C-2 Unexploded Ordinance Management Plan

Aim and Objective

The aim of **C-2 Unexploded Ordnances Management Plan** is to reduce the risk of interaction between workers/communities and unexploded ordinance (UXO) and to identify the procedures to follow in the event of the accidental discovery or "chance find" of UXOs.

Summary of Impacts and Risks

A UXO risk assessment has been completed for the Project to identify likely locations where UXOs are located based on historical records (refer **Annex C-2-I**). The nature and extent of remnant UXO contamination is shown in **Annex C-2-II UXO Risk Zones** and summarised below:

- In **UXO Zone 1**, there is limited evidence of possible firing by Allied and Japanese forces during battles or conflict that occurred closer to the coast. There is also significant evidence of Allied munitions usage within or close to this Zone however it cannot currently be determined if this was due to battles, live firing during training or dumped/abandoned munitions. It cannot currently be determined whether UXO contamination in this area is confined to a small, localised areas or whether it is more widespread.
- In **UXO Zone 2**, there is ample evidence of WWII live firing most likely during military training in the period 1943-1945 including primarily US artillery, anti-tank weapons, mortars, shoulder-fired anti-tank weapons, hand-thrown and projected grenades. Munitions usage was likely 'substantial'. The diversity and spread of munitions in this Zone suggest that many additional UXO likely exist throughout most of this Zone (i.e. UXO are likely widespread and not confined to a few localised areas).
- In **UXO Zone 3,** there is currently no evidence that this Zone was ever part of any battles or targeted during military forces live firing training. The likelihood of remnant UXO existing in this Zone is currently assessed as 'Low' however research is not sufficiently progressed to state this with certainty. 'Chance Finds' of occasional UXO could occur in this Zone.

Many of the HEC's activities have a medium to high probability of interacting with these residual EO/UXO hazards and many of these interactions – if not mitigated - could potentially result in moderate to catastrophic consequences (loss of life, serious injury, incapacitation, illness, significant schedule slippage, significant unforeseen costs, legal action or reputation damage). There are also activities where 'perception of risk' may be substantially higher than 'actual risk'. Even though 'perception of risk' may not cause physical harm, it is still a risk that may have negative consequences (e.g. reluctance to work in areas, higher insurance costs and growing public concerns).

Mitigation and Management Actions

#	Issue or Risk	Action	Timing / Frequency	Responsibility
C-2-1.	Presence of UXO on site (prior to land clearing and pre-construction activities)	• Before any ground disturbance or vegetation clearance occurs anywhere on site, a **Pre-Construction UXO survey** will be completed for each works location by a suitably qualified UXO survey subcontractor approved by THL. Any UXOs identified will be removed in accordance with the UXO survey subcontractor's procedures under guidance from Royal Solomon Islands Police Force Explosives Ordinance Unit (RSIPF EOU). – The UXO survey subcontractor will prepare a Health, Safety, Security and Environment Plan for the survey work, which is approved by THL, HEC and PO in advance of commencing the survey. This Plan will be adhered to on site by HEC, the subcontractor and any affiliates involved in the survey. – A **UXO Survey Notification** will be provided to communities in the vicinity of the survey one week prior to works being undertaken. UXO notification will include: o Notification of the location, commencement and likely duration of the UXO survey and any likely precautions that should be taken. o Information about the area to be cleared, including the meaning of the cleared area markings or signage (i.e. the location of the cordon and the delineation between cleared and un-surveyed areas). – Any vegetation clearance associated with the UXO survey will be undertaken in accordance with **C-3 Forest Clearance Plan** (FCP). – RSIPF EOU will be solely responsible for the handling, storage, transport and/or disposal of UXOs (if found). Disposal will take into consideration best practices for the safety to human health, the environment and for the protection of infrastructure. The priority method of UXO disposal will be removal and disposal at RSIPF Hells Point UXO disposal area. Where this is not possible, due to potential danger to personnel, in-situ detonation by RSIPF may be undertaken. – Following removal of any UXOs, the UXO survey subcontractor will conduct a final search to ensure there are no more potential hazardous items in the vicinity of the find. HEC will produce a **provisional UXO Incident Report** that will be countersigned by RSIPF EOD Officer that recovered the UXO. This provisional report will remain valid until the final clearance reports are released. • After the completion of the survey, the UXO survey subcontractor will certify that the risk of UXO contamination within the survey area has been reduced to As Low As Reasonably Practicable (**ALARP Certification**), to the safe engineering and construction working depths identified by the UXO survey subcontractor.	Prior to vegetation clearance and any construction activities	HEC E&S Manager Royal Solomon Islands Police Force Explosives Ordinance Unit (RSIPF EOU) RSIPF EOD Technician
C-2-2.	Work in medium and high probability UXO zones	• One week prior to any ground disturbance or related construction activity, the HEC Construction Manager and HEC HSE Manager will lead a UXO risk assessment discussion with the construction team, including subcontractors. The discussion will be attended by an EOD Technician from RSIPF. Advice should also be sought from UXO survey subcontractor to confirm mitigation measures required, such as the degree of EOD Technician supervision which is appropriate. The risk assessment will include: – Examination of the UXO survey results and the risk maps identified by the UXO risk assessment (**Annex C-2-I**) – Preparation of a comprehensive **Job Hazard Analysis** (as per **HEC-AH-H04-H03 HEC Risk Assessment Procedure**) tailored to the work to be undertaken. – Confirmation of any additional protective equipment (e.g. guards for machinery) required to be used and/or purchased. – The required **Permits to Work** will be identified, and workers assigned to preparing the required documentation and seeking approval. • During the works, an EOD Technician will make a minimum of one daily visit to the work site and will remain on call for the duration of works. Any further supervision will be agreed upon during the risk discussion. • If excavation is to a depth greater than 600 mm below existing ground level (the certified depth at which the smallest UXO grenades and artillery ammunition can be found), or in Zone 2, an EOD Technician will be present AT ALL TIMES to supervise construction and identify and manage potential risks.	Prior to vegetation clearance and any construction activities	HEC E&S Manager RSIPF EOD Technician
C-2-3.	Chance finds of UXOs	• The **Chance Find Procedure, as per Annex C-2-III** will be implemented whenever an actual or potential UXO is found at anytime, anywhere on the Project. • The RSIPF EOD representative will provide written confirmation that the UXO has been removed before any Permits to Work are activated. • The RSIPF will also provide a **Certificate of Clearance** of the UXO.	Throughout construction	HEC Construction Manager HEC E&S Manager RSIPF EOU
C-2-4.	UXO awareness for workers	• UXO Safety will be included as part of the construction worker training program (refer **P-1 CESMP**). This will train all construction workers in the potential risks associated with disturbance of UXO and procedures to be followed if potential items of UXO are identified during construction activities. A copy of the current UXO induction module is attached in **Annex C-2-IV**. • When working on high probability UXO zone (refer **Annex C-2-II**) the RSIPF EOD Technician will provide additional site-specific training to all involved work force.	Throughout construction	HEC Training Supervisor RSIPF EOD Technician

Monitoring Requirements					
#	**Title**	**Description**	**Target / Performance Indicator**	**Timing / Frequency**	**Responsibility**
C-2-A.	Pre-construction UXO Clearance	• UXO Clearance Report and ALARP Certification obtained prior to all vegetation clearance and related pre-construction activities. • UXO survey notifications recorded in the Stakeholder Engagement Database	UXO Clearance Reports and ALARP Certification on file for each area No UXO incidents or grievances	Prior to vegetation clearance / works in each new area	HEC HSE Manager HEC E&S Manager
C-2-B.	Chance Find UXO Clearance	• Certificate of Clearance on file for each chance find UXO	Certificate of Clearance on file No UXO incidents or grievances	Throughout construction	HEC HSE Manager
C-2-C.	Training records	• Complete UXO Safety training and annual refreshers for all construction workers (as per **P-1 CESMP** and **Annex C-2-IV**).	Training completed for all workers No UXO incidents or grievances	Upon employment and annual refreshers Reported in HEC quarterly E&S reports	HEC Training Supervisor

Supporting Documents		
Annex	**Name**	**Description**
C-2-I.	EO/UXO Risk Assessment	EO/UXO Risk Assessment completed by BOZ Technical Services Pty Ltd for THL and OPEC, July 2019
C-2-II.	UXO Risk Zones	The figure in this Annex documents and categorises the UXO Risk Zones as per the probability of existence of UXO/EO. It also documents OH&S requirements of working in an UXO Risk Zone.
C-2-III.	Chance UXO Find Procedure	The protocol that needs to be implemented on finding an UXO in a construction area is documented in this Annex.
C-2-IV.	UXO Training Induction Module May 2020	This Annex sets a training module to undertake UXO training for the construction staff.

Annex C-2-1 UXO Risk Assessment

BOZ Technical Services Pty Ltd
ABN 14 098 755 072

27 Robinson Place
Currumbin Waters, QLD 4223, Australia

Ph: +61-(0)7-5598-5062
Mobile: +61-(0)488-985062
E-mail: boztec@bigpond.com

EO/UXO Risk Assessment

(Interim Report)

Tina River Hydropower Development Project

(Guadalcanal Island, Solomon Islands)

HYUNDAI ENGINEERING CO., LTD.

OPEC SYSTEMS

Client: **OPEC (on behalf of Hyundai Engineering and the Solomon Islands Government)**

Report Date: **15 Jul 2019**

Report Status: **Rev 01 - Approved For Use (AFU)**

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Revision History:

Date	Rev	Purpose	Issued/Endorsed By:
01 Jun 2019	A	Draft – internal purposes	Ian Bullpitt, Director, BOZ Technical Services
27 Jun 2019	B	Draft Interim Report – issued for Client preliminary review	Ian Bullpitt, Director, BOZ Technical Services
03 Jul 2019	C	Draft Report – issued for Client review	Ian Bullpitt, Director, BOZ Technical Services
15 Jul 2019	01	Approved For Use – Interim Report	Ian Bullpitt, Director, BOZ Technical Services

Report Limitations and Safety Warnings:

This is an Interim Report pending access to certain archival files that have not yet been reviewed and which may affect the findings of this report.

Important: This Report is a desktop study of past military and other relevant activities at the subject Site. Findings and conclusions contained herein have not been subjected to any form of field verification.

While all reasonable care has been taken in specifying affected areas, hazards and potential risks, the nature of historical research does not always allow areas, hazards and risks to be accurately defined. This is often due to – for example – discrepancies/errors in early maps & plans, incomplete/inaccurate reports of activities, material sourced from the Client and other Third Parties, missing key information, security/sensitivity issues and the like. The information and conclusions in this report may include interpretations and subjective opinions which should not be taken as being absolutely accurate or precise – where credible risks are identified, Clients/Users may need to undertake additional research and/or field investigations to provide additional accuracy or precision.

This report is commercial-in-confidence and has been prepared for a specific purpose/project which may include specific locations and specific activities. Certain information may have been omitted or altered to suit these specific purposes. Unless otherwise clearly indicated, this report is not intended for use by entities other than the Client (and its contractors) for the specified project. No responsibility is accepted or undertaken to any other such third parties in relation to this document. Any such use by other parties is expressly forbidden.

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TERMINOLOGY, ACRONYMS & ABBREVIATIONS

Technical Terminology & Acronyms Used in Report

Munition	A complete device charged with explosives, propellants, pyrotechnics, initiating composition, or nuclear, biological or chemical material for use in military operations.
EO	Explosive Ordnance: All munitions containing explosives or chemical agents. This includes bombs and warheads; guided and ballistic missiles; artillery, mortar, rocket and small arms ammunition; all mines, torpedoes, depth charges and demolition charges; pyrotechnics, clusters and dispensers; cartridge and propellant actuated devices; electro-explosive devices; clandestine and improvised explosive devices; and all similar or related items or components explosive in nature.
Inert munition	A munition that contains no explosive, pyrotechnic, lachrymatory, radioactive, chemical, biological or other toxic components or substances.
EOD	Explosive Ordnance Disposal: The detection, identification, field evaluation, rendering safe and final disposal of unexploded ordnance. It may also include the rendering safe and/or disposal of explosive ordnance, which may have become hazardous by damage or deterioration.
EOW	Explosive Ordnance Waste: Inert material associated with munitions or inert remnant material from the initiation or functioning of explosive ordnance.
SAA	Small Arms Ammunition: all ammunition less than 20mm in calibre and all gauges of shotgun cartridges.
UXO	Unexploded Ordnance: Explosive ordnance that has been primed, fused, armed, or otherwise prepared for action, and have been fired, dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, installation, personnel, or materiel but remains unexploded either by malfunction, design, or any other cause. UXO includes items of EO that have been removed from their original resting place for any reason, including souveniring by members of the public.
AXO (US: DMM)	Abandoned Explosive Ordnance (US: Discarded Military Munitions): Explosive ordnance that that has not been used, has been left behind or dumped by a party, and which is no longer under control of the party that left it behind or dumped it. Abandoned explosive ordnance may or may not have been primed, fused, armed or otherwise prepared for use (Modified CCW protocol V[1])
UXO Assessment Survey	An operation designed to determine, assess and report on all or some of the Following: 1. whether an area is affected by UXO; 2. the boundaries of the affected area; 3. the densities of UXO, including the locations and characteristics of impact areas, within the affected area; and 4. the residual depths, types and natures of UXO and inert ordnance-related items within the affected area.
UXO Remediation	An operation to reduce the hazards associated with UXO or other EO. UXO remediation may be 'complete' (100% area search and all EO hazards removed to the maximum projectile penetration depth) or 'partial' (area searched and EO hazards removed to a level that is acceptable to the appropriate approving authority with regard to the planned use of the land)
UXO Hazard Reduction	Partial UXO remediation – see previous item
Hazard	Hyundai: Source, or situation with a potential, for harm in terms of a human injury or ill health, damage to property, damage to the environment, or a combination of these.
Hazard Identification	Hyundai: The Process of recognizing that hazards exist and defining their characteristics
Risk	Effect of uncertainty on objectives. A function of the probability of the occurrence of an event and the consequence of that event. Hyundai: The combination of the likelihood of an

[1] CCW - the 1980 Convention on Certain Conventional Weapons; Protocol V - Explosive Remnants of War (ERW)

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	occurrence of a hazardous event or exposure and the severity of injury or ill health that may be caused by the event or exposure.
Risk Assessment	Hyundai: The process of evaluating the risk, taking into account the adequacy of any existing controls, and deciding whether or not the risk is acceptable
Likelihood	Hyundai: Used as qualitative description of probability or frequency
Event	Occurrence or change of a particular set of circumstances. Sometimes referred to as an "incident" or "accident". An event without consequences may also be referred to as a "near miss", "incident", "near hit" or "close call".
Incident/ Accident[2]	Incident: an event that gives rise to an accident or has the potential to lead to an accident (HSE practitioners often refer to these as being 'Near Misses') Accident: an undesired event which results in harm. (Note: Modified from definition in OHSAS 18001:1999)
HSE Critical Task	Hyundai: A task with potential to cause major injury or health effects to people, local damage to assets, localized effects to the environment or considerable impact on reputation
Mitigation	Risk treatment - process to modify risk. When used in relation to EOD/UXO: A feature that reduces, limits, or controls the consequences of a munition.
ALARP	Relates to management of risk to a point where it is 'As Low As Reasonably Practicable' (ALARP). Hyundai definition: To reduce a risk to a level, which is "as low as reasonably practicable" involves balancing reduction in risk against the time trouble, difficulty and cost of achieving it. ALARP represent the point, objectively assessed at which the time, trouble, difficulty and cost of further reduction measures becomes unreasonably disproportionate to the additional risk reduction achieved.

Other Terminology & Acronyms Used in Report

AA	Anti-Aircraft
Arty	Artillery
ADB	Asian Development Bank
AWM	Australian War Memorial
Bn	Battalion (a military unit. Infantry Bn approx. 750-1,000 soldiers)
Bty	Battery (artillery unit typically comprising 3 or 4 guns)
Chem	Chemical (associated with CW munitions). Note: The US definition of 'chemical' included both toxic substances (mustard, phosgene, etc) and non-toxic substances (e.g. Smokes & Obscurants).
CW	Chemical Warfare/Weapons (typically mustard and phosgene gases)
Div	Division (a military unit. Infantry Div approx. 10-15,000+ soldiers)
FEED	Front-End Engineering & Design
HE	High Explosive
HQ	Headquarters
Hy	Heavy
Illum	Illumination
Lt	Light
Mdm	Medium
MG	Machine Gun (LMG = Light Machine Gun, HMG = Heavy Machine Gun)
NAA	National Archives Australia
NLA	National Library Australia
pdr/pr	'pounder' (e.g. 25 ***pdr*** artillery gun) – refers to the weight of the fired projectile
Prac	Practice
Pyro	Pyrotechnic(s)
RSIP	Royal Solomon Islands Police

[2] IMAS 04.10, 'Glossary of mine action terms, definitions and abbreviations', 2nd Ed., Amdt 7, Aug 2014

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Regt	In US military terms, a sub-unit of a Division comprising approx. 3-5000 personnel
Smk	Smoke
Sqn	Squadron (a military unit of varying size depending on whether Army, Air Force or Navy)
TRHDP	Tina River Hydro Development Project
USAAF	United States Army Air Force
WB	The World Bank
WP	White Phosphorus

Qualitative Risk/Probability Terms Used in this Assessment[3]

Hyundai Phrase (Score)	**Description** (Modified descriptors more relevant to UXO assessments)	**Alternative Probability Phrase(s)**
Frequent (5)	Expected to occur in most circumstances. Is expected to occur multiple times within a year or incident is clearly imminent. For Safety Risks: Could occur several times a year at location. There is significant exposure to the hazard and therefore it is almost certain that the risk event will occur or incident is clearly imminent.	Very High (Almost certain)
Often (4)	Probably occur in most circumstances. Guide: Is expected to occur approximately once per year. For Safety Risks: There is regular exposure to the hazard and therefore, it is likely that the risk event will occur.	High
Likely (3)	Could occur at some time. Guide: Likely to occur approximately once every 5 years. For Safety Risks: There is periodic exposure to the hazard and therefore, it is possible that the risk event will occur.	Medium
Possible (2)	Not expected to occur. Guide: Likely to occur approximately once every 5 – 10 years. For Safety Risks: There is sporadic exposure to the hazard and therefore, it is unlikely that the risk event will occur.	Low
Rare (1)	Exceptional circumstances only. Guide: Likely to occur with less frequency than once every 10 years. For Safety Risks: There is little or no exposure to the hazard and therefore, it is rare that the risk event will occur.	Extremely Low

[3] These definitions are based on but have not yet been fully aligned with Hyundai's '*Risk Assessment Procedure*'

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BACKGROUND

CLIENT DETAILS

Client/Principal: OPEC (on behalf of Hyundai Engineering and the Solomon Islands Government)
(hereinafter referred to as '*the Client*')

Client's Representative:

Contact:	Mike Ransom, OPEC Defence Services
Address:	48-50, 7 Narabang Way, Belrose, NSW 2085
Phone:	(02) 9454 2500
E-mail:	mransom@opecsystems.com

PROJECT DETAILS

Name/Title: Tina River Hydropower Development Project

Location: Guadalcanal Island, Solomon Islands

Project Status: Pre-Construction/FEED Stage

The Tina River Hydro Development Project (TRHDP) is a National project of the Solomon Islands aimed at providing electricity for Honiara from indigenous renewable energy sources. The Project entails construction of a large concrete dam, hydro power station and supporting infrastructure to connect the generated power to the existing grid as well as other infrastructure required for construction. The possible presence of EO or other military-related hazards is a potential threat to construction contractors, long-term users and others who may access the area as well presenting possible schedule and financial risks to the Project.

UXO CONSULTANT

Company:	BOZ Technical Services Pty Ltd (ABN 14 098 755 972)
Address:	27 Robinson Place, Currumbin Waters, Qld 4223
Tel:	+61 07 5598 5062
E-mail:	boztec@bigpond.com

BOZ Technical Services is an accredited UXO Consultant with the Australian Dept of Defence '*Defence Environment and Heritage Panel*' (DEHP). EO/UXO Assessment Reports prepared by DEHP members are generally accepted by Local, State and Federal authorities as these contractors work to investigation, assessment and remediation procedures that are recognised as best practice throughout Australia.

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SITE & PROJECT DETAILS

Figure 1 – Overview of Tina River Hydro Development Project

The Tina River Hydro Development Project (TRHDP) is a National project of the Solomon Islands, managed by a dedicated Project Office under the Ministry of Mines, Energy and Rural Electrification, (MMERE). The TRHDP is part of a broader initiative known as the '*Solomon Islands Sustainable Energy Project*' (SISEP) and has as its objective the provision of electricity for Honiara from indigenous renewable energy sources (hydro) to provide more affordable and reliable energy options to the capital. Electricity for Honiara is currently produced solely from diesel-fired thermal generation plant, is unreliable because of the age and limited capacity of the plant and is reported to be one of the most expensive in the Pacific.

The proposed development is situated on the Tina River, a tributary of the Ngalimbiu River on Guadalcanal. The Ngalimbiu flows to the Iron Bottom Sound about 15 km east of the capital Honiara – see Figure 1. The southern portion of the Site (dam site and power station) is comprised of mountain terrain along the Tina river; the middle and northern sections are relatively level as the river flows northwards through coastal plains towards the ocean.

The Tina River Hydropower development project was first studied in some detail by a World Bank Power Mission in 2006 and an initial feasibility study was conducted in 2010. After a series of optimisations and two significant geotechnical studies, the current preferred option was identified and confirmed in November 2013.

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Figure 2 - Tina River Hydro Project - location of key structures

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Figure 3 - Tina River Hydro Project - dam and power station

This Assessment is based on the project comprising the following key construction elements (see Figure 2 and Figure 3):

- *Dam*: Water will be captured by a Roller Compact Concrete (RCC) dam approx. 71.5m high and 219m long. The Reservoir Volume Capacity is estimated to be 28 ha and approx. 18 million m^3.
- *Headrace Tunnel*: Water from the dam will fed to a powerhouse via a 3.3 km long underground tunnel (3.5m dia).
- *Power Station*: The powerhouse will be located approx. 5.4 km downstream from the dam on the bank of the Tina River. Current plans envisage a single power station with 3 x turbines, each with a capacity of 5-8MW producing just over 80 GWh in an average hydrological year (about the equivalent of Honiara's current demand).
- *Power Distribution*: Power will be conveyed to the Lungga substation, on the eastern outskirts of Honiara (a distance of approx. 22 km) by twin 33kV transmission lines.
- *Access Roads*: Several access roads including upgrading, widening and realignment of the existing Black Post Road and the creation of new site access roads for the dam site and power station:
    - New road: Length 8.1km (1~2 lanes), Gravel Pavement (cement pavement partially);
    - Permanent existing Black Post road - unsealed 13.3km (2 lanes), Gravel Pavement; and
    - Road(s) to quarries - to be confirmed at detailed design.
- *Infrastructure Corridor*:
    - Along Black Post Road, land may be acquired to provide for a 50 meter wide improved public roadway and power transmission corridor (Northern Infrastructure Corridor).
    - The Tina Infrastructure Corridor - The Tina transmission line will travel north from the Tina powerhouse where it will turn west and link to the wider power network
    - The Lungga corridor - routes to take the transmission line from the Tina Infrastructure Corridor to the Lungga power station. The corridor to Lungga is being constructed by another entity as part of its wider network development (this project component is not addressed as part of this assessment).

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- *Site Office & Camp*: A site office is planned to be constructed in the vicinity of the power station. A project camp is planned to be constructed in the close to the Kukum Highway.
- *Quarries*: Two quarries may be required:
  - Quarry 1 – located near the dam site. Area: 150,000m^2; Volume: 300,000m^3
  - Quarry 2 – located near the powerhouse. Area: 80,000m^2; Volume: 160,000m^3

CLIENT'S PROPOSED ACTIVITIES

Activities which could interact with EO/UXO in the short and longer term may include:

- pedestrian and vehicular access over the Site;
- vegetation clearance;
- ground-intrusive activities using hand tools (e.g. soil, geotech, ecology sampling); and
- ground-intrusive activities using machines (dozers, excavators, graders, augers, etc).

Experience from projects at similar sites indicates a medium to high potential for remnant explosive ordnance (EO) or unexploded ordnance (UXO) items. Interaction with any such items has the potential to kill or injure personnel, impose unforeseen delays/costs on the project or produce other undesirable consequences.

Past experience with similar projects indicates that a high degree of confidence is likely required to allay concerns of EO/UXO encounters and possible increased costs, legal action or schedule delays.

OBJECTIVES & METHODOLOGY

SCOPE

If explosive ordnance (EO) hazards exist in this area, the client (and its contractors) could face various risks through unplanned encounters with such EO. Accordingly, BOZ Technical Services was requested to provide an EO/UXO Risk Assessment including:

- definition of the possible nature, location and extent of EO/UXO contamination;
- assessment of munitions-related risks related to the Client's activities; and
- recommendations regarding measures to mitigate or reduce risks.

SCOPE & OBJECTIVES

The primary objectives of this EO/UXO Risk Assessment were as follows:

- Determine the extent to which the Site may be contaminated by military ordnance (munitions) including but not limited to:
  - explosive ordnance (EO);
  - unexploded ordnance (UXO) or abandoned explosive ordnance (AXO);
  - explosive ordnance waste (EOW);
  - hazardous explosive ordnance components (fuses, etc); and
  - hazardous explosive ordnance constituents (residual chemicals, etc).

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- Provide advice regarding:
  - the nature, location and extent of such contamination,
  - the potential EO/UXO risks faced by the Client, and
  - options to mitigate any identified risks associated with EO/UXO.

CONDUCT OF THE ASSESSMENT

The EO/UXO Assessment of the Sites was conducted as follows:

- Desktop research to clarify military activities of relevance that occurred at or near the site (units, timeframes, weapons systems, etc) – including:
  - examination of records held at the Australian War Memorial, US and Australian Archives, various National Libraries, and numerous other online sources;
  - examination of munitions-related activities;
  - examination of hydrographic, topographic and historic land use data; and
  - review of relevant site investigation reports and past construction works.
- Sourcing UXO-related information held by various entities – including:
  - reports of munitions-related activities at or near the site;
  - reports of any munitions-related incidents of finds at or near the site; and
  - past works and site investigations.
- Plotting, recording and analysis of all relevant material to:
  - identify activities that may generate munitions-related hazards, and
  - determine the possible location, magnitude and nature of EO contamination.
- Analysis of the interaction between munitions hazards and Client's activities to quantify UXO risks (risk assessment) - in line with *'AS ISO 31000:2018 Risk management - Guidelines*' and Hyundai's current Risk Management Framework[4]; and
- Investigation into and analysis of possible measures to mitigate or reduce risks to an acceptable level.

Important *At the time of preparing this Interim Report, historical research was ongoing and numerous potentially useful archival files had not been reviewed.*

This Assessment is therefore based on incomplete information – conclusions & recommendations given herein may significantly change if additional information becomes available.

[4] Hyundai 'Risk Assessment Procedure', Doc. # HEC-AH-H04-H01, Rev. 0, dated 31 Oct 2017

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HISTORICAL INFORMATION

INTRODUCTION

Gathering historical information regarding past military usage is vital to the development of an EO/UXO Risk Assessment which, if done properly, can determine whether further mitigations are needed or not. If further mitigations are needed, the risk assessment is essential to developing appropriate and cost-effective solutions that are commensurate with the EO/UXO risk.

In most cases it is rare to develop a complete and accurate picture of all military activities at any location. This EO/UXO Assessment was not able to examine all historical records related to military activities at or near the site – records may not exist or extra time would be needed to locate, obtain and analyse additional material. Despite this limitation, sufficient data was obtained to develop a reasonable understanding of activities around the Site. This Assessment has been based on information obtained to date however readers are cautioned that the historical analysis is incomplete and additional or new material could have a significant effect on the findings of this EO/UXO Risk Assessment.

HISTORICAL MILITARY ACTIVITIES

This section describes historical military activities that occurred in or near the Site as well as the broader Guadalcanal region. Some of the information provided has little direct bearing on the Site being assessed however is provided as context or to justify conclusions within this Assessment.

The map below identifies various locations on Guadalcanal that are referred to in the historical narrative. Many of the places described have changed their names or have moved since WWII – locations as shown in Figure 4 below are primarily the names and locations as used during WWII:

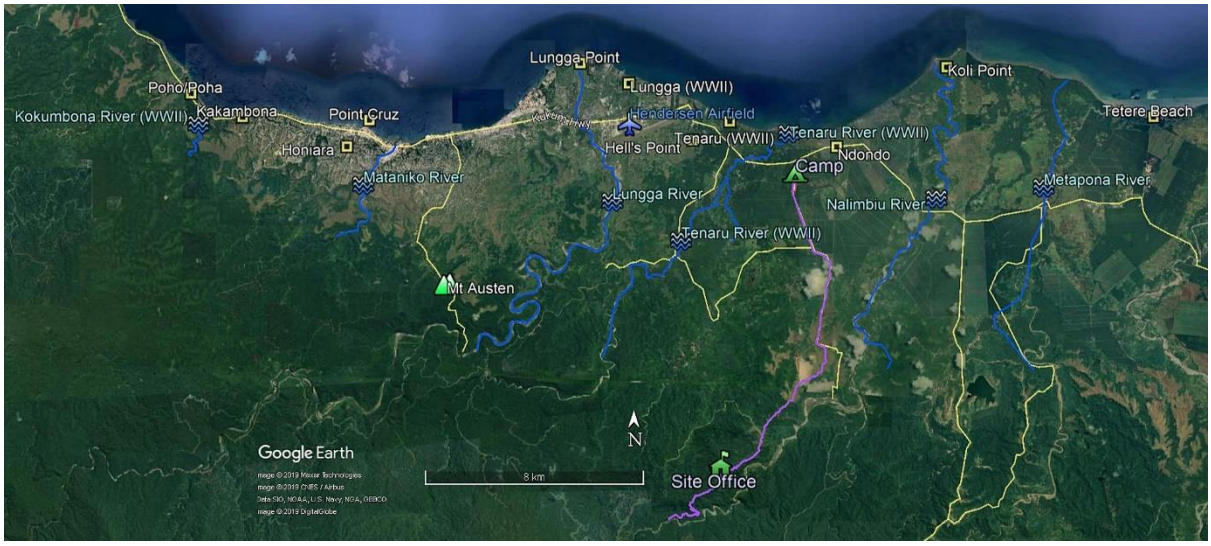

Figure 4 - Key place names used in UXO Assessment Report

Pre-WWII

- Preliminary research did not identify any military or other activities that may have generated UXO or other EO-related hazards.

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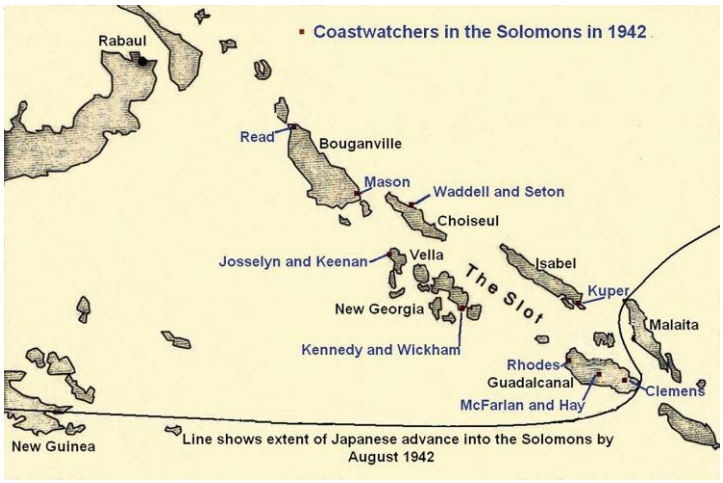
WWII (1939-45)

1939-1941

- Preliminary research did not identify any military or other activities in this period that may have generated UXO or other EO-related hazards.
- Dec 1941: When war was declared between Japan and the Allied nations (principally the US, Australia, Netherlands East Indies and NZ), an allied coastwatching network was already well established and encompassed much of the south-west Pacific. Over 100 coastwatchers were stationed in a 2,500-mile arc from the western end of the Territory of New Guinea, through Papua and the Solomons, to the New Hebrides. Most of these coastwatchers soon found themselves behind enemy lines. There were 23 coastwatching stations in the Solomons group, extending from Bougainville in the north-west to San Cristobal in the southeast.



1942

- May 1942:
  - Japanese occupied Tulagi in May 1942 and constructed a seaplane base nearby.
  - Japanese Engineers and officers arrived at Guadalcanal, Solomon Islands to inspect prospective airfield building sites.
  - These Japanese bases were to be part of a forward line aimed at protecting Japan's major base at Rabaul as well as allowing the Japanese to threaten Allied supply and communication lines and establish a staging area for a planned offensive against Fiji, New Caledonia and Samoa. The Japanese planned to deploy 45 fighters and 60 bombers to Guadalcanal.
  - In preparation for the Allied offensive in the Pacific in May 1942, US 1st Marine Division moved from the US to New Zealand. Other Allied land, naval and air force units were sent to establish or reinforce bases in Fiji, Samoa, New Hebrides and New Caledonia.
- Jun-Aug 1942:
  - Japanese engineers commenced construction of facilities on Guadalcanal.
  - Japanese engineers were joined by 2,571 men of the 11 and 13 Construction Units to construct a new airfield at Lungga. The new runway being constructed would be 3778' (1150 meters) long and would threaten Allied bases in the New Hebrides and communications with Australia.

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- As a consequence of the growing threat to security in the South Pacific, Allied command approved an offensive operation to re-capture the Solomons as part of Operation CARTWHEEL. The Tulagi-Guadalcanal invasion itself was designated Operation WATCHTOWER which centred on an amphibious assault of the islands by US Marines with a target date of Aug 1942.
- Allied intelligence estimates overestimated the number of Japanese at Lungga Point (where the airfield was located) at 5,275 men, including a reinforced regiment. As a consequence, the Allied landings at Guadalcanal were planned to be further to the east (near Tenaru-Ndondo) to flank the Japanese.
- USAAF began a 7-day bombardment against Tulagi and Guadalcanal. The Allied invasion force (75 warships and transports with 16,000 men on aboard) departed for Guadalcanal.

- 7-8 Aug 1942:
  - 7 Aug: Under the cover of Allied naval bombardments and air attacks, the US 1st Marine Division (1, 5 and 11 Marine Regt plus supporting elements) landed on Guadalcanal (Beach Red – near KP 0+000 - see Figure 5) and also at Tulagi.
  - 8 Aug: US Marines captured the Japanese airfield at Lungga Point. Completion of the airfield began at once by the Allies (later renamed '*Henderson Field*').
  - 8 Aug: Japanese bombers and fighters attacked US ships off Guadalcanal.
  - 8 Aug: 7 x Japanese cruisers and 1 x destroyer engaged the Allied fleet after sundown (the Battle of Savo Island) which resulted in the sinking of 3 x US cruisers, 1 x Australian cruiser, and 1 x US destroyer; 1,077 US personnel were killed in this battle.

Figure 5 - 7-8 Aug 42: Allied landings and capture of Lungga Point

Note: While it is known that the Allied landings at Beach Red were supported by extensive naval bombardments and air attacks against the Japanese forces, it is currently unclear whether the naval shelling and air attacks included areas near KP 0+000 or whether Japanese artillery fired on the landing US forces or during the US advance towards Lungga.

- 12 Aug 1942 - Goettge Patrol: US Marine 25-man reconnaissance patrol was attacked by Japanese troops west of Matanikau River (near Honiara); only 3 survived.

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- 18-21 Aug 1942:
    - Construction of Henderson Field was sufficiently completed to allow the first US attack aircraft to arrive. The air fleet at Henderson Field was dubbed "Cactus Air Force".
    - Japanese destroyers delivered 916 troops to Taivu Point (~25 km east of the project area) and at Kokumbona (near Honiara) who were tasked to recapture the Lungga Point Airfield.
    - US Marines attacked Japanese forces west of the Matanikau River and at Kokumbona (Honiara area).
    - Battle of Tenaru (Ilu) River - Japanese troops unsuccessfully attacked the US Marines defensive perimeter at Tenaru River ending with the 740 x Japanese and 44 x US killed.

Figure 6 - Aug 1942 - Battle of Tenaru River

- 22-30 Aug 1942:
    - USAAF aircraft arrived to reinforce Cactus Air Force at Henderson Field.
    - Japanese destroyer bombarded Henderson Field but caused little damage.
    - USAAF shot down 10 x Japanese bombers and fighters over Guadalcanal.
    - Ongoing naval and air battles off Guadalcanal (Iron Bottom Sound).
    - Japanese attempted to reinforce Guadalcanal with 3,500 men, but the convoy was detected, attacked by Henderson Field-based US aircraft and turned back.
    - Another Japanese fleet successfully landed troops at Taivu Point (25 km east of Project area) at night. This shifted the Japanese strategy to reinforce only at night - these night supply runs would later be nicknamed "Tokyo Express" by the Allies.
    - 1,000 newly arrived Japanese troops (delivered by 8 x destroyers before the previous midnight) began organizing an attack toward Henderson Field on Guadalcanal.
    - USMC 1st Raider Battalion and the USMC 1st Parachute Battalion arrived at Guadalcanal.

Sep 1942

- 1 Sep 1942: Naval Construction Battalion arrived at Guadalcanal to improve and expand Henderson Field.
- 4 Sep 1942: Japanese destroyers delivered 1,000 Japanese troops at Taivu.

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- Throughout Sep 1942: On 5 Sep, Japanese destroyers shelled Henderson Field – both ships were sunk by naval and land-based guns. On 15 Sep, Japanese battleships bombarded US positions on Guadalcanal
- 8 Sep 1942: Japanese troops began moving from the Taivu area toward the US positions at Lungga. US Raider Battalion landed at Taivu, destroying or capturing ammunition and supplies to disrupt the Japanese advance.
- 11 Sep 1942: Japanese destroyers landed more troops at Guadalcanal; in the past two weeks, 6,000 Japanese forces were successfully delivered to the island. Japanese aircraft attacked Henderson Field.
- 12-14 Sep 1942 - Battle of Bloody Ridge/Edson's Ridge: The three-day Battle of Bloody Ridge (or Edson's Ridge) involved 6,200 Japanese troops attacking positions held by 12,500 US troops. The Japanese attack was supported in the air by aircraft and from the sea by a Japanese cruiser and 3 x destroyers.

  Note: Historical information indicates that the Japanese move towards the US positions at Lungga was largely undetected by the US thus it is currently assessed unlikely that significant allied air or artillery attacks occurred on the advancing Japanese at or near the Project Site.

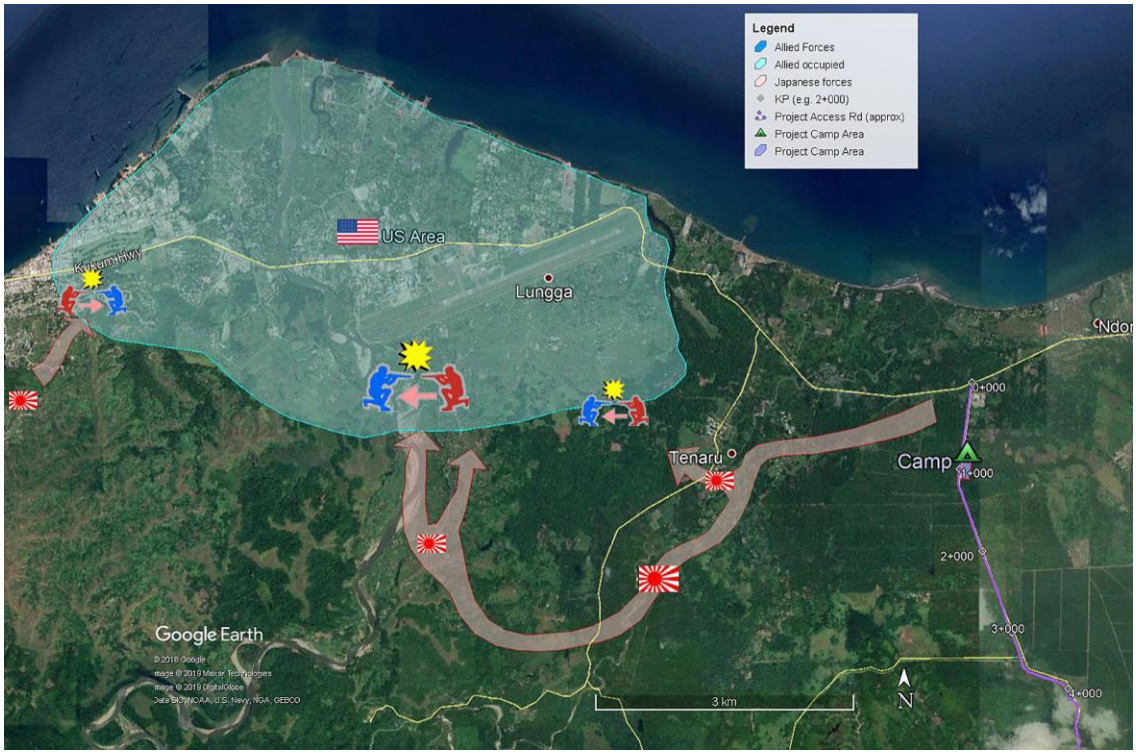

Figure 7 - 12-14 Sep 1942 - The Battle of Bloody Ridge

- 18 Sep 1942: 4,180 men of US 7th Marine Regiment arrived at Guadalcanal bringing the total allied forces to some 22,500 men.
- During Sep 1942: Japanese troops retreated to the area west of the Matanikau (Honiara) however numerous groups of Japanese stragglers were scattered throughout the area between the Lungga Perimeter and the Matanikau River. US forces decided to conduct a series of operations around the Matanikau Valley to mop up the scattered groups of Japanese troops east of the Matanikau.

  Note: Available historical information did not find any evidence that Japanese forces retreated towards the Project area – all Japanese forces appear to have been moving west (towards Honiara) to establish a new consolidated position in that area.

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- 23-26 Sep 1942: US Marines attacked Japanese positions at the Matanikau River in failure.

Oct 1942

Note - For information. There is currently no evidence of military activity at or near the Project areas during this period.

- 7 Oct 1942: US Marines crossed the Matanikau River to raid Japanese positions.
- 13 Oct 1942: Japanese battleships bombarded Henderson Field destroying more than 40 x US aircraft.
- 13 Oct 1942: The US 164th Infantry Regiment was the first US Army unit to arrive on Guadalcanal to support the US Marines.
- 14 Oct 1942: Japanese destroyers landed 1,000 more troops on Guadalcanal.
- 15 Oct 1942: After a naval bombardment, 2 x Japanese Regiments (3-4,000 men) landed at Tassafaronga (15 km NW of Honiara). With the arrival of these reinforcements, some 20,000 Japanese troops were now on Guadalcanal and the Japanese command ordered a new offensive against Henderson Field.
- 16-18 Oct 1942: Japanese warships bombarded Henderson Field – in one period of firing (1 hr 23 min), two battleships fired 973 x 14-inch shells into the Lungga area, most of which fell in and around the airfield. Many of the shells were fragmentation shells, specifically designed to destroy land targets.
- 20-23 Oct 1942: Japanese combat forces, supported by tanks, were driven back by US Marines at the Matanikau River (Honiara).
- 25-26 Oct 1942: Japanese forces launched offensives aiming to capture Henderson Field; US Marines repeatedly drove back the waves of attacks. The Japanese lost 2,200–3,000 troops in the battle while the US lost around 80.

Note: The US remained completely unaware of the approach of the Japanese forces thus it is unlikely that any allied air or artillery attacks occurred on the advancing Japanese.

Figure 8 - 20-26 Oct 1942 - Japanese offensives

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- 26 Oct 1942: Japanese forces ceased further attacks. Forces west of Lungga retreated back to the Matanikau River area while the Japanese forces that had been attacking in the east/south east retreated towards Koli Point (approx. 7 km east of the Project KP 0+000).

Nov 1942

- 1-4 Nov 1942 - Kokumbona Offensive: US launched westwards offensives against Japanese in the Matanikau River (Honiara) area towards the Kokumbona area (west of Honiara). The following is illustrative of the use of artillery and mortar fire in attacks:

  "*Full use was to be made of supporting artillery and mortar fire. The 11th Marines and attached battalions were to mass fire first in front of the 5th Marines. Artillery and mortar fire were to be placed on each objective and on each ravine and stream approached by the infantry. At least two battalions of artillery were to fire at targets as far west as the Poha, displacing their howitzers forward as the need arose. Aircraft were to strike enemy troop concentrations and artillery positions. Spotting planes for the division artillery would be furnished by the 1st Marine Air Wing*".

- 2 Nov 1942: 2 x US 155mm gun batteries (approx. 6-8 x 155mm guns) arrived into the Lungga area. The firing range of these artillery guns was approx. 23 km.

- 2-3 Nov 1942: To provide support to the Japanese forces that had retreated east towards Koli Point, 300 fresh troops (including 2 x 75mm artillery guns) were shipped with plans to land in the Koli Point area.

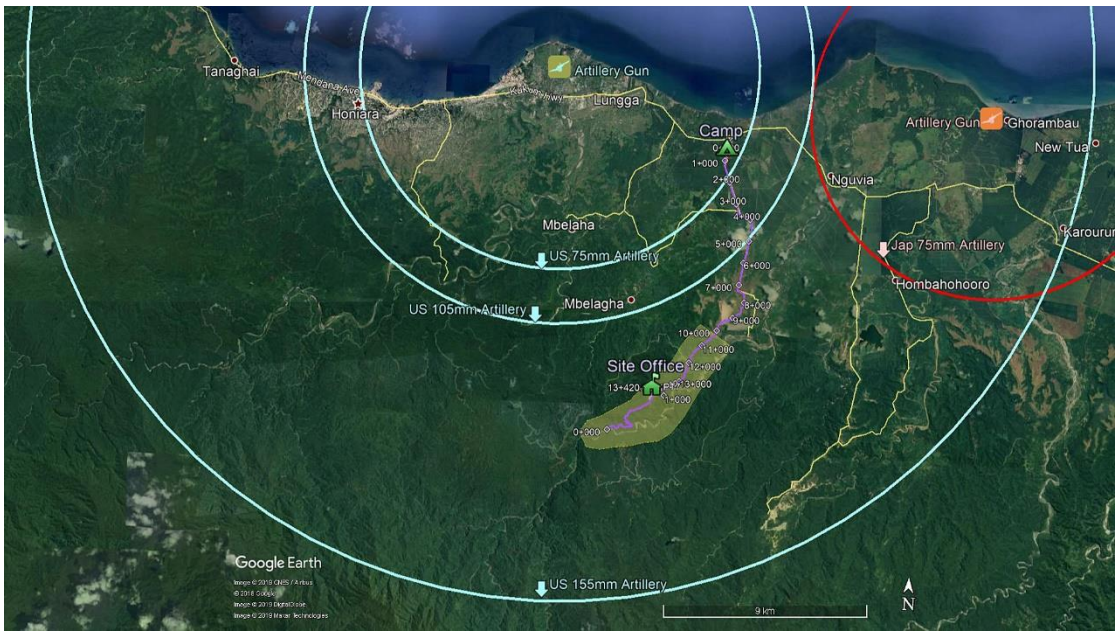

Figure 9 - Indicative firing ranges of US & Japanese land artillery

- 2-3 Nov 1942: US radio intelligence had intercepted Japanese communications and sent a Marine battalion to intercept the arriving Japanese force. A dawn battle with mortar, machine gun, and small arms fire began and the newly landed Japanese artillery guns soon joined in the battle. The US forces withdrew to near the Nalimbiu River.

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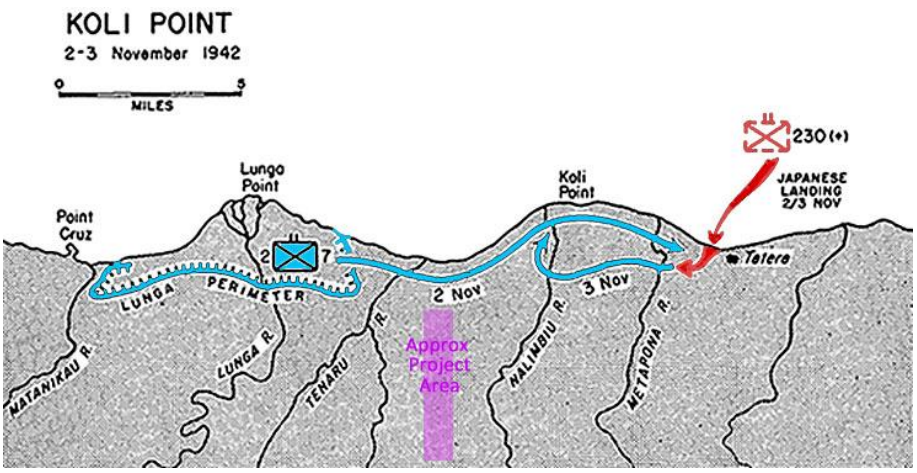

Figure 10 - 2-3 Nov 1942 - Initial Battle at Koli Point

- 4 Nov 1942: The US divided their controlled areas on Guadalcanal into two sectors:
  - East Sector – under US Marines.
  - West Sector – under US Army.
- 5-11 Nov 1942:
  - The US 8th Marine Regiment and a battalion of US 10th Marine Regiment arrived.
  - US Navy Construction Battalion personnel arrived at Aola Bay to begin construction of a new airfield; they were guarded by 2 x US Army battalions and US Marine Raiders.
  - Battle of Koli Point: US forces sent additional troops to reinforce the US unit near Koli Point. US forces then attacked the Japanese units in that area forcing the Japanese to fall back toward the Metapona River to avoid envelopment.
  - 9-11 Nov: Japanese forces in the Koli Point area were ordered to abandon their positions at Koli and rejoin Japanese forces at Kokumbona in the Matanikau area (Honiara). Between 9-11 Nov, 2-3,000 Japanese escaped into the jungle to the south.
  - 12 Nov: US forces overran the remaining Japanese soldiers left in the Koli/Tetere pocket. 450–475 Japanese were killed and most of the Japanese heavy weapons were captured.

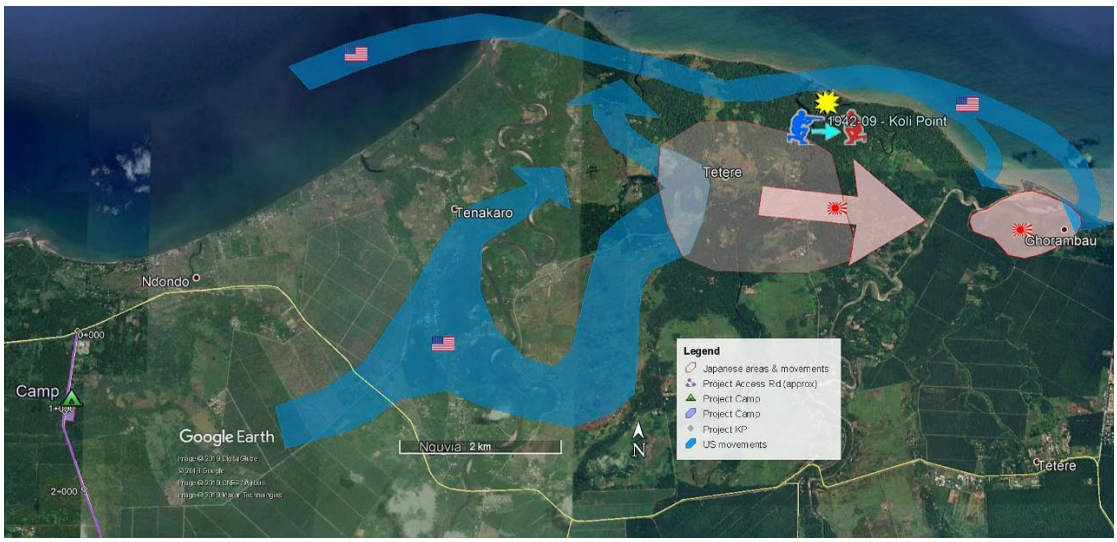

Figure 11 - 5-11 Nov 42 - Battle of Koli Point

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- 6 Nov to 4 Dec 1942: The US Marine Raiders who had arrived at Aola Bay marched west overland to attack any of Japanese forces that had escaped from Koli Point. During the 29-day patrol from Aola to the Lungga perimeter (Carlson's Patrol), the Raiders fought several battles with Japanese retreating forces, killing almost 500 of them.

Figure 12 - 6 Nov to 4 Dec 1942: US Marine Raider patrol

Note: Despite the US patrol crossing over part of the Project area, there is currently no evidence of any battles at or near the Project area in this period.

- 10 Nov 1942: US Marines unsuccessfully attacked westward from Point Cruz (Honiara) toward Kokumbona.
- 11-12 Nov 1942: Approx. 6,000 additional US troops arrived at Guadalcanal.
- 13 Nov 1942: Japanese cruisers came close to shore and bombarded Henderson Field. The First Naval Battle of Guadalcanal ended before dawn with the US Navy task force driving off the Japanese naval bombardment group.
- 14-15 Nov 1942: After dark, the Second Naval Battle of Guadalcanal began with Japanese ships wiping out the American destroyer screen. US navy fought off the Japanese attack, but four Japanese transports were able to deliver 2,000 troops to Guadalcanal.
- Mid-Nov 1942: By the time the retreating Japanese forces reached the Lungga River in mid-November (about halfway to their destination near Matanikau/Honiara), only 1,300 men remained with the main body. When they finally reached the Japanese main position west of the Matanikau, only 700 to 800 survivors remained.
- 18-24 Nov 1942: US forces attacked Japanese positions west of Honiara. Initially halted by the Japanese, US forces eventually reached Poho (near Tanaghai, west of Honiara) on 24 Nov.

Dec 1942

- 8 Dec 1942: The US 3rd Infantry Regiment and US 132nd Regimental Combat Team, both of the US Army, arrived in Guadalcanal.
- 9 Dec 1942: American operations on Guadalcanal, previously conducted by the US Marines, were turned over to the US Army. The 1st Marine Division began its withdraw to Australia.
- TBC Dec 1942: US XIV Corps was formed on Guadalcanal in Dec 1942 – units under its command included the US 23rd Infantry Division and 25th Infantry Divisions, the US 2nd Marine Division, and the US 147th Infantry Regimental Combat Team who were primarily involved in the final drive that expelled the Japanese from Guadalcanal.

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- 17 Dec 1942:
  - US Marines captured Mt. Austen.
  - US Army 25th Infantry Division started arriving on the island.

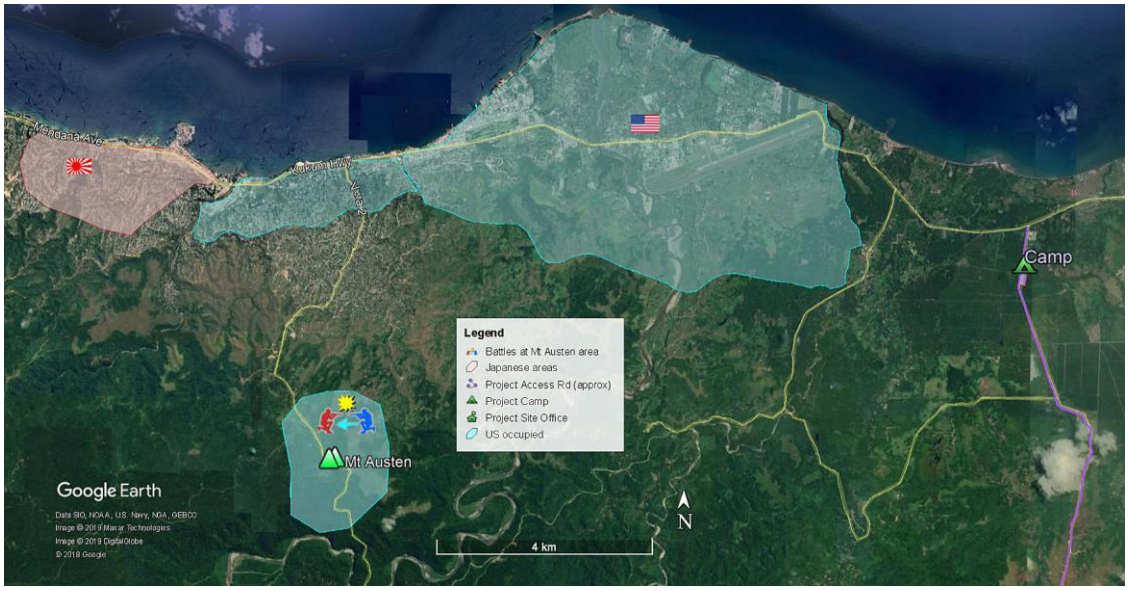

Figure 13 - Dec 1942 - Battles at Mt Austen

- During Dec 1942:
  - The Japanese Navy proposed that Guadalcanal be abandoned. At the same time, the Japanese Imperial General Headquarters (IGH) also suggested that further efforts to retake Guadalcanal would be impossible.
  - On 26 Dec, the IGH's top leaders agreed to withdraw from Guadalcanal, establish a new defensive line in the central Solomons, and shift priorities and resources to the campaign in New Guinea.
  - On 31 Dec, the Japanese Emperor formally endorsed the decision to withdraw from Guadalcanal and the Japanese began to prepare for the evacuation (*Operation Ke*) scheduled to begin during the latter part of Jan 1943.

Jan to Jun 1943

- Jan 1943: Throughout Jan 1943, more US Army, Marine and Air Forces arrived at Guadalcanal and the growing allied force continued offensive actions against the Japanese forces based near Honiara forcing them to progressively withdraw west towards Cape Esperance (NW tip of Guadalcanal).
- 1 Feb 1943: Japanese troops began to be evacuated from Guadalcanal.
- 7 Feb 1943: The Japanese Army completed '*Operation Ke*', the evacuation of Guadalcanal, as the final 1,796 soldiers were evacuated by 18 ships.

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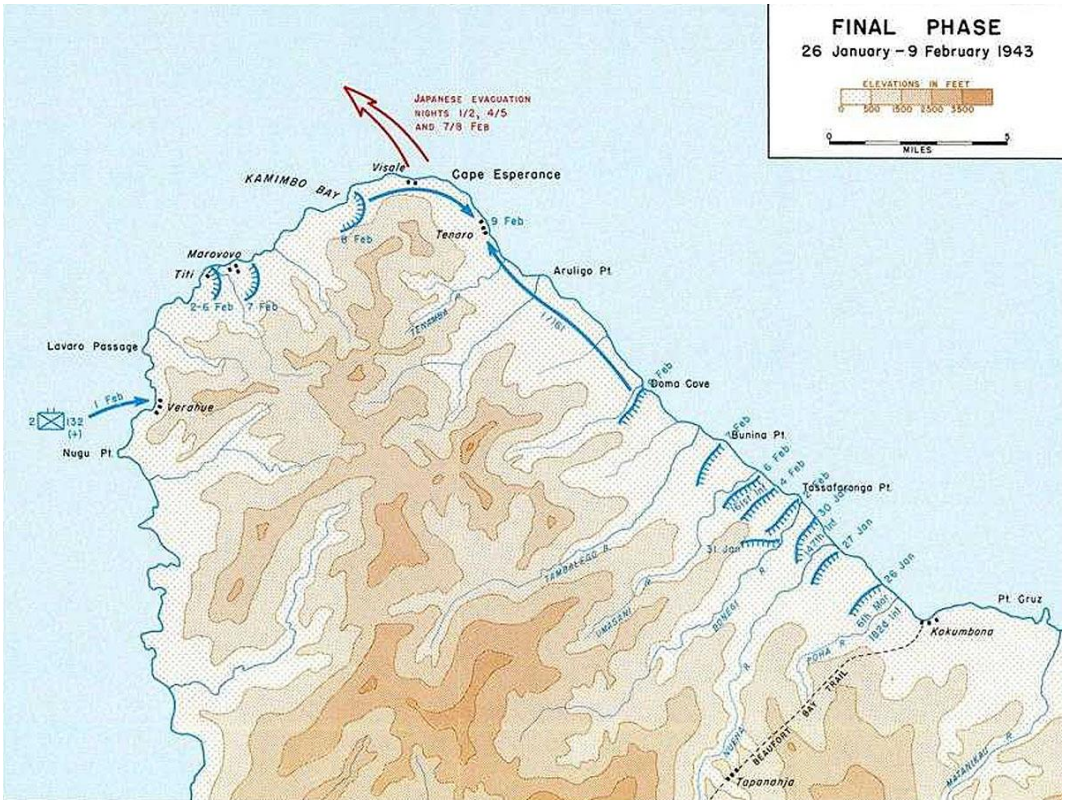

Figure 14 - Jan-Feb 1943 - Final Phase

- 9 Feb 1943: Allied authorities declared Guadalcanal secure after Japan evacuated its remaining forces from the island.
- The following illustrates the volume of munitions fired during battles up to this time (note that this is only <u>one</u> of numerous US divisions that were engaged in battles):

b. During the whole operation all units of this command fired a total of 32,232 rounds of high explosive, weighing 1,374,707 pounds or 687 tons, the equivalent, incidentally, of 2750 five hundred pound aerial bombs. Of this total 5148 rounds were 155mm weighing 489,060 pounds or 244½ tons, and 657 rounds were 105mm time shells. In addition 1499 rounds of smoke shell was expended, making a total expenditure of nearly 3½ units of fire. These figures do not include rounds fired by reinforcing units of the Americal Division and the Marines.

Figure 15 – Munitions expended by US 25th Infantry Div. on Guadalcanal

<u>Feb-Dec 1943</u>

- Following the withdrawal of Japanese forces from Guadalcanal, the island became a significant base for allied operations in the south pacific region. Over a period of time, military facilities were progressively developed to include <u>at least</u> the following major facilities:
  - 6 x airfields;
  - 3 x major hospitals;
  - Large ammunition ‘dumps’ and ordnance depots;
  - wharves, refuelling facilities and the like required by navy vessels;
  - numerous office, camp/accommodation and other administrative areas; and
  - numerous firing ranges (see later point).

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Most of the construction work associated with these facilities was undertaken by Army, Navy, Marine and Air Force military engineer units – throughout 1943 until after the end of WWII, many military engineer units were assigned to, or staged through, Guadalcanal including:

- some 17 x US Army Engineer construction battalions (including 5 x special battalions);
- some 39 x US Navy construction brigades and battalions; and
- an unknown number of air force/airfield construction units.

Note: The period from Feb 1943 until 1946 (when Guadalcanal was a major allied base) is still being researched. While military battles are often extremely well documented, base activities and unit training activities at these bases are often poorly documented and invariably require considerably more time to research. Information provided from this point on represents only limited historical material which has been uncovered to date.

- Early 1943: The '*Cactus Air Force*', which had been formed on Guadalcanal in Aug 1942, was subsumed into a joint command of Allied air units in the Solomon Islands. During the period that air operations were conducted on and from Guadalcanal, a significant number of allied air units were based or operated from the 5 or 6 major airfields on the island (see Figure 16) including:
  - approx. 20 x US Marine air squadrons;
  - at least 6 x US Air Force squadrons;
  - at least 5 x US Navy squadrons (not including squadrons based on aircraft carriers that periodically were flown off their ships for temporary basing on Guadalcanal airfields); and
  - 1 x New Zealand squadron.

Figure 16 - Allied airfields on Guadalcanal

- Feb 1943: Allied aircraft from airfields on Guadalcanal began the neutralization of the enemy's vital Munda airfields on New Georgia.
- At some time during the development of the allied base at Guadalcanal (likely during 1943), numerous firing ranges were established for land-based forces to conduct firing of their weapons as part of ongoing training and in preparation for coming battles. The following firing ranges have been identified to date:

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- 3 x rifle ranges – these are mostly used for shooting practices for rifles and machine guns but may also periodically be used for firing of mortars.
- 7 x 'combat' ranges – these often involve the firing of rifles, machine guns, mortars, grenades, man-carried anti-tank weapons and may also involve towed- or trailer-mounted anti-tanks guns as well as artillery firing. Some 'combat' ranges may also be used for dropping of aircraft bombs e.g. dropped while ground troops are practicing attacks or assaults.
- 1 x artillery 'impact area' – 'impact areas' are the areas where artillery guns fire their projectiles (see Figure 17).

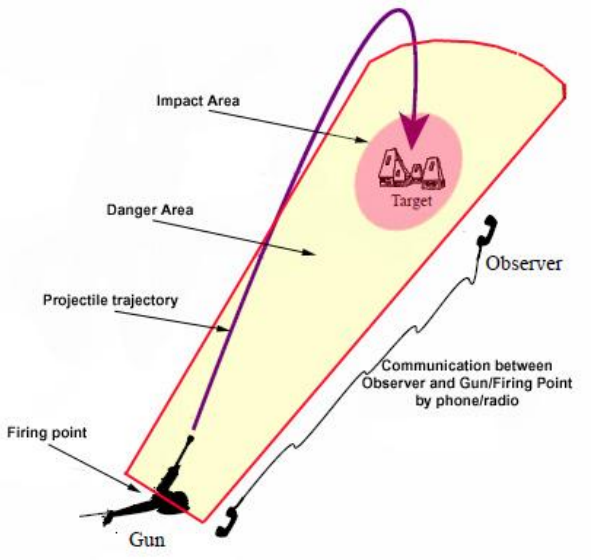

Figure 17 - Typical artillery firing range

Of the 11 firing ranges identified to date, one directly overlaps the Project area while a second is located relatively close to the Project area (see Figure 18 and Figure 19) – unfortunately, the original document does not show the southern extent of the two ranges that overlap or are near the Project area:

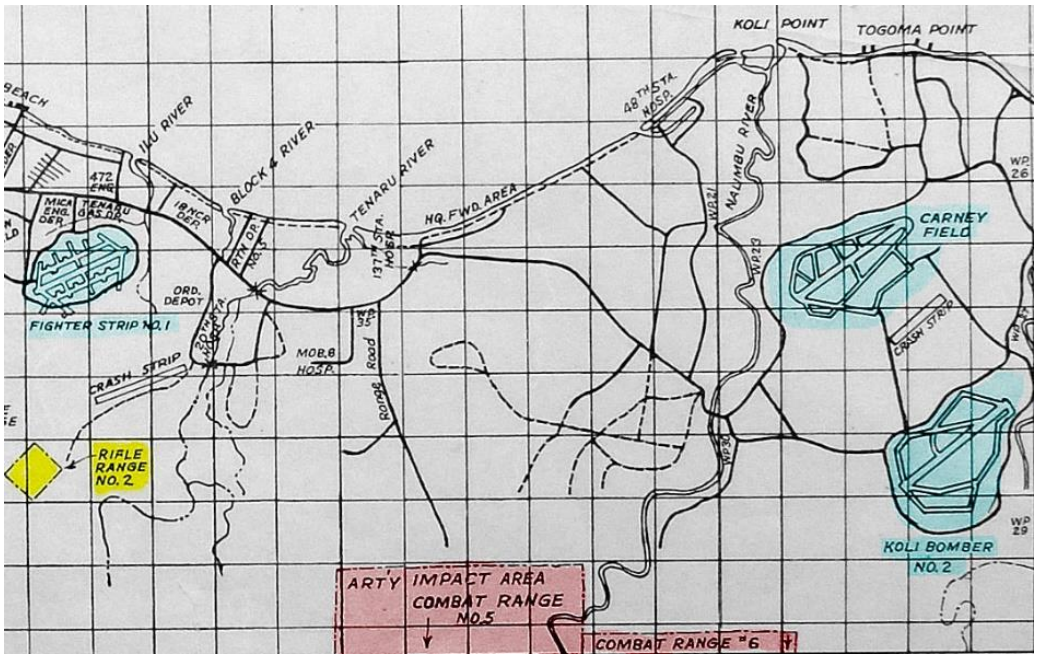

Figure 18 – Military Firing Ranges at/near Project area

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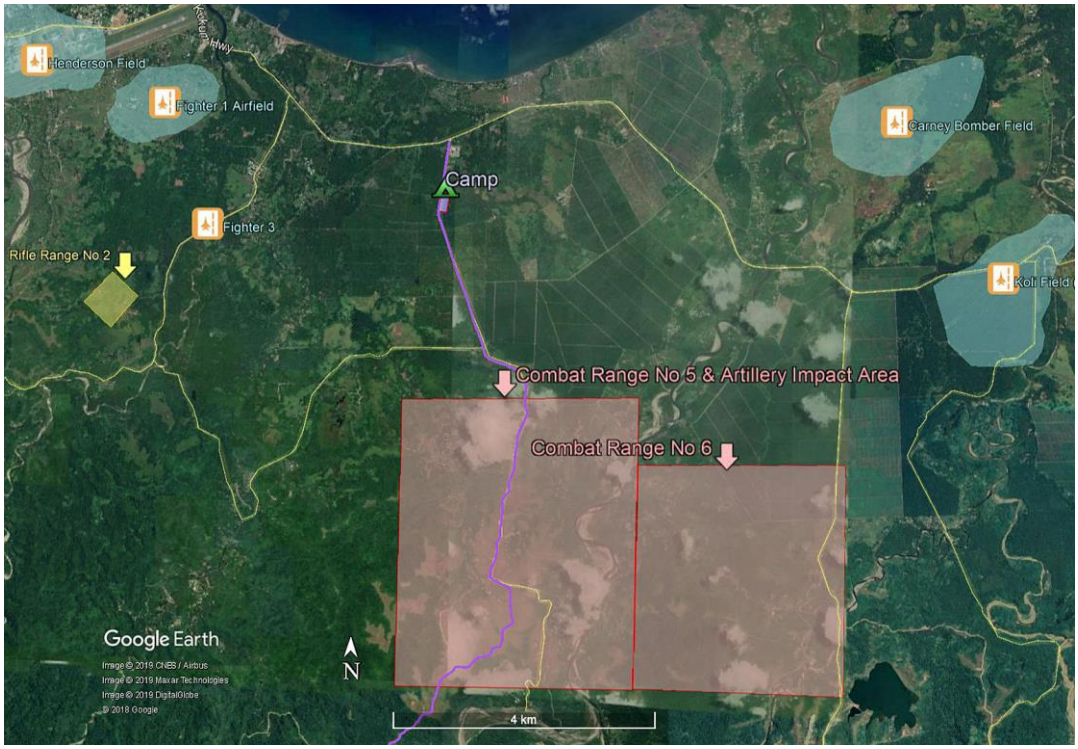

Figure 19 - Firing Ranges of relevance superimposed on Project area

Important:

1. *The southern 2/3rds of Combat Ranges No 5 & No 6 are assumed areas based on knowledge of typical US firing ranges and examination of topography. Readers are cautioned that the actual southern boundaries may extend further south.*
2. *Of the 7 x Combat Ranges identified to date on Guadalcanal, Combat Range No 5 is the only range which is also shown as being an "artillery impact area". While it cannot be stated with certainty, it is possible that all artillery firing that was done by allied forces during training may have been aimed into this particular range.*
3. *The training activities of **air** units at Guadalcanal have not yet been researched however it was common practice at other major allied bases for pilots to undertake regular bombing and Air-to-Ground (A-to-G) firing practices at designated air force firing ranges in the area controlled by that base. Bombing and A-to-G firing ranges were usually located on relatively flat, open areas – it is currently assessed possible that some air force firing ranges may have been located somewhere close to (but likely not on) the Project's footprint.*
4. *Refer later discussion regarding munitions found in these ranges and surrounds.*

As research is still ongoing, only sample military activities are provided in the following paragraphs to illustrate the nature and extent of military activities on Guadalcanal while it was an allied base.

- *For guidance, an Army or Marine 'division' typically comprises some 10-15,000 personnel and the following weapons:*
  - *Approx 48 x artillery guns (75mm, 105mm or 155mm depending on unit);*
  - *Approx 60-70 x towed anti-tank (AT) guns (37mm or 57mm);*
  - *Approx 30+ x 60mm and/or 81mm mortars;*
  - *Approx 250+ x 0.50 calibre (0.5"/12.7mm) machine guns (MG);*
  - *Approx 700 x .30 calibre machine guns; and*

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- *Some 500 x 9mm sub-machine guns, 4,000 x semi-automatic rifles and 10,400 x .45 calibre pistols.*
- *A typical single artillery firing practice could involve 200-1000 or more artillery shells. Most units would typically conduct numerous such firing practices.*

- 17 Feb 1943: US 43rd Infantry Div moved to Guadalcanal before onward movement to the Russell Islands c. 21 Feb.
- Feb-Jul 1943: Following the withdrawal of the Japanese from Guadalcanal, the US 25th Infantry Div was garrisoned on the island until 21 Jul 1943 when the Division commenced moving to Munda, New Georgia.
  - No training activity was undertaken by 25 Div during Feb1943 as the division was busy constructing and improving beach defenses.
  - Training was resumed in Mar 1943 with particular emphasis on methods to rectify the mistakes made in the Guadalcanal campaign. New weapons were tested as they became available.
  - *It is likely that this unit conducted many live firing practices before it departed Guadalcanal in Jul 1943.*
- 5 Mar 1943: The US Americal/23rd Infantry Div moved from Guadalcanal to the Fiji Islands, to assume the defense of the main island and to engage in extensive training.
  - *It is unlikely that this unit conducted any significant live firing practices before it departed Guadalcanal.*
- 25 Mar 1943: A Japanese reconnaissance flight over Henderson Field, Guadalcanal discovered about 300 Allied aircraft at the base.
- Apr-Jul 1943: US 37th Infantry Div moved to Guadalcanal where it undertook training in preparation for the Munda campaign starting in Jul 1943.
  - *It is likely that this unit conducted many live firing practices before it departed Guadalcanal in Jul 1943.*
- 7-17 Jun 1943: The Japanese began a renewed **air** offensive against Guadalcanal which lasted until approx. 17 Jun 1943.
- Jun-Nov 1943: The US 3rd Marine Div moved to Guadalcanal for training where it remained until Nov 1943 when it moved to take part in the Battle of Bougainville. The last of the 3rd Marine Division's units (US 21 Marine Regiment) did not arrive at Bougainville until 9 Jan 1944.
  - *During the period Jun 1943 to Jan 1944, US 21 Marine Regiment was an independent regiment however this unit's activities in this period have not yet been confirmed. The 21st Regiment may have been stationed on Guadalcanal for this period.*
  - *It is likely that unit of US 3 Marine Div conducted many live firing practices before it departed Guadalcanal in Nov 1943.*
- 21 Jul 1943: Responsibility for beach defenses in the Guadalcanal sector passed to the US 3rd Marine Div with the departure of the 161st Combat Team for New Georgia.
- Sep 1943: US 37th Infantry Div returned to Guadalcanal on 9 Sep 1943, for rest, rehabilitation and training until Nov 1943 when it departed for operations on Bougainville.
  - *It is likely that this unit conducted many live firing practices before it departed Guadalcanal in Jul 1943.*

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- 25 Oct to 5 Dec 1943: US 25th Infantry Div reassembled on Guadalcanal and prepared for movement to New Zealand arriving over the period 1-15 Nov.

1944

- Jan 1944: US 3rd Marine Div returned to Guadalcanal in Jan 1944 to rest, refit, and retrain. They remained on Guadalcanal until Jul 1944 when they redeployed to fight on the island of Guam.
    - *It is likely that this unit conducted many live firing practices before it departed Guadalcanal in Jul 1944.*
- Jan-Feb 1944: US 43rd Infantry Div used Guadalcanal as a staging area. Camps were established at Koli Point on Guadalcanal.
    - *1943/44: After training at Munda, the 43rd moved to Guadalcanal and thence to New Zealand for rest and rehabilitation.*
    - *It is unlikely that this unit conducted many live firing practices before it departed Guadalcanal in Jul 1944.*
- Aug 1944: All units of the US 1st Marine Div moved to the Cape Esperance area of Guadalcanal for landing rehearsals preparatory for the assault on the Palau Islands.
- 21 Dec 1944 to 11 Jan 1945: US 25th Infantry Div moved from New Caledonia and arrived at Tetere Beach, Guadalcanal where they conducted practice assault landings. The Division then commenced moving to Manus Island then arrived at Lingayen Gulf on 11 Jan 45.
    - *It is possible-likely that this unit conducted artillery live firing practices before it departed Guadalcanal.*

1945

- Feb-Mar 1945: In Feb 1945, the US 1st Marine Div moved to Guadalcanal for manoeuvres. On 7 Mar, a full-scale exercise was held at Cape Esperance, but a shortage of landing craft prevented the participation of the entire regimental combat team.
- Aug 1945: The surrender of Imperial Japan was announced on 15 Aug (formally signed on 2 Sep 1945).

Post-WWII

1945-46

- TBC 1945 to 1949: Limited research suggests that military units from various countries (US, Australia and possibly others) undertook some destruction, offshore dumping or removal of leftover WWII ammunition at Guadalcanal. *No information has yet been found regarding these activities however:*
    - *these most likely only focussed on removing leftover ammunition that was stored in various 'dumps' around the island,*
    - *it is unlikely that any work was done to locate and remove UXO that had occurred on various firing ranges on the island.*
- Apr 1946: Naval construction units were still active or based on Guadalcanal.
- Jun 1946: The naval air base on Guadalcanal was disestablished on 12 June 1946.

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- *While not yet confirmed, it is likely that a major military presence on Guadalcanal was wound-down during the first half of 1946. Any military activities thereafter were likely to have been primarily administration (however there is limited evidence that some bomb disposal and bomb dumping activities on the island were being undertaken during 1945-1954).*

1950s

- 1951-1954: An Australian military bomb disposal team was based on Guadalcanal (possibly as early as 1950 or earlier) and operated there until at least 1954. An initial examination of their records did not identify any bomb disposal work being undertaken within or near the Project area:
    - Most of the bomb disposal work was focussed on cleaning-up and disposing of leftover ammunition at former bomb dumps in the Lungga area, Honiara, Munda (on New Georgia) and other islands.
    - Large dangerous concentrations of UXO were established midway between Lungga & Tenaru Rivers - these were then dumped at sea on or beyond the 100 fathoms line.
    - In a four-year period to 1954, 4000-5000 tons of WWII ammunition was destroyed in the Solomons.
- 1950-1954: To illustrate the amount of ammunition remaining on Guadalcanal after WWII, the following are selected items of the work undertaken by the Australian Bomb Disposal unit:
    - 1950: UXO clean-up work commenced at Henderson Field c. Aug 1950 and was still ongoing in 1951. Large dumps of ammunition had been found scattered over a large area. The EO had to be recovered from pits and dumped at sea or blown in stacks.
    - 1950: At the Hell's Point Ammunition Dump (near Henderson Airfield), an estimated 20,000 tons of HE projectiles of all sizes existed, and many thousands of projectiles were scattered only 200 m from big dump. Australian's started clearing this area in Oct 1950 and continued until at least late 1953 (possibly later). They estimated it would take another 6+ years to fully clear the area.
    - 1951: At Sun Valley (suburb of Honiara), some 37,000 HE projectiles of all sizes were collected and dumped at sea the Australian Bomb Disposal unit. This area was the only one that was officially declared "cleared" on Guadalcanal.
    - Dec 1953: 10 tons of ammunition was destroyed at Henderson Field.

1960's

- *No information of relevance has yet been found.*

1970s, 80s & 90s

- *Incomplete data for this period.*
- The Solomon Island government continued to undertake UXO clean-ups and destruction of found UXO throughout this period. No data is currently available regarding the nature and locations of items found in this period.
- Australia regularly provided Defence personnel to support the Solomon Islands' own UXO teams in ongoing clearance of munitions throughout the country. Other countries may have also provided UXO assistance in this period.

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2000 Onwards

- *Incomplete data for this period.*
- 2009 to Present: Operation '*Render Safe*' (an Australian Defence Force initiative utilising the combined resources of the Australian Navy and Army personnel with the assistance of other nations such as US, Canada, UK and New Zealand) has deployed to the Solomons on numerous occasions. The first deployment to the Solomons was in 2009 and regular support programs has continued until the present. The exact nature and locations of activities has not yet been confirmed. Numerous UXO at or near the Project area were attended to during various Operation '*Render Safe*' deployments however it is assessed unlikely that any physical UXO area searches were conducted (most, if not all, activities were likely responses to UXO found by locals or during construction).
- 2011: The US '*Golden West Humanitarian Foundation*' (with funding support from the US Department of State and the Office of Weapons Removal and Abatement, AusAID and Japan's ODA) commenced a project in Guadalcanal with the main goal being to support the Solomon Islands Police Force in its UXO/EOD programs in the South Pacific. The current status of this project has not yet been ascertained however, during the 35 months covering May 2011 to April 2014, there were 25,417 munitions items removed from public areas.
- Jun 2012: The Australian Defence Cooperation Program (DCP) completed its final financial commitment to the Australian/ Solomon Islands bilateral support to the RSIPF Explosive Ordnance Disposal (EOD) Program at Hell's Point. Additional DCP support was continued into 2012/13.

EO/UXO INCIDENTS

No munitions-related incidents or accidents have been identified at or in the vicinity of the current project site. However, numerous accidents, incidents and '*near misses*' have occurred at other various locations on Guadalcanal - the following is a small sample of munitions-related incidents that illustrate the nature and causes of such incidents:

- 1943: A series of ammunition explosions occurred at the US ammunition dump at Hell's Point (near Henderson airfield) Report. At this time, this was the largest ammunition depot on Guadalcanal. The explosions continued for 5 days exploding thousands of thousands of tons of ammunition however large quantities did not detonate and were scattered around the area. US forces fenced off area leaving some 15,000 tons of EO lying in the marshy grounds.
- 1951: Local government officials reported that landmines, shells and live bombs were still a hazard in the jungles of Guadalcanal. Fires in various areas had caused remnant UXO to explode and cause several casualties among the local residents.
- Aug 1953: A government bulldozer exploded 2 x landmines while working near the radio (these were presumed to be anti-personnel rather than antitank landmines as no damage was caused to the bulldozer's tracks or driver.
- 1953 (Date TBC): A bulldozer undertaking levelling work turned up dozens of anti-tank shell cases as well as steel helmets, canteens, parts of jeeps, tanks and trucks, etc. The reported stated that "*every day I expect to hear a tremendous blast as it hits a shell or a buried bomb*".
- Jan 1954: A presumed Jap 90mm HE projectile exploded in a vegetable garden adjacent to the powerhouse. The explosion was caused by the shell being lodged beside a tree stump, which was being removed by burning. 3 x additional shells (of same type) were located 20 m from the explosion and were immediately removed for disposal.

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- 2005-2010: 12 deaths and 33 injuries were reported due to UXO (this may be under-reported).
- 22 June 2019: An incident was reported on the Project site - full details were not available at the time of preparing this report however it appears that ammunition shrapnel and 2 x UXO were found during road surveys.

Globally, there have been many serious incidents involving munitions recovered former battle areas and military training/live firing sites. While there have been numerous cases of UXO causing deaths, there are few known cases related AXO (this is often due to AXO not being fuzed or armed). However, many construction delays have occurred (some very costly) due to finds of AXO.

EO/UXO REMEDIATION ACTIVITIES

UXO REMOVAL AFTER BATTLES

It is relatively uncommon for military forces to 'clean-up' UXO from battle areas unless such areas are mined or booby-trapped or are occupied by military forces. While no battles appear to have occurred in the southern half of the project area (thus no battle-related UXO likely exist), there is a possibility that some UXO may have occurred in the northern portion of the Site close to where some of the identified battles occurred.

The northern portion of the Project appears to have been used as, or close to, an area that contained a military hospital and likely other administrative/logistics facilities thus should theoretically have been relatively 'clean' of UXO. However, at least 36 x UXO have been found in this area. Of this 36, 21 x 75mm artillery munitions were found in a very small area – as this area is approx. 4-5 km due south of the artillery Impact Area, it is speculated that the location of the proposed Project Camp may have been the artillery firing point and the 21 x 75mm artillery munitions may have been dumped or otherwise left behind after artillery firing practices had been conducted.

UXO REMOVAL AFTER TRAINING/FIRING

It has been a long-standing requirement that efforts should be made to locate and remove any live munitions left after live firing or other military training activities have been conducted.

While no specific information has yet been found regarding how many UXO (or other EO items) were addressed after military live firing or training activities were conducted by occupying forces during WWII, evidence indicates that WWII military units in operational areas often did not find or remove many of the UXO that occurred. Based on the number of UXO that have been found in later years, it is assessed that minimal effort was made to locate and dispose of UXO within the *Combat Range No. 5* and *Artillery Impact Area*.

Based on past research of similar sites, it is also relatively common for occasional 'live' munitions to be found at military training areas, live firing ranges and even within camp areas. It is worth noting again that it is suspected that the location of the proposed Project Camp may have been an artillery firing point – some 36 x UXO have been found in this area (21 x 75mm artillery munitions may have been dumped or otherwise left behind after artillery firing practices) and it is possible-likely that additional AXO (abandoned or dumped EO) may exist.

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PLANNED INVESTIGATION/REMEDIATION

Despite many UXO being found within or close to the Project area, no evidence has yet been found of any planned or systematic UXO investigation or remediation at or near the Project Site. It is likely that most or all UXO reported to date were found either by local residents during farming or other activities or were found during construction or similar activities.

SUMMARY – NATURE & EXTENT OF EO/UXO

MUNITIONS USED AND FOUND TO DATE

Types & Locations of Munitions Found At/Near Site

More than 320 x UXO have been found within or very close to the Project in the past 9+ years (see later maps). No data is presently available for years prior to 2011.

Note: For the purpose of this Assessment, munitions listed in the table below includes some items that have been found up to 2.0 km from the proposed construction footprint (<10% of total shown) – primarily to illustrate the quantity and diversity of EO that may exist in the general area of the Project.

Generic Weapon Type	**Qty Reported** (for period 2011-2019)	**Comments**
Hand Thrown Grenades	8	All US MkII 'Pineapple' grenades
Mortar – 60mm	31	1 x Illum, 30 x HE
Mortar – 81 mm	35	5 x WP, 30 x HE
Mortar – Other	1	Jap 50mm Type 89 HE
Shoulder-Fired Anti-Tank	47	Mostly 2.36" 'Bazooka' and M19A1 projected anti-tank grenades
Towed Anti-Tank	17	Mostly 37mm AP & HE
Artillery – 75mm	149	114 x AP, 35 x HE
Artillery – 105mm	26	2 x WP, 24 x HE
Artillery – 155mm	7	2 x WP, 5 x HE
Artillery - Other	6	1 x US 6in MK34 AP, 1 x US 40mm MK1 Mod 5 HE, 1 x US 8 Inch Mk21 APHE, 3 x 90mm HE
Total	***327***	***Approx. 75% are likely categorised as 'dangerous' (can kill or seriously injure)***

- The majority of EO to date (~90%) were found in the former "*Artillery Impact Area and Combat Range No. 5*" (approx. KP 4+000 to KP 10+000).
- Another cluster of EO (approx. 5%) were found near the proposed Project camp location (approx. KP 1+000).
- No EO have as yet been found in the southern (dam) sector (approx. KP 10+000 to dam site).
- All except one reported item were Allied munitions and are consistent with weapons used by US/Allied forces that were based on Guadalcanal during WWII. The one Japanese item may have related to Japanese weapon firing however it is equally plausible that Allied forces also fired these items (It is known that both opposing forces often tested, evaluated and used in training the munitions from their opposing force).
- No data is available for the period before 2011. Depending on when villages, roads, farms, etc were developed, numerous additional EO may have been found that are not included in the table above.

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The approximate locations of EO/UXO found to date in relation to the current project construction plans are shown in the following Figures:

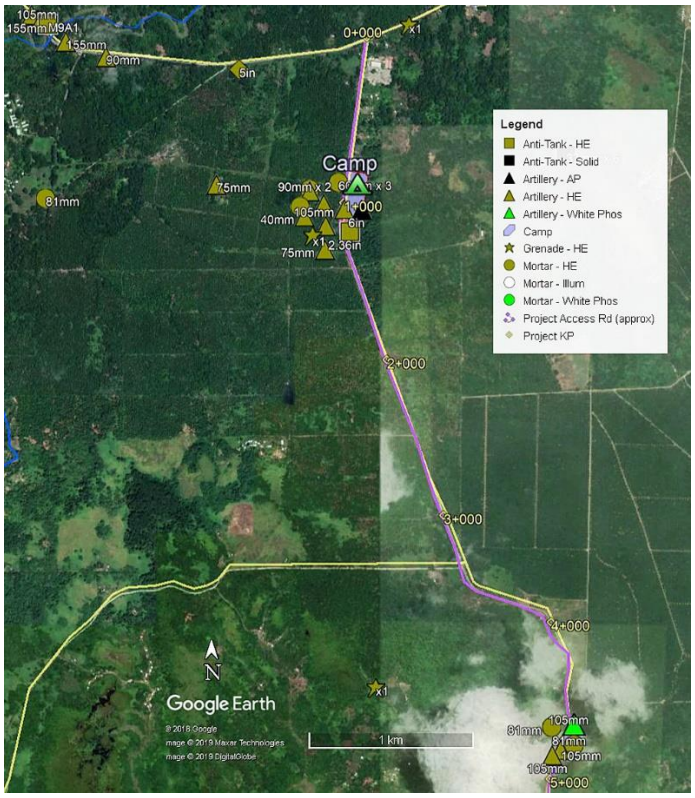

Figure 20 - UXO - KP 0 to KP 5

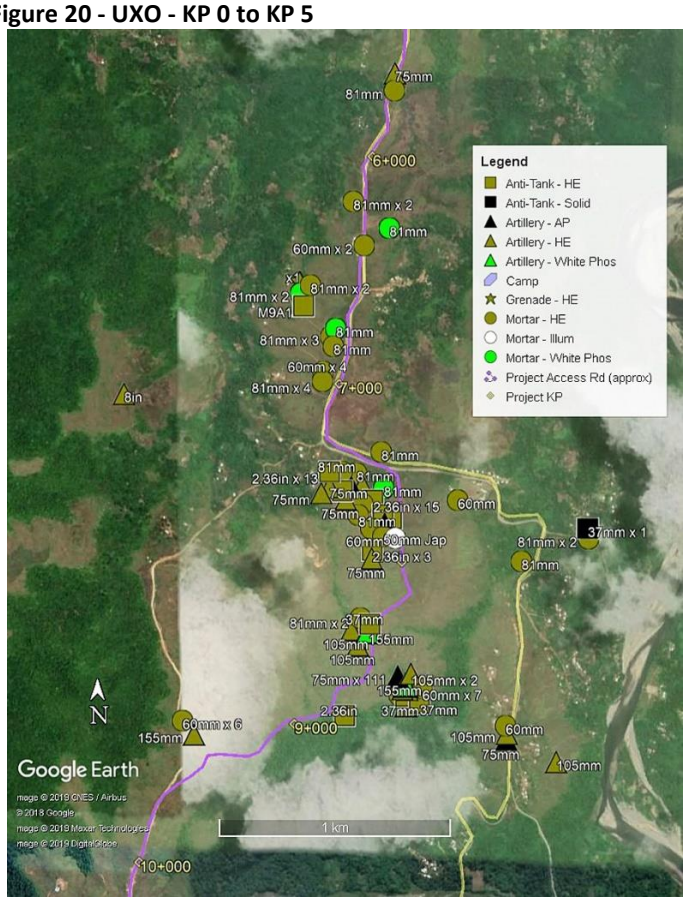

Figure 21 - UXO - KP 5 to KP 10

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Important: *Most reported EO have been found in areas where some form of development has occurred (e.g. roads or villages have been constructed or farming has occurred). Such ground-intrusive activities do not appear to cover the entire project area, nor do these activities typically exceed approx. 300mm into the ground. It is currently assessed that many more UXO could exist in either:*

- *undeveloped areas, or*
- *deeper than 300mm in developed areas.*

In addition to the earlier list of munitions, it is possible that some or all of the following munitions may exist within the project area:

- *Japanese EO*: Assessed unlikely to possible. If these exist, they are more likely to occur in the northern portion of the Site.
- *Landmines*: Assessed unlikely however rare items may still exist. Most likely to be anti-personnel landmines and booby traps (one archival item examined showed some 250 landmines and booby traps had been laid by US forces in area approx. 2000m x 2000m however the map does not specify where on Guadalcanal these were laid). If these still exist, they are more likely to be in the northern part of the Site and closer towards the Tenaru River.
- *Aircraft Bombs*:
    - Both Allied and Japanese aircraft attacked Guadalcanal during which large quantities of aircraft bombs were dropped. Most of this bombing was focussed on Henderson airfield, other airfields and military facilities thus it is not expected that significant numbers of bombs would exist at or near the Project area.
    - Allied and Japanese aircraft may also have attacked opposition forces that were moving throughout the Guadalcanal however, again, it is not expected that significant numbers of bombs would exist at or near the Project area due to these attacks.
    - The training activities of air units at Guadalcanal have not yet been researched however it was common practice at other major allied bases for pilots to undertake regular bombing and Air-to-Ground (A-to-G) firing practices at designated firing ranges. Allied bombing and A-to-G firing may have been undertaken in or near *Combat Range No. 5* as part of training/live firing activities being conducted by land forces.
- *Naval EO*: Most of the Allied and Japanese naval bombardments were likely focussed on the Lungga area however some ship-to-shore firing may have periodically targeted opposition forces away from this area but generally closer to the coast. Occasional naval EO may still exist in the northern portion of the Project area.
- *Aircraft Wrecks*:
    - It has been estimated that the Allies lost some 330 aircraft and Japan lost some 1120 during the battles in the Solomons Islands region however it is currently not known how many of these may have occurred on Guadalcanal or near the Project area.
    - Many of these aircraft likely contained bombs, pyrotechnics, gun ammunition or other EO when they crashed - live EO may still be present in or near the site of such crashes.
    - Many WWII aircraft gun munitions contained a small amount of high explosive (HE) and fuzes similar in design to those found in much larger projectiles. Despite containing relatively small amounts of HE, such munitions can seriously injure or kill and should therefore always be treated with the same degree of caution as other larger munitions.

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Nature of EO Hazards

For guidance, all munitions should be regarded as potentially dangerous (including pyrotechnics and SAA). The dangers posed by differing munitions varies considerably depending on factors including but not limited to the size of the munition, the nature of contents, sensitivity of fuzing mechanisms, state of arming mechanisms, age/condition of the munition and circumstances in which the munition is encountered.

The following offers broad guidance on the relative dangers of various munitions however should not be taken as definitive:

- *'HE' (High Explosive)*: These are generally regarded as presenting the greatest risks.
- '*Smk*' (Smoke) & '*Chem*' (Chemical): Generally regarded as presenting less risks than HE:
    - Chem regarded as being more dangerous than Smk. Smoke munitions containing White Phosphorus (WP) are usually considered more dangerous than those containing Hexachloroethane (HC);
    - explosive HE 'burster charges' used in some smoke & chemical munitions may make them potentially as dangerous as HE munitions.
- *Exploding pyrotechnics ('Pyro')*:
    - generally less dangerous than HE or Smk due to the significantly reduced charge;
    - may cause moderate to severe injuries if initiated very close to a person;
    - some *'illum'* (illumination) projectiles may contain explosive burster or ejection charges which have the potential to cause serious injuries.
- *Non-Exploding Pyrotechnics*: Generally less dangerous than exploding pyrotechnics however may still cause serious injuries if initiated very close to a person.
- '*Prac*' (Practice): These frequently contain little to no explosive charge however this is not always the case. Some Prac munitions may contain small explosive charges and – at close range - may be potentially as dangerous as some HE munitions.
- *'SAA'* (Small Arms Ammunition): Unfired SAA are relatively benign but still potentially dangerous in certain circumstances (can explode in fires, when crushed or when propellent destabilizes).
- *'Solid Shot'*: These are typically armour-piercing projectiles which do not contain any high explosive (but may contain a small amount of pyrotechnic to act as a tracer). While these are usually not dangerous, they can easily be mistaken for exploding munitions and invariably cause 'stop works' or other delays while the item is correctly disposed of.

Penetration Depths

Soil penetration depths for munitions vary considerably depending on a range of factors including impact velocity, angle of strike, shape of projectile, soil type & hardness, amount of vegetation … to name a few. While it is possible to calculate theoretical maximum depths using a variety of equations, most generally over-estimate the penetration depth – real-world experiences suggest that actual UXO depths are often less but, at the same time, may vary significantly. In addition, the depths of UXO may be further varied by soil deposition and soil erosion - in the case of UXO 70+ years old, a mere 2mm of extra soil deposited every year (e.g. on alluvial flats) could add ~150mm to the original depth of the UXO.

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There is currently no consolidated data from which reasonably accurate munitions penetration depths can be derived for specific site conditions. In most cases UXO depths are estimated based on either approximations provided by formulas or based on past experiences – both with some site-specific adjustments. The table below provides example depths of UXO found during various UXO remediation work:

Generic Munition Type	**Typical Depth Expected** (mm)	**Maximum Found Depth** (mm)
Hand-Thrown & Rifle-Projected Grenades	Surface up to 300mm	425mm
Shoulder-Fired Anti-Tank Weapons	Surface up to 300mm	Not known
2”, 50mm, 60mm Mortar	Partially buried to ~300mm	450mm
81mm (~3”) Mortar	Up to 500mm	Periodically 750+mm; Isolated case >1000mm
Towed Anti-Tank Guns	Surface up to 300mm	Can penetrate 500mm (or more) on sloping ground
75mm to 105mm Artillery	Surface to 1000mm	Not unusual for reports of penetration >1.5m
Heavy Artillery (155mm, 5in, 6in, 8in, etc)	Surface to 1500mm	Could exceed 2.0m in certain conditions

Effects of Age & Weather

Many of the EO/UXO that may be present within the area being assessed are 75 years old. The nature and extent of EO/UXO degeneration over time is a subject that is not well understood (globally) and is being investigated by a number of entities (primarily by the US EPA and military). At this time, there appears to be no definitive study that confirms the effects of age and weather on UXO however the consensus amongst competent EO/UXO practitioners is as follows:

- Explosives used in many munitions may breakdown over time – in some cases the munitions become less sensitive however in other cases the munitions may become increasingly sensitive/unstable.
- The explosives used in older munitions (particularly those used in the early years of WWII) are more likely to become unstable over time – notable amongst these are explosives that use a nitro-glycerine base or Lyddite/Picric Acid.
- In some situations, degenerating explosives may react with metals in the munitions casings to form explosive compounds that are inherently unstable and may be even more sensitive than the original explosives.
- Improved explosives used in later munitions (introduced later in WWII e.g. TNT, RDX, PETN) are generally less likely to become unstable over time however the complete munition may still become unstable or increasingly sensitive due to a variety of chemical reactions that may occur within the munition.
- Some munition constituents breakdown into relatively benign substances. Other munitions constituents breakdown into substances which have been linked to a wide range of illnesses (including cancer) and which may enter the water system or food chain e.g. through uptake by plants which are consumed by humans or consumed by animals which are part of the human food chain.

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- Most munitions (with some exceptions) are designed to withstand 'mildly extreme' (but tolerable) climatic conditions without any significant degeneration or performance loss. 'Normal' climatic conditions in the Solomons (moderate to high temperatures and humidity) could potentially accelerate degeneration.

In the absence of credible reports on this subject, it should be assumed that the effects of age and weather have unpredictable results on EO/UXO and, as such, all EO/UXO within the assessment area should be regarded as being potentially dangerous irrespective of their age.

It is worth noting that numerous problems were reported with White Phosphorus munitions that had not been stored properly.

TYPES & LOCATIONS OF REMNANT MUNITIONS

Figure 22 defines the current assessed UXO 'zones' based on research to date:

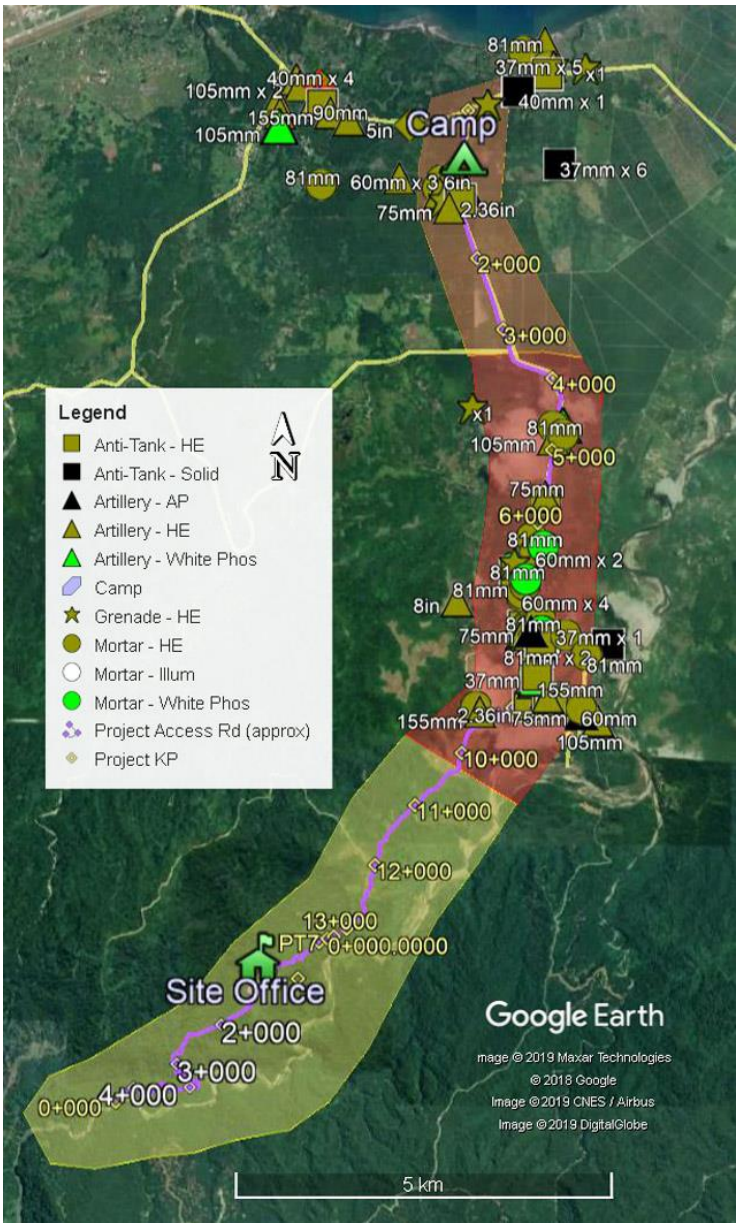

Figure 22 - UXO Risk Zones

Zone 1 – Medium to High probability of UXO/EO

- From approx. KP 0+000 to KP 3+000
- Possibly contains a variety of smaller UXO (e.g. grenades & mortars) as well as potentially artillery munitions (more likely to be dumped or abandoned items)

Zone 2 – High probability of UXO/EO

- From approx. KP 3+000 to KP 10+000
- Former artillery and other weapons firing area
- Likely contains a wide variety of both smaller and larger UXO (including up to 155mm or 8") as well as potentially dumped or EO abandoned items (various types)

Zone 3 – Low probability of UXO/EO

- From approx. KP 10+000 onwards
- Currently no evidence of EO/UXO however 'chance finds' of occasional EO items could still occur

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RISK ASSESSMENT & MITIGATIONS

EO/UXO RISK MANAGEMENT PROCESS

The Risk Assessment methodology used in this Assessment:

- is based on various international EO industry standards (e.g. various IMAS and IATG[5]), US DoD & EPA guidelines and global EOD industry accepted 'best practices';
- has utilised the current Hyundai's current Risk Management Framework[6]; and
- is consistent with Australian Standards for Risk Management *'AS ISO 31000:2018 Risk management - Guidelines'*.

Risk analysis involves consideration of the sources of risk their consequences and the likelihood that those consequences may occur (Hyundai).

LIKELIHOOD/PROBABILITY DEFINITIONS

Table 1 – Probability Definitions[7]

Hyundai Phrase (Score)	Description (Modified descriptors more relevant to UXO assessments)	Alternative Probability Phrase(s)
Frequent (5)	Expected to occur in most circumstances. Is expected to occur multiple times within a year or incident is clearly imminent. For Safety Risks: Could occur several times a year at location. There is significant exposure to the hazard and therefore it is almost certain that the risk event will occur or incident is clearly imminent.	Very High (Almost certain)
Often (4)	Probably occur in most circumstances. Guide: Is expected to occur approximately once per year. For Safety Risks: There is regular exposure to the hazard and therefore, it is likely that the risk event will occur.	High
Likely (3)	Could occur at some time. Guide: Likely to occur approximately once every 5 years. For Safety Risks: There is periodic exposure to the hazard and therefore, it is possible that the risk event will occur.	Medium
Possible (2)	Not expected to occur. Guide: Likely to occur approximately once every 5 – 10 years. For Safety Risks: There is sporadic exposure to the hazard and therefore, it is unlikely that the risk event will occur.	Low
Rare (1)	Exceptional circumstances only. Guide: Likely to occur with less frequency than once every 10 years. For Safety Risks: There is little or no exposure to the hazard and therefore, it is rare that the risk event will occur.	Extremely Low

[5] IMAS – International Mine Action Standards, including EO/UXO activities; IATG - International Ammunition Technical Guidelines (IATG) including IATG 02.10:2012[E]
[6] Hyundai 'Risk Assessment Procedure', Doc. # HEC-AH-H04-H01, Rev. 0, dated 31 Oct 2017 – with adaptations
[7] These definitions are based on but have not yet been fully aligned with Hyundai's '*Risk Assessment Procedure*'

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POTENTIAL IMPACT AND CONSEQUENCE RATINGS

Table 2 - Impact and Consequence Ratings (Hyundai)

Area Impacted (a)	Insignificant Consequences (Score = 1)	Minor Consequences (Score = 2)	Medium Consequences (Score = 3)	Major Consequences (Score = 4)	Catastrophic Consequences (Score = 5)
SAFETY					
PEOPLE Health and Safety	Minor injuries, which may require self- administered first aid. Injured personnel can continue to perform normal duties.	Injuries requiring on-site treatment by medical practitioner. Personnel unable to continue to perform duties.	Serious injuries requiring off-site treatment by medical practitioner or immediate evacuation to hospital. Potential long-term or permanently disabling effects.	Single fatality.	Multiple fatalities.
ASSETS Total cost of Impacts or Incident Event	Financial loss (compensation, fines, cost to repair, plant damage) of less than 1,000 USD.	Financial loss (compensation, fines, cost to repair, plant damage) of 1,000-10,000 USD	Financial loss (compensation, fines, cost to repair, plant damage of 10,000- 100,000USD	Financial loss (compensation, fines, cost to repair, plant damage) of 100,000-500,000 USD.	Severe financial penalties or legal liabilities. Financial loss (compo, fines, cost to repair, plant damage) of greater than 500,000 USD
PRODUCTION Loss	Incident event without causing production loss.	Production loss or delay up to one week.	Production loss or delay of one week to one month.	Production loss or delay for over one month.	Loss of license to operate or ability to produce indefinitely.
HEALTH					
Health Effects	Insignificant impact on surrounding communities.	Minor complaints or exposure during plant shutdown or maintenance. Maximum occurrence limited to two times per	Ongoing complaints from community. Significant emission or discharge that impacts on surrounding population.	Major ongoing long-term health effects likely to surrounding communities and workers.	Extreme health risk-potential for death in community.
ENVIRONMENT					
Enviro. Effect	Slight effect – Local environmental damage. Within the fence and within systems. Negligible financial consequences.	Minor effect – Contamination. Damage sufficiently large to attack the environment but not irreversible. Single exceedance of statutory or prescribed criterion. Single complaint.	Local effect – Limited discharge of known toxicity. Repeated exceedance of statutory or prescribed limit. Affecting neighbourhood.	Major effect – Severe environmental damage. The company is required to take extensive measures to restore the contaminated environment to its original state. Extended exceedance of statutory or prescribed limits.	Massive effect – Persistent severe environmental damage or severe nuisance extending over a large area. In terms of commercial or recreational use or nature conservancy, a major economic loss for the company. Constant, high exceedance of statutory or prescribed limits.

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Cultural Heritage (Indigen. & Modern)	Minor repairable damage to commonplace structures.	Minor repairable damage to structures/items of cultural significance, or minor infringements of cultural values.	Medium damage to structures/items of cultural significance, or significant infringement of cultural values/sacred locations.	Major damage to structures/ items of cultural significance or major infringement of cultural values/sacred locations.	Irreparable damage to highly valued structures/items/ locations of cultural significance or sacred value
REPUTATION					
REPUTATION	Slight impact – Public awareness may exist but there is no public concern	Limited impact – Some local public concern. Some political attention with potentially adverse aspects for company operations.	Considerable impact – Local public concern with attention in local media. Extensive political attention. Adverse stance of government and/or action groups.	National impact – National public concern. Extensive adverse attention in the national media. Regional / national policies with potential restrictive measures and / or impact on grant of licenses. Mobilization of action groups.	International impact – International public attention. Extensive adverse attention in international media. National / international policies with potentially severe impact on access to new areas, grants of licenses and/or licenses and / or tax legislation

RISK ASSESSMENT MATRIX & RISK CATEGORIES

"*Risk evaluation involves comparing the level of risk found during the analysis process with risk criteria established when the context was considered. The objectives of the nominated entity and the extent of opportunity that could result are considered. Decisions take into account the wider context of the risk and include consideration of the tolerability of the risks borne by parties other than the entity that benefit from it, for example the community*" (Hyundai).

Table 3 - Risk Assessment Matrix & Risk Categories

Likelihood		**Consequence**				
		Insignificant (1)	**Minor (2)**	**Medium (3)**	**Major (4)**	**Catastrophic (5)**
Rare	(1)	1	2	3	4	5
Possible	(2)	2	4	6	8	10
Likely	(3)	3	6	9	12	15
Often	(4)	4	8	12	16	20
Frequent	(5)	5	10	15	20	25
11 – 25		**High Risk**	Activity or industry should be modified to include remedial planning and action and be subject to detailed HSE assessment.			
4 – 10		**Medium Risk**	Activity or industry can operate subject to management and/or modification.			
1 – 3		**Low Risk**	No action required, unless escalation of risk is possible.			

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GENERIC UXO RISK EVENTS & CONSEQUENCES

The main risk events associated with EO/UXO contamination are typically as follows:

- ***Explosion of EO/UXO***:
    - Self-explanatory however it should be noted that an explosion typically produces a dangerous blast/shock wave (confined to a relatively small area of <50m diameter) and potentially lethal fragmentation (which may travel hundreds of metres).
    - Could result in injury or death to personnel or damage to assets as well as possible litigation, regulatory involvement and adverse PR.
    - Exposed personnel are most at risk; vehicle and machinery operators may be provided some protection by the machinery.
    - May affect both people on-site (e.g. munition explodes during ground intrusive work) and off-site (e.g. munition is inadvertently transported to recycler and explosion occurs during recycling).
    - Even if no injury occurs, an unplanned explosion would almost certainly trigger a 'stop work' while the incident was investigated. Additional consequences could include full site shutdown while the area was investigated/remediated, legal action, adverse PR, increases in insurances as well as other negative consequences.
- ***Encountering EO/UXO/components (without explosion)***: i.e. circumstances where EO/UXO are uncovered or otherwise observed without there being an explosion (found by local resident, field worker, etc). Finding or sighting EO/UXO/components (without an explosion) has the potential to:
    - cause schedule delays due to the need to stop work, deploy an EOD response team, conduct EO remediation work or undertake investigations;
    - incur additional costs related to disposal of EO/UXO, delays costs (extended delays/stoppages of work), increases in insurances and possible need for full site remediation;
    - raise concerns of workers or users of the site (see '*Perception of risk*' later); or
    - if the finding of a 'live' EO/UXO is not properly controlled, this may escalate to explosion causing fatalities or damages.
- ***Release of or exposure to harmful chemicals***: Many munitions contain a variety of chemicals which may:
    - be harmful to people if these chemicals come in contact with flesh (e.g. WP), inhaled, absorbed or ingested;

        Note: White Phosphorus (WP) is used in smoke, incendiary and other munitions. It is highly flammable and pyrophoric (self-igniting) upon contact with air as well as toxic if ingested or inhaled in sufficient quantities. It continues to burn until expended or deprived of atmospheric oxygen and often results in numerous, deep and severe burns. It can remain dormant in soil/containers for many years and spontaneously ignite when exposed to air.
    - if sufficient quantities of these chemicals exist or are released, may contaminate the soil or water, enter the human food chain or otherwise damage the ecosystem.
- ***Perception of risk***: 'Perception of Risk' related to EO/UXO is largely an emotive response (often not directly linked to the nature of hazard or the likelihood of undesired events) and may occur even when evidence clearly shows that EO/UXO are unlikely or the likelihood of

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injuries/damages is extremely low. Personnel or companies that are working in suspected EO/UXO-contaminated areas may perceive that they are exposed to various risks:

- Individuals – concern over possible injury or death which may result in refusals or reluctance to work or wage demands to compensate for the risk; and
- Contractors – concern over H&S exposures, schedule delays, cost increases, legal implications, insurance implications, etc.

In addition to the generic risks described above, construction companies working in UXO-affected areas should be aware of other potential risks not directly associated with construction - including the following:

- Excavated earth containing munitions is transported to other locations – in addition to the risk of munitions exploding during transportation, there are risks that contaminated spoil may be dumped or used in non-contaminated areas thereby widening the potential area of risk.
- Excavated or scrap metal containing munitions is sent to recycling centre – there have been numerous cases globally where a munition explosion has occurred at recycling centres (contained in material delivered from a UXO area); some of these incidents have caused injuries.
- Inappropriate UXO management practices or controls may encourage very unsafe or high risk practices among local residents (this is often especially important when working in developing countries).
- Insurances and contractual arrangements may need to be reviewed - there is some uncertainty (globally) regarding whether EO/UXO events are covered by 'standard' insurance policies and who may be held responsible in the event of a serious incident (as illustrated in the example below):

  The detonation of a WWII bomb in Munich (Germany) in Aug 2012 caused massive damage to surrounding buildings. The extent of the damage was expected to be in the millions of Euros. A spokesperson for Allianz insurance company (a major global insurer) advised that although ***acts of war were excluded from their policy coverage****, the company* ***would make an exception*** *and still cover damages to policy holder's homes and belongings. It remained unclear whether the city would pay for the damages. The Munich Mayor called the issue of liability a "difficult question of law, which will likely end up being decided by experts," but added that "[the issue of UXO liability] may need to be addressed as part of the Client's risk management responsibilities".*

  As intimated by the Munich Mayor, legal issues surrounding EO/UXO incidents are unclear and largely untested. This is not unique to Germany - many countries (both developed and developing countries) face similar issues and some (e.g. US and UK) have already seen several UXO-related cases in the courts.

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INHERENT (UNMITIGATED) RISK RATINGS

The inherent (or unmitigated) risk is based on the assumption that no controls are in place. This may overestimate the risk as it is unlikely that no controls whatsoever are in place. However, this approach then ensures all controls are noted to demonstrate that the risk has been controlled to ALARP. The main risk events, consequences/impacts and the assessed risk ratings for unmitigated general scenarios are provided below:

Table 4 - Risk Ratings - Inherent (Unmitigated) Risk Scenarios

Risk Event	Consequence Type	Controls	Risk/Consequence/Impact Description	Risk Ratings & Scores		
				Probability Term	*Consequence Term*	*Risk Score & Term*
Explosion or Uncontrolled Release of Munition Contents	H&S	None	Assessed very likely that both UXO & AXO exist at within site. Multiple fatalities are possible ('worst case') - single fatality and/or multiple permanent impairments are more realistic scenarios.	Often – 4	Major - 4	**High - 16**
	Environment	None	Environmental impact assessed '*rare*' for single munition explosion/release.	Rare – 1	Minor – 2	Minor - 2
	Reputation	None	Adverse attention from national media, national govt and general public only if fatality/serious injury (explosion without injury - localised media/public attention). Could result in critical attention/scrutiny by, for example, Safety Dept or Minister. Likely significant concern from employees and contractors.	Often – 4	Medium - 3	**High - 12**
	Cultural Heritage	None	Heritage impact assessed '*rare*' for single munition explosion/release.	Rare – 1	Minor – 2	Low - 2
	Financial/ Schedule	None	Schedule & cost estimates based on requirement to conduct unplanned UXO remediation over large area coupled with litigation, delays of 3+ months, etc	Often – 4	Major - 4	**High - 16**
Find, sight or uncover EO/EOW (no explosion or release)	H&S	None	No known case where an EO item did not explode but caused injury however the event could escalate to an 'explosion'. Assessed that an H&S consequence from find/sight EO is unrealistic.	N/A	N/A	N/A
	Environment	None	No known case where an EO item was found, did not explode but caused environmental impact. Assessed that an Env consequence arising from find/sight EO is unrealistic.	N/A	N/A	N/A
	Reputation	None	Experience with similar events indicates that media & public concern is minimal and short-lived. Some interest from could be expected but unlikely to result in any major adverse govt/public reaction or response.	Often – 4	Minor – 2	Medium - 8
	Cultural Heritage	None	No known case where an EO item did not explode but caused heritage damage/loss. A Heritage consequence from find/sight EO is unrealistic.	N/A	N/A	N/A
	Financial/ Schedule	None	Schedule & cost estimates could include unplanned requirement to conduct UXO search/remediation over large area (or whole area) coupled with delays of 3+ months, insurance implications or other consequent costs. Numerous cases	Often – 4	Major - 4	**High - 16**

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			where finding EO items (without explosions) has resulted in legal/contractual issues arising. Generally minor in nature but occasionally can escalate. Most likely contractual issues with contractors, employees, etc. Worst case assumed.			
Exposure to or release of EO Chemicals	H&S	None	Single EO items or small quantities of EO are unlikely to release sufficient chemicals to cause H&S impacts. (Release of WP - capable of causing severe, permanent injuries and death - is included in 'Explosion').	Rare – 1	Minor – 2	Low - 2
	Environment	None	Single or small qty of EO are generally unlikely to release sufficient chemicals to cause environmental impacts – impacts assessed as being very low level and localised.	Rare – 1	Insignificant - 1	Low - 2
	Reputation	None	Adverse attention from media and general public possible but only if fatality/serious illnesses or major contamination. Could result in critical attention/scrutiny by, for example, state environment authorities, etc. Possibly significant concern from employees and contractors and local communities.	Rare – 1	Minor – 2	Low - 2
	Cultural Heritage	None	No known case where an EO release caused heritage damage/loss. Assessed that a Heritage consequence from EO exposure or release is unrealistic.	N/A	N/A	N/A
	Financial/ Schedule	None	Assessed unlikely that sufficient EO chemicals exist that would cause any major financial or schedule implications however these scenarios have occasionally occurred on other projects.	Rare -1	Major - 4	Medium - 4
Perception of EO/UXO risk	H&S	None	Perception only – no actual injury/illness (virtually impossible other than possible stress-related illness).	N/A	N/A	N/A
	Environment	None	Perception only – no actual environmental damage (virtually impossible).	N/A	N/A	N/A
	Reputation	None	A number of cases have occurred where contractors, government bodies, etc have accused companies of "*disregard for worker safety*" when expected to work in areas even if only suspected to contain EO – usually resulting in work stoppages and local grievances but typically resolved through local negotiation (and education).	Likely – 3	Medium – 3	Medium - 9
	Cultural Heritage	None	No known cases to date where perception of risk related to UXO has had any heritage implication. A Heritage consequence from perception of risk is unrealistic.	N/A	N/A	N/A
	Financial/ Schedule	None	Numerous cases on similar projects – even when actual risks were extremely low or almost non-existent. Could force Client to conduct unplanned UXO remediation over a large area, cause insurances to rise, raise the cost of obtaining finances for projects, contractors demanding 'hazard pay' or some other negative financial impact. Potential 3+ months delay & >$100K costs	Likely – 3	Major - 4	**High - 16**

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REDUCTION OF RISKS - MITIGATIONS/CONTROLS

The following defines mitigations that should be considered to reduce potential EO/UXO risks:

- Impose strict controls on access into and work within Zones 1 & 2 areas.
- Provide UXO 'safeguarders' to accompany foot traffic and support any ground-intrusive activities in Zone 1 and Zone 2.

  Note: If any evidence is found of UXO existing in Zone 3, this mitigation may need to be extended to cover Zone 3.
- Conduct EO/UXO awareness/education for personnel working at the Site and selected Client management as well as implement a '*chance UXO find*' protocol/SWP (preventative control and mitigating control). This is an important control even if areas have been UXO-investigated for the following reasons:
  - UXO search/remediation processes are rarely 100% effective – a performance target of 99.7% is generally accepted within the EO/UXO industry. It is important that those using remediated sites understand that '*chance finds*' of occasional EO/UXO could still occur and be observant during their work.
  - EO/UXO awareness/education is also a key control used reduce '*perceptions of risk*' by dispelling common myths and misunderstandings regarding EO/UXO.
  - A proper EO/UXO Safe Working Procedure ('*Chance Find Procedure*') aims to minimise unsafe practices in the event that EO/UXO are encountered and reduce the likelihood that encounters will escalate to more serious consequences.
- Initially, undertake limited UXO investigations in all three zones (UXO Zones 1, 2 & 3 – with priority likely Zones 1 & 2) to more accurately determine the extent to which these three zones may be affected by remnant EO. Once initial UXO investigations have been completed:
  - update the UXO Risk Assessment to incorporate findings from the UXO field investigations; and
  - if UXO risks are still deemed to be high, medium or otherwise not ALARP, prepare a more specific UXO mitigation plan
  - *For guidance:*
    - *UXO investigations should aim to achieve approx. 10% sampling of areas where ground intrusive works are planned (plus possibly cover additional areas to act as a safety buffer).*
    - *Additional UXO work may need to include full remediation (100% coverage) of those parts of the site that have been identified as likely being UXO-affected).*
- Review insurances and proposed contract clauses to ensure that these adequately address EO/UXO risks. As discussed previously, legal and contractual issues surrounding remnant EO/UXO are unclear and largely untested.
- Continue to review the UXO Risk Assessment as new data from field work and construction comes to hand. Ongoing re-evaluation of risks is a key aspect of an effective risk management system.

Note:

Every effort should be made to avoid knocking, handling or otherwise disturbing any suspicious items found or observed. Some of the munitions in this area (e.g. 37mm HE) are known to be extremely sensitive – even accidently knocking these EO while walking could cause explosion.

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MITIGATED RISK RATINGS

Assuming the recommended mitigations/controls are adopted, the mitigated risk ratings remaining after risk treatment (residual risk) are as shown in the table below. In nearly all cases, residual risks are significantly reduced and normally within 'tolerable' levels (i.e. '*As Low As Reasonably Practicable*'/ALARP):

Table 5 - Mitigated Risk Ratings (Mitigations/Controls Applied)

Risk Event	Consequence Type	Controls	Risk/Consequence/Impact Description	Risk Ratings & Scores		
				Probability Term	*Consequence Term*	*Risk Score & Term*
Explosion or Uncontrolled Release of Munition Contents	H&S	▪ UXO survey ▪ Awareness ▪ SWP	UXO pre-screening areas will drastically reduce likelihood of accidental detonation as well as provide additional data to further refine areas that may need to be UXO-remediated at a later date. Awareness reduces likelihood of inadvertent interaction with UXO. SWP (combined with awareness) reduces likelihood of inadvertent interaction with UXO as well as reducing likelihood of 'worst case' consequences by proper site controls and pre-planning responses. Probability of explosion significantly reduced however credible consequence of UXO explosion (fatality) only marginally reduced.	Rare - 1	Major – 4	Medium - 4
	Note: When using conventional 5x5 Risk Assessment Matrices, it is almost impossible to reduce the overall risk rating for UXO-related H&S events into the 'green' zone – even if the probability is rare or almost impossible. This does not mean that the residual risks are not tolerable but rather illustrates the difficulties that can arise when using relatively simplistic risk decision tools. Other more sophisticated risk modelling tools would likely demonstrate that risks are extremely low (negligible) however it must be noted that there will usually be some residual risk of a fatality/serious injuries even if full remediation of the Site is undertaken.					
	Environment	▪ As above	As above. Probability and consequence both reduced.	Rare – 1	Insignificant - 1	Low - 1
	Reputation	▪ As above	As above. Probability and consequence both reduced. If explosion did somehow occur, some adverse attention from media, general public and regulators may still result (if fatality/serious injury) however such interest would likely be less critical and short-lived as the client will be able to demonstrate that reasonable precautions were taken to minimise the event.	Rare – 1	Minor- 2	Low - 2
	Cultural Heritage	▪ As above	As above. Probability and consequence both reduced.	Rare – 1	Insignificant - 1	Low - 1

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	Financial/ Schedule	▪ As above	As above. Probability and consequence both reduced. If explosion did somehow occur, potential for an urgent, unplanned response over a large area (thus more expense) would likely be reduced. Response would likely be measured, focussed and thus less expensive. Proposed mitigations would likely also reduce flow-on costs associated with unplanned delays, rise in insurances, etc.	Rare – 1	Medium – 3	Low - 3
Find, sight or uncover EO/EOW (no explosion or release)	H&S	None required	H&S consequence arising from find/sight EO assessed unrealistic.	N/A	N/A	N/A
	Environment	None required	Env consequence arising from find/sight EO is unrealistic.	N/A	N/A	N/A
	Reputation	▪ UXO survey ▪ Awareness ▪ SWP	As above. Probability and consequence both reduced. Potential for reputation to be **enhanced** as the Client may be seen by personnel to be implementing sound controls to minimise risks.	Rare – 1	Insignificant - 1	Low - 1
	Cultural Heritage	▪ As above	Heritage consequence arising from find/sight EO is unrealistic.	N/A	N/A	N/A
	Financial/ Schedule	▪ As above	As above. Probability and consequence both reduced. In the unlikely event that EO/EOW is found after implementing the proposed controls, the potential for an urgent, unplanned response over a large area (and thus more expense) would likely be reduced. Response would likely be measured, focussed and thus less expensive. Proposed mitigations would likely also reduce flow-on costs associated with unplanned delays, rises in insurances, etc.	Rare – 1	Medium – 3	Low - 3
Exposure to or release of EO Chemicals	H&S	▪ As above	As for 'explosion, 'H&S' – proposed controls significantly reduce likelihood of event and potentially also reduce severity through having pre-planned responses.	Rare – 1	Medium – 3	Low - 3
	Environment	▪ As above	As above. Probability and consequence both reduced.	Rare - 1	Insignificant - 1	Low - 1
	Reputation	▪ As above	Probability and consequence both reduced. If exposure/release did somehow occur, some adverse attention from media, general public and regulators may still result however such interest would likely be less critical and short-lived as the client will be able to demonstrate that reasonable precautions were taken to minimise such an event.	Rare – 1	Minor - 2	Low - 2
	Cultural Heritage	▪ As above	Heritage consequence arising from EO exposure or release is unrealistic.	N/A	N/A	N/A
	Financial/ Schedule	▪ As above	As for 'explosion', 'financial' – severity & likelihood both reduced.	Rare – 1	Minor - 2	Low - 2

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Perception of EO/UXO risk	H&S	None required	H&S consequence arising from 'perception' alone assessed unrealistic.	N/A	N/A	N/A
	Environment	None required	Env. consequence arising from 'perception' alone assessed unrealistic.	N/A	N/A	N/A
	Reputation	▪ UXO survey ▪ Awareness ▪ SWP	Evidence from many other similar situations indicates that implementing the proposed controls usually significantly reduces the severity and likelihood of this event. Some minor concerns may still remain, but these rarely result in any adverse impact; in many instances the controls can improve the client's reputation in the eyes of employees and contractors.	Rare – 1	Minor - 2	Low - 2
	Cultural Heritage	▪ As above	Heritage consequence arising from EO exposure or release is unrealistic.	N/A	N/A	N/A
	Financial/ Schedule	▪ As above	Implementing the proposed controls should all but eliminate the likelihood of this event occurring.	Rare – 1	Minor - 2	Low - 2

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CONCLUSIONS & RECOMMENDATIONS

The primary objectives of this EO/UXO Risk Assessment were as follows:

- Determine the extent to which the Sites may be contaminated by military ordnance including but not limited to:
  - explosive ordnance (EO);
  - unexploded ordnance (UXO) or abandoned explosive ordnance (AXO);
  - explosive ordnance waste (EOW);
  - hazardous explosive ordnance components (fuses, etc); and
  - hazardous explosive ordnance constituents (residual chemicals, etc)
- Provide preliminary advice regarding:
  - the nature, location and extent of such contamination;
  - the EO/UXO risks faced by the Client; and
  - options to mitigate risks associated with EO/UXO.

The findings of this Assessment may change if additional information is received or reviewed**.**

KEY CONCLUSIONS

The key conclusions drawn from research to date are as follows:

- There is significant and reliable evidence that parts of the Project site have been subjected to military activities that are likely to generate remnant munitions. These military activities include:
  - possible battle areas;
  - possible areas targeted by air forces (bombing, etc), naval bombardment or artillery;
  - military live firing and other training involving ammunition; and
  - lost or abandoned EO items.
- There is currently no evidence of:
  - large-scale munitions disposal (however isolated 'dumping' or disposal of small quantities may have occurred); or
  - activities involving persistent or other military chemicals.
- A significant number of UXO (approx. 320) have been found within or very close to the Project area in the past 9+ years. No data is presently available for years prior to 2011.
  - The majority of EO to date (~90%) were found in the former "*Artillery Impact Area and Combat Range No. 5*" (approx. KP 4+000 to KP 10+000).
  - Another cluster of EO (approx. 5%) were found near the proposed Project camp location (approx. KP 1+000).
  - No EO have yet been found in the southern sector (approx. KP 10+000 to dam site).
- Despite many UXO finds, there is currently no evidence that the Project site has ever been methodically searched and cleared of all remnant UXO.

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- The nature and extent of remnant UXO contamination broadly fits into three main areas:

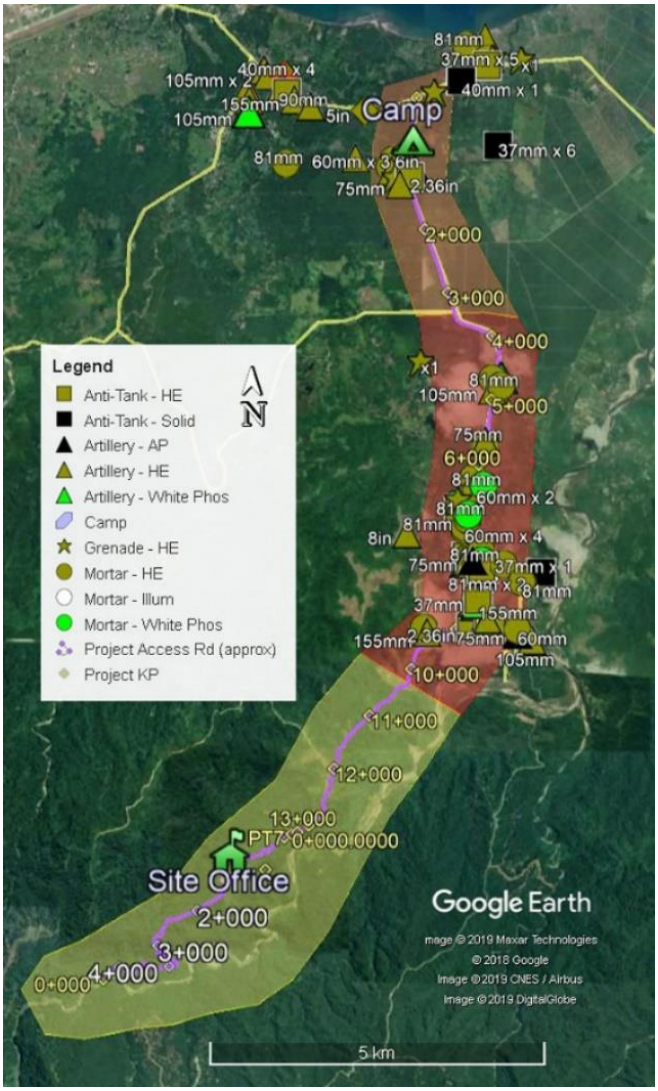

Figure 23 - UXO Risk Zones

Zone 1 – Medium to High probability of UXO/EO
- From approx. KP 0+000 to KP 3+000
- Possibly contains a variety of smaller UXO (e.g. grenades & mortars) as well as potentially artillery munitions (more likely to be dumped or abandoned items)

Zone 2 – High probability of UXO/EO
- From approx. KP 3+000 to KP 10+000
- Former artillery and other weapons firing area
- Likely contains a wide variety of both smaller and larger UXO (including up to 155mm or 8") as well as potentially dumped or EO abandoned items (various types)

Zone 3 – Low probability of UXO/EO
- From approx. KP 10+000 onwards
- Currently no evidence of EO/UXO however 'chance finds' of occasional EO items could still occur

- In UXO Zone 1, there is limited evidence of possible firing by Allied and Japanese forces during battles or conflict that occurred closer to the coast. There is also significant evidence of Allied munitions usage within or close to this Zone however it cannot currently be determined if this was due to battles, live firing during training or dumped/abandoned munitions. It cannot currently be determined whether UXO contamination in this area is confined to a small, localised areas or whether it is more widespread.
- In UXO Zone 2, there is ample evidence of WWII live firing most likely during military training in the period 1943-1945 including primarily US artillery, anti-tank weapons, mortars, shoulder-fired anti-tank weapons, hand-thrown and projected grenades. Munitions usage was likely '*substantial*'. The diversity and spread of munitions in this Zone suggests that many additional UXO likely exist throughout most of this Zone (i.e. UXO are likely widespread and not confined to a few localised areas).
- In UXO Zone 3, there is currently no evidence that this Zone was ever part of any battles or targeted during military forces live firing training. The likelihood of remnant UXO existing in this Zone is currently assessed as 'Low' however research is not sufficiently progressed to state this with certainty. 'Chance Finds' of occasional UXO could occur in this Zone.

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- While no EO accidents have been identified within or close to the Project site, numerous UXO accidents have occurred on Guadalcanal in past years. Many of these have resulted in deaths or severe injuries. At least one incident has already occurred within this Project and within this Site.
- Many of the Client's activities in the area have a medium to high probability of interacting with these residual EO/UXO hazards and many of these interactions – if not mitigated - could potentially result in moderate to catastrophic consequences (loss of life, serious injury, incapacitation, illness, significant schedule slippage, significant unforeseen costs, legal action or reputation damage).
- The Site likely contains various inert or relatively benign EO/EOW. While most of these items are unlikely to result in injuries, finds of such items during construction could cause unplanned stoppages, delays, schedule slippage or unforeseen costs.
- There are also activities where '*perception of risk*' may be substantially higher than '*actual risk*'. Even though '*perception of risk*' may not cause physical harm, it is still a risk that may have negative consequences (e.g. reluctance to work in areas, higher insurance costs and growing public concerns).
- Effective mitigations are available that could significantly reduce most (if not all) risks that presently exist - these may include but are not limited to:
    - good planning, awareness training and sound advice;
    - procedures and other site controls; and
    - physical EO/UXO investigations or hazard reduction/remediation work in selected areas.

RECOMMENDED ACTIONS

The following summarises recommended mitigations that should be considered for the Project:

- Impose strict controls on access into and work within Zones 1 & 2 areas.
- Conduct general UXO awareness and implement a UXO 'chance find' procedure (SWP) for personnel working at the Project Sites (including selected managers). This is an important control even if areas have been UXO-investigated.
- Provide UXO 'safeguarders' to accompany foot traffic and support any ground-intrusive activities in Zone 1 and Zone 2.

  Note: If any evidence is found of UXO existing in Zone 3, this mitigation may need to be extended to cover Zone 3.
- Initially, undertake limited UXO investigations in all three zones (UXO Zones 1, 2 & 3 – with priority likely Zones 1 & 2) to more accurately determine the extent to which these three zones may be affected by remnant EO. Once initial UXO investigations have been completed:
    - update the UXO Risk Assessment to incorporate findings from the UXO field investigations; and
    - if UXO risks are still deemed to be high, medium or otherwise not ALARP, prepare a more specific UXO mitigation plan
- Review insurances and proposed contract clauses to ensure that these adequately address EO/UXO risks. As discussed previously, legal and contractual issues surrounding remnant EO/UXO are unclear and largely untested.

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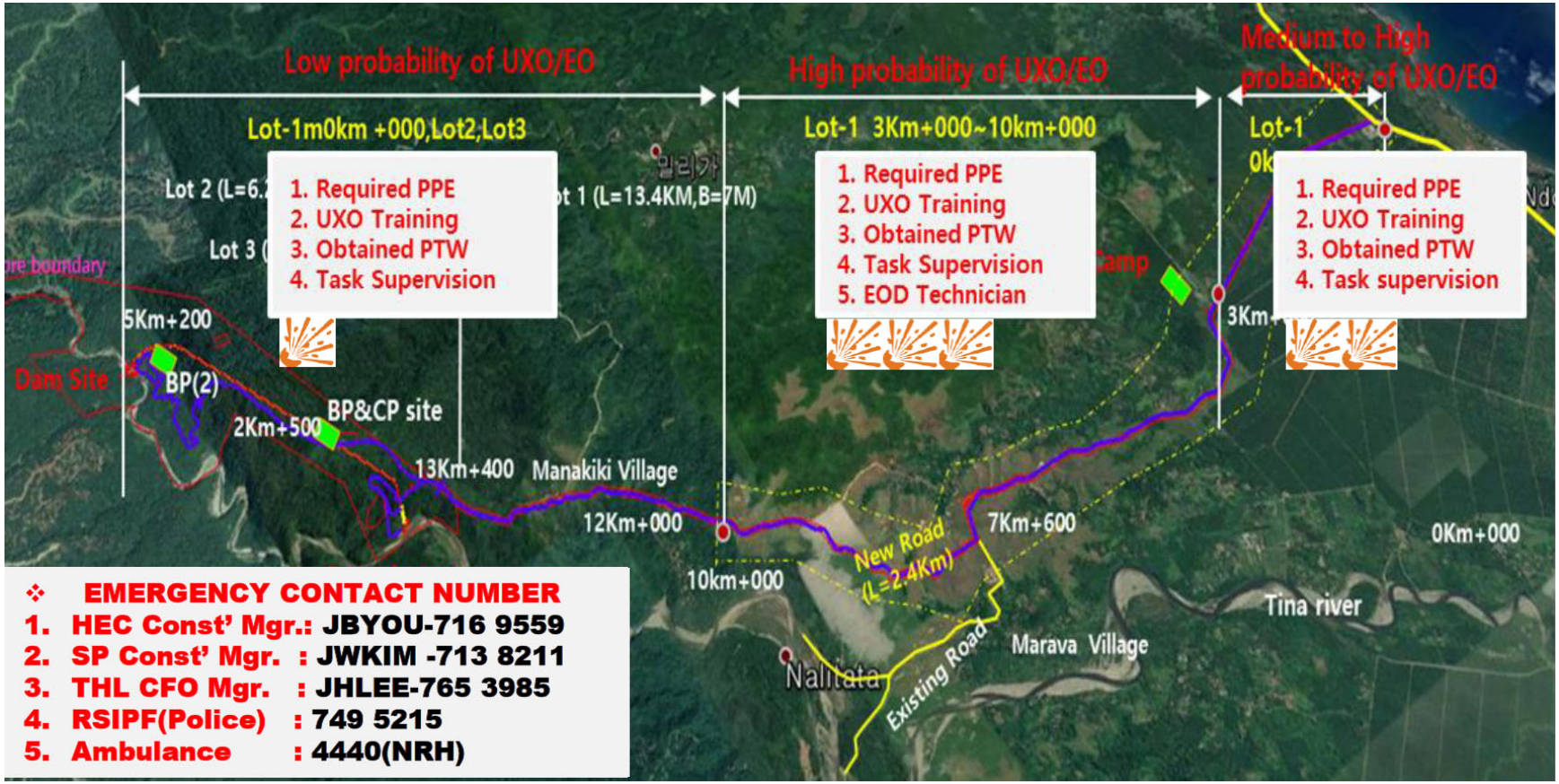
UXO RISK ZONES



Zone 3 – Low probability of UXO/EO	Zone 2 – High probability of UXO/EO	Zone 1 – Medium to High Probability of UXO/EO
From approx. KP 10+000 onwards Currently no evidence of EO/UXO however 'chance finds' of occasional EO items could still occur	From approx. KP 3+000 to KP 10+000 Former artillery and other weapons firing area Likely contains a wide variety of both smaller and larger UXO (including up to 155mm or 8") as well as potentially dumped or EO abandoned items (various types)	From approx. KP 0+000 to KP 3+000 Possibly contains a variety of smaller UXO (e.g. grenades & mortars) as well as potentially artillery munitions (more likely to be dumped or abandoned items)

- Review risk assessment as new data from field work comes to hand. Ongoing re-evaluation of risks is a key aspect of an effective risk management system.

Ian Bullpitt
Director
BOZ Technical Services Pty Ltd

Landline: +61-(0)7-55985062
Mobile: +61-(0)488-985062
E-mail: boztec@bigpond.com OR ianbullpitt@bigpond.com

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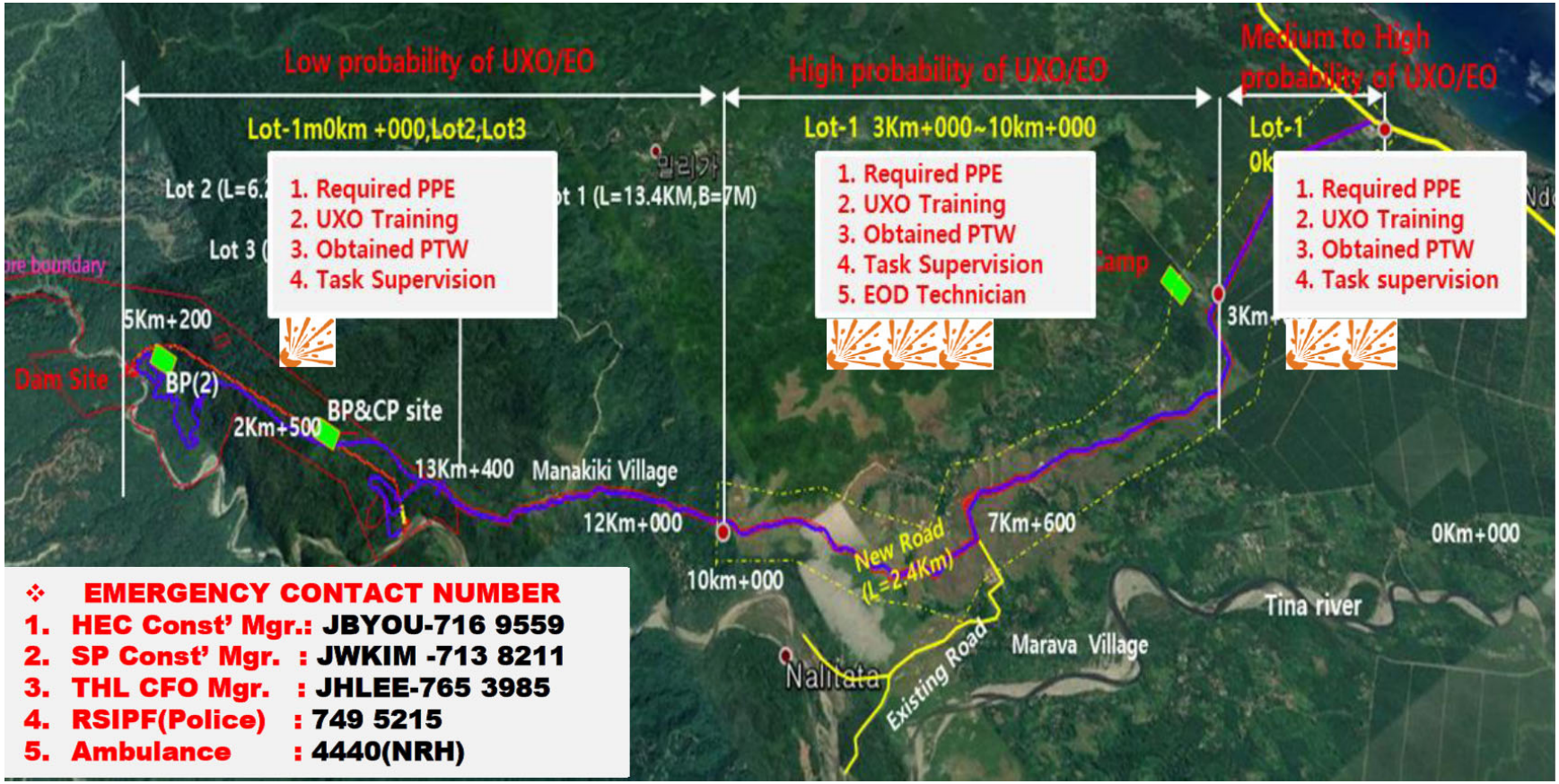
Annex C-2-11 UXO Risk Zones Rev0

UXO RISK ZONES



Zone 3 – Low probability of UXO/EO	Zone 2 – High probability of UXO/EO	Zone 1 – Medium to High Probability of UXO/EO
From approx. KP 10+000 onwards Currently no evidence of EO/UXO however 'chance finds' of occasional EO items could still occur	From approx. KP 3+000 to KP 10+000 Former artillery and other weapons firing area Likely contains a wide variety of both smaller and larger UXO (including up to 155mm or 8") as well as potentially dumped or EO abandoned items (various types)	From approx. KP 0+000 to KP 3+000 Possibly contains a variety of smaller UXO (e.g. grenades & mortars) as well as potentially artillery munitions (more likely to be dumped or abandoned items)

ANNEX C-2-111 Change UXO Finds Procedure Rev1

ANNEX C-2-III CHANCE FIND PROCEDURE

Chance Find Procedure

1 – Introduction

For the purpose of this procedure, UXO is used as the general term to describe both unexploded and abandoned ordnance, munitions and explosive devices, which represents a hazard to people.

Although UXO is not captured in the Environmental Act 1998 and Environmental Regulation 2008, UXO clearance activities have become an integral part of any development activity in the Solomon Islands.

It should be noted that this document only provides guidance in relation to the Chance Find Procedure. More guidance on international standards on unexploded ordnance for the construction industry can be obtained from CIRIA C681: Unexploded Ordnance (UXO).

2 – Purpose and Scope

The overall purpose of this document is to provide a procedure to be followed in case of UXO find during the construction activities. It provides guidance on the steps to be followed, the parties to be informed and engaged.

This procedure applies to all parties involved in construction activities or visiting the site, such as HEC employees, THL employees, PO and any subcontractor involved in the construction activities. All parties are responsible for the wellbeing of their on-site personnel. At initial contract meetings, all subcontractors should be advised of their responsibilities, the process to manage UXO finds, and who to contact at HEC regarding UXO sightings and threats during project construction.

3 – Requirements for Construction activities at UXO Risk Zone

1. All Workers will be inducted by HEC HSE Training supervisor to aware of UXO risks and emergency response. Reporting protocol and mitigation measures in case of UXO finds should be emphasized to prevent incident caused by unexpected explosion.

2. All workers working within the UXO risk Zone will be trained by HEC HSE training supervisor before starting work. Specified UXO training program will be used for road construction workers. When working on high probability UXO zone (Lot1 3+~Lot1 10+), Explosive Ordinance Detection (EOD) technicians will educate all involved workforce during TBM.

3. Permit to Work (PTW) for all activities on UXO risk Zone should be obtained by performing authority at least 24 hours in advance. Cold Work Permit is required for any dangerous work that does not involve use of ignition source or sparks generation. It will be used for road construction work with excavation certificate. Required documents for PTW are as below:

a. Cold work permit (if not use ignition source) (Annex2)

b. Excavation certificate for manual and mechanical excavation work (Annex2)

c. Drawing to ensure task requirements (Annex3)

d. JHA to verify risks and mitigation measures related with construction activities (Annex 4)

PTW for UXO risk zone should be completed and implemented according to the HEC-AH-H04-H04 permit to work procedure.

4. As soon as PTW is approved by approving authority, performing authority should inform to EOD technician for working on high probability area and communicate with communities if necessary.

5. Approved PTW and required documents should be placed at workplace for daily PTW check to ensure that the works are executed in a proper manner according to permit requirements. Daily check should be performed by performing authority, area authority, HSE authority.

6. Receiving authority (site supervisor) and safety supervisor should be present to monitor construction activities and take immediate action in case UXO finds as per PTW and JHA. When working on high probability UXO zone, EOD technician will supervise tasks with receiving authority and safety supervisor to provide technical supports.

7. In case of UXO finds, the work permit is withdrawn and work must be immediately stopped and the relevant Area Authority to be informed. The permit is considered "suspended" from this time and must be returned to the PTW Office. A new PTW must then be obtained for resumption of work.

8. When task is completed HEC Area authority should visit site to make sure housekeeping and material arrangement, barricade at risk area. PTW close and revalidation should be carried out by area authority.

9. When PTW is approved by approving authority, it should be communicated with all involved parties as below (Figure 1).

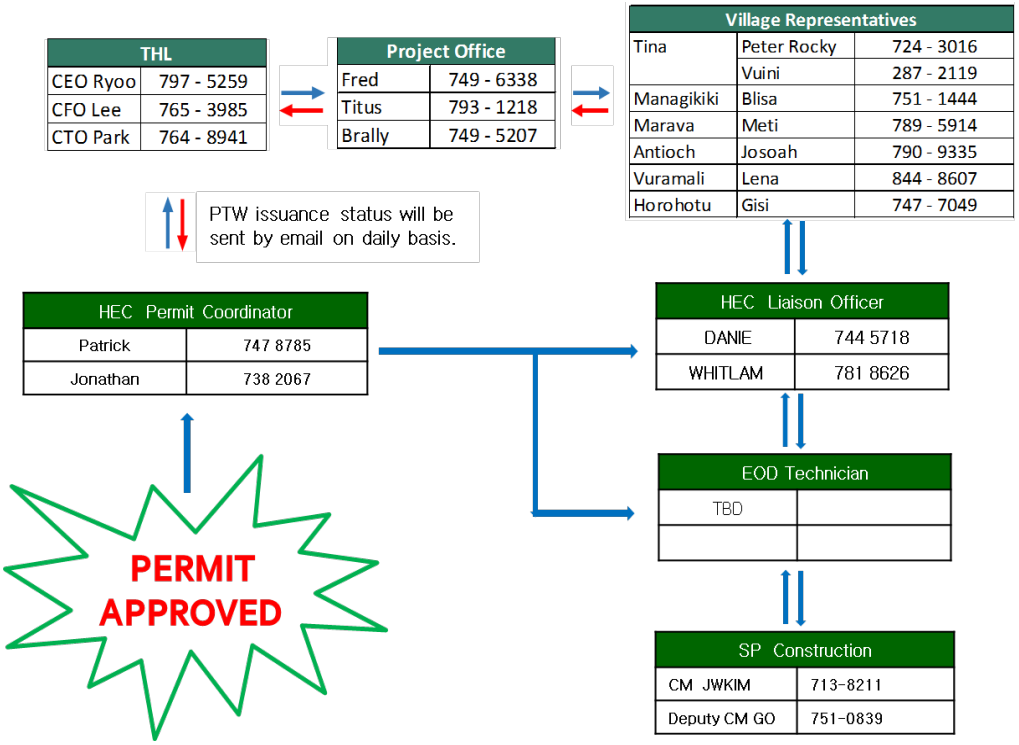


Figure 1 PTW Approval chain [1]

4– Mitigation measures in case of UXO finds

In the event of a suspicious find by any party involved in the construction activities, the following steps should be followed:

Step 1: Works should cease in the immediate area. **DO NOT TOUCH, DISTURB OR TAMPER WITH THE ITEM.** This includes making attempt to move the item to a 'safe' location.

Step 2: Cordon off and mark the location so it can be found later. Coloured tape or paint make easily recognised marker material. In placing marking material DO NOT TOUCH the item.

Step 3: Inform the HEC Staff of found item and record details in the Incident Report.

[1] EOD Technician, John Periporo, 7536598

Step 4: The Site Supervisor shall inform HEC Construction Manager (or to a designate in their absence) and the Royal Solomon Island Police Force's (RSIPF) Explosive Ordnance Unit (RSIPF EOU). HEC will be responsible for the assessment, mitigation or elimination of any UXO related hazard with input from the responsible authorities and EOD clearance contractors. HEC will keep data and records of UXO information from UXO studies done on its sites, and provide this information to public upon request, as follows:

- A reporting system will be established, communicated to all parties and managed for UXO clearance activities;
- HEC will be responsible for public awareness and consultation and building employee and stakeholder capacity to respond to UXO threats (in accordance with the Project Stakeholder Engagement and Communication Plan, SECP (P3)).

The RSIPF EOU is the body responsible for clearance and disposal of UXO finds in the Solomon Islands. The RSIPF EOU also responds to public reports of UXO and undertakes clearance activities. Following removal of UXO, a provisional UXO incident report will be prepared by HEC (refer to the template attached), countersigned by RSIPF EOD Officer, recovering the UXO. The RSIPF EOU Officer or qualified company will provide a Certificate of Clearance after suspected UXO ordnance has been removed prior to any construction work commencing. This certificate must be kept on file in Project Space and hard copy by the HEC HSE Manager.

Step 5: Communicate the UXO risk to surrounding communities by following the communication chain visualized in Figure 2.

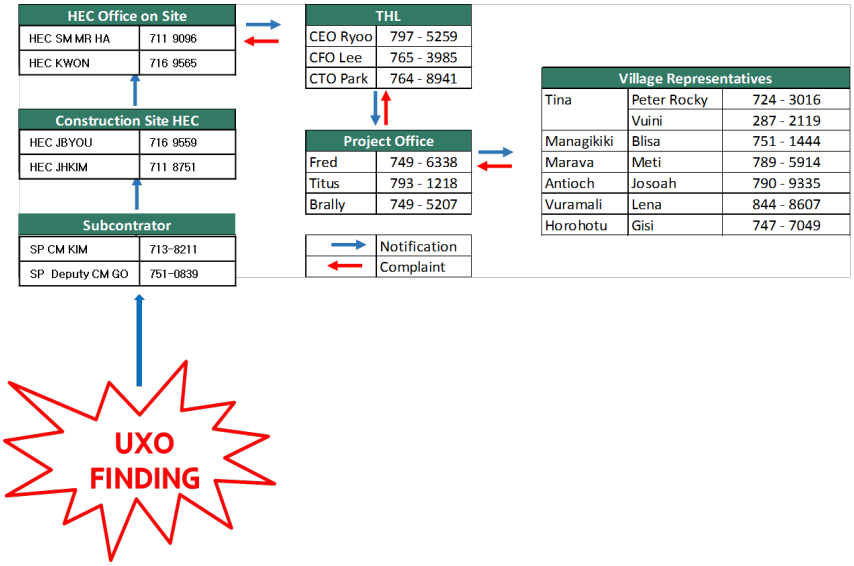


Figure 2: Communication chain in the event of a Chance Find

The following Table 1 presents further contact details of personnel to be notified in case of emergency (as per Figure 2), for quick reference.

Table 1: Emergency contact details, UXO chance finds.

Organisation	Contact Details
Eui Man Moon, HEC Project Manager	Tel: 758-4604

Organisation	Contact Details
Mr D Y Kim, HEC HSE Manager	Tel: 7411755
RSIPF	Officer in Charge Explosive Ordnance Unit P.O. Box G1723 Honiara Tel: 20443
Ministry of Environment, Climate change, Disaster Management	Director Environmental Conservation Division P.O. Box 21 , Honiara Tel: 23031

ANNEX c-2-lll ATTACHMENT UXO CHANCE FIND PROVISIONAL REPORT TEMPLATE REV1

Tina River Hydropower Development Project

PROVISIONAL EOD INCIDENT REPORT
(HEC Copy)

UXO Chance Find/Discovery Reporting					
Date of Reporting					
Time of Reporting					
Reporting Person Name					
Organization					
Contact Details					
Location of UXO Chance find					
GPS Coordinates	Easting	Southing			
Nearest Landmark/community					
Details of UXO discovery					
Origin	Positive ID	Category	Qty	Weight per item	Total Weight
UXO Recovery Status					
Date					
Time					
Recovered by					
In the presence of					
Signature					
HEC	**RSIPF**				
Name:	Name:				
Sign:	Sign:				

Note: This report is provisional and intended for project reporting purposes only until the RSIPF EOD Incident Report is received from RSIPF.

Tina River Hydropower Development Project

PROVISIONAL EOD INCIDENT REPORT
(RSIPF Copy)

UXO Chance Find/Discovery Reporting					
Date of Reporting					
Time of Reporting					
Reporting Person Name					
Organization					
Contact Details					
Location of UXO Chance find					
GPS Coordinates	Easting	Southing			
Nearest Landmark/community					
Details of UXO discovery					
Origin	Positive ID	Category	Qty	Weight per item	Total Weight
UXO Recovery Status					
Date					
Time					
Recovered by					
In the presence of					
Signature					
HEC	**RSIPF**				
Name:	Name:				
Sign:	Sign:				

Note: This report is provisional and intended for project reporting purposes only until the RSIPF EOD Incident Report is received from RSIPF.

ANNEX C-2-IV TRAINING INDUCTION MODULE MAY 2020

UXO Training Module for Construction work

Tina River Hydropower Development Project, Solomon Islands

2020. 05.

HYUNDAI ENGINEERING CO., LTD.

1. What is a UXO
2. Where you might encounter UXO
3. Three R's (Recognize, Retreat, Report)
4. General Safety Guidelines
5. Practice Ordnance

What is a UXO

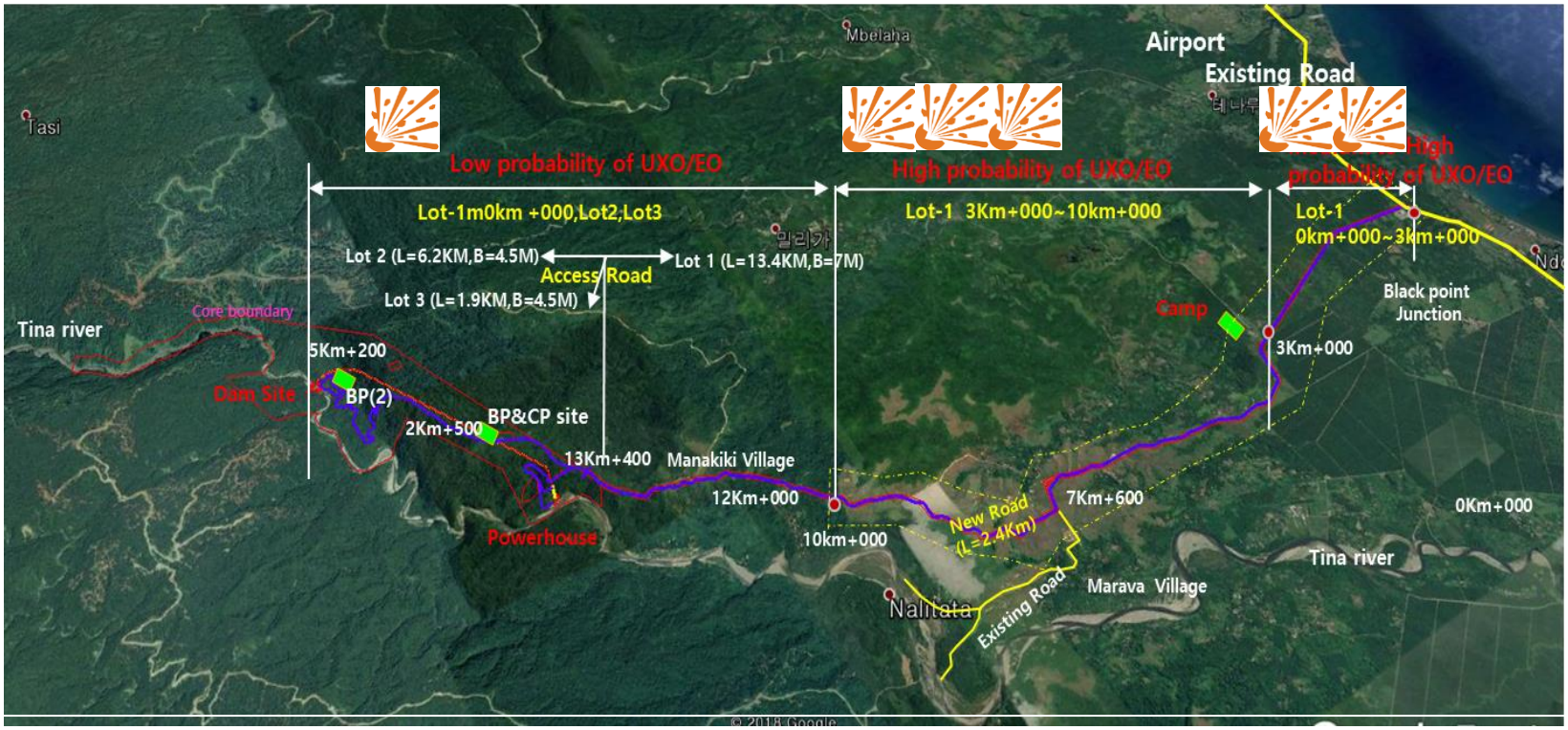
- A UXO stands for Unexploded ordnance.

Ordnance is what we call ammunition, such as:
- Bullets, bombs, duds, grenades, blasting caps, shells and fuses

Unexploded ordnance is :
- Ammunition that was fired but did not explode
- Ammunition that could explode
- New or old… shiny or rusty…clean or dirty

All of it is dangerous!

Where you might encounter a UXO



As above drawing Lot1 3+~Lot1 10 area is high probability of UXO.

Recognizing a UXO

- UXO's come in all shapes and sizes (i.e. bombs, rockets, grenades, various sized projectiles, and may even look like truck parts)
- The color is not always an identifying factor in determining if it is safe or not
- If you think that it "could be" a UXO, leave it alone and have immediate supervisor or RSIPF notified

Retreat and mark in case of UXO finds

- **Work should cease immediately.**
- **Place the coloured tape or paint make easily recognized maker material**
- **Do not stake anything in the ground. Just because you can not see another UXO, it doesn’t mean that it’s not underground.**
- **Retreat/leave the area and do not return until RSIPF or EOD technician arrives**

Report the UXO

- **Report the UXO to immediate manager and RSIPF, please find reporting protocol**
- **Attempt to give as much information about the UXO that you can recall**
- **Give approximate diameter, length and directions**

REMEMBER WHAT TO DO IF YOU FIND UXO

- Recognize it
- Retreat
- Report it

General Safety Guidelines(1)

- Never transmit a radio near a UXO, keep away 25 feet from UXO, Radio send out electrical currents which could initiate some UXO's
- Never attempt to move or disturb a UXO
- Avoid the area where a UXO is located
- The ordnance item may function as designed if disturbed.
- REMEMBER, YOU HAVE NO IDEA WHY IT DIDN'T DETONATE.YOU DON'T WANT TO BE THE ONE WHO FINDS OUT WHY.

General Safety Guidelines(2)

Avoid the area where a UXO is located

- **Disturbing the ground near the UXO may move the UXO**
- **There might be more UXO's in the area**
- **Make sure the UXO area is clearly marked so other personnel will stay away from it**
- **Evacuate all nonessential personnel**
- **Supervisor or foreman must conduct area control to avoid unauthorized entering until RSIPF or EOD technician arrives**
- **Communicate adjacent community representative if necessary**

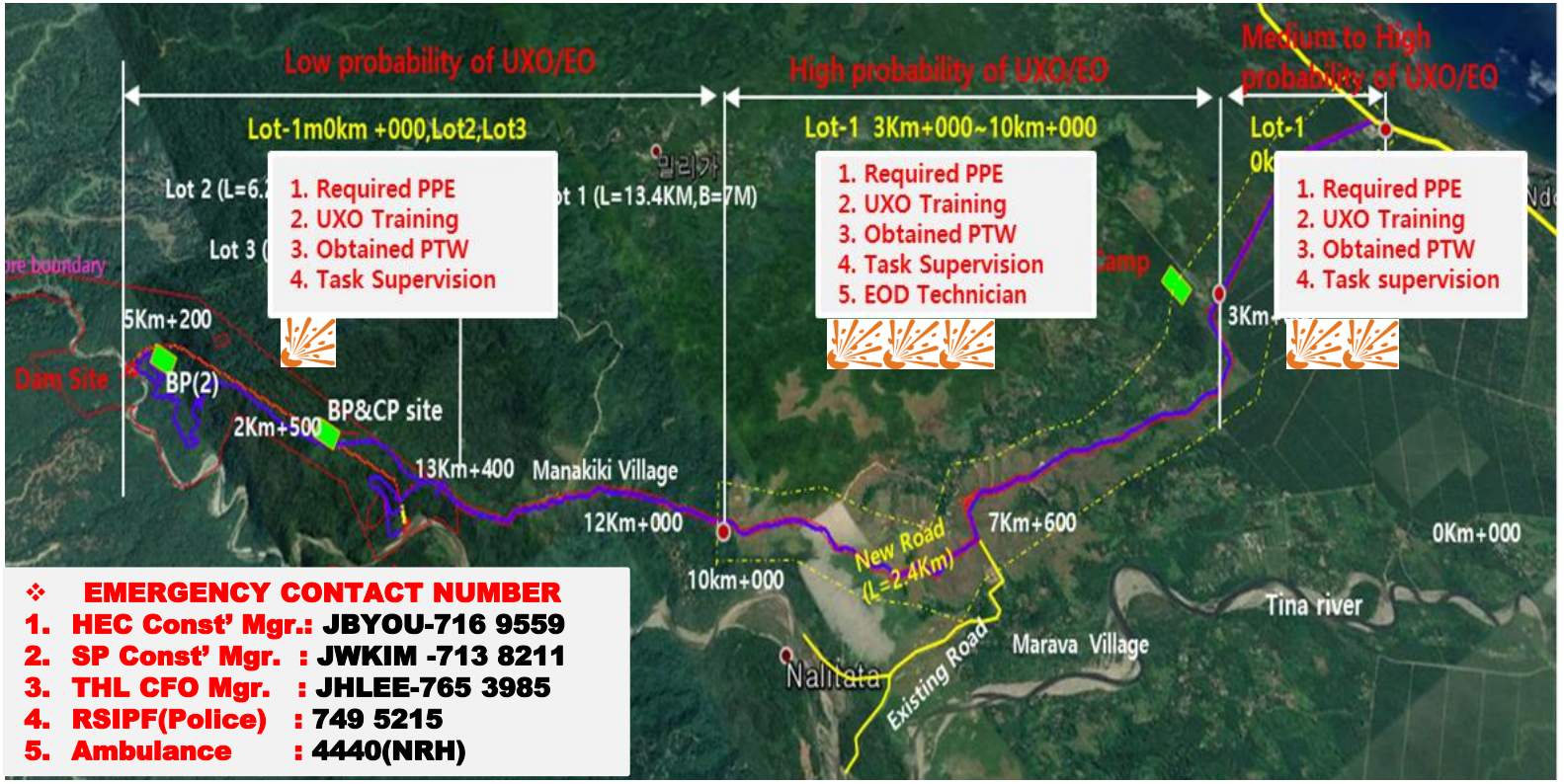
Practice Ordnance (pictures)

Project Requirements for construction work at UXO Risk Zone(1)

1. Training – All workforces involved UXO risk Zone should take special training to ensure 3R(recognize, retreat, report).
2. PTW should be obtained in advance for construction activities. Detailed PTW process has been addressed on chance find procedure.
3. Task supervision should be present for construction activities at UXO risk Zone.
4. EOD technician should be present for high probability zone(Lot1 3+ ~ Lot1 10+)
5. Do not take photos and don not interview with medias without THL approval.

Project Requirements for construction work at UXO Risk Zone(2)

* Requirements for working at UXO Risk zone



UXO Reporting Protocol

HEC Office on Site	
HEC SM MR HA	711 9096
HEC KWON	716 9565

Construction Site HEC	
HEC JBYOU	716 9559
HSE JHKIM	711 8751

Subcontrator	
SP Manager KIM	713-8211
HSE Manager HO	751-0839

THL	
CEO Ryoo	797 - 5259
CFO Lee	765 - 3985
CTO Park	764 - 8941

Project Office	
Fred	749 - 6338
Titus	793 - 1218
Brally	749 - 5207

→	Notification
←	Complaint

Village Representatives		
Tina	Peter Rocky	724 - 3016
	Vuini	287 - 2119
Managikiki	Blisa	751 - 1444
Marava	Meti	789 - 5914
Antioch	Josoah	790 - 9335
Vuramali	Lena	844 - 8607
Horohotu	Gisi	747 - 7049

ANNEX P-4-I UNSKILLED & SEMISKILLED OCCUPATIONAL POSITIONS REV2

ANNEX P-4-I – LIST OF UNSKILLED AND SEMISKILLED OCCUPATION POSITIONS

The table below outlines the semi-skilled and unskilled positions which will be required during construction of the Project. The level of skill required for semi-skilled and unskilled positions has been defined on the basis of equivalent qualifications frameworks commonly referenced in the Pacific region; namely the Australian Qualifications Framework (AQF) and New Zealand Qualifications Framework (NZQF). Potential employees on the Project will be required to demonstrate that they can meet the qualification, experience and skill requirements equivalent to those listed for the type of position they are applying for. The basic requirements for each skill level, and equivalent qualifications, are respectively outlined in **Tables D1 and D2** below.

This approach is commensurate with agreements reached during the EPC Contract negotiation period.

Useful definitions:

Job:

A set of tasks designed to be performed by one person for an Employer in return for payment or profit.

Skill Level:

A function of the range and complexity of the set of tasks performed in a particular occupation.

Skill level is measured operationally by:

- *The level or amount of formal education and training.*
- *The amount of previous experience in a related occupation.*
- *The amount of on job training.*

List of Unskilled and Semiskilled Occupation Positions

Occupational Description	Peak	Experience	Education	Certificate (License)	Skill Level	Language
Document Controller	3	Over 3 years	Min Bachelor	Not Required	Skilled	English with fluency
Officie Clerk	3	Over 3 years	Min Bachelor	Not Required	Skilled	English with fluency
Construction Supervisor	1	Over 7 years	Min Bachelor	Not Required	Skilled	English with fluency
Civil Staff	26	Over 3 years	Min Bachelor	Not Required	Skilled	English with fluency
Architecture staff	2	Over 3 years	Min Bachelor	Not Required	Skilled	English with fluency
Quality team	4	Over 3 years	Min Bachelor	Not Required	Skilled	English with fluency
H&S Supervisor	1	Over 7 years	Min Bachelor	Not Required	Skilled	English with fluency
H&S Officer	10	Over 3 years	Min Bachelor	Not Required	Skilled	English with fluency
Emergency Supervisor	1	Over 5 years	Min Bachelor	Not Required	Skilled	English with fluency
Training supervisor	1	Over 5 years	Min Bachelor	Not Required	Skilled	English with fluency
Training staff	1	Over 1 years	Min Bachelor	Not Required	Skilled	English with fluency
E&S Supervisor	2	Over 7 years	Min Bachelor	Not Required	Skilled	English with fluency
Environmental Officer	5	Over 3 years	Min Bachelor	Not Required	Skilled	English with fluency
Social Supervisor	1	Over 7 years	Min Bachelor	Not Required	Skilled	English with fluency
CLO	4	Over 7 years	Min Form 6	Not Required	Semi-skilled	English with fluency
Doctor	1	Over 10 years	Min Bachelor	Required	Skilled	English with fluency
Nurse	2	Over 10 years	Min Bachelor	Required	Skilled	English with fluency
HR staff	5	Over 3 years	Min Bachelor	Not Required	Skilled	English with fluency
Admin staff	5	Over 3 years	Min Bachelor	Not Required	Skilled	English with fluency
Camp Manager	1	Over 10 years	Min Bachelor	Not Required	Skilled	English with fluency
Camp Maintenance	15	Over 3 years	Min Diploma	Not Required	Semi-skilled	English with fluency
Mechanic	9	Over 3 years	Min Diploma	Not Required	Skilled	English with fluency
Excavator operator	3	Over 5 years	Min Form 6	Required	Skilled	English with fluency
Dump truck driver	8	Over 3 years	Min Form 6	Required	Semi-skilled	English with fluency
Wheel loader operator	2	Over 5 years	Min Form 6	Required	Skilled	English with fluency
Mixer truck driver	4	Over 3 years	Min Form 6	Required	Semi-skilled	English with fluency
Cargo crane operator	3	Over 5 years	Min Form 6	Required	Skilled	English with fluency
Roller operator	1	Over 5 years	Min Form 6	Required	Skilled	English with fluency
Dozer operator	1	Over 5 years	Min Form 6	Required	Skilled	English with fluency
Water truck driver	1	Over 3 years	Min Form 6	Required	Semi-skilled	English with fluency
Fuel truck driver	1	Over 3 years	Min Form 6	Required	Semi-skilled	English with fluency
Grader operator	1	Over 5 years	Min Form 6	Required	Skilled	English with fluency
50ton crane opeator	1	Over 5 years	Min Form 6	Required	Skilled	English with fluency
Feller	7	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Carpenter	41	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Rebar worker	34	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Concrete worker	24	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Plumber	6	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Stonemason	2	Over 3 years	Min Form 6	Not Required	Semi-skilled	English with fluency
Guardrail worker	3	Over 3 years	Min Form 6	Not Required	Semi-skilled	English with fluency
Landscaping worker	12	Over 3 years	Min Form 6	Not Required	Semi-skilled	English with fluency
Paver	3	Over 3 years	Min Form 6	Not Required	Semi-skilled	English with fluency
Blaster	10	Over 7 years	Min Form 6	Not Required	Skilled	English with fluency
Shotcrete worker	13	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Scaffolder	15	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Anchoring worker	11	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Grouting worker	7	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Structural steel worker	6	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Mechanic	8	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Electrician	10	Over 5 years	Min Form 6	Not Required	Skilled	English with fluency
Welder	11	Over 7 years	Min Form 6	Not Required	Skilled	English with fluency
Casual worker	120	Over 1 years	Min Form 6	Not Required	Unskilled	English with fluency
House keeper	17	Over 1 years	Min Form 6	Not Required	Unskilled	English with fluency
Flag man	8	Over 1 years	Min Form 6	Not Required	Unskilled	English with fluency
Surveyor	2	Over 1 years	Min Form 6	Not Required	Unskilled	English with fluency
Helper	3	Over 1 years	Min Form 6	Not Required	Unskilled	English with fluency
Kitchen staff	20	Over 1 years	Min Form 6	Not Required	Unskilled	English with fluency
Nursery staff	3	Over 1 years	Min Form 6	Not Required	Unskilled	English with fluency
Driver	23	Over 3 years	Min Form 6	Required	Unskilled	English with fluency
Toal	548					

Table 1 Requirements for Skilled, Semi-skilled and Unskilled workers

Skill Category	Skill Level	Required work experience/training	Relevant qualifications (equivalent to)
Skilled	1	At least five years of relevant experience may substitute for the formal qualification. In some instances relevant experience and/or on-the-job-training may be required in addition to the formal qualification.	Bachelor degree or higher qualification
	2	At least three years of relevant experience may substitute for the formal qualifications listed. In some instances relevant experience and/or on-the-job-training may be required in addition to the formal qualification.	NZQF Diploma OR AQF Associate Degree, Advanced Diploma or Diploma.
	3	At least three years of relevant experience may substitute for the formal qualifications listed. In some instances relevant experience and/or on-the-job-training may be required in addition to the formal qualification.	NZQF Certificate Level 4 OR AQF Certificate IV OR AQF Certificate III including at least two years of on-the job training.
Semi-skilled	4	At least one year of relevant experience may substituted for the formal qualifications listed. In some instances relevant experience may be required in addition to the formal qualification.	NZQF Certificate Level 2 or 3 OR AQF Certificate II or III.
Unskilled	5	Short period of on-the-job training may be required in addition to or instead of the formal qualification. In some instances, no formal qualification or on-the-job training may be required.	NZQF Certificate Level 1 OR AQF Certificate I OR compulsory secondary education.

Table 2 Equivalent qualifications required for each skill level

Qualification	Purpose / Summary	Outcomes	Skills	Application
Australian Qualifications Framework (AQF)[1]				
Certificate I	Graduates at this level will have knowledge and skills for initial work, community involvement and/or further learning.	Graduates at this level will have foundational knowledge for everyday life, further learning and preparation for initial work.	Graduates at this level will have foundational cognitive, technical and communication skills to: • undertake defined routine activities • identify and report simple issues and problems	Graduates at this level will apply knowledge and skills to demonstrate autonomy in highly structured and stable contexts and within narrow parameters

Qualification	Purpose / Summary	Outcomes	Skills	Application
Certificate II	Graduates at this level will have knowledge and skills for work in a defined context and/or further learning.	Graduates at this level will have basic factual, technical and procedural knowledge of a defined area of work and learning.	Graduates at this level will have basic cognitive, technical and communication skills to apply appropriate methods, tools, materials and readily available information to: • undertake defined activities • provide solutions to a limited range of predictable problems	Graduates at this level will apply knowledge and skills to demonstrate autonomy and limited judgement in structured and stable contexts and within narrow parameters.
Certificate III	Graduates at this level will have theoretical and practical knowledge and skills for work and/or further learning.	Graduates at this level will have factual, technical, procedural and some theoretical knowledge of a specific area of work and learning.	Graduates at this level will have a range of cognitive, technical and communication skills to select and apply a specialised range of methods, tools, materials and information to: • complete routine activities • provide and transmit solutions to predictable and sometimes unpredictable problems	Graduates at this level will apply knowledge and skills to demonstrate autonomy and judgement and to take limited responsibility in known and stable contexts within established parameters.
Certificate IV	Graduates at this level will have theoretical and practical knowledge and skills for specialised and/or skilled work and/or further learning.	Graduates at this level will have broad factual, technical and some theoretical knowledge	Graduates at this level will have a broad range of cognitive, technical and communication skills to select and apply a range of methods, tools,	Graduates at this level will apply knowledge and skills to demonstrate autonomy, judgement and limited responsibility in known or changing contexts and within

Qualification	Purpose / Summary	Outcomes	Skills	Application
		of a specific area or a broad field of work and learning.	materials and information to: • complete routine and non-routine activities • provide and transmit solutions to a variety of predictable and sometimes unpredictable problems	established parameters.
Associate Degree, Advanced Diploma or Diploma (Level 5/6)	Graduates at this level will have specialised knowledge and skills for skilled/paraprofessional work and/or further learning	Graduates at this level will have technical and theoretical knowledge in a specific area or a broad field of work and learning.	Graduates at this level will have a broad range of cognitive, technical and communication skills to select and apply methods and technologies to: • analyse information to complete a range of activities • provide and transmit solutions to sometimes complex problems • transmit information and skills to others	Graduates at this level will apply knowledge and skills to demonstrate autonomy, judgement and defined responsibility in known or changing contexts and within broad but established parameters. Graduates at Level 6 would additionally provide specialist advice and functions.
New Zealand Qualifications Framework[2]				
Certificate Level 1	Qualifies individuals with basic knowledge and skills for work, further learning and/or community involvement	N/A	A graduate of a level 1 certificate is able to: • demonstrate basic general and/or foundation knowledge • apply basic skills required to carry out simple tasks • apply basic solutions to simple problems • apply literacy and numeracy skills for participation in everyday life • work in a highly structured context	

Qualification	Purpose / Summary	Outcomes	Skills	Application
			• demonstrate some responsibility for own learning • interact with others.	
Certificate Level 2	Qualifies individuals with introductory knowledge and skills for a field(s)/areas of work or study.	N/A	A graduate of a level 2 certificate is able to: • demonstrate basic factual and/or operational knowledge of a field of work or study • apply known solutions to familiar problems • apply standard processes relevant to the field of work or study • apply literacy and numeracy skills relevant to the role in the field of work or study • work under general supervision • demonstrate some responsibility for own learning and performance • collaborate with others.	
Certificate Level 3	Qualifies individuals with knowledge and skills for a specific role(s) within fields/areas of work and/or preparation for further study	N/A	A graduate of a level 3 certificate is able to: • demonstrate some operational and theoretical knowledge in a field of work or study • select from and apply a range of known solutions to familiar problems • apply a range of standard processes relevant to the field of work or study • apply a range of communication skills relevant to the role in the field of work or study • apply literacy and numeracy skills relevant to the role in the field of work or study • work under limited supervision • demonstrate major responsibility for own learning and performance • adapt own behaviour when interacting with others contribute to group performance.	
Certificate Level 4	Qualifies individuals to work or study in broad or specialised field(s)/ areas	N/A	A graduate of a level 4 certificate is able to: • demonstrate broad operational and theoretical knowledge in a field of work or study • select and apply solutions to familiar and sometimes unfamiliar problems	

Qualification	Purpose / Summary	Outcomes	Skills	Application
			• select and apply a range of standard and non-standard processes relevant to the field of • work or study • apply a range of communication skills relevant to the field of work or study • demonstrate the self-management of learning and performance under broad guidance • demonstrate some responsibility for performance of others.	
Certificate Level 5 / Diploma	Qualifies individuals with theoretical and/or technical knowledge and skills within a specific field of work or study.	N/A	A graduate of a level 5 diploma is able to: • demonstrate broad operational or technical and theoretical knowledge within a specific • field of work or study • select and apply a range of solutions to familiar and sometimes unfamiliar problems • select and apply a range of standard and non-standard processes relevant to the field • of work or study • demonstrate complete self-management of learning and performance within • defined contexts • demonstrate some responsibility for the management of learning and performance • of others.	

Notes:

[1] *From the Australian Qualifications Framework, Second Edition January 2013, available at https://www.aqf.edu.au/aqf-levels*

[2] *From the New Zealand Qualifications Framework, May 2016, available at https://www.nzqa.govt.nz/assets/Studying-in-NZ/New-Zealand-Qualification-Framework/requirements-nzqf.pdf*