Part I: INTRODUCTION

Background

Returned Peace Corps Volunteer, William Nutt, (RPCV Southern Leyte-Philippines 1979-1981), serving as a Peace Corps Response Volunteer (PCRV), conducted this assessment from mid-June to the end of November 2014. William was assigned to the Municipal Government Planning office, in Guiuan, Eastern Samar as a "Comprehensive Environmental Land Use Planning Expert". Guiuan was the municipality that received the initial and direct impact of Super Typhoon Yolanda November 8, 2013. These locations are shown in Figure 1 below. As a member of the Guiuan Planning and Emergency Recovery Group, William participated in the gathering of local environmental data, and provided technical assistance in data processing, analysis, and geo-spatial presentation.

Figure 1: Location of Guiuan in the Central Philippines and Locations of Volunteer Service

The typhoon of November 8, 2013 is named Yolanda locally and Haiyan internationally. In this report, it will be referred to as "the typhoon" or Yolanda (Figure 2). The recovery and rebuilding efforts over the past year by the citizens of Guiuan have been remarkable. Local leaders are single minded in their resolve to "build back better" and are assisted by many Non-government agencies both international and Philippine based. UN agencies, OXFAM, and the Red Cross are among some of the high profile agencies that have made long-term commitments to the recovery. Credit goes to Operation Blessing and Y'S Men, two faith-based organizations, for restoring water sources in areas with the most critical needs.

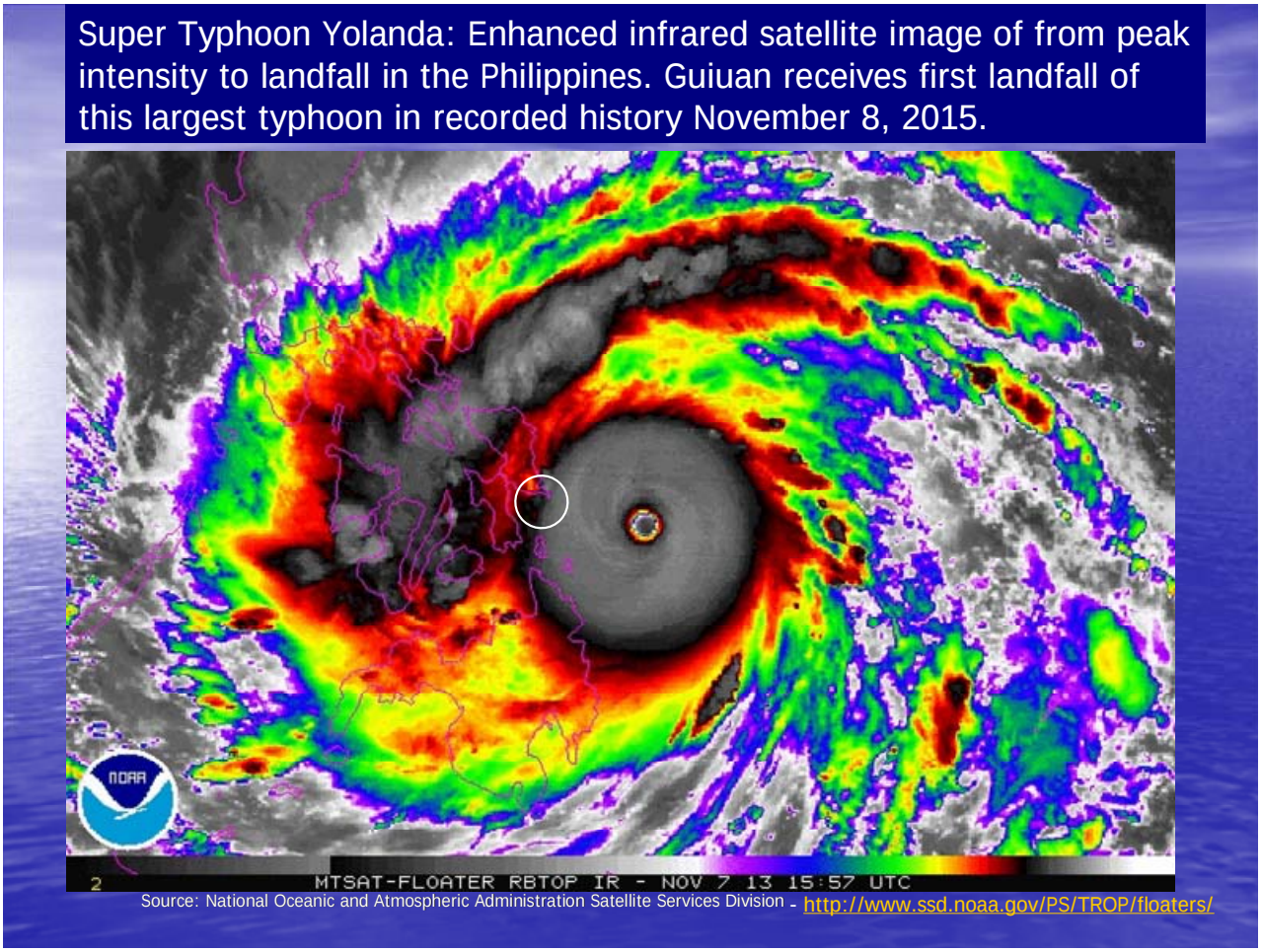


Figure 2: Super Typhoon Yolanda takes aim at Guiuan.

This report documents aspects and access to the freshwater resources of the karst aquifer along with evaluation of other ecological sensitive areas. Using ArcGIS, the volunteer was instrumental in producing an accurate political boundary map by coordinating the geo-referencing and digitizing the blueprint cadastral survey maps and other printed maps of the 60 barangays.

The assessment of water resources can be used in revising the Comprehensive Land Use Plan 2014-2022 as the municipality strives to build on what has been accomplished post-disaster and achieve long- term planning goals. The leaders and citizens of Guiuan are working to restore and improve the quality of life of residents while protecting and conserving the environment for future generations and restore its position as a premier location for ecotourism in the Philippines.

Local leadership as referred to throughout this report emphasizes that leadership in any form is a powerful force in improving the environment in our communities. While this all inclusive term refers primarily to elected representatives and executives, appointed officials, and staff members at the municipal and barangay level, local leadership may represent those environmentally inclined leaders, young and old, found in every community: The young man who vigorously protects his spring from contamination when used by his neighbors in Cagdara-o; the elderly lady in Ward 12 who comes to tears when she speaks of a time the stream ran free from litter. All citizens have a stake in protecting the environment and leadership may come from unexpected places in the community.

Environmental problems are local. The NGOs only provide temporary assistance. They will be gone tomorrow. We cannot wait for the various levels of government to trickle down the money necessary to improve the environment in our communities. Often, they are complicit with the global economic growth interests in the wholesale destruction of our natural

ecosystem. The environment needs local leadership. The poorest among us will perhaps do more to save the natural world with the challenges we face today. There are serious environmental issues at the national and global level, however, if we are proper stewards of the earth at home and in our communities, we can contribute and do our part in working toward solutions to global environmental issues.

The stresses involved with typhoon recovery have driven home the point that the scenic landscape is also functional and provides valuable environmental services. In addition to their aesthetic qualities, sustainable forest and agricultural practices protect the watershed. Coral reefs, old growth tropical forests and mangroves are nurseries for wildlife and fish and shelter coastal barangays from the effects of storms. As pressures of development, population growth and natural disasters such as Yolanda increase, homegrown Philippine environmentalism in the form of local preservation and conservation movements have emerged.

Environmentalism is not simply a matter of recycling, litter cleanup or promoting eco-tourism. These one dimensional and limited campaigns and programs, emphasized by the politicians and development officials, work to deflect the attention from the real issues and true principals of sustainable development. The lush paradise of the Philippines is being ravaged at a rapid pace by mining and logging companies, extensive coastal fish farms and multinational agribusiness corporations (Broad 1993). Economic development is pursued at all cost. Supported by national government policies, these cost in the form of degradation to the natural environment cannot be sustained.

As the threat of global climate change compounds the negative effects of unsustainable growth on the overfished waters, scarce agriculture lands, and disappearing forests, rural populations are placed in a position of having to fight for their survival. Guiuan is one of the front battle lines in this struggle. Frequent news from rural areas of Homonhon and Manicani

Islands tells us of local revolts where protesters block mining operations, risking their lives (Holden 2012). The people of Guiuan, along with their international partners, are striving to "build back better" and "get it right" when it comes to protecting the environment and ensure sustainable future for everyone.

Initial Mapping Methodology

Guiuan is a municipality, or Local Government Unit (LGU), at the southern tip of Eastern Samar consisting of a narrow peninsula surrounded by numerous large islands that make up a substantial part of the total Municipal area. As an essential part of this assessment, the first mapping task was to construct an accurate GIS map of Guiuan. The existing maps in shapefile (GIS) format available at the Philippine GIS clearinghouse were found to be produced with little consideration for accurate boundaries and were of little use for this study (Figure 3). Surprisingly, while they did not represent the actual boundaries, they were in widespread use by relief agencies currently undertaking rebuilding efforts in Guiuan.

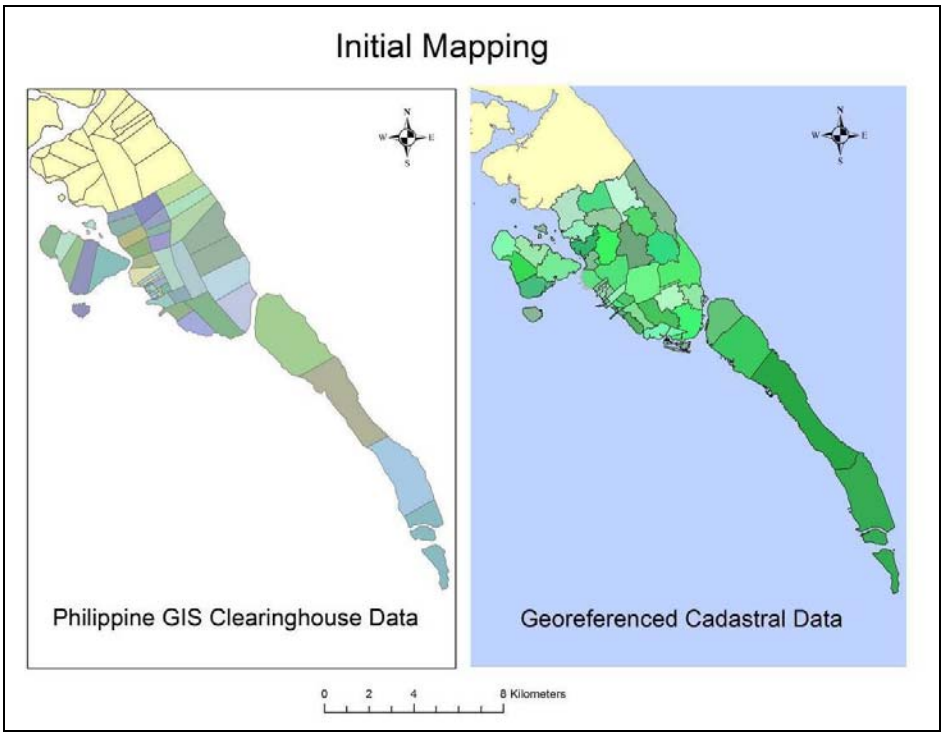


Figure 3: Before and after maps illustrating the improvements made in the representation of the political boundaries of Guiuan.

Figure 4: The Guiuan Peninsula with major outlying Islands of Calicoan, Tubabao, Manicani, Homonhon, and Suluan and the political boundaries of the Barangays.

Having a map with spatially accurate barangay boundaries was an initial imperative recognized early on by the LGU recovery team. The regional offices provided recent cadastral survey maps in scanned bitmap format. UN staff constructed the first detailed GIS map from a current Google Earth image. This initial map contained high-resolution coastal details and the major and minor outlying islands (Figure 4). The volunteer geo-referenced the cadastral maps using ArcGIS 10.2 onto the coastline base map. Using the coastal data along with open source road shapefiles, the volunteer produced a more accurate barangay map. Where no cadastral data existed of barangays boundaries, the volunteer interpolated borders from neighboring barangays and other printed maps. Further ground confirmation using GPS data points along

with local knowledge, improved the accuracy of the base map. The maps in Figures 5 to 10 below present boundaries of the 60 Barangays of Guiuan.

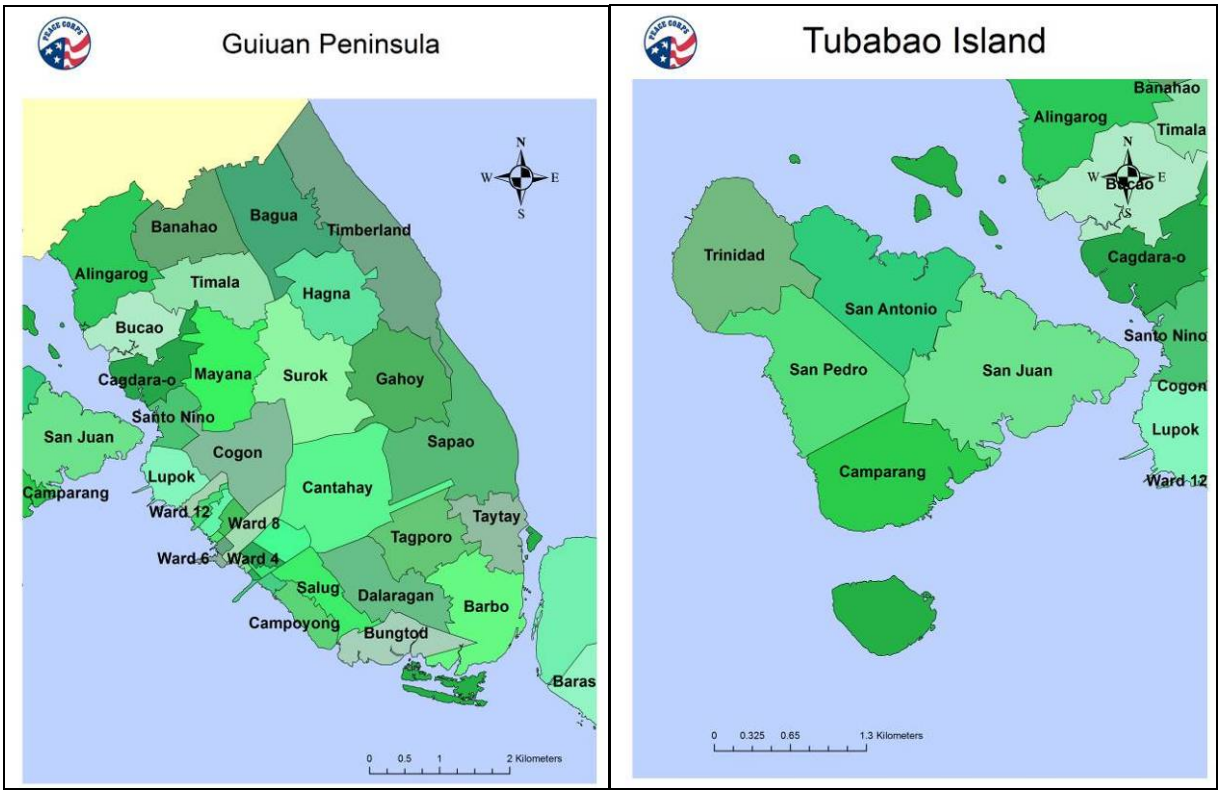


Figure 5 & 6

Figure 7 & 8

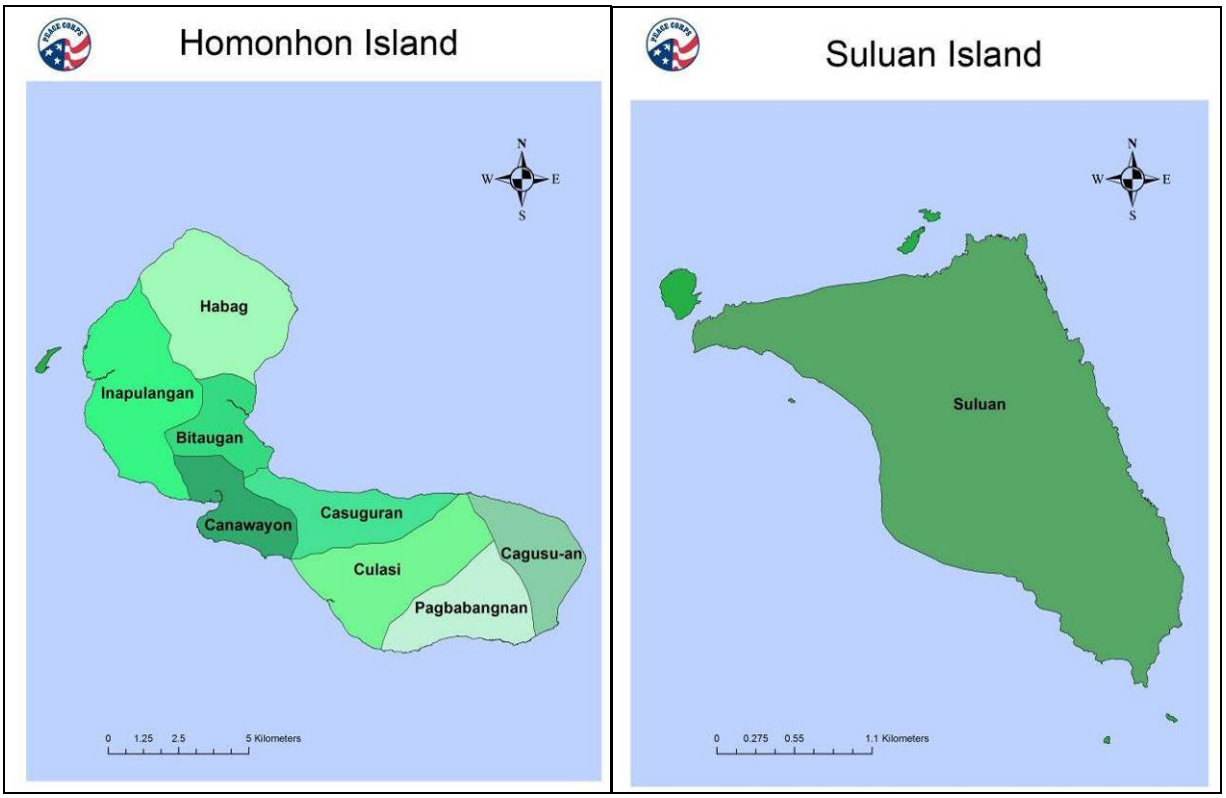


Figure 9 & 10

Geology of Guiuan

The Philippine Islands were formed by tectonic forces that coalesced into the present island archipelago from continental elements once connected to Australia and Asia. Since formation, the islands have been, and continue to be, influenced by further uplift, volcanic activity, and changing sea level due to climate variations. The basement rocks of Samar are composed of highly eroded layers of sandstone and shale on top of layers of volcanic origin laid down about 100 million years ago during the Cretaceous Period. Later tectonic forces and reef-building have shaped the landscape during the last million years. There are two different limestone formations in Guiuan, both of reef origin, the Coralline Limestone that was formed during the Lower to Middle Miocene Geologic Periods, about 25 million years ago, and the Calicoan Limestone from the Upper Pliocene to Pleistocene Geologic Periods, about 2 million years old (Travaglia 1978). Figure 11 contains an estimation of the major events of the formation of Guiuan in relation to Geologic Time.

Era	Period	Epoch	MYA	Guiuan Geology	Worldwide
Cenozoic	Quaternary	Holocene	Recent	Reef Building, Tectonic Uplift, Volcanism	Humans transform the environment.
		Pleistocene	0.01	Calicoan Limestone Formed	Humans emerge; Ice Ages
	Tertiary	Pliocene	1.6	Pacific Ridge Formation	Apes and monkeys appear
		Miocene	5	Coraline Limestone Formed	Rise of grasses
		Oliogocene	25		First elephants; Massive coral extinction
		Eocene	34		Extinction events; climate extremes
		Paleocene	54		Mammals become dominant
Mesozoic	Cretaceous		65	Basement layers of Samar Formed	Dinosaurs become extinct
	Jurassic		145		Dinosaurs rule the Earth
	Triassic		208		Dinosaurs emerge; first mammals
Paleozoic	Permian		250		Conifers appear
	Pennsylvanian		290		Vast forests create coal beds
	Mississippian		323		First forests appear
	Devonian		362		Fern type plants appear
	Silurian		408		First land plants and jawed fishes
	Ordovician		439		Ocean vertibrates
	Cambrian		510		Ocean invertibrates
Precambrian			570		Early multicellular animals
			4500		Earth Formation

Figure 11: Geological Time Scale including Guiuan Geological History.

The Coralline Limestone (Slide 3) caps a great part of central and southern Samar including Guiuan. It is a thick and massive reef limestone and exhibits well developed karst landforms in the region. The Calicoan limestone (Slide 2 & 4), on the other hand, is soft and porous with poorly developed karst topography. It occurs in scattered areas along the eastern coast of Samar between Sulat north of Borongan and the southern tip of its namesake, Calicoan Island. Both Coralline and Calicoan limestone have a color that ranges from light cream to pinkish cream on fresh surfaces and light or dark gray when weathered. The Guiuan Peninsula and Calicoan Island, constituting an elongated landmass striking southeast at the southern tip of mainland Samar, were shaped by the tectonic forces that control the main Philippine Fault System running the length of the Philippine Islands and bisecting Leyte to the east (Figure 12). One of these major forces is the subduction occurring at the Philippine Trench located to the east of Guiuan and dipping to the west. Another zone of subduction lies to the west of the Philippine archipelago (Travaglia 1978).

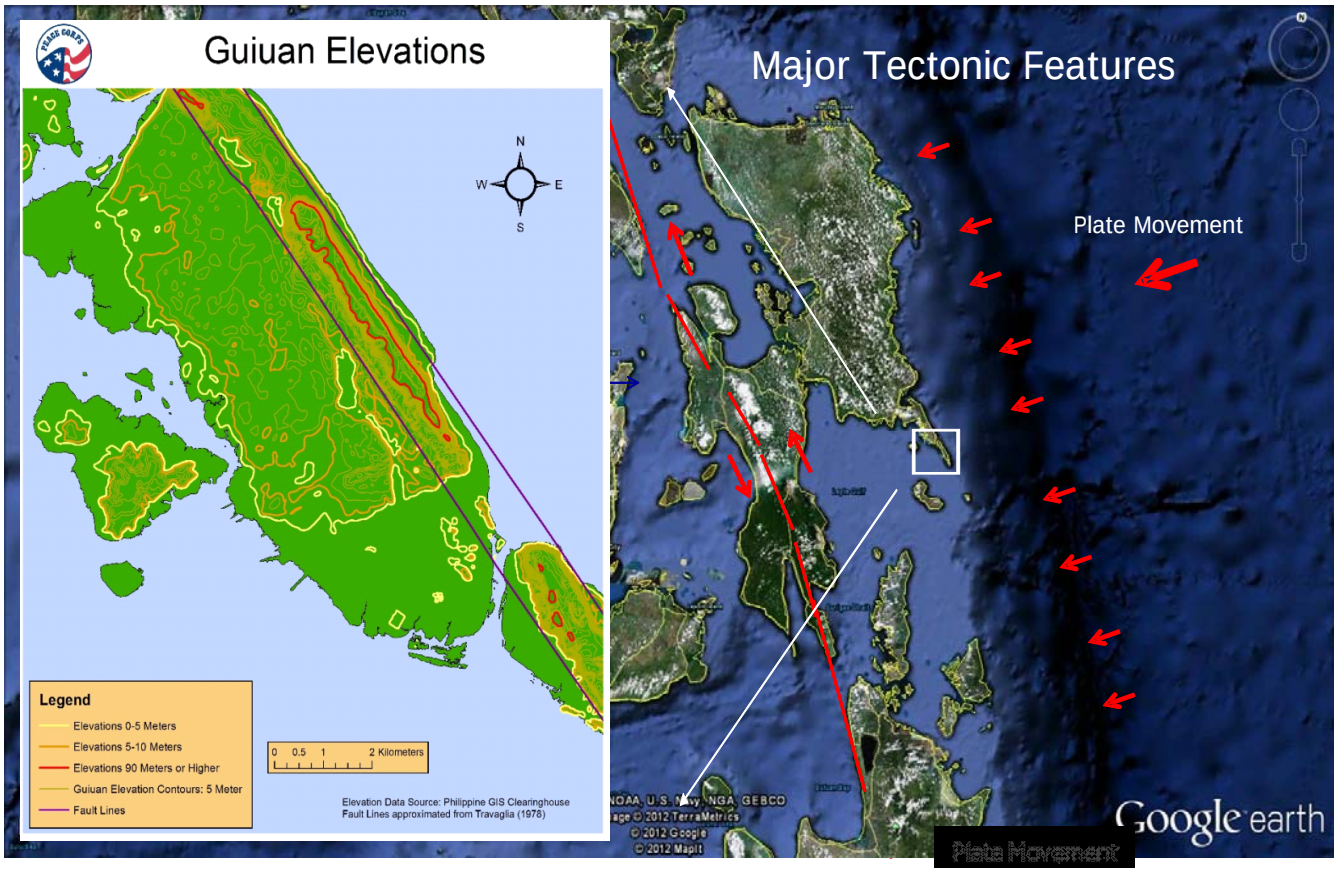
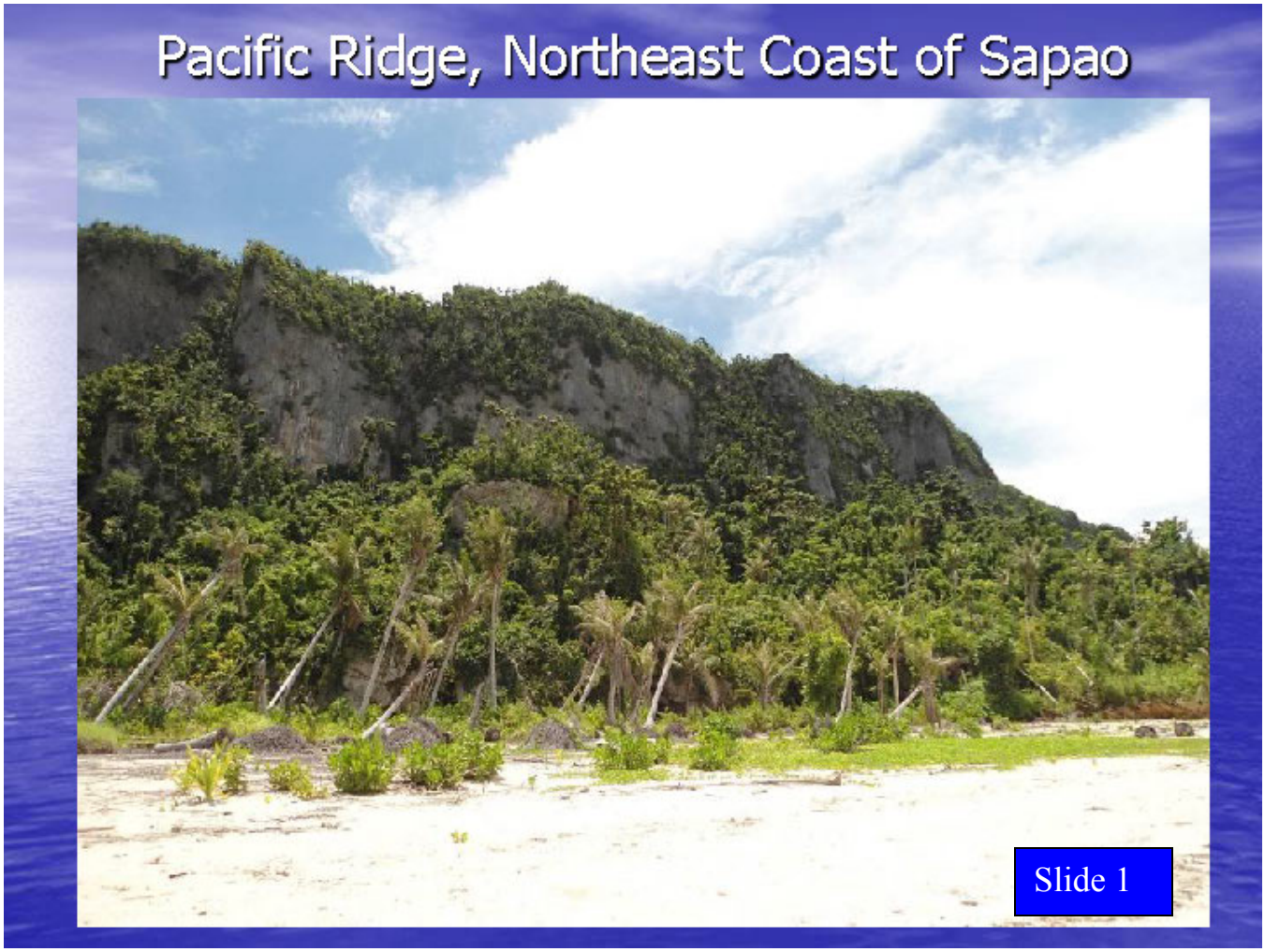


Figure 12: Major Tectonic Features and Elevations of Guiuan

The backbone of Guiuan is constituted by a massive linear ridge that dominates the landscape (Slide 1). The ridge extending down the Pacific coast is fault controlled and straight, trending northwest and is composed of an uplifted block, about 100 meters high, of Coralline limestone. Tectonic forces creates shearing that has caused the block of older limestone to uplift. The faults along the ridge are part of the larger system that crisscross Samar. Subsequent younger coral formations accumulated around this block of crystallized limestone and form the rolling hills to the west of the ridge and an almost continuous strip along the east coast. An additional uplift of 40 meters occurred and the subsequent erosion created the karst landscape we see today. Dolines, either originated by solution of limestone or by collapse of underlying caves with underground channels and rivers are very common. There is evidence

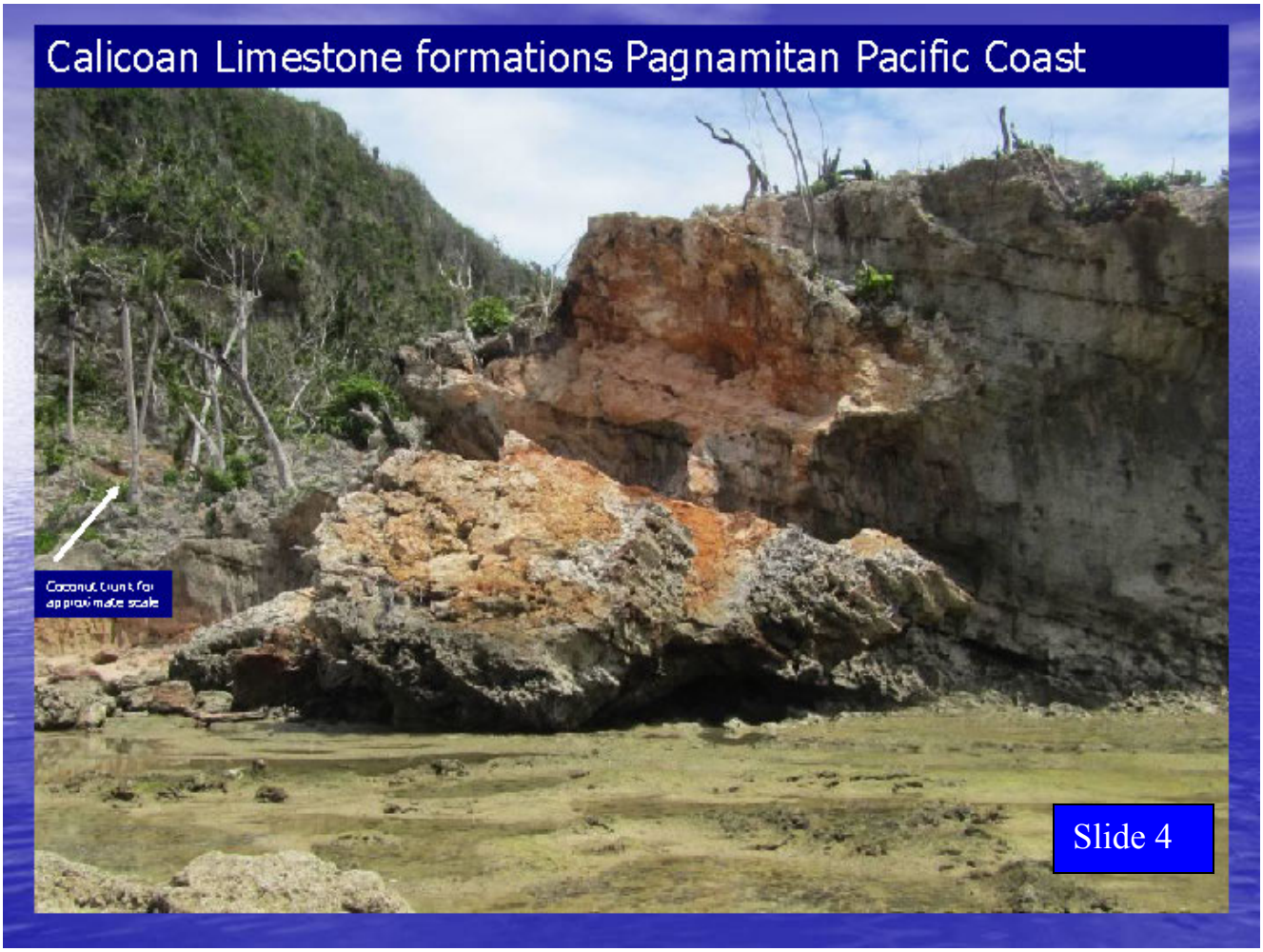
of extensive regions of collapse along and north of the Navy Road in Cogon and along the barangay connecting road through Gahoy, Hagna and Bagua (Travaglia 1978).



Another dominant feature of the peninsula and island geology is the red clay or "terra rosa" that is found in most areas and elevations. The coastal regions have sediments and beach deposits typical of those formed by the tidal forces in coral reef environments. There are significant quantities of limestone breccas, coralline rubbles and sand deposits that are being mined for housing and infrastructure rebuilding and development. Mining of the granulated coral deposits consists of large borrow pits excavated with earth moving equipment or small “cottage industry” household manual chipping operations among the limestone formations.


Calicoan Limestone formations Pagnamitan Pacific Coast
Coconut trunk for approximate scale
Slide 2


Coralline Limestone outcrop, Sapao North Pacific Coast.
Garmin GPS for scale
Slide 3



The field survey found evidence of recent volcanism at the northwestern tip of Suluan Islands in the form of basaltic pillow lava formations and remnants of cinder cones. On Tubabao Island in San Juan, traces of a volcanic crater and extrusive volcanic rocks and boulders are present. The major roads through the barangay are paved with andesitic gravel that is actively being quarried from the rim and floor of the crater. Homonhon Island beaches are littered east and west with angular basaltic boulders (Slides 5 to 10).

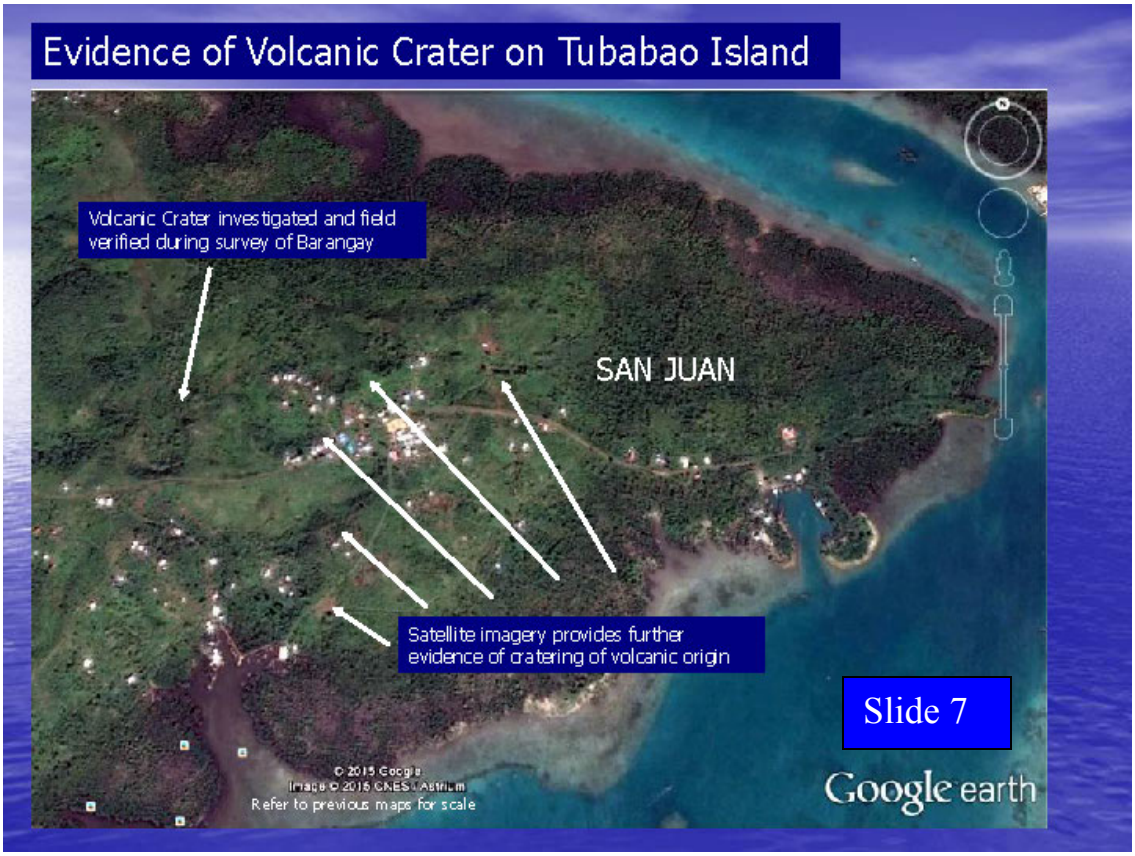
Differential Weathering in Calicoan Limestone formations on Pagnamitan Pacific Coast. Dark red inclusions of perhaps volcanic origin.

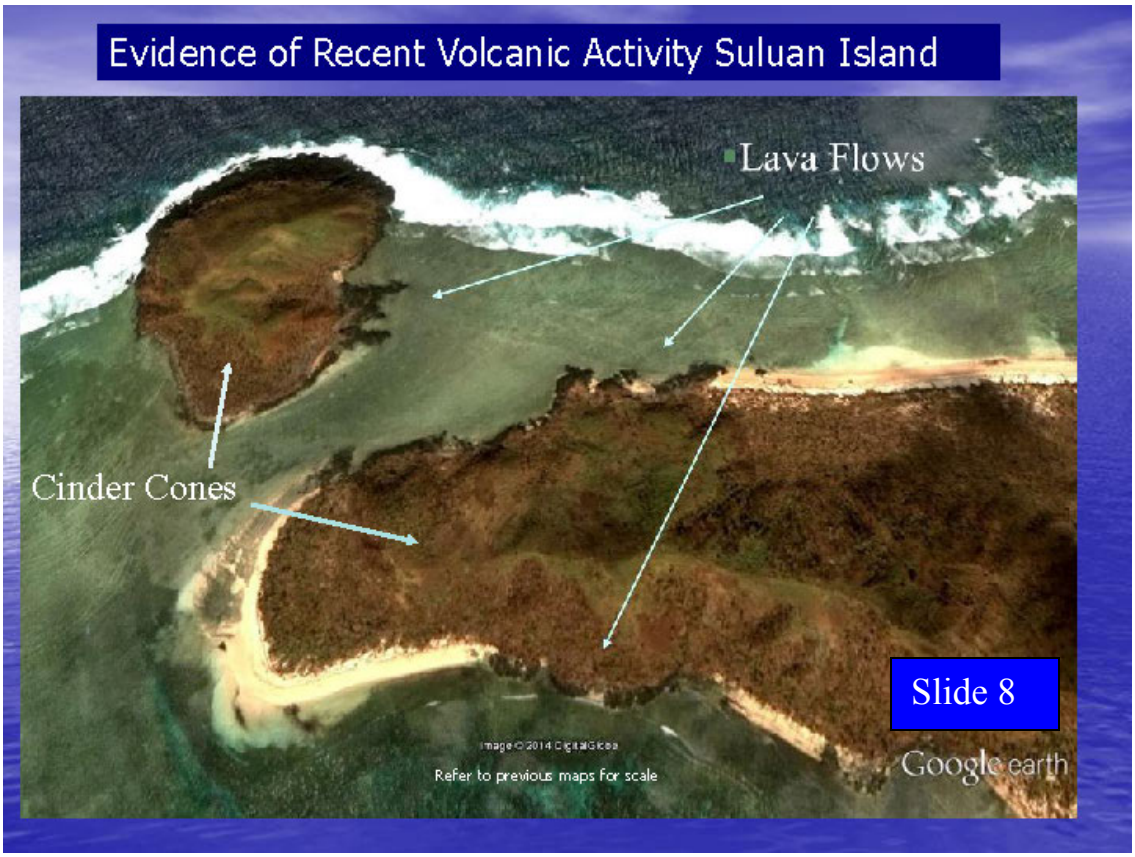
Slide 5

Andesitic gravel pile

Andesitic boulder being quarried on floor of crater

Slide 6


Evidence of Volcanic Crater on Tubabao Island
Volcanic Crater investigated and field verified during survey of Barangay
SAN JUAN
Satellite imagery provides further evidence of cratering of volcanic origin
Slide 7
Refer to previous maps for scale
Google earth


Evidence of Recent Volcanic Activity Suluan Island
Lava Flows
Cinder Cones
Slide 8
Refer to previous maps for scale
Google earth


Evidence of Recent Volcanic Activity Suluan Island Lava Flows
Lava Flows
Slide 9


Pillow Lava Northwest Peninsula Suluan Island
Slide 10

Guiuan and World War II

The local geology of Guiuan played a key role during the Liberation of the Philippines from the Japanese during World War Two (Slides 11 to 14). When the allied forces landed in Leyte, they found the soil unsuitable for the construction of their advance support bases. The drive to liberate the islands required extensive repair, logistics and tactical facilities to land and store material for carrying out the fight throughout the archipelago. After the initial survey of Leyte did not turn up any contiguous usable sites for their facilities, the US Navy decided on the thin soiled Guiuan Peninsula and Islands for their expansive bases. The ample coral outcrops and sturdy base rocks proved ideal for the construction of a large airfield and numerous satellite facilities (U.S. Navy 1946).

The initial survey party of four officers and 100 enlisted men arrived in Guiuan on November 30, 1944. The work on the airfield began almost immediately and was carried on around the clock. Two weeks later the first heavy planes landed. The Navy produced 7000 feet of a 100-foot wide airstrip with taxiways, requiring the movement of more than 344,000 yards of mud and coral. The first fighter plane squadron was positioned there on December 22 and

the final surface of yellow coral was finished on the 15th of January. This allowed for heavy bombers to be stationed in Guiuan (U.S. Navy 1946).

Tubabao Island was the location of a receiving station consisting of a Quonset city with accommodations for 10,000 men that included recreation facilities and mess halls. Tubabao was connected to the peninsula by a timber bridge, 515 feet long and 22 feet wide, with a 58-foot clear span in the center of the channel. A major destroyer repair base and ship repair unit were built on Manicani Island that included wharves and berths for six large floating dry-docks. On Manicani, facilities for 10,000 men were constructed on 150 acres of swamp that was filled with coral excavated from the surrounding waters using blasting and dredging (U.S. Navy 1946).

On Calicoan Island, the Navy built facilities for storage and issue of general provisions and automotive/construction spare parts that supported the entire Philippine area of operation. Provisions for perishable goods consisted of twenty-four 6,800 cubic-foot refrigerators. Pier facilities were built on the Leyte Gulf side of Calicoan with places for seven cargo ships and five smaller vessels (U.S. Navy 1946).

Among the warehouses on Calicoan were a post office and movie theatre. To construct access roads and other hard areas, rolled coral was used and provided an excellent all weather surface. When the total project was complete in August of 1945, the Navy had used 150 tons of dynamite for grading and quarry work. A hospital and PT boat facility were built in Mercedes and Salcedo to the north. Overall, only Guam exceeded Samar in the Navy's total monetary investment in advanced bases in the Far East (U.S. Navy 1946).

Figure 14a: From the US Navy ArchiveAdditional picture of the Guiuan Airfield at peak of activity during WWII. Downtown Guiuan is in the bottom left-hand corner.