Quality

193. There is no known air quality data available for Ha'apai. The known impacts to air quality are from the generation of dust from the unpaved or unmaintained roads and fugitive emissions of vehicle traffic and generators which may occur predominantly in Nuku'alofa on the island of Tongatapu. Due to the low population size and moreover the wind direction and height of the land where the schools are located, any air borne particulates will be moved away from the schools quickly.

Land

194. The sixteen schools are located on Crown land that is currently controlled by MoET and/or Church land.

Ecological Resources

195. The following section provides background on the ecological environment both in the immediate area of the project and with a broader context across the Ha'apai Island Group. It should be noted that there is very limited direct ecological material available for the Ha'apai Island Group as the majority of studies have been undertaken on 'Eua, Tongatapu and Vava'u. Where any real research has been undertaken in Ha'apai, it has been on the terrestrial ecology and botany of Tofua and Kao Islands rather than on Lifuka (eg Park, and Whistler, 2001). Accordingly, the below is predominantly based on the site assessment. No ecological surveys were undertaken as part of this IEE and the author believes that no targeted surveys are required considering the already disturbed nature of the existing environment.

Biodiversity – Terrestrial Areas

196. The natural vegetation pattern observed when travelling on Ha'apai included secondary fallow vegetation. All islands visited have a cover of coconuts, but few other trees, to protect the land from wind and salt spray, and for this reason, soil erosion is a problem. The consequence of erosion and the practice of slash and burn agriculture have had a decline on soil productivity and therefore vegetation more generally.

197. A 2009 land use survey for the Ha'apai Island Group indicated that natural woodland made up only 2,450ha (19%), coconut in the form of grassland, scrubland and cropland controlled over 8,198ha (63) and 2,330 (18%) was other including buildings. The majority of this natural woodland is located on Tofua and Koa Islands. No significant vegetation is located near the schools.

198. Steadman (1998) undertook research to assess the distribution, relative abundance, and habitat requirements of indigenous terrestrial bird species on 13 islands in the Ha'apai Island Group. Steadman (1998) observed that some primary forest still exists only on Tofua. Steadman further observed that on the remainder of the islands, the vegetation was dominated by a mosaic of active and abandoned agricultural plots, nearly all with an over story of coconut trees. Steadman hypothesized that as a result of cultivation practices, very little of removed vegetation reverted to secondary forest. His research indicated that of the 15 resident species of terrestrial birds that survive on Ha'apai Island Group, nine were widespread and at least, locally common within Ha'apai, although only four (*Gallirallus philippensis, Ptilinopus porphyraceus, Halcyon chloris, Aplonis tabuensis*) certainly or probably occur on all 13 islands. Three species (*Gallicolumba stairii, Ptilinopus perousii, and Clytorhynchus vitiensis*) are extirpated or extremely rare on all islands surveyed except Tofua. Overall species richness and abundance of terrestrial birds was much greater on Tofua than on the other islands and this is clearly as a result of the presence of primary forest on Tofua.

199. During the site visit, only exotic terrestrial fauna species were observed including a number of horses, dogs and pigs.

Biodiversity – Coastal and Marine Areas

200. The marine environment plays an important role in Ha'apai. From a tourism perspective, the use of the waters by migrating whales provides valuable income to the local people, although tourism numbers are higher in Vava'u than Ha'apai.

201. There are no significant mangrove communities located within the Ha'apai Island Group (a few mangroves were observed near the causeway). The coastal marine ecosystems includes rocks and terraces which make up 1,581 ha, sandy beaches (185ha) and the vast majority of the coastal environment is made up of reef flat (4,719ha) (Matoto, 2010).

202. Protected areas also play a critical role in the management of the marine ecosystems in Ha'apai. There are three special management areas including 'O'ua, Ha'afeva and Felemea. Further, there is an area of 10,000ha that has been set aside as the Ha'apai Conservation Area but there seems to be no active management of the area (Matoto, 2010).

203. There are a number of schools that are in close proximity to the marine areas.

Land Use and Industries

204. Adjacent to the vast majority of schools are local residential properties, other schools and disturbed bushland. The only industry observed on Ha'apai is agriculture and none of the schools were in proximity to any agricultural activities.

Social and Cultural Resources

Population

205. With respect to the Ha'apai Island Group, the 2011 Census data indicates that a total of 6,616 individuals living in the Ha'apai Group. The populations is split fairly equally between females (3,210) and males (3,406). There was decrease in the populations of Ha'apai Island Group (decrease of 12.6% - 954 less individuals – -2.7% annual growth rate) between the 2006 (7,570) and 2011 Census. The population density across the island group was 61 individuals/km^2.

206. In Pangai specifically, the 2011 Census indicated a population of 2,410 (1,234 males and 1,176 females) accommodated within 469 households. There was decrease in the number of residents in Pangai (decrease of 18.8% - 557 less individuals – -4.2% annual growth rate) between the 2006 (2,967) and 2011 Census. The composition of the family unit was split across the following age groups as shown in Table 5.

207. In Foa specifically, the 2011 Census indicated a population of 1,359 (684 males and 675 females) accommodated within 231 households. There was decrease in the number of residents in Foa (decrease of 8.1% - 120 less individuals – -1.7% annual growth rate) between the 2006 (1,479) and 2011 Census. The composition of the family unit was split across the following age groups as shown in Table 5.

208. In Ha'ano (including Mo'unga'one), the 2011 Census indicated a population of 511 (250 males and 261 females) accommodated within 106 households. There was decrease in the number of residents in Ha'ano (decrease of 17.4% - 108 less individuals – -3.8% annual growth rate) between the 2006 (611) and 2011 Census. The composition of the family unit was split across the following age groups as shown in Table 5. The composition of the family unit was split across the following age groups as shown in Table 5.

209. In 'Uiha (including Lofanga), the 2011 Census indicated a population of 672 (361 males and 311 females) accommodated within 145 households. There was decrease in the number of residents in 'Uiha (decrease of 16% - 128 less individuals – -3.5% annual growth rate) between the 2006 (800) and 2011 Census. The composition of the family unit was split across the following age groups as shown in Table 5. The composition of the family unit was split across the following age groups as shown in Table 5.

Table 5 2011 Census Data – Aged Based Population

Age Group	Ha'apai Island Group	Pangai	Foa	Ha'ano – includes Mo'unga'one	'Uiha – includes Lofanga
0-4	831	229	206	68	85
5-9	865	310	170	73	92
10-14	790	327	160	62	63
15-19	657	293	142	45	58
20-24	450	152	91	33	42
25-34	842	289	188	50	86
35-44	744	176	140	66	66
45-54	546	215	110	39	62
55-64	425	145	84	32	49
65-74	312	109	51	29	46
75+	154	65	17	14	23

Socio-economic Conditions

210. Materials for house construction vary across Ha'apai. Within the Island Group (1,258 houses), the vast majority of houses were built from wood with concrete block and metal being the next most favored although substantially less Similar results were observed in Pangai (361 houses) , Foa (173 houses), Ha'ano (94 houses) and 'Uiha (123 houses). Table 6 provides information on the various house construction materials used across the four project areas.

Table 6 2011 Census Data – House Construction Material

Location	Poured Concrete	Concrete Blocks	Metal	Wood	Thatched
Ha'apai	18	146	68	1,017	9
Pangai	9	68	25	361	0
Foa	6	37	11	173	2
Ha'ano	1	8	3	94	0
'Uiha	1	11	8	123	2

211. As to roofing for their properties, the primary roofing material used across both Ha'apai; Pangai, Foa, Ha'ano and 'Uiha is metal sheeting (1207 houses = 96%; 448 houses = 97%; 218 houses = 97%; 139 houses = 96% respectively). As to floor construction, the majority of properties have concrete flooring (Ha'apai – 813 concrete floors, 422 wood; 23 other; Pangai – 352 concrete floors, 106 wood; 5 other; Foa – 173 concrete floors, 55 wood; 1 other; Ha'ano – 59 concrete floors, 47 wood; 'Uiha – 95 concrete floors, 47 wood; 3 other).

212. The vast majority of drinking water across Ha'apai; Pangai, Foa, Ha'ano and 'Uiha is sourced from cement tanks, (Ha'apai = 90%; Pangai = 88%; Foa = 92%, Ha'ano = 89% and 'Uiha = 90%) while water is also sourced from neighbors (Ha'apai = 10%; Pangai = 11%; Foa = 7%, Ha'ano = 11% and 'Uiha = 10%). Across Ha'apai and in Pangai and Foa, only four houses used piped water for drinking, with this being split between one house in Pangai and three houses in Foa respectively. For non-drinking water, the vast majority of households utilized piped water (Ha'apai = 73%; Pangai = 93%; Foa = 86%, Ha'ano = 75% and 'Uiha = 92%)

while water is also sourced from tanks (Ha'apai = 23%; Pangai = 3%; Foa = 13%, Ha'ano = 25% and 'Uiha = 8%). Forty four homes relied on water obtained from their own well.

213. All except three properties and one property is Ha'apai and Pangai respectively had a shower or a bath and only one property did not have a toilet. For hot water, all except 24 houses in Ha'apai, seven houses in Pangai, 4 houses in Foa, 1 house in Ha'ano and 6 houses in 'Uiha relied on alternative sources of electricity to provide hot water.

214. As for lighting, the vast majority of houses across Ha'apai, Pangai and Foa were connected to mains electricity for their lighting (930 house = 74%; 452 house = 98%; 211 houses = 92% respectively), while the numbers were lower but still high on Ha'ano and 'Uiha (80 house = 76%; 103 houses = 71% respectively). Solar was relied upon in Ha'ano (19%) but less so in the other locations - across all Ha'apai = 13%; Pangai = 0%; Foa = 1%, and 'Uiha = 2%). Forty eight homes across Ha'apai and one in Pangai and two houses in Ha'ano had their own electricity generator while the 93 houses that used kerosene for lighting across the island group were located in Pangai (six house); Foa (14 houses); Ha'ano (six houses) and 'Uiha (29 houses).

215. As for cooking, the majority of households used collected wood for cooking (Ha'apai = 73%; Pangai = 58%; Foa = 79%, Ha'ano = 92% and 'Uiha = 94%) followed by gas (Ha'apai = 20%; Pangai = 37%; Foa = 18%, Ha'ano = 5% and 'Uiha = 6%). Twenty six, sixteen; five, three and one house utilized mains electricity across Ha'apai, Pangai; Foa, Ha'ano and 'Uiha respectively, while six, four and two houses respectively used kerosene for cooking across Ha'apai, Pangai and Foa. Kerosene was not used by any households for cooking on Ha'ano and 'Uiha.

216. In Ha'apai, 2,230 residents identified themselves as being Free Wesleyan Church members, 1,429 were members of the Church of Tonga, 1200 were Latter Day Saints, 638 were Free Church of Tonga, and 500 were Roman Catholic, while the remainder of the residents were split across 14 other denominations. No individuals identified themselves as not being a member of a church.

217. In Pangai itself, 927 residents identified themselves as being Free Wesleyan Church members, 495 were Church of Tonga, 307 were Latter Day Saints, 136 were Free Church of Tonga while the remaining residents split over other denominations. In Foa itself, 399 residents identified themselves as being Latter Day Saints, 371 were Free Wesleyan Church members, 226 were Church of Tonga, 158 were Free Church of Tonga while the remaining residents split over other denominations. In Ha'ano, 148 residents identified themselves as being Church of Tonga, 128 were Latter Day Saints, 103 were Free Wesleyan Church members, 77 were Free Church of Tonga while the remaining residents split over other denominations. In 'Uiha, 305 residents identified themselves as being Free Wesleyan Church members, 99 were Latter Day Saints, 95 were Church of Tonga, 79 were Free Church of Tonga while the remaining residents split over other denominations.

Employment

218. In the Ha'apai Island Group, 2,656 identified themselves as being within the labor market. Of those, 1,435 males were employed while 1,221 females were employed. Of the 2,656, 238 were employed by Government (4.564 indicated they were employed by Government in total across all Islands), 68 were Quasi Government (1320 in total); 951 were a private employee (8,714 in total), 20 were an employer (343 in total), 924 were self-employed (8,740 in total) and 1,069 were an unpaid family worker (9,741 in total).

Schooling and Educational Level

219. The 2011 Census data provides information on school attendance on Ha'apai. Table G32 split the age groups slightly differently to Table G31 insofar as it broke the ages down to 5-9 (865), 10-14 (790) and 15-19 (657 - a total of 2,312 were of school age). Of these, 1,986 attended school on a full time basis, one attended school on a part time basis and 335 were not attending school. The school age students not attending school were split between the 5-9 age group (64) and the 10-14 age group (37) with a 234 individuals in the 15-19 age

group not attending school. Of those attending school, in the younger age bracket (5-9), 88% (702) attended a Government or Public School while the remainder (99) attended a Private or Church School. In the 10-14 age bracket, there was a higher percentage attending Government or Public School (450) in contrast to those attending a Private or Church School (303 = 40%). However, like the remainder of Tonga, in the 15-19 age group; the school preference is reversed with 245 students attending Private or Church Schools (67%) in contrast to 178 students attending Government or Public School. It is noted there are four Private or Church High Schools in Pangai and one Government or Public High School.

220. The level of education in an important aspect in the development of schools. Across Tonga, of the 64,135 people who are 15 years or older (31,495 males and 32,640 females), 36,050 (18,303 males and 17,747 females) had no qualification; 19,923 (9,141 males and 10,782 females) had completed their secondary school certificate; 6,136 (2,923 males and 3,213 females) had passed a technical vocational and professional qualification; 1,462 (792 males and 670 females) had attained a undergraduate degree; and 501 (300 males and 201 females) had some form of postgraduate qualification. An additional 63 (36 males and 27 females) had some other qualification. Higher education levels were higher in urban areas compared to rural areas.

221. Across Ha'apai, 4,074 (2,056 males and 2,018 females) were 15 years or older and provided data on their educational qualification status. Across Ha'apai, 2,883 (1,491 males and 1,392 females) had no qualification; 917 (411 males and 560 females) had completed their secondary school certificate; 234 (132 males and 132 females) had passed a technical vocational and professional qualification; 30 (18 males and 12 females) had attained a undergraduate degree; and 4 (1 male and 3 females) had some form of postgraduate qualification. An additional 6 (3 males and 3 females) had some other qualification. Details on the education status of individuals across the whole of the Ha'apai Island Group and within the specific Islands are provided in Table 7.

Cultural Heritage

222. There are no known cultural heritage sites in the immediate proximity of the projects.

Table 7: 2011 Census Data – Qualification Status of Individuals 15 years and over

Qualification Status	Ha'apai Island Group	Pangai	Foa	Ha'ano	'Uiha
No Qualification	2,883	869	566	234	375
Males	1,491	441	284	117	194
Females	1,392	428	279	117	181
Secondary School Certificate	917	491	215	54	39
Males	411	232	89	21	20
Females	506	259	126	33	19
Technical Vocation and Professional Qualification	234	131	24	13	14
Males	132	72	11	7	9
Females	102	59	13	6	5
Undergraduate Degree	30	25	1	0	1
Males	18	15	1	0	1
Females	12	10	0	0	0
Post Graduate Degree	4	2	1	0	1
Males	1	1	0	0	0
Females	3	1	1	0	1
Other Qualification	6	4	1	0	0
Males	3	2	1	0	0
Females	3	2	0	0	0

Screening of Potential Environmental Impacts

223. The following section provided an overview of the likely potential impacts, both direct and indirect as well as highlighting the beneficial impacts from the projects. If the avoidance and mitigation measures as highlighted below and within the Construction Environmental Management Plan (CEMP) (Annexure 1 Construction Environmental Management Plan
224.) are followed, then the projects are unlikely to have a significant impact on the environment.

Direct Impacts

225. The environmental impacts envisaged for the projects are temporary in nature and are associated with reconstruction activities of the schools only. The majority of works associated with buildings will involve the removal and replacement of fixings such as windows; gutters and roofing. Where necessary, the demolition of extensively damaged buildings within schools that are not earthquake proof and/or in a location that has been mapped within the hazard mapping and/or the reconstruction of those buildings either on the same site or at an alternative location. The proper handling of debris and new construction material, and where possible, recycling and reuse will have insignificant impacts on the environment if handled appropriately. Where earth moving will be undertaken, the scale of actual work is not significant, this being that they are all relatively small projects with some excavation works.

226. The majority of the schools are on low level terrain with the compounds having minimal slopes although Mo'unga'one GPS slopes away to the coastal zone. Any movement or ground breaking activity can result in sediment movement once disturbed. During construction for all projects, any stockpiles must be covered to minimize sediment runoff during rainfall. Stockpiles should also be sited in areas where they will not drain directly to the coastal environments. The most effective measure in relation to this would be that no construction occurs during the wet season, thereby mitigating the potential impacts of runoff totally unless there is a rain event during this period. Reference should be made to the Tongan Meteorological Office with respect to forecasting.

227. There is the potential, although limited for the construction activities to generate sediment that may increase silt load into the adjacent coastal environments after rainfall and subsequently the marine environment. The CEMP requires among other things that the contractor install silt/grit traps and number of silt curtains to contain transportable sediment from the outset and to ensure there is no overland flow during rain events.

228. Mitigative controls could potentially be required for the management of acid sulfate soils (ASS) and/or potential acid sulfate soils (PASS) due to their locations of the projects close to coastal areas. ASS are naturally occurring soils, sediments or organic substrates that are formed under waterlogged conditions. Deposits of ASS are commonly found in less than five meters ASL, particularly in low-lying coastal areas. Mangroves, salt marshes, floodplains, swamps, wetlands, estuaries, and brackish or tidal lakes are ideal areas for ASS formation. The presence of ASS may not be obvious on the soil surface as they are often buried beneath layers of more recently deposited soils and sediments of alluvial or aeolian origin. These soils contain iron sulfide minerals (predominantly as the mineral pyrite) or their oxidation products. In an undisturbed state below the water table, ASS are benign. However if the soils are drained, excavated or exposed to air by a lowering of the water table, the sulfides react with oxygen to form sulfuric acid. The release of this sulfuric acid from the soil can in turn release iron, aluminum, and other heavy metals (particularly arsenic) within the soil. Once mobilized, the acid and metals can create a variety of adverse impacts including killing vegetation, seeping into and acidifying groundwater and water bodies, killing fish and other aquatic organisms and degrading concrete and steel structures to the point of failure.

229. Prior to any excavation and/or earth works, sediments should be tested for their presence of ASS or PASS. Sampling should be undertaken consistent with that proposed by the Queensland Acid Sulfate Soils Investigation Team as described in Ahern *et al* (1998) and laboratory analysis consistent with Ahern *et al* (2004). If the analysis proves positive, the sediment can be treated by a range of techniques including but not limited to liming the

sediment. The contractor should refer to management measures provided by for example by Dear *et al* (2002) to mitigate the impacts. One of the most significant impacts is via infiltration into the water table from an ASS stockpiling/treatment area. To reduce this impact, a compacted clay liner should be developed including where possible limed clay although this may reduce the efficiency of compaction and hence increase the permeability of the liner. Every effort should be made to ensure there is no direct or residual impact following treatment.

230. None of the projects will create temporary and/or permanent habitats for mosquito breeding.

231. Air Quality is unlikely to be affected due to the limited exhaust emissions from construction vehicles and machinery, fugitive emissions from aggregates, dust from exposed soils and stock piles particularly in that the areas are open environments. Mitigation measures include maintaining vehicles and machinery to good working condition; covering loads on haul trucks and during barge transport; and spraying water on exposed surfaces in dry weather for dust suppression are all included in the CEMP as appropriate mitigation measures. If complied with, it is expected that there will be no adverse impacts from chemicals and fuels as a result of the projects. It should be noted, that this equipment will only be required for part of the school improvement works.

232. Heavy machinery and haul trucks can generate high noise levels within and along the project area and routes to the schools. All machinery and vehicles used will be restricted to 7am to 5pm Monday to Saturday. Construction outside these times should not be undertaken to avoid disturbance to local residents. Where possible, high noise generating activities should be conducted outside of school hours. The CEMP identifies appropriate mitigation measures and if complied with, it is expected that there will be no on-going adverse impacts from noise as a result of the projects. Importantly, all heavy vehicles should be monitored and escorted when entering, on and leaving school compounds to ensure the safety of the staff and students.

233. The projects are very unlikely to result in any significant risk to water pollution from oil, grease and fuel spills, and other materials from vehicles working on site. Construction vehicles could affect water quality by accidents from vehicles carrying hazardous substances (chemicals and fuel). Oil and grease from engine leaks can pollute surface water. While it is unlikely that there will be an impact as a result of a chemical, fuel and oil spill, these lubricants need to be handled with caution and importantly, where possible, should not be brought on site. In the case of a spill, every effort must be made that it does enter the coastal environment. Mitigation measures are included in the CEMP and include:

   a. No fuelling and or servicing of vehicles and machinery will occur on any of the school sites;

   b. Spill clean-up kits are to be placed within the construction area and personnel trained to use it; and

   c. Oil and water mixes from workshop and fuel storage yard off site shall be passed through an Oil Separator prior to being moved from the site. Waste oil to be collected and sent to Fiji for recycling

234. If the above mitigation measures are followed as described in the CEMP, it is not expected that there will be any adverse impacts from chemicals and fuels as a result of the school projects.

235. The school projects have the potential generate medium quantities of waste. Waste will be generated from used materials that have been stockpiled from damaged schools (observations indicate that the waste is being stored in locations that could be detrimental to the environment, particularly the marine environment – see Figure 109 and Figure 110); from the removal of current infrastructure and fittings etc at schools that have been damaged; and from the construction and rebuilding of both new and existing schools.

Figure 109 Piled Debris at Faleloa GPS

Figure 110 Piled Debris at Tailulu College

236. All waste such as glass, brickwork, damage concrete and metal sheeting from replaced roofs should be stored in an appropriate manner to reduce the impacts on the environment. Civil contractors must ensure that all site personnel are aware of waste management practices on site and materials should be stored separately for potential reuse or recycling. Contractors need to follow the rules of the preferred waste management practice such as:

a. waste re-use;

b. waste recycling; and

c. waste disposal.

237. All biodegradable wastes will be transferred to Tapuhia Landfill.

238. Nikau Contractors confirmed the presence of asbestos in both destroyed and damaged housing, the existing Niu'ui Hospital, Mata'aho GPS and other buildings. Nikau Contractors assess the magnitude of the asbestos problem and developed an asbestos handling, removal and disposal strategy for the Ha'apai Islands. Based on their preliminary findings, about 250-300 tons of asbestos containing material and asbestos contaminated debris has been identified. Once the asbestos handling strategy has been finalized and approved by the GoT, Nikau Contractors will train selected local people on the safe handling of asbestos and implement the asbestos strategy to safely remove and secure the Asbestos Containing Material. The plastic wrapped asbestos will be stored in a safe and secure location (likely in 20 foot. containers) awaiting final disposal (after safe transport) to the Tapuhia landfill site in Nuku'alofa, which is designed to handle hazardous waste and has the capacity to handle and safely dispose of asbestos waste. The CEMP provides further advice on mechanism to reduce impacts. If followed, there will be no adverse impacts from waste as a result of the projects.

239. The school projects are unlikely to have any impact on the community especially is works are undertaken outside of school times. The project managers and contractor will establish a complaints and grievances register as detailed below (see Complaints Register).

Indirect Impacts

240. For reconstruction projects where the schools have been extensively damaged, the projects will require dirt and/or quarry material. Accordingly, there may be a need for a crusher/quarry to supply the projects. If the quarry is a new one, the contractor will need to submit an approved Quarry Operation Management Plan that covers regular spot inspection by MoET and Ministry of Land, Environment, Climate Change and Natural Resources (MLECCNR). This is currently not a requirement by MLECCNR but in light of the numerous quarries being developed around Tongatapu to cater for increased development; this might be beneficial to control development and extraction activities in the future.

Potential Beneficial Impacts

241. The reconstruction and improvements to the sixteen schools will have significant direct impacts on and improve the educational capacity of students using the schools as well as parents. The schools provide educational facilities for about 1,346 students current either being able to use the schools, or in some cases, not being able to attend the schools as a result of the extensive damage sustained to the schools.

242. From a student perspective, the reconstruction of the schools will allow students to attend school during and post climatic events when previously, students may be forced to stay away from school. Further, the reconstruction of the schools will allow for the schools to withstand certain climatic events and potentially earthquakes, this reducing lost time in education as well as providing a greatly improved facility in terms of safety.

243. Further, the works will remove current debris and in particular, asbestos that is current on the Ha'apai Island Group. This will reduce the potential impacts of mesothelioma and other asbestos related illness from potentially impacting students and parents in proximity to both schools and other Government facilities.

Institutional Requirements for the Construction Environmental Management Plan

Overview

244. As the school projects will be funded by the ADB, civil works contractors must adhere to the CEMP and appropriate avoidance and mitigation measures set out in the IEE. The plans will be assessed for each project by MoET and ADB prior to any works being undertaken. The CEMP identifies potential risks to the environment from the reconstruction projects and outlines strategies for managing those risks and minimizing undesirable environmental impacts. It incorporates recommended actions from the IEE.

245. The MoET will be responsible for the supervision of the CEMP. The MoET with gain the endorsement of the MLECCNR and will ensure the CEMP is adequate and followed. The supervising engineer will ensure timely remedial actions are taken by the contractor where necessary.

Site Supervisor

246. The site supervisor is responsible for ensuring compliance with the CEMP. The site supervisor will provide advice on effective environmental management of the project to the MoET, MLECCNR, ADB Staff and all site personnel. The site supervisor is to also ensure the environmental awareness of project personnel is maintained through appropriate training. A compliance report on mitigation measures will be submitted by the MoET to ADB and MLECCNR for the contractor. An independent review of the compliance may be undertaken during construction and post construction where deemed necessary.

Environmental Procedures and Site and Activity-Specific Work Plans/Instructions

247. Environmental procedures provide a written method describing how the management objectives for a particular environmental element are to be obtained. They contain the necessary detail to be site or activity-specific and are required to be followed for all construction works. Site and activity-specific work plans and instructions are to be issued through the following methods:

Erosion, Drainage and Sediment Control Plan (EDSCP)

248. These are site and activity-specific plans that outline all erosion, drainage and sediment controls. The measures contained within the CEMP are applicable to all projects.

Asbestos Removal

249. In preparation for the physical removal of asbestos from the schools and hospital, the Asbestos Contractor will recruit local Tongans and provide them with hands on training in

health, environment and safety aspects of handling asbestos and Asbestos Containing Material. The MLECCNR will provide six staff to participate in the proposed asbestos training so that they can respond to requests to handle / remove small amounts of Asbestos Containing Material.

Environmental and Incident Reporting

250. Any incidents, including non-conformances to the procedures of the CEMP are to be recorded using an Incident Record and the details entered into a register. For any incident that causes or has the potential to cause material or serious environmental harm, the site supervisor shall notify MoET and MLECCNR as soon as possible. The contractor must cease work until remediation has been completed as per the approval of MoET and MLECCNR.

Daily and Weekly Environmental Inspection Checklists

251. A daily environmental checklist is to be completed at each work site by the relevant site supervisor and maintained within a register. The completed checklist is forwarded to MoET and MLECCNR for review and follow-up if any issues are identified. A weekly environmental checklist is to be completed and will include reference to any issues identified in the daily checklists completed by the Site Supervisors.

Corrective Actions

252. Any non-conformances to the CEMP are to be noted in weekly environmental inspections and logged into the register. Depending on the severity of the non- conformance, the site supervisor may specify a corrective action on the weekly site inspection report. The progress of all corrective actions will be tracked using the register. Any non-conformances and the issue of corrective actions are to be advised to MoET and MLECCNR.

Complaints Register

253. A complaints register will be established to record any concerns raised by the community during construction. Any complaint will be advised to MoET within 24 hours of receiving the complaint. The complaint will be investigated and following the investigation, if it relates to a significant incident, the matter will be referred to the ADB for commentary and/or advice.

Review and Auditing

254. The CEMP and its procedures are to be reviewed at least two month by MoET, MLECCNR and ADB Staff. The objective of the review is to update the document to reflect knowledge gained during the course of construction operations and to reflect new knowledge and changed community standards (values). Any changes are to be developed and implemented in consultation with MoET, MLECCNR and ADB Staff. When an update is made, all site personnel are to be made aware of the revision immediately through a tool box meeting.

Public Consultation and Environmental Disclosure

255. The school projects are being undertaken within existing schools. Accordingly, there will be no resettlement issues.

256. The projects were discussed at Workshops and with GoT staff. While no on ground consultation has been undertaken at this time, it is expected that consultation with affected parents and school staff will be undertaken when the detail design of school improvements are available by the MoET. This will also include advising parents of changes to student pickup and access to school compounds. It is anticipated that based on the communities' needs, the projects will be fully accepted.

Findings and Recommendations

257. The IEE has identified the works proposed at the sixteen schools that were impacted by Tropical Cyclone Ian. This IEE has found that there are no important habitats within the location of the sixteen schools; particularly given they are existing locations although there is the potential for the construction of new infrastructure at different locations depending on the outcomes of the risk assessment. Should alternative site be considered for construction, then an appropriate environmental assessment of that site be undertaken prior to construction.

258. It is recommended that the outcomes of the SOPAC modeling are carefully considered in relation to any projects currently located within the red and yellow zone in Lifuka; and where it is suggested that they would fall into a similar zone based on their proximity to the coastal environment and/or based on their elevation above sea level.

259. Potential civil earthworks at schools located in close proximity to coastal environmental have the potential to impact these areas, particularly in relation to debris and overland flow. However, it is unlikely there will be the potential for deleterious environmental impacts. Further, while there will be the replacement of some materials including glass and wooden louvers and metal roof sheeting, this material potentially can be recycled and/or reused. Where residual impacts may exist, which is considered unlikely, these will be mitigated by the implementation of the detail CEMP.

260. With respect to asbestos observed at Mata'aho GPS and other locations around Ha'apai that have been impacted by Tropic al Cyclone Ian, with appropriate removal and handling by trained staff and the containment within a dedicated cell at Tapuhia Landfill, then it is unlikely that any residual impact will occur. Importantly, the removal of this material will be of benefit to students attending Mata'aho GPS and other locations around Ha'apai where asbestos has been observed as part of the Nikau Contractors' investigation.

261. Proper implementation of the detail CEMP would replaces the need to have an Environmental Impact Assessment (EIA) undertaken for projects.

Conclusions

262. On 11 January 2014, Tropical Cyclone Ian, a Category Five Cyclone lashed the Ha'apai Island Group in the Kingdom of Tonga. This was the first Category Five Cyclone to ever affect Tonga. Tropical Cyclone Ian caused extensive damage across a number of the island and the loss of one life. An estimated 5,500 people of the local population of the Ha'apai Island Group (6,616) were directly affected. The main islands affected by Tropical Cyclone Ian included Foa, Ha'ano, Lifuka, Lofanga, Mo'unga'one, 'Uiha and Uoleva.

263. The GoT formally requested international assistance on 23 January once the extent of damage was clearer. As a result of the impacts of Tropical Cyclone Ian, the GoT has received emergency assistance funding from the ADB ($2.47 million USD) and the GoNZ ($5 million NZD – approximately $4.25 million USD) following Cyclone Ian that caused extensive damage in the Ha'apai Island Group on 11 January 2014.

264. The ADB funding has been provided for the reconstruction and climate and disaster proofing of ten GPS that were damaged in Ha'apai and the provision of furniture such as blackboards, desks and chairs.[7] The reconstruction and climate and disaster proofing of these primary schools will allow classes to resume in a safe and conducive learning environment and will reduce the number of days that schools are closed during extreme weather events in the future. The GoNZ funding is for the provision of rebuilding other schools including both Government and Non-Government (Church) High/Secondary Schools. All sixteen school projects are categorized as Environmental Category B consistent with the ADB SPS (2009).

[7] The identified damaged GPS are: Fakakai, Faleloa, Fotua, Ha'ano, Koulo, Lofanga, Mata'aho, Mo'unga'one, Pangai and Tongoleleka.

265. A range of potential construction impacts have been identified for all school projects. These impacts are confined mostly to short construction periods and, as long as proper clean-up and site rehabilitation measures are implemented both from existing debris from damaged buildings, and any future construction activities; all can be classed as temporary impacts. Importantly, the works will also remove asbestos from schools and other buildings within the Ha'apai Island Group, therefore reducing potential future health complaints.

266. The overall findings of the IEE are that the majority of the proposed works will not cause any significant adverse environmental impacts if adequate avoidance and mitigation measures are implemented. The proposed mitigation measures are prescribed conceptually in the IEE and included in the CEMP in Annexure 1. By following the CEMP through contractor adherence in the construction phase, all impacts will be of a temporal nature and will not cause long term impacts. Where deleterious impacts cannot be mitigated, offsets should be developed where there is a net environmental benefit although it is not anticipated that any offsets will be required for the six projects. The supervision of the CEMP will be undertaken by MoET on behalf the GoT. MoET will report regularly to the ADB and MLECCNR on the projects.

267. Based on this IEE, it is concluded that there are no outstanding environmental issues remaining and as all impacts can be avoided and in the alternative, effectively mitigated and no EIS is considered necessary for the project although there may be the requirement for a number of design studies undertaken prior to construction.

References

Ahern, C.R., Ahern, M.R. and Powell, B. (1998) *Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland* QASSIT, Department of Natural Resources, Resource Sciences Centre, Indooroopilly

Ahern, C.R., McElnea, A.E. and Sullivan, L.A. (2004) *Acid Sulfate Soils Laboratory Methods Guidelines*, In Queensland Acid Sulfate Soils Manual, Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia

Dear, S.E., Moore, N.G., Dobos, S.K., Watling, K.M. and Ahern, C.R. (2002) *Soil Management Guidelines, In Queensland Acid Sulfate Soil Technical Manual*, Department of Natural Resources and Mines, Indooroopilly, Queensland, Australia

Mueller-Dombois, D. and Fosberg F. R., (1998) *Vegetation of the tropical Pacific Islands*, Springer-Verlag, New York, 733 pp

Tongan Department of Statistics (2011) *Tonga National Population and Housing Census* available at www.spc.int/prism/tonga

Whistler, W. A., (1992) Vegetation of Samoa and Tonga, *Pacific Science* **46**:159-178.

Annexure 1 Construction Environmental Management Plan

Objectives of the Construction Environmental Management Plan

268. A CEMP is a management tool used to assist in minimizing the impact to the environment and reach a set of environmental objectives. To ensure the environmental objectives of the projects are met, this CEMP will be used by the contractor to structure and control the environmental management safeguards that are required to avoid or mitigate adverse effects on the environment.

269. The environmental objectives of the improvements to the school buildings and reduction in flooding are to:

a) encourage good management practices through planning, commitment and continuous improvement of environmental practices;

b) provide rational and practical environmental guidelines so as to:

c) minimize or prevent the pollution of land, air and water;

d) protect native flora and fauna;

e) comply with all applicable laws, regulations and standards for the protection of the environment; and

f) adopt the best practicable means available to prevent or minimize environmental impact.

g) describe all monitoring procedures required to identify impacts on the environment; and

h) provide an overview of the obligations of MoET, MLECCNR staff and contractors in regard to environmental obligations.

270. The CEMP will be updated from time to time by the Contractor in consultation with the MoET and MLECCNR to incorporate changes in the detailed design phase of the projects.

Governing Legislation

Environmental Management Act 2010

271. The enactment of the *Environmental Management Act 2010* created a new overarching regulatory framework for the Kingdom of Tonga. The objectives of the Act

a) co-ordinate the role of Government in relation to all environmental management, including climate change issues, and decision-making processes;

b) promote meaningful public involvement in relation to issues of environment management, including climate change;

c) ensure the observance within the Kingdom of its international obligations relating to the protection of the environment;

d) promote the concept of sustainable development in relation to the environment and natural resources of the Kingdom;

e) facilitate an assessment of the impacts on the environment of any activity likely to affect it, prior to a proposed activity taking place;

f) promote the understanding, management, conservation and protection of the biological diversity of the Kingdom; and

g) facilitate implementation of measures to increase the resilience of the Kingdom and its environment to climate change

272. The civil contractors will need to comply with any approval and conditions granted under the Act by the MLECCNR. Under the Act, the MLECCNR has the ability to order the cessation of works should there be non-compliance with the CEMP.

Environment Impact Assessment Act 2003

273. The *Environmental Impact Assessment Act 2003* (EIA Act 2003) is the legislation for the regulatory management of EIS in the Kingdom of Tonga. It provides for the undertaking of EIAs where they fall within the relevant provisions of Schedule 1 for major projects.

General Management Structure and Responsibilities

274. The MoET and MLECCNR are accountable for the provision of specialist advice on environmental issues to the contractor and for environmental monitoring and reporting. The MoET and MLECCNR will assess the environmental performance of the contractor in charge of construction throughout the project and ensure compliance with the CEMP.

275. The MoET will be responsible for monitoring the implementation of the CEMP by relevant supervisory staff during construction. During operations the contractor will be accountable for implementation of the CEMP. Contractors working on the school upgrade have accountability for preventing or minimizing environmental impacts.

Community Liaison

276. The MoET will develop and release Community Flyers on a regular basis to provide interested stakeholders including parents whose children attend the schools with an update on the construction status of the projects. A publicized telephone number will be maintained throughout the construction of all projects to serve as a point of contact for enquiries, concerns and complaints. All enquiries, concerns and complaints will be recorded on a register and the appropriate manager will be informed.

277. Where there is a community issue raised, the following information will be recorded:

   a) time, date and nature of enquiry, complaint or concern;

   b) type of communication (eg telephone, letter, personal contact);

   c) name, contact address and contact number;

   d) response and investigation undertaken as a result of the enquiry, complaint or concern; and

   e) actions taken and name of the person taking action.

278. Some enquiries, complaints and concerns may require an extended period to address. The complainant(s) will be kept informed of progress towards rectifying the concern. All enquiries, complaints and concerns will be investigated and a response given to the complainant in a timely manner.

279. A nominated contractor staff will be responsible for undertaking a review of all enquiries, complaints and concerns and ensuring progress toward resolution of each matter.

Training of Contractors

280. The main contractor has the responsibility for ensuring systems are in place so that relevant employees, contractors and sub-contractors are aware of the environmental requirements for construction, including the CEMP.

281. All construction personnel will attend an induction which covers health, safety, environment and cultural requirements.

282. All staff and contractors engaged in any activity with the potential to cause serious environmental harm (e.g. handling of hazardous materials) will receive task specific environmental training.

Administration

283. The MoET in consultation with the MLECCNR will be responsible for the revision or updates of this document during the course of work. It is the responsibility of the person to whom the document is issued to ensure it is updated.

284. The site supervisor will be responsible for daily environmental inspections of the construction site. The PM will cross check these inspections by undertaking monthly audits.

285. The contractor will maintain and keep all administrative and environmental records which would include a log of complaints together with records of any measures taken to mitigate the cause of the complaints.

286. The contractor will be responsible for the day to day compliance of the CEMP.

287. MoET will be the implementing agency, and long with the MLECCNR will be responsible for the implementation and compliance with the CEMP via the contractor. The CEMP will be part of any tender documentation.

288. The MoET Supervising Engineer/Project Manager will supervise the contractor, while the MLECCNR will be responsible for environment issues.

Key Environmental Indicators

289. This section identifies the Key Environmental Indicators identified for the project and outlines respective management objectives, potential impacts, control activities and the environmental performance criteria against which these indicators will be judged (i.e. auditable). This section further addresses the need for monitoring and reporting of environmental performance with the aim of communicating the success and failures of control procedures, distinguish issues which require rectification and identify measures which will provide continuous improvement in the processes by which the projects are managed.

Water Quality

290. A number of the schools are located within the coastal zone environment. While none of these areas are protected and/or pristine environments (affected by diffuse land based pollution), there is a necessity to maintain appropriate water quality standards within these environments when undertaking the flood mitigation works.

Performance Criteria

291. The following performance criteria are set for the school improvement projects:

    a. No significant decrease in water quality of the coastal environments as a result of activities at each school;

    b. No significant decrease in the quality of surface and/or groundwater as a result of construction activities within the schools;

    c. Water quality shall conform to any approval conditions stipulated by ADB staff, MoET, MLECCNR and/or other government departments, or in the absence of such conditions follow a ‘no worsening’ methodology;

    d. No offsite impact in the event of a release; and

    e. Effective implementation of site-specific EDSCP.

292. By following the management measures set out in the CEMP, the reconstruction works at the schools will not have a significant impact on water quality across the broader area.

Monitoring

293. A standardized water quality monitoring program has been developed for the projects. The Program is subject to review and update at least every two months from the date of issue. The site supervisor will be required to conduct a daily visual inspection for hydrocarbons and turbidity within or adjacent to their work area as a part of the daily site inspection checklist.

Reporting

294. All water quality monitoring results and/or incidents will be tabulated and reported as outlined in the CEMP. The MLECCNR must be notified immediately in the event of any suspected instances of material or serious environmental harm, or if a determined level with respect to water quality is exceeded.

Table 8: Water Quality Management Measures

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
W1: Elevated suspended solids, silt content and turbidity in drainage from the site into the coastal environments.	W1.1: Develop and implement a site specific Erosion, Drainage and Sediment Control Plan (EDSCP) to address drainage control, sediment and erosion controls and stockpiling of materials including soil during construction.	Pre Earthworks	Site Supervisor	Initial set up and then as required with reporting to MLECCNR
	W1.2: EDSCP measures to be inspected regularly to ensure all devices are functioning effectively.	Entire construction phase	All Personnel	Weekly with reporting to MLECCNR
	W1.3: Conduct regular surface water quality monitoring in location where the coastal environments are likely to be impacted.	Entire construction phase	Site Supervisor	Twice weekly with reporting to MLECCNR
	W1.4: Schedule works in stages to ensure that disturbed areas are revegetated and stabilized progressively and as soon as practicable after completion of works.	No works not be undertaken during wet season	Site Supervisor and MLECCNR	Maintain records
	W1.5: Construction materials will not be stockpiled in proximity to the coastal environments. Construction equipment will be removed from in proximity to the coastal environments at the end of each working day or if heavy rainfall is predicted	Entire construction phase	Site Supervisor	Maintain daily records
W2: Eutrophication of water bodies from elevated nutrient levels.	W2.1 Minimize the release of clays and very fine silts into the coastal environments through the installation of sediment basins, rock checks and sediment fences in appropriate places as outlined in the EDSCPs.	Entire construction phase	All Personnel	Weekly with reporting to MLECCNR

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
W2: Eutrophication of water bodies from elevated nutrient levels.	W2.2 Manage the application of fertilizers (if required during rehabilitation of the site) to ensure that over application does not occur.	Post Construction	Site Supervisor	Maintain records
W3: Increase of gross pollutants, hydrocarbons, metals and other chemical pollutants into the coastal environment.	W3.1: Reuse suitable water runoff from site to supplement construction water supply.	Entire construction phase	All Personnel	Weekly with reporting to MoET and MLECCNR
	W3.3: Check all vehicles, equipment and material storage areas daily for possible fuel, oil and chemical leaks.	Entire construction phase	All Personnel	Daily and maintain records
	W3.4: Rubbish and waste materials to be placed in suitable facilities to ensure that they do not enter the coastal environments. Ensure all absorbent material is placed in contaminant bags.	Entire construction phase	All Personnel	Weekly reporting to MoET and MLECCNR
	W3.5: Minimize the use of herbicides and use only biodegradable herbicides that have minimal impact on water quality and fauna.	Pre and Post Construction	All personnel	Maintain records
W4. Reduced quality and/or contamination of groundwater	W4.1: No storage of fuels, oils, chemicals or other hazardous liquids onsite.	Entire construction phase	All Personnel	Daily and maintain records
W5. Flood impacts from the Project.	W5.1: Where practicable, construct detention ponds to mitigate flows where adverse impacts are otherwise unavoidable to the coastal environments.	Entire Project Construction Phase	All personnel	Maintain records

Erosion, Drainage and Sediment Control

295. The majority of the Tongan islands sit on volcanic and sedimentary rocks which are overlain by raised reef limestone. The younger rock is valuable and is usually a source for quarry material. The islands morphology and surface geology are mainly the result of subaerial and marine erosion. A marine dissolution process, termed solution cliffing, is thought to be responsible for excavating depressions and channel-ways below present sea level in the interiors of the islands.

296. Soils on the islands of Tonga are coral base covered with around 3 meters of volcanic ash deposited from the chain of volcanoes to the west.

297. Mitigative controls could potentially be required for the management of acid sulfate soils (ASS) and/or potential acid sulfate soils (PASS) during any excavation works at a number of the schools due to their locations close to coastal areas and where mangroves have been and/or are currently located.

298. ASS is naturally occurring soils, sediments or organic substrates that are formed under waterlogged conditions. Deposits of ASS are commonly found in less than five meters ASL, particularly in low-lying coastal areas. Mangroves, salt marshes, floodplains, swamps, wetlands, estuaries, and brackish or tidal lakes are ideal areas for acid sulfate soil formation. The presence of ASS may not be obvious on the soil surface as they are often buried beneath layers of more recently deposited soils and sediments of alluvial or aeolian origin. These soils contain iron sulfide minerals (predominantly as the mineral pyrite) or their oxidation products. In an undisturbed state below the water table, ASS is benign. However if the soils are drained, excavated or exposed to air by a lowering of the water table, the sulfides react with oxygen to form sulfuric acid. The release of this sulfuric acid from the soil can in turn release iron, aluminum, and other heavy metals (particularly arsenic) within the soil. Once mobilized, the acid and metals can create a variety of adverse impacts including killing vegetation, seeping into and acidifying groundwater and water bodies, killing fish and other aquatic organisms and degrading concrete and steel structures to the point of failure.

299. Prior to any excavation, sediments should be tested for their presence of ASS or PASS. Sampling should be undertaken consistent with that proposed by the Queensland Acid Sulfate Soils Investigation Team as described in Ahern *et al* (1998) and laboratory analysis consistent with Ahern *et al* (2004). If the analysis proves positive, the sediment can be treated by a range of techniques including but not limited to liming the sediment. The contractor should refer to management measures provided by for example by Dear *et al* (2002) to mitigate the impacts. Of critical importance for ground water quality especially as this is the source of potable water in Tongatapu, one of the most significant impacts is via infiltration into the water table from an ASS stockpiling/treatment area. To reduce this impact, a compacted clay liner should be developed including where possible limed clay although this may reduce the efficiency of compaction and hence increase the permeability of the liner. Every effort should be made to ensure there is no direct or residual impact following treatment.

Performance Criteria

300. The following performance criteria are set for the school improvement projects:

    a. No build-up of sediment in the coastal environments as a result of construction activities within the project corridors;

    b. No degradation of water quality on or off site;

    c. All water exiting the site is to have passed through best practice erosion, drainage and sediment controls;

    d. No impacts on water quality and groundwater from ASS if observed; and

    e. Effective implementation of site-specific EDSCP.

301. By following the management measures set out in the CEMP, construction of the school improvement projects will not have a significant impact as a result of sedimentation across the broader area.

Monitoring

302. A standardized sediment control monitoring program has been developed for the projects. The program is subject to review and update at least every two months from the date of issue. The site supervisor will be required to:

   a. Conduct site inspections on a weekly basis or after rainfall events exceeding 20mm in a 24 hour period;

   b. Develop a site-specific checklist to document non-conformances to this CEMP or any applicable EDSCPs; and

   c. Communicate the results of inspections and/or water quality testing to the Site Supervisor and ensure that any issues associated with control failures are rapidly rectified and processes are put in place to ensure that similar failures are not repeated.

303. It is the responsibility of the site supervisor to:

   a. Conduct daily inspections of EDS control measures as part of the Daily Check Procedure; and

   b. Consult MoET and MLECCNR when a non-conformance is suspected and amend accordingly.

Reporting

304. All sediment and erosion control monitoring results and/or incidents will be tabulated and reported as outlined in the CEMP. The MLECCNR must be notified immediately in the event of any suspected instances of material or serious environmental harm, or if a determined level with respect to erosion and sediment control is exceeded.

Table 9: Erosion, Drainage, Sediment Control Measures

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
E1: Loss of soil material and sedimentation of coastal environments from site due to earthwork activities	E1.1: Develop and implement an EDSCP for any surface works, embankments and excavation work, water crossings and stormwater pathways.	Entire construction phase	All Personnel	Maintain records
	E1.2: Ensure that erosion and sediment control devices are installed, inspected and maintained as required.	Entire construction phase	All Personnel	Maintain records
	E1.3: Schedule/stage works to minimize cleared areas and exposed soils at all times.	Pre and during construction	Site Supervisor	Maintain records
	E1.4: Incorporate design and location of temporary and permanent EDSCP measures for all exposed areas and drainage lines. These shall be implemented prior to pre-construction activities and shall remain onsite during work	Pre and during construction	Site Supervisor	Maintain records
	E1.5: Schedule/stage proposed works to ensure that major vegetation disturbance and earthworks are carried out during periods of lower rainfall and wind speeds.	Pre and during construction	Site Supervisor	Maintain records
	E1.6: Strip and stockpile topsoil for use during revegetation.	Pre and during construction	Site Supervisor	Maintain records
	E1.7: Schedule/stage works to minimize the duration of stockpiling topsoil material	During construction	All Personnel	Maintain records
	E1.8: Locate stockpile areas away from drainage pathways, waterways and sensitive locations.	Pre and during construction	Site Supervisor	Maintain records

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
E1: Loss of soil material and sedimentation of coastal environments from site due to earthwork activities	E1.9: Design stormwater management measures to reduce flow velocities and avoid concentrating runoff.	Pre and during construction	Site Supervisor	Maintain records
	E1.10: Include check dams in drainage lines where necessary to reduce flow velocities and provide some filtration of sediment.	Pre and during construction	Site Supervisor	Maintain records
	E1.11: Mulching shall be used as a form of erosion and sediment control and where used on slopes, include extra sediment fencing during high rainfall.	During construction	All Personnel	Maintain records
	E1.12: Bunding shall be used either within watercourses or around sensitive/dangerous goods as necessary.	During construction	All Personnel	Maintain records
	E1.13: Grassed buffer strips shall be incorporated where necessary during construction to reduce water velocity.	During construction	Site Supervisor	Maintain records
	E1.14: Silt curtain to be installed at drainage course to protect from increased sediment loads.	During construction	Contractors	Maintain records
	E1.15: Excess sediment in all erosion and sediment control structures (eg. sediment basins, check dams) shall be removed when necessary to allow for adequate holding capacity.	During construction	Contractors	Maintain records
E2: Soil contamination	E2.1: If contamination is uncovered or suspected, undertake a preliminary site contamination investigation. The contractor should cease work if previously unidentified contamination is encountered and activate management procedures and obtain advice/permits/approval (as required).	Entire construction phase	All Personnel	Daily and maintain records
	E2.2: Adherence to best practice for the removal and disposal of contaminated soil/ material from site (if required), including contaminated soil within the school grounds.	Entire construction phase	All Personnel	Daily and maintain records

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
E2: Soil contamination	E2.3: Drainage control measures to ensure runoff does not contact contaminated areas (including contaminated material within the school grounds) and is directed/diverted to stable areas for release.	Entire construction phase	All Personnel	Daily and maintain records
	E2.4: Avoid importing fill that may result in site contamination and lacks accompanying certification/documentation. Where fill is not available through on site cut, it must be tested in accordance with geotechnical specifications.	Entire construction phase	All Personnel	Daily and maintain records
	E2.5: Ensure no impact of ASS soils on water quality and groundwater systems. Where observed, ensure compliance with best practice for the sampling, analysis and handing of all ASS contaminated soils	During construction	Site Supervisor	Maintain records, immediately advise MoET and MLECCNR of any ASS

Noise and Vibration

305. All construction activities have the potential to cause noise nuisance. Vibration disturbance to nearby residents and students if works are undertaken during school terms is likely to be caused through the use of machinery required to move earth material. Blasting is not required to be undertaken as part of this project.

306. There are no sensitive receptors in proximity to the schools.

307. Contractors involved in construction activities should be familiar with methods of controlling noisy machines and alternative construction procedures as explained in the Tongan *Health Services Act 1991* or in its absence, the Australian Standard AS2436 – 1981, *Guide to Noise Control on Construction, Maintenance and Demolition Sites* may be used if the legislation has not been enacted**.**

308. This standard detail, typical equipment sound power levels, provides advice on project supervision and gives guidance noise reduction. Potential noise sources during construction may include:

    a. excavation equipment;

    b. delivery vehicles; and

    c. power tools and compressors although these are unlikely to be required.

Performance Criteria

309. The following performance criteria are set for the school improvement projects:

    a. Noise from construction activities must not cause an environmental nuisance at any noise sensitive place;

    b. Undertake measures at all times to assist in minimizing the noise associated with construction activities;

    c. No damage to off-site property caused by vibration from construction activities; and

    d. Corrective action to respond to complaints is to occur within 48 hours.

Monitoring

310. A standardized noise monitoring program has been developed for the projects. The program is subject to review and update at least every two months from the date of issue. Importantly, the site supervisor will:

    a. ensure equipment and machinery is regularly maintained and appropriately operated

    b. carry out potentially noisy construction activities during daylight hours only; i.e. 7am - 5pm.

Reporting

311. All noise monitoring results and/or incidents will be tabulated and reported as outlined in the CEMP. The MLECCNR must be notified immediately in the event of any suspected instances of material or serious environmental harm, or if a determined level with respect to noise is exceeded.

Table 10: Noise and Vibration Management Measures

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
N1: Increased noise levels	N1.1: Select plant and equipment and specific design work practices to ensure that noise emissions are minimized during construction.	Pre and during construction	Contractor	Maintain records
	N1.2: Specific noise reduction devices such as silencers, mufflers and/or acoustic rock breaking heads shall be installed as appropriate to site plant and equipment.	Pre and during construction	Contractor	Maintain records
	N1.3 Minimize the need for and limit the emissions as far as practicable if noise generating construction works are to be carried out outside of the hours: 7am-5pm (Mon - Fri) and outside of school terms.	Construction phase	All Personnel	Daily and maintain records
	N1.4: Consultation with school principals and any nearby residents in advance of construction activities particularly if noise generating construction activities are to be carried out outside of the hours: 7am-5pm (Mon - Fri) and 7am-3pm (Sat).	Construction phase	All Personnel	Daily and maintain records
	N1.5 The use of substitution control strategies shall be implemented, whereby excessive noise generating equipment items onsite are replaced with other alternatives.	Construction phase	All Personnel	Daily and maintain records
	N1.6 Provide temporary construction noise barriers in the form of solid hoardings where there may be an impact on specific residents and/or students if the works are undertaken during the school term.	Construction phase	Site Supervisor	Daily and maintain records
	N1.7 All incidents complaints and non-compliances related to noise shall be reported in accordance with the site incident reporting procedures and summarized in the register.	Construction phase	Site Supervisor	Maintain records
	N1.8 The contractor should conduct employee and operator training to improve awareness of the need to minimize excessive noise in work practices through implementation of measures.	Pre and during construction	Contractor	Maintain records

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
N2. Vibration due to construction	N2.1: Identify properties, structures and habitat locations that will be sensitive to vibration.	Pre and during construction	Contractor	Maintain records
	N2.2: Design to give due regard to temporary and permanent mitigation measures for noise and vibration from construction and operational vibration impacts.	Pre-construction	Contractor	Maintain records
	N2.3: All incidents, complaints and con-compliances related to vibration shall be reported in accordance with the site incident reporting procedures and summarized in the register.	Construction phase	Site Supervisor	Maintain records
	N2.4: During construction, standard measure shall be taken to locate and protect underground services from construction and operational vibration impacts	Construction phase	Site Supervisor	Maintain records

Air Quality

312. All construction activities have the potential to cause air quality nuisance.

313. Vibration disturbance to nearby residents is likely to be caused through the use of earthmoving equipment. Blasting is not required to be undertaken as part of this project.

314. There are no sensitive receptors in proximity to the schools unless the students are attending at the time of the works.

315. Contractors involved in construction activities should be familiar with methods minimizing the impacts of deleterious air quality and alternative construction procedures as explained in the Tongan *Health Services Act 1991.*

Performance Criteria

316. The following performance criteria are set for the school improvement projects:

    a. Release of dust/particle matter must not cause an environmental nuisance;

    b. Undertake measures at all times to assist in minimizing the air quality impacts associated with construction activities; and

    c. Corrective action to respond to complaints is to occur within 48 hours.

Monitoring

317. A standardized air monitoring program has been developed for the projects. The program is subject to review and update at least every two months from the date of issue. Importantly, the site supervisor will:

    a. ensure all stockpiles are covered so as to not allow dust to generate; and

    b. the requirement for dust suppression will be visually observed by all personnel daily and by MoET and MLECCNR when undertaking routine site inspections (minimum frequency of once per week).

Reporting

318. All air quality monitoring results and/or incidents will be tabulated and reported as outlined in the CEMP. The MLECCNR must be notified immediately in the event of any suspected instances of material or serious environmental harm, or if a determined level with respect to air quality is exceeded.

Table 11: Air Quality Management Measures

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
A1: Increase in dust levels at sensitive locations	A1.1: Implement effective dust management measures in all areas during design, construction and operation.	Pre and during construction	All Personnel	Daily and maintain records
	A1.2: Manage dust/particulate matter generating activities to ensure that emissions do not cause an environmental nuisance at any sensitive locations	During construction	Site Supervisor	Daily and maintain records
	A1.3: Construction activities should minimizing risks associated with climatic events.	During construction	Site Supervisor	Daily and maintain records
	A1.4: Implement scheduling/staging of proposed works to ensure major vegetation disturbance and earthworks are minimized.	Entire construction	Contractor	Daily and maintain records
	A1.5: Ensure that materials to be stockpiled onsite are not ordered and/or purchased until they are required for works.	Entire construction	Contractor	Daily and maintain records
	A1.6: Locate material stockpile areas as far as practicable from sensitive receptors.	During construction	Site Supervisor	Daily and maintain records
	A1.7: Source sufficient water of a suitable quality for dust suppression activities complying with any water restrictions.	During construction	Site Supervisor	Daily and maintain records
	A1.8: Schedule revegetation activities to ensure optimum survival of vegetation species.	During construction	Site Supervisor	Maintain records
	A1.9: Ensure an air quality management plan is developed and implemented.	Pre and during construction	Contractor	Maintain records
	A1.10: Rubbish skips and receptacles should be covered and located as far as practicable from sensitive locations.	During construction	Site Supervisor	Maintain records
	A1.11: Cover loads of haul trucks and equipment and plant when not in use and in transit.	During construction	Site Supervisor	Daily and maintain records

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
A2. Increase in vehicle emissions (including odors and fumes)	A2.1 Ensure construction vehicles are switched off when not in use.	During construction	Site Supervisor	Daily and maintain records
	A2.2 Ensure only vehicles required to undertake works are operated onsite.	During construction	Site Supervisor	Daily and maintain records
	A2.3 Ensure all construction vehicles, plant and machinery are maintained and operated in accordance with design standards and specifications.	During construction	Site Supervisor	Daily and maintain records
	A2.4 Develop and implement an induction program for all site personnel, which includes as a minimum an outline of the minimum requirements for environmental management relating to the site.	Pre and during construction	Contractor	Daily and maintain records
	A2.5 Locate construction car park and vehicle/plant/equipment storage areas as far as practicable from sensitive locations.	During construction	Site Supervisor	Daily and maintain records
	A2.6 Direct exhaust emissions of mobile plant away from the ground.	During construction	Site Supervisor	Daily and maintain records
	A2.7 Rubbish skips and receptacles should be covered and located as far as practicable from sensitive locations.	During construction	Site Supervisor	Daily and maintain records

Flora and Fauna

319. The majority of the projects are in an area that has been extensively disturbed although vegetation still exists including some weed species. From the desk top assessment, there is no vegetation species or community of Conservation Significance as reflected in the *Birds and Fish Preservation Act 1989*.

320. There are no sensitive ecosystems in proximity to the school grounds.

321. Contractors involved in construction activities should be familiar with methods minimizing the impacts of clearing vegetation to minimize the footprint to that essential for the works of the school improvement program and rehabilitate disturbed areas. By doing these activities, the projects should minimize the impact upon fauna where ever practical.

Performance Criteria

322. The following performance criteria are set for the school improvement projects:

    a. No clearance of vegetation outside of the designated clearing boundaries;

    b. No death to native fauna as a result of clearing activities;

    c. No introduction of *new* weed species as a result of construction activities;

    d. No increase in *existing* weed proliferation within or outside of the school grounds as a result of construction activities; and

    e. Successful establishment of rehabilitation works incorporating species native to the local area as per the design of the school improvement program.

Monitoring

323. A flora and fauna monitoring program has been developed for the projects. The program is subject to review and update at least every two months from the date of issue. Importantly, the site supervisor will when undertaking clearing works, will compile a weekly report to MoET and MLECCNR outlining:

    a. Any non-conformances to this CEMP;

    b. The areas that have been rehabilitated during the preceding week; and

    c. Details of the corrective action undertaken.

Reporting

324. All flora and fauna monitoring results and/or incidents will be tabulated and reported as outlined in the CEMP. The MLECCNR must be notified immediately in the event of any suspected instances of death to fauna and where vegetation if detrimental impacted.

Table 12: Flora and Fauna Management Measures

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
FF1. Habitat loss and disturbance of fauna	FF1.1 Limit vegetation clearing and minimize habitat disturbance through adequate protection and management of retained vegetation.	During construction	Site Supervisor	Daily and maintain records
	FF1.2: Ensure that all site personnel are made aware of any sensitive fauna/habitat areas and the requirements for the protection of these areas.	During construction	Contractor	Daily and maintain records
	FF1.3 Minimize disturbance to onsite fauna and recover and rescue any injured or orphaned fauna during construction.	During construction	Contractor	Daily and maintain records, report to MLECCNR
FF2. Introduced flora and weed species	FF2.1: Implement an EDSCP to reduce the spread of weeds through erosion and sediment entering waterways and therefore spreading.	Pre and during construction	Contractor	Maintain records
	FF2.2: Revegetate disturbed areas using native and locally endemic species that have high habitat value.	During construction	Site Supervisor	As required and maintain records
	FF2.3: Minimize disturbance to mature remnant vegetation, particularly canopy trees.	During construction	Site Supervisor	Daily and maintain records
	FF2.4: The removal of regrowth native trees should be minimized particularly where the width of a forest is narrow.	During construction	Site Supervisor	Daily and maintain records
	FF2.5: Small trees and shrubs shall be removed in preference to large trees.	During construction	Site Supervisor	Daily and maintain records
	FF2.6: Vegetation to be removed shall be clearly marked using paint or flagging tape.	During construction	Site Supervisor	Daily and maintain records

Waste Management

325. The MoET and MLECCNR advocate good waste management practice in accordance with the Tongan *Waste Management Act 2005*; *Hazardous Wastes and Chemicals Act 2010* and *Building Control and Standards Act 2002* (and 2007 Regulation). The preferred waste management hierarchy and principles for achieving good waste management is as follows:

    a. waste avoidance(avoid using unnecessary material on the project) ;

    b. waste re-use (re-use material and reduce disposing);

    c. waste recycling(recycle material such as cans, bottles, etc.; and

    d. waste disposal (All petruscible to be dumped at the Tapuhia Landfill).

326. The key waste streams generated during construction are likely to include demolition wastes this being the removal of windows, wooden louvers and metal roof sheeting. When undertaking earthworks for the flood mitigation, this will include, but not limited to, shrubs/trees etc. The wastes to be generated will mostly be vegetation-based and also include:

    a. the excavation wastes unsuitable for reuse during earthworks; and

    b. general wastes including scrap materials and biodegradable wastes

327. Contractors involved in construction activities should be familiar with methods minimizing the impacts of clearing vegetation to minimize the footprint and rehabilitate disturbed areas. By doing these activities, the projects should minimize the impact upon fauna where ever practical.

Asbestos Removal, Handling and Transport

328. Asbestos has been observed at Mata'aho Government Primary School. The roof of the building will be removed as part of the works proposed. Asbestos has also been observed in houses, the hospital and Government buildings. Prior to removal, all relevant permits must be obtained from the MLECCNR.

329. All asbestos removal and handling will be undertaken by highly trained international professionals in association with trained local Tongan staff. All removal and handling will include the appropriate personal protective equipment including but not limited to:

    a. P2 / P3 HEPA filtered half face masks;

    b. Disposable coveralls Type 5 & 6 (hazardous dust and splash);

    c. Disposable gloves;

    d. Construction hard hats; and

    e. Sturdy work boots or gumboots with steel capped toes.

330. All asbestos from Ha'apai will be removed from building and placed in special packing material, such as Hazibags. The material will be transported in containers and/or other approved containment to prevent any migration during transportation.

331. In 2001, the Australian Department of Foreign Affairs and Trade (then AusAID) funded a solid waste management facility for Tongatapu based on the Solid Waste Management Plan (SWMP) of March 2000. The Plan recommended that the old, disused Tapuhia Quarry site be developed as a modern waste management and sanitary landfill facility to service the solid waste management needs of Nuku'alofa and other villages on Tongatapu. At 10,000 tons/year of waste, the Tapuhia Landfill has a life of about 30 years.

332. The first landfill waste disposal cell (currently in use) was developed in the southwest corner of the quarry. The cell floor was raised above the groundwater level to ensure that no leachate escaped directly into groundwater. The cell floor was lined with 500mm layer of low permeability compacted clay followed by a geosynthetic clay liner (Bentofix X1000) to form a composite liner system. A leachate collection system was placed directly above the liner system to direct the leachate to a sump / extraction system. A 300mm layer of drainage aggregate was placed over the entire floor of the cell to complement the leachate pipe network and to protect the liner system. Bentofix X2000 liner, with geo-fabrics on either side of the liner, was used to provide protection from the quarry face and initial UV radiation. When full, the entire cell will be covered with compacted soil cover, followed by geosynthetic Bentofix liner and capped with drainage aggregate and topsoil. The cell surface will be sloped to direct surface drainage away from the cell. The current cell is now almost full and a new 30,000 ton capacity cell is currently under construction using the same design.

333. The Tapuhia facility also includes a low level (household chemicals, hospital autoclave and medical waste) hazardous waste landfill cell with its own leachate collection facility draining into the common sump. Leachate from the sump is pumped to a treatment pond, where it is recirculated and aerated. Following suitable treatment and settling period, it is released to a storage pond for spray irrigation of the facility green areas and gardens or sprayed on the landfill. The facility also has four boreholes; one at each corner of the landfill, to monitor for groundwater contamination.

334. The Tapuhia facility has sufficient capacity to accommodate the estimated 300 tons of asbestos waste and cyclone generated construction and demolition waste debris.

335. All work will be carried out in accordance with the New Zealand Guidelines for the Management and Removal of Asbestos (3rd Edition) produced by the New Zealand Demolition and Asbestos Association (NZDAA). Reference should also be made to Annexure 2 and Annexure 3 of this IEE.

Performance Criteria

336. The following performance criteria are set for the school improvement projects:

a. Waste generation is minimized through the implementation of the waste hierarchy (avoidance, reduce, reuse, recycle);

b. No litter will be observed within the project corridor or surrounds as a result of activities by site personnel;

c. No complaints received regarding waste generation and management;

d. Any waste from on-site portable sanitary facilities will be sent off site for disposal by a waste licensed contractor; and

e. Waste oils obtained from the oil separator will be collected and disposed or recycled off-site, at for example Tonga Power station, local oil companies or shipped to Fiji for recycling.

Monitoring

337. A waste management monitoring program has been developed for the projects. The program is subject to review and update at least every two months from the date of issue.

Reporting

338. The MLECCNR must be notified immediately in the event of any suspected instances of material or serious environmental harm, or if a determined level with respect to waste is exceeded.

Table 13: Waste Management Measures

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
WT1: Production of wastes and excessive use of resources	WT1.1: Preference shall be given to materials that can be used to construct the project that would reduce the direct and indirect waste generated.	Pre and during construction	Contractor	Maintain records
	WT1.2: Consideration shall be given to the use of recycled aggregates and fly-ash cement mixes.	Pre and during construction	Contractor	Maintain records
	WT1.3: Daily waste practices shall be carried out unless these are delegated to the activities of external waste management bodies.	During construction	Site Supervisor	Daily and maintain records
	WT1.4: The use of construction materials shall be optimized and where possible a recycling policy adopted.	During construction	Site Supervisor	Weekly and maintain records
	WT1.5: Separate waste streams shall be maintained at all times i.e. general domestic waste, construction waste and contaminated waste. Specific areas on site shall be designated for the temporary management of the various waste streams. Adequate signage and color coded bins will be used for each waste streams.	During construction	Site Supervisor	Weekly and maintain records
	WT1.6: Any contaminated waste including but not limited to asbestos shall be disposed of within the appropriate cell at the Tapuhia Landfill in accordance with New Zealand Guidelines for the Management and Removal of Asbestos (3rd Edition).	During construction	Site Supervisor	Weekly and maintain records
	WT1.7: Disposal of waste shall be carried out in accordance with the GoT requirements.	During construction	Site Supervisor	Weekly and maintain records
	WT1.8: Fuel and lubricant leakages from vehicles and plant shall be immediately rectified.	During construction	Site Supervisor	Daily and maintain records
	WT1.9: Major maintenance and repairs shall be carried out off-site whenever practicable.	During construction	Site Supervisor	Weekly and maintain records
	WT1.10: Where possible, fuel and chemical storage and handling shall be undertaken at central fuel and chemical storage facilities, such as petrol stations, but definitely offsite.	During Construction	Site Supervisor	Daily and maintain records

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
WT1: Production of wastes and excessive use of resources	WT1.11: Disposal of trees shall be undertaken in accordance with one or more of the following methods: a. Left in place; b. Chipped and mulched; and c. Large trunk sections may be sold/passed on to a commercial mill.	During Construction	Site Supervisor	Weekly and maintain records
	WT1.12: Where possible, fuel and chemical storage and handling shall be undertaken at central fuel and chemical storage facilities, such as petrol stations, but definitely offsite.	During Construction	Site Supervisor	Daily and maintain records
	WT1.13: Any waste oils and lubricants are to be collected and transported to recyclers or designated disposal sites as soon as possible.	During Construction	Site Supervisor	Daily and maintain records

Chemical and Fuel Management

339. No chemicals and fuels will be stored on-site during construction. All chemicals and fuels will be stored off site and include but are not limited to:

   a. Diesel and unleaded petrol for the refueling of plant equipment and generators;

   b. Grease;

   c. Bitumen emulsions;

   d. Truck wash;

   e. Sulphuric acid; and

   f. Lime, etc include:

340. If not handled, stored or used appropriately, contamination of land around workshops and yards could occur. The accidental discharge of hazardous materials during fuelling etc activities is a potential risk to the local environment. Accordingly, all oil, grease, diesel and petrol should be stored off site.

341. Potential activities which could result in spills are:

   a. use of machinery and vehicles – potential for fuels, oils and lubricant spills;

   b. transport, storage and handling of fuels, machinery oils, grease;

   c. transport, storage and handling of cement/asphalt(bitumen) and other construction materials; and

   d. Impacts associated with hazardous materials will primarily be associated with the storage and handling during the construction phase.

Performance Criteria

342. The following performance criteria are set for the school improvement projects:

   a. Handling and storage of hazardous material off site is in accordance with the relevant legislation and best management practices;

   b. All spills are reported to MoET and MLECCNR within ***one hour*** of occurrence; and

   c. No spills enter the coastal environments; and

   d. Prevent the uncontrolled release of oil, grease, and diesel to the environment; and

   e. No spills of hazardous materials.

Monitoring

343. A chemical and fuel management program has been developed for the projects for all offsite works. The program is subject to review and update at least every two months from the date of issue. Importantly, the site supervisor should:

   a. Conducted daily chemical and fuel assessments as part of their daily check procedure;

   b. Manage the selection, purchase, storage, handling and disposal of chemicals to ensure minimal environmental impact;

   c. Regularly inspect equipment that uses fuel, lubricants, and/or hydraulic fluid;

   d. Develop procedures and install equipment to contain, minimize and recover spills; and

   e. Provide staff with procedures and training in spill prevention and clean up.

Reporting

344. The MLECCNR must be notified immediately in the event of any suspected instances of material or serious environmental harm, or if a determined level as a result of a chemical or fuel leak or spill.

Table 14: Chemical and Fuels Management Measures

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
C1 Poor management of chemicals and fuels	C1.1: Prepare spill management plan addressing measures	Pre-construction	Contractor	Maintain records and weekly reporting
	C1.2: Store and handle all chemicals, fuels, oils and potentially hazardous materials as specified in relevant standards and guidelines. All hazardous materials and construction fuel will be stored offsite in appropriate storage facilities (e.g. fuel will be stored in a bunded area).	During Construction	Site Supervisor	Daily and maintain records
	C1.3: Fuel and chemical storage and handling shall be undertaken at central fuel and chemical storage facilities, such as petrol stations/site depot away from the school grounds.	During Construction	Site Supervisor	Daily and maintain records
	C1.4: Emergency clean up kits for oil and chemical spills will be available onsite and in all large vehicles.	During Construction	Site Supervisor	Daily and maintain records

Archaeological and Cultural Heritage

345. The *Tonga Historical and Cultural Heritage Act* provides for the preservation and management of natural and man-made features of anthropological, cultural, historical, pre-historical or societal significance. It aims to foster dissemination of knowledge of the history of Tonga and promote the understanding of the historic continuum within the country. This could cover burial sites, tomb area, sites of historical value to the members of the public and the Royal Family of the Kingdom of Tonga.

346. There are no known Archaeological and Cultural Heritage sites within any of the school grounds.

Performance Criteria

347. The following performance criteria are set for the school improvement projects:

    a. There will be no impact on any Archaeological and Cultural Heritage sites;

    b. Manage any specific sites of cultural significance (significant sites); and

    c. Allow the participation of locals who are familiar with the history of the area during the construction phase of the project.

Monitoring

348. An Archaeological and Cultural Heritage monitoring program has been developed for the projects. The program is subject to review and update at least every two months from the date of issue. Importantly, the plan should:

    a. provide cultural heritage awareness training to all construction site personnel (including contractors);

    b. identify and collect any cultural heritage items worthy of protection;

    c. consult with the Tongan Museum which is located within the Tongan National Cultural Centre, about any cultural heritage material discovered during construction; and

    d. cease work in the area where any human remains are discovered and consult with the Police and the Tonga Museum.

Reporting

349. The MoET, MLECCNR, Police and Tongan Museum must be notified immediately in the event of any suspected find related to Archaeological and Cultural Heritage.

Table 15: Archaeological and Cultural Heritage

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
CH1: Damage or disturbance to significant cultural heritage during the earth disturbances and land clearing activities	CH1.1: Should any Archaeological and Cultural Heritage sites, immediately cease work within the area that the site has been observed and consult with the Tonga Museum/traditional owner groups, MoET and archaeologist available for implementation during construction.	Pre and during construction	Contractor	Daily, maintain records and immediately notify MoET, MLECCNR, Tongan Museum and Police of any find

Emergency Response Plan

350. In the event of actions occurring, which may result in serious health, safety and environmental (catastrophic) damage, emergency response or contingency actions will be implemented as soon as possible to limit the extent of environmental damage.

351. The project areas are generally wet and in some areas swampy for some periods of the year. However, there is a higher risk of fire occurring during the drier months of June to October. There are residences located close to the school ground that may be damaged in the event of a fire.

352. The contractor will need to incorporate construction emergency responses into the school projects complying with the requirements under the Occupational, Health and Safety Policy of the contractor or the work related Tongan *Health Services Act 1991.*

Performance Criteria

353. The following performance criteria are set for the school improvement projects:

    a. No incident of fire outbreak during construction;

    b. Reduce the risk of fire by undertaking hot works within cleared locations;

    c. Provide an immediate and effective response to incidents that represent a risk to public health, safety or the environment; and

    d. Minimize environmental harm due to unforeseen incidents.

Monitoring

354. An emergency response monitoring program has been developed for the projects. The program is subject to review and update at least every two months from the date of issue. Importantly, visual inspections will be conducted by site supervisor daily with reporting to MoET and MLECCNR on a weekly basis (minimum) noting any non-conformances to this CEMP.

Reporting

355. The MoET and MLECCNR must be notified immediately in the event of any emergency, including fire or health related matter including those that have resulted in serious environmental harm.

Table 16: Emergency Management Measures

Issue	Control Activity (and Source)	Action Timing	Responsibility	Monitoring and Reporting
E1. Fire and Emergency management and prevention strategies implemented	E1.1: Flammable and combustible liquids Bunding/storage areas to be designed in accordance with appropriate international standards (eg AS1940)	Pre and during construction	Contractor	Daily and maintain records
	E1.2: Fire extinguishers are to be available within all site vehicle	During construction	Contractor	Daily and maintain records
	E1.3: No open fires are permitted within the project area	During construction	Site Supervisor	Daily and maintain records
	E1.4: No cigarette butts are to be disposed of onto the ground throughout the project area, all smokers must carry a portable disposal bin to reduce the risk of a spot fire starting and general litter	During construction	All Personnel	Daily and maintain records
	E1.5: Any stockpiles of mulch are not to exceed two meters in height and width and must be turned regularly.	During construction	All Personnel	Daily and maintain records
	E1.6: Train all staff in emergency preparedness and response(cover health and safety at the work site)	During construction	Site Supervisor	Daily and maintain records
	E1.7: Check and replenish First Aid Kits	During construction	Site Supervisor	Daily and maintain records
	E1.8: Use of Personal Protection Equipment	During construction	All Personnel	Daily and maintain records

Annexure 2 Good Practice Guidance Note on Asbestos Management, by World Bank, May 2009

World Bank Group, May 2009

Good Practice Note: Asbestos: Occupational and Community Health Issues

1. SUMMARY

The purpose of this Good Practice Note is to increase the awareness of the health risks related to occupational asbestos exposure, provide a list of resources on international good practices available to minimize these risks, and present an overview of some of the available product alternatives on the market. The need to address asbestos-containing materials (ACM) as a hazard is no longer under debate but a widely accepted fact.

Practices regarding asbestos that are normally considered acceptable by the World Bank Group (WBG) in projects supported through its lending or other instruments are addressed in the WBG's General Environmental, Health and Safety (EHS) Guidelines.[8] This Good Practice Note provides background and context for the guidance in the WBG EHS Guidelines.

Good practice is to minimize the health risks associated with ACM by avoiding their use in new construction and renovation, and, if installed asbestos- containing materials are encountered, by using internationally recognized standards and best practices (such as those presented in Appendix 3) to mitigate their impact. In all cases, the Bank expects borrowers and other clients of World Bank funding to use alternative materials wherever feasible.

ACM should be avoided in new construction, including construction for disaster relief. In reconstruction, demolition, and removal of damaged infrastructure, asbestos hazards should be identified and a risk management plan adopted that includes disposal techniques and end-of-life sites.

2. ASBESTOS AND HEALTH RISKS

2.1. What is Asbestos, and Why are We Concerned with its Use?

Asbestos is a group of naturally occurring fibrous silicate minerals. It was once used widely in the production of many industrial and household products because of its useful properties, including fire retardation, electrical and thermal insulation, chemical and thermal stability, and high tensile strength. Today, however, asbestos is recognized as a cause of various diseases and cancers and is considered a health hazard if inhaled.[9] The ILO estimates that over the last several decades 100,000 deaths globally have been due to asbestos exposure,[10] and the WHO states that each year 90,000 people globally die because of occupational asbestos exposure.

Over 90% of asbestos[11] fiber produced today is chrysotile, which is used in asbestos-cement (A-C) construction materials: A-C flat and corrugated sheet, A-C pipe, and A-C water storage tanks. Other products still being manufactured with asbestos content include vehicle brake and clutch pads, roofing, and gaskets. Though today asbestos is hardly used in construction materials other than asbestos-containing products, it is still found in older buildings in the form of friable surfacing materials, thermal system insulation, non-friable flooring materials, and other applications. The maintenance and removal of these materials warrant special attention.

Because the health risks associated with exposure to asbestos are now widely recognized, global health and worker organizations, research institutes, and some governments have enacted bans on the commercial use of asbestos and they urge the enforcement of national standards to protect

---

[8] See generally, International Finance Corporation (2012) Performance Standards and Guidance Notes, available at http://www.ifc.org/

[9] Stayner L., Smith, R., Bailer, J., Gilbert, S., Steenland, K., Dement, J., Brown, D., and Lemen, R., (1997) "Exposure-Response Analysis of Risk of Respiratory Disease Associated with Occupational Exposure to Chrysotile Asbestos" *Occupational Environmental Medicine.* 54: 646-652

[10] World Health Organization (2006) *Elimination of asbestos related disease*, available at http://www.who.int/

[11] Asbestos defined in Castleman, B. *Asbestos: Medical and Legal Aspects* 5th Ed. New York: Aspen, 2005, 894 pp

the health of workers, their families, and communities exposed to asbestos through an International Convention.[12]

2.2. Health Concerns Linked to Asbestos-Containing Products

Health hazards from breathing asbestos dust include asbestosis, a lung scarring disease, and various forms of cancer (including lung cancer and mesothelioma of the pleura and peritoneum).[13] These diseases usually arise decades after the onset of asbestos exposure. Mesothelioma, a signal tumor for asbestos exposure, occurs among workers' family members from dust on the workers' clothes and among neighbors of asbestos air pollution point sources.[14] Some experimental animal studies show that high inhalation exposures to all forms of asbestos for only hours can cause cancer.[15]

Very high levels of airborne asbestos have been recorded where power tools are used to cut A-C products and grind brake shoes. For chrysotile asbestos, the most common variety, there is no threshold (non-zero) of exposure that has been shown to be free from carcinogenic risks. Construction materials are of particular concern, because of the large number of workers in construction trades, the difficulty of instituting control measures, and the continuing threat posed by in-place materials that eventually require alterations, repair, and disposal. Renovations and repairs in buildings containing A-C materials can also endanger building occupants. In addition to the problems from products made with commercial asbestos, asbestos also occurs as a contaminant in some deposits of stone, talc, vermiculite, iron ore, and other minerals. This can create health hazards for workers and residents at the site of excavation and in some cases in the manufacture and use of consumer products the materials are used to make. While asbestos is a known carcinogen when inhaled, it is not known to be carcinogenic when ingested, as through drinking water,[16] although pipe standards have been issued for A-C pipes conducting "aggressive" water.[17]

From the industrial hygiene viewpoint, asbestos creates a chain of exposure from the time it is mined until it returns to the earth at a landfill or unauthorized disposal site. At each link in the chain, occupational and community exposures coexist. Workers in the mines are exposed to the fibers while extracting the ore; their families breathe fibers brought home on work clothes; workers in the mills and factories process the fiber and manufacture products with it; and their families are also secondarily exposed. Communities around the mines, mills, and factories are contaminated with their wastes; children play on tailings piles and in contaminated schoolyards; transportation of fiber and products contaminates roads and rights-of-way.[14] Tradesmen who install, repair, and remove ACM are exposed in the course of their work, as are bystanders, in the absence of proper controls. Disposal of asbestos wastes from any step in this sequence not only exposes the workers handling the wastes but also local residents when fibers become airborne because of insufficient covering and erosion control. Finally, in the absence of measures to remove ACM from the waste stream

---

[12] ILO Asbestos Convention No. 162, (see http:www.ilo.org

[13] Directive 2003/18/EC of the European Council and Parliament amending Council Directive 83/477/EEC, and Directive 99/77/EEC

[14] "Asbestos." *World Health Organization IARC Monographs on the Evaluation of Carcinogenic Risks to Humans/ Overall Evaluations of Carcinogenicity: An Updating of IARC Monographs 1 to 42*, Suppl. 7. Lyon: International Agency for Research on Cancer, 1987, pp. 106-116.

[15] Wagner JC, Berry G, Skidmore JW, Timbrell V. "The Effects of the Inhalation of Asbestos in Rats." *Br. J. Cancer* 29: 252-269 (1974).

[16] Jones, Robert "Living in the Shadow of the Asbestos Hills (The Need for Risk Based Cleanup Strategies for Environmental Asbestos Contamination in South Africa)." Environmental Exposure, Crisis Preparedness and Risk Communication, Global Asbestos Congress, Tokyo, Japan, November 19 - 21, 2004. http://park3.wakwak.com;. See also Oberta, AF "Case Study: An Asbestos Cement Plant in Israel -- Contamination, Clean-up and Dismantling." Hellenic Asbestos Conference, Athens, Greece, October 29 - 31, 2002. http://www.ibas.btinternet.co.uk/Frames/f_lka_hellen_asb_conf_rep.htm

[17] Boer, A.M., L.A. Daal, J.L.A. de Groot, J.G. Cuperus "The Combination of the Mechanical Separator and the Extraction Cleaner Can Process the Complete Asbestos-containing Waste-stream and Make it Suitable for Reuse.

and dispose of them properly, the cycle is often repeated when discarded material is scavenged and reused.[18]

3. INTERNATIONAL CONVENTION AND STANDARDS FOR WORKING WITH ASBESTOS

3.1. International Convention

The International Labor Organization (ILO) established an Asbestos Convention (C162) in 1986 to promote national laws and regulations for the "prevention and control of, and protection of workers against, health hazards due to occupational exposure to asbestos."[17] The convention outlines aspects of best practice: Scope and Definitions, General Principles, Protective and Preventive Measures, Surveillance of the Working Environment, and Workers' Health. As of March 4, 2008, 31 countries had ratified the Convention;[19] 17 of them have banned asbestos.

Some of the ILO asbestos convention requirements:

a. work clothing to be provided by employers;

b. double changing rooms and wash facilities to prevent dust from going home on street clothes;

c. training of workers about the health hazards to themselves and their families;

d. periodic medical examinations of workers,

e. periodic air monitoring of the work environment, with records retained for 30 years;

f. development of a work plan prior to demolition work, to protect workers and provide for proper waste disposal; and

g. protection from "retaliatory and disciplinary measures" for workers who remove themselves from work that they are justified in believing presents a serious danger to health.

Standard considerations for working with and procuring ACM are common to most projects.

3.2. International Standards and National Regulations

Standards and regulations for work involving ACM have been published by nongovernmental organizations and government agencies. Appendix 3 lists of some resources, including international organizations (e.g., WHO, ISO, ASTM) and national governments (e.g., UK, US, Canada, South Africa). The resources range from manuals to individual standards and cover a variety of work guidelines, including surveys, identification, inspection, maintenance, renovation, repair, removal, and disposal. Some of the key issues discussed in these standards and regulations are as follows:

The scale of occupational hazards. The health risk is not simply a function of the properties of the ACM, but also reflects the type of work being done and the controls used. Although A-C products, for example, may seem to intrinsically present less of a risk than fire-proofing, air monitoring has shown that cutting dry A-C sheet with a power saw can release far greater amounts of airborne fibers than scraping wet, saturated fireproofing off a beam. The relationship between the nature of A-C products, the work being done and the controls used to control the release of fibers and debris is important (as discussed in ASTM E2394 and HSG189/2[19]).

Controlling exposure to airborne fibers. Because asbestos fibers are primarily an inhalation hazard, the basic purpose of the regulations and standards is to control the concentration of asbestos fibers in the air inhaled by workers or others. Concentration limits have been set by regulations in numerous countries for workers whose duties involve contact with ACM; however, they do not purport to totally eliminate the risk of asbestos disease, but only to reduce it. Exposure limits for individuals other than workers, including occupants of

---

[18] European Conference on Asbestos Risks and Management, Rome, Italy, December 4 -6, 2006. http://venus.unive.it/fall/menu/Boer.pdf

[19] See Basel Convention Secretariat http://www.basel.int/

buildings and facilities and the community, are lower than those for workers in deference to the very young and old as well as the physically compromised.

Measuring exposure to airborne fibers. Compliance with exposure limits is demonstrated by air sampling in workers' breathing zone or in the space occupied by the affected individuals, with analysis of the sample by optical or electron microscopy, as explained in Appendix 3. Abatement protocols determine whether a building can be reoccupied after asbestos abatement.

Proper disposal. Proper disposal of ACM is important not only to protect the community and environment but also to prevent scavenging and reuse of removed material. ACM should be transported in leak-tight containers to a secure landfill operated in a manner that precludes air and water contamination that could result from ruptured containers. Similar requirements apply to remediation of sites such as mines, mills, and factories where asbestos fiber was processed and products manufactured.

Transboundary movement of waste. Waste asbestos (dust and fibers) is considered a hazardous waste under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. The Basel Convention imposes use of a prior informed consent procedure for movement of such wastes across international borders. Shipments made without consent are illegal. Parties have to ensure that hazardous waste is disposed of in an environmentally sound manner. Strong controls have to be applied from the moment the material is generated, to its storage, transport, treatment, reuse, recycling, recovery, and final disposal.[20]

Identifying asbestos products. A-C products include flat panels, corrugated panels used for roofing, water storage tanks, and pressure, water, and sewer pipes. In some countries asbestos may still be used in making wallboard, heat-resistant gloves and clothes for industrial use, and brake and clutch friction elements and gaskets used in vehicles.[21] Thermal insulation containing asbestos and sprayed asbestos for insulation and acoustic damping were widely used through the 1970s and should be looked for in any project involving boilers and insulated pipes. Insulation dating from before 1980 should be presumed to contain asbestos unless analyzed and found not to. The microscopic methodology for analyzing bulk samples for the presence of asbestos is widely available in industrialized countries and is not expensive; it is less available in developing countries. In a developing country samples may have to be mailed out for testing; alternatively, training may be available for a laboratory in the country.

Training. It is impossible to overemphasize the importance of training for working with ACM in any capacity—whether it involves inspections, maintenance, removal, or laboratory analysis. The duration of the training and the course content depend on the type of work the individual will be doing. Quality control and proficiency testing for laboratories and individual analysts are also important.

4. ALTERNATIVES TO ASBESTOS-CONTAINING MATERIALS

4.1. Growing Marketplace

Safer substitutes for asbestos products of all kinds are increasingly available (see Appendix 4). These include fiber-cement products using combinations of local vegetable fibers and synthetic fibers, as well as other products that serve the same purposes.[22] The WHO is actively involved in evaluating alternatives.[23]

4.2. Cost and Performance Issues

Fiber-cement roof panels using polyvinyl alcohol (PVA) or polypropylene combined with cellulose now cost 10-15% more to manufacture than A-C sheets. Polypropylene-cellulose-cement roofing, a new product, is made at a cost of about 12 percent more than A-C roofing and has superior impact resistance. The non-asbestos fiber- cement panels are lighter, less brittle, and have improved availability over A-C. The increase in the overall cost of building construction that such products represent is to some degree offset by the obviation of special hygiene measures in installation/maintenance/renovation, the lack of a continuing hazard to building workers and occupants, and reduced costs of waste removal and disposal. Micro concrete tiles are cheaper than A-C to produce, and can be made in a basic workshop near the building site with locally available small contractors and materials, lowering transport costs. Compared with A-C pipes, iron pipes can be transported and installed with less difficulty and breakage, take greater compression loading and last longer.

5. WORLD BANK GROUP APPROACH TO ASBESTOS HEALTH RISK

The WBG EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice.[20] When one or more members of the WBG are involved in a project, the EHS Guidelines are applied as required by their respective policies and standards.

The WBG's EHS Guidelines specify that the use of ACM should be avoided in new buildings and construction or as a new material in remodeling or renovation activities. Existing facilities with ACM should develop an asbestos management plan that clearly identifies the locations where the ACM is present, its condition (e.g., whether it is in friable form or has the potential to release fibers), procedures for monitoring its condition, procedures to access the locations where ACM is present to avoid damage, and training of staff who can potentially come into contact with the material to avoid damage and prevent exposure. The plan should be made available to all persons involved in operations and maintenance activities. Repair or removal and disposal of existing ACM in buildings should be performed only by specially trained personnel[21] following host country requirements or, if the country does not have its own requirements, internationally recognized procedures.[22] Decommissioning sites may also pose a risk of exposure to asbestos that should be prevented by using specially trained personnel to identify and carefully remove asbestos insulation and structural building elements before dismantling or demolition.

[20] Defined as the exercise of professional skill, diligence, prudence, and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

[21] Training of specialized personnel and the maintenance and removal methods applied should be equivalent to those required under applicable regulations in the United States and Europe

[22] Examples include the ASTM International E1368 - Standard Practice for Visual Inspection of Asbestos Abatement Projects; E2356 - Standard Practice for Comprehensive Building Asbestos Surveys; and E2394 - Standard Practice for Maintenance, Renovation and Repair of Installed Asbestos Cement Products

Annexure 3 Considerations for working with Asbestos Materials in Existing Structures

A. Evaluation of alternatives

1. Determine whether the project could include the installation, replacement, maintenance, or demolition of any of the following:

   a. Roofing, siding, ducts or wallboard;

   b. Thermal insulation on pipes, boilers, and ducts;

   c. Plaster or fireproofing;

   d. Resilient flooring materials; and

   e. Other potentially asbestos-containing materials.

2. If the use of asbestos-containing materials (ACM) has been anticipated for new construction or renovation, provide information about alternative non-asbestos materials and their availability. For new construction, determine the expected difference for the entire project—on initial and operating costs, employment, quality, expected service life, and other factors—using alternatives to ACM (including consideration of the need for imported raw materials).

3. In many cases, it can be presumed that ACM are part of the existing infrastructure that must be disturbed. If there is a need to analyze samples of existing material to see if it contains asbestos, provide information on how and where can that be arranged.

4. Once the presence of ACM in the existing infrastructure has been presumed or confirmed and their disturbance is shown to be unavoidable, incorporate the following requirements in tenders for construction work in compliance with applicable laws and regulations.

B. Understanding the regulatory framework

1. Review the host country laws and regulations and the international obligations it may have entered into (e.g., ILO, Basel conventions) for controlling worker and environmental exposure to asbestos in construction work and waste disposal where ACM are present. Determine how the qualifications of contractors and workers who maintain and remove ACM are established, measured, and enforced.

2. Determine whether licensing and permitting of the work by authorities is required.

3. Review how removed ACM are to be disposed of to minimize the potential for pollution, scavenging, and reuse.

4. Incorporate in tenders involving the removal, repair, and disposal of ACM the requirements set out in Section C below.

C. Considerations and possible operational requirements related to works involving asbestos

1. **Contractor qualification -**
   a. Require that contractors demonstrate that they have experience and capability to observe international good practice standards with asbestos, including training of workers and supervisors, possession of (or means of access to) adequate equipment and supplies for the scope of envisioned works, and a record of compliance with regulations on previous work.

2. **Related to the technical requirements for the works**
   a. Require that the removal, repair, and disposal of ACM be carried out in a way that minimizes worker and community asbestos exposure, and require the selected contractor to develop and submit a plan, subject to the engineer's acceptance, before doing so.
   b. Describe the work in detail in plans and specifications prepared for the specific site and project, including but not limited to the following:
      (i) Containment of interior areas where removal will occur in a negative pressure enclosure;
      (ii) Protection of walls, floors, and other surfaces with plastic sheeting;

(iii) Construction of decontamination facilities for workers and equipment;
(iv) Removing the ACM using wet methods, and promptly placing the material in impermeable containers;
(v) Final clean-up with special vacuums and dismantling of the enclosure and decontamination facilities;
(vi) Disposal of the removed ACM and contaminated materials in an approved landfill;[23] and
(vii) Inspection and air monitoring as the work progresses, as well as final air sampling for clearance, by an entity independent of the contractor removing the ACM.

c. Other requirements for specific types of ACM, configurations and characteristics of buildings or facilities, and other factors affecting the work must be enumerated in the plans and specifications, and applicable regulations and consensus standards must be specifically enumerated.

3. **Related to the contract clauses[24]**

a. Require that the selected contractor provide adequate protection to its personnel handling asbestos, including respirators and disposable clothing.

b. Require that the selected contractor notifies the relevant authorities of the removal and disposal according to applicable regulations as indicated in the technical requirements and cooperates fully with representatives of the relevant agency during all inspections and inquiries.

4. **Related to training and capacity building**

a. Determine whether specialist industrial hygiene expertise should be hired to assure that local contractors learn about and apply proper protective measures in work with ACM in existing structures.

---

[23] Alternative guidance for circumstances where approved landfills are not available for disposal of hazardous substances, such as asbestos, guidance is provided in the EHS General Guideline, reference above as well as in the Guideline on Waste Management Facilities

[24] Standard contract clauses for asbestos work exist but are too extensive for this short note. To view an example, the U.S. National Institute of Building Sciences “Asbestos Abatement and Management in Buildings: Model Guide Specification” has a complete set – in copyright form – and the clauses and instructions for using them fill a two-inch binder