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The cover image is a view of the Chixoy River, Guatemala. Image courtesy of Brent K. S. Woodfill.

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FEATURE

# ETHNOGRAPHY AND ARCHAEOLOGY OF WATER IN THE MAYA LOWLANDS

By Alexander E. Rivas and William G. B. Odum

**P**rocurring potable water is an important factor for daily life in the semitropics, especially for contemporary populations in rural Guatemala. Seasonal subsistence practices are crucial for survival, especially regarding agriculture, droughts, and flooding. This article focuses on the Salinas de los Nueve Cerros region in Alta Verapaz, Guatemala to highlight contemporary

land-use practices among the Q'eqchi' Maya, their adaptations to flooding, droughts, and uses of different water resources. It then uses these data to better hypothesize how the ancient Maya inhabitants may have used these resources in the same landscape. Additionally, this research offers an account of how the site's contemporary residents imagine the terrain in relation to its



*A modern groundwater well in an ancient depression. Q'eqchi' farmers are taking advantage of ancient landscape practices for their own subsistence. Image courtesy of Alexander Rivas.*

historical inhabitants, and how this influences their current subsistence patterns. In understanding how ancient and current populations interacted with and modified their landscapes,

our research highlights the potential for solving issues of water scarcity and potability through the creativity and agency of the local population for a direct applied result of collaborative work.

## Introduction

Water is an essential resource for sustaining society, communities, and ecology. Many ancient societies emerged and urbanized in areas with natural water resources, which elites took advantage of to control hydraulic systems and exact tribute from local populations. Water in the Maya Lowlands, comprising parts of Mexico and upper Central America (Figure 1), was historically scarce during the dry season, lasting from late May through December and receiving less than ten percent of the annual rainfall. The region is largely a karst environment, which means that water quickly flows through to the groundwater system with limited surface accessibility due to the porous nature of the limestone bedrock. Water in swamps, ponds, or karst aquifers is prone to contamination and salinity. Despite these issues, the success of ancient communities rested on hydraulic systems. This drove ancient Maya populations to not only use the naturally available water resources, such as rivers, streams, ponds, and the sea, but also to construct their own water catchment features, such as water reservoirs, wells, and canals.

For archaeologists, recording the location of water catchment areas and other water resources, including rivers, streams, lakes, and swamps, is just as important as their excavation and laboratory analyses. Spatial analyses of these locations can provide information on settlement patterns, which is important for understanding decision-making and resource availability in the past. Using the location of water catchment areas and settlements, archaeologists can try to determine how different parts of a site were used. The use of GIS (geographic information systems) can aid with the settlement pattern research by creating

distinct watershed views, looking at drainage patterns, and creating 3-D models of such archaeological features (Weaver et al. 2015). Field excavations of canals, wells, and water reservoirs also provide insights into the formation of these catchments, their size, and their relationship to the surrounding archaeological features.

Many ancient Maya cities were able to control and exploit natural resources for over a millennium, even in times of uncertainty, while others collapsed. These conditions allow us to consider multiple research questions pertinent to the analysis of the riverine settlement at Salinas de los Nueve Cerros. How did the ancient Maya control their water resources at the site? How did seasonality affect resource exploitation? What systems of water procurement allowed the inhabitants of Salinas de los Nueve Cerros, meaning “Saltworks of the Nine Hills” (now referred to simply as Nueve Cerros), to adapt to seasonal droughts and political collapse? To answer these questions, we took a dual ethnographic and archaeological approach, using ethnographic data on current Q’eqchi’ land-use practices and understandings of seasonality, topography, and water, as well as archaeological GIS data providing spatial information on the multiple water resources located within Nueve Cerros. We argue that the ancient Nueve Cerros inhabitants most likely developed a decentralized system of water control, with groundwater providing potable water for most of the ancient population as it does for the Q’eqchi’ today. This greatly contrasts with the system of water procurement elsewhere in the ancient Maya Lowlands. This study explains how a multi-disciplinary approach using GIS/remote sensing modeling and ethnographic investigation can



*Figure 1. Map of the Maya region with locations of major archaeological sites. Map courtesy of Alexander E. Rivas.*

bring new perspectives into ancient Maya water management. In addition, this article considers how the relationship between contemporary populations and ancient water-use practices can inform approaches to modern issues with water scarcity and potability.

Our aim is to outline the relational analogies that can be made between current Q'eqchi' inhabitants of Nueve Cerros and the ancient Maya population that lived in this region. In relational analogies (as described by Wylie 2002 and Lane 2008), similarities between ancient and modern practices are justified either by close cultural continuity between archaeological and ethnographic cases, or through similarities in cultural forms. We outline how landscape management practices

and opportunistic strategies of water collection today may have been similar among the ancient inhabitants. The authors recognize that current practices by Q'eqchi' have been heavily influenced by a multitude of factors. Wartime and post-war conditions and the growing prevalence of cattle farms and African palm oil production have displaced communities. Additionally, modern property law, debt, and ownership systems define people's relationship—often precarious—with the land (Grandia 2012, Ybarra 2018, Woodfill 2019). However, the analogies being made here will focus on aspects of the daily water management practices that the Q'eqchi' and ancient Nueve Cerros peoples faced living on the very same terrain.

## The Ancient Maya

The earliest evidence of people inhabiting the Maya Lowlands began in what is considered the Paleoindian and Archaic Periods, ranging from about 12000 to 2000 B.C. Archaeological remains such as spearpoints and mammoth bones during this period show strong similarities to other Archaic Period artifacts across the Americas. These groups of peoples included nomadic hunter-gatherers and territory based foragers, as well as people inhabiting small villages. The cultural identity of what we consider Maya peoples did not appear until after the archaic, in the Preclassic Period (1000 B.C.–A.D. 250). The three major cultural developments that occurred during this period were the beginnings of agriculture with maize as a staple crop, the adoption of ceramic technology, and the rise of sedentism and ceremonial centers (Inomata et al. 2013). Many large Maya cities began to emerge toward the end of the Preclassic, ushering in new political systems and long-distance networks of exchange between people in different areas of the Maya Lowlands. Termed the Classic Period (A.D. 250–900), this florescence of Maya culture was marked by the development of hieroglyphic

writing, the establishment of divine kingships, and large-scale landscape modifications (Sharer and Traxler 2006). However, by A.D. 900 many cities experienced rapid depopulation and political collapses. Most hieroglyphic inscriptions in Classic Maya cities ceased by A.D. 900. The reasons for the collapse are uncertain, but scientific evidence suggests that there were a series of major droughts between A.D. 800 and 900. The restructuring of Maya culture can be seen by a rise in large political centers located in the northern Lowlands in what is termed the Postclassic Period (A.D. 900–1521). These final Maya cities persisted until the arrival of Spanish conquistadors in 1521. The Classic Period collapse and the arrival of the Spanish did not result in a total population collapse, however, and there are many indigenous Maya populations currently inhabiting Central America and Mexico.

With the chronology of the Maya region in mind, Maya archaeologists strive to understand the specifics of Maya culture. Research topics range from plant/animal relations with the Maya, to the chronology of dynastic rulerships as recorded

on stelae, or standing stone monuments, to broadening our understanding of the full landscape management by Maya settlers (Chinchilla Mazariegos 2017; Coe and Houston 2015). For

## Salinas de los Nueve Cerros

Salinas de los Nueve Cerros is located in the Guatemalan department of Alta Verapaz, near the border of El Quiche, Guatemala and Chiapas, Mexico. The site is defined by multiple dramatic topographic features (see Figure 2). The Nueve Cerros Ridge is 21 km long and forms the western border of the site. The Tortugas salt dome is approximately 3 sq km and forms the southeastern limit and central part of the city. The Chixoy River forms the northern and north-eastern boundary of the site, and serves as an artery for trade. The hydrological features at the site are very complex, with streams leading into the Chixoy River from springs around the site, a perennial brine stream leading from the hills to the Chixoy River, and seasonal swamps located near the southern portion of the site (Woodfill et al. 2015). The salt flats surrounding the brine stream have 1,500 metric tons of salt available on the surface at any given time. In fact, salt was a critical economic stimulus for Nueve Cerros as it was produced and traded for nearly 2000 years (Woodfill et al. 2015).

Nueve Cerros has a long history of occupation beginning in the Middle Preclassic (1000 B.C.) and continuing until the early Postclassic Period (A.D. 900–1200). Currently the northern area of the site, the Tierra Blanca zone, is the earliest architectural group at the site and also has the longest occupational history from the Preclassic to the early Postclassic. Southern Lowland style ceramics, usually characterized by a deep red slip, are the primary ceramic groups recovered in Preclassic contexts, suggesting strong early ties to other Southern Lowland sites. There was also evidence of heavy mound construction around the brine stream, or the Salt Production zone, in

our research questions, we focused on a specific Maya site to understand the water management practices of the people who lived on the site, past and present.

the Late Preclassic Period. Overall, by the end of the Preclassic most of the site was occupied and consisted of one contiguous zone.

During the Classic Period, function and economic roles of the areas of the site became much clearer. The Salt Production zone became the economic center, and the epicenter, which is the location of large monumental elite architecture, became the administrative center. The Tierra Blanca area to the north most likely served as the port to the city. Triadic structures, plaza groups, monuments, and the ballcourt, which are all architectural representations of a prosperous Maya city, were constructed during the Classic Period. By the end of the Classic Period, the artifacts at Nueve Cerros became much more diverse, showing more styles than just that of the Southern Lowlands.

During the Terminal Classic Period, the Southern Maya Lowland elites began to experience a collapse in their political economy. The Highlands, on the other hand, experienced a florescence, and the inhabitants of Nueve Cerros gained from their successes. By the Early Postclassic, all of the material was Highland in style, with evidence of zoomorphic-footed plates, hourglass incense burners, and a plumbate bowl, all of which are related to the Northern Highlands. This evidence of Postclassic ceramics suggests the Nueve Cerros center survived the Classic Maya collapse and continued for approximately 400 years after the series of droughts and political turmoil seen at other Southern Lowland Maya cities. There is no Late Postclassic artifactual evidence at Nueve Cerros after A.D. 1200, outside of a single cave in the Nueve Cerros Ridge (Woodfill 2019).



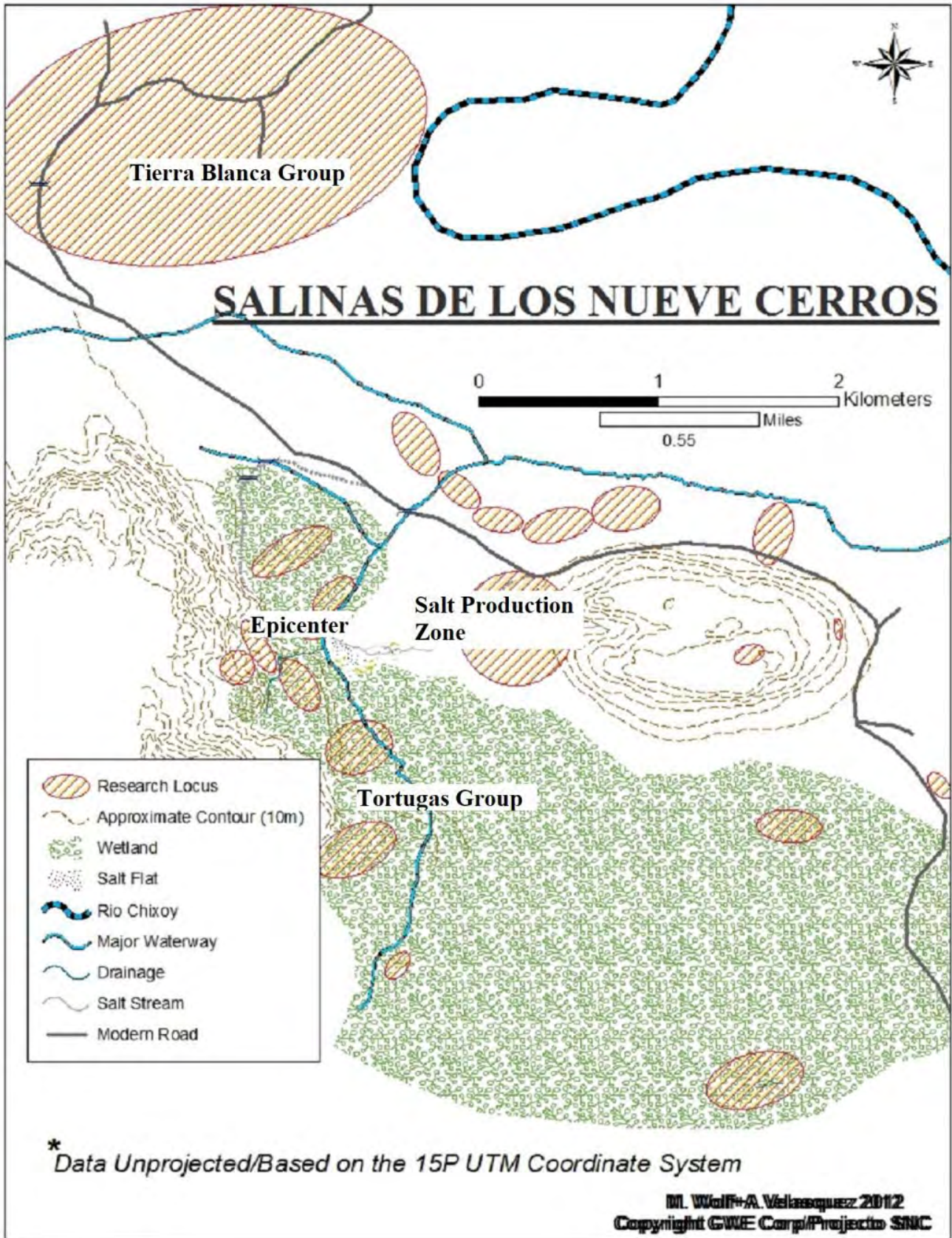


Figure 2. Map of Salinas de los Nueve Cerros with associated ancient architectural groups. Map courtesy of Brent K. S. Woodfill, modified by Alexander E. Rivas.

As previously stated, Nueve Cerros had clear economic importance during the Late Classic (A.D. 600–900) when the inhabitants of the site had the potential to sustainably produce 10,000 metric tons of salt per year (Woodfill et al. 2015). The ancient Maya's ability to produce salt at this site allowed them to participate in major

exchange networks throughout the Lowlands and Highlands. Elite rulers were buried near the salt production zone during the Classic Period, directly associating themselves with salt production and suggesting the importance of salt production to the rulers of Nueve Cerros.

## Ancient Maya Water Management Systems

To contextualize Nueve Cerros in the larger framework of ancient Maya society, it is necessary to understand the history of water management in the Maya Lowlands.

To alleviate water shortages during the dry season, the Maya built reservoirs and containment systems. In the Late Preclassic, Maya living in large cities took advantage of depressions in the natural landscape by constructing concave watershed systems. Preclassic Maya centers, such as El Mirador and Cerros, followed this format of settlement organization. Scarborough (1998: 139) defines the Preclassic adaptation as a “passive form of water management” in which the early communities made use of the natural depressions and basins in their surroundings.

At the Preclassic coastal center of Cerros, Belize, Scarborough also identifies “basin canals” in which water was conserved during the dry season through the manipulation of sills and dams. The site itself was carefully selected for its mosaic of environmental features, and the settlement throughout time focused on adapting to this landscape. Scarborough's research showed that the earliest Maya may have focused their settlements near streams and riverine settings, but by the Late Preclassic, the landscape was altered for reservoirs and diversion features that allowed settlements to develop in more varied geographies, with settlement size influenced by water storage capacity.

Eventually, Classic Maya cities began to have much greater reliance on constructed reservoirs, with water systems growing across different centers (see Figure 3 for a simplified schematic). When new, large Classic Period Maya centers emerged, water systems were controlled and released in the city centers and managed throughout the peripheries. Reservoirs, dams, channels, sluices, and filtration systems can be seen at many Classic Period sites (Scarborough 2003). Importantly, during the dry season, this system allowed for water to continuously be diverted into agricultural fields and holding ponds, which could be used for other economic purposes such as fishing, ceramic production, and architecture construction (Lucero et al. 2014). In order to keep some of this water potable and free of diseases, they would add water lilies as well as other marine organisms to purify water through the removal of excess phosphorus and nitrogen (Conrad 1905). People living in riverine systems also constructed artificial reservoirs and water retention systems. Rivers may not have always been safe for drinking water, with low rivers having murky waters and heavy rains during the rainy season depositing sediments.

By the Classic Period, many regional Maya capitals, such as Tikal and Calakmul, were located in regions without permanent water sources but were surrounded by swamps or seasonal swamps. The interior lowlands also had more fertile soils than those along the coasts, but with very little surface water. The dry season, from January through May, was particularly problematic

with little to no rainfall for months, and with an increase in temperature and humidity. Little agriculture was practiced during the dry season, but potable water was clearly still a necessity. In the tropics, people can lose up to 10 liters of water per day through perspiration, causing a need for more water than those living in temperate climates (Bacus and Lucero 1999). The rainy season also potentially posed problems, with too much water accumulating and flooding. Water quality is also an issue, with standing water allowing for waterborne diseases.

By the end of the Classic Period, artificial reservoirs were not sufficient in the Southern Lowlands due to frequent long-lasting droughts.

Many centers were becoming abandoned, leading to the Maya collapse. While the ruling elite and major polities ceased, many people continued to live in the Southern Lowlands; small communities continued to occupy these mostly abandoned cities after the collapse. However, most of the people settled along or near rivers and lakes or in the coastal areas where wetland agriculture could still take place. Most of the inhabitants however moved away from the interior Southern Lowlands to the Northern Lowlands. Overexploitation of natural resources was also evident in the Southern Maya Lowlands. Soils were eroded (Dunning et al. 2015), and many cities were already reaching their carrying capacity and were unsustainable (Lentz et al. 2014).

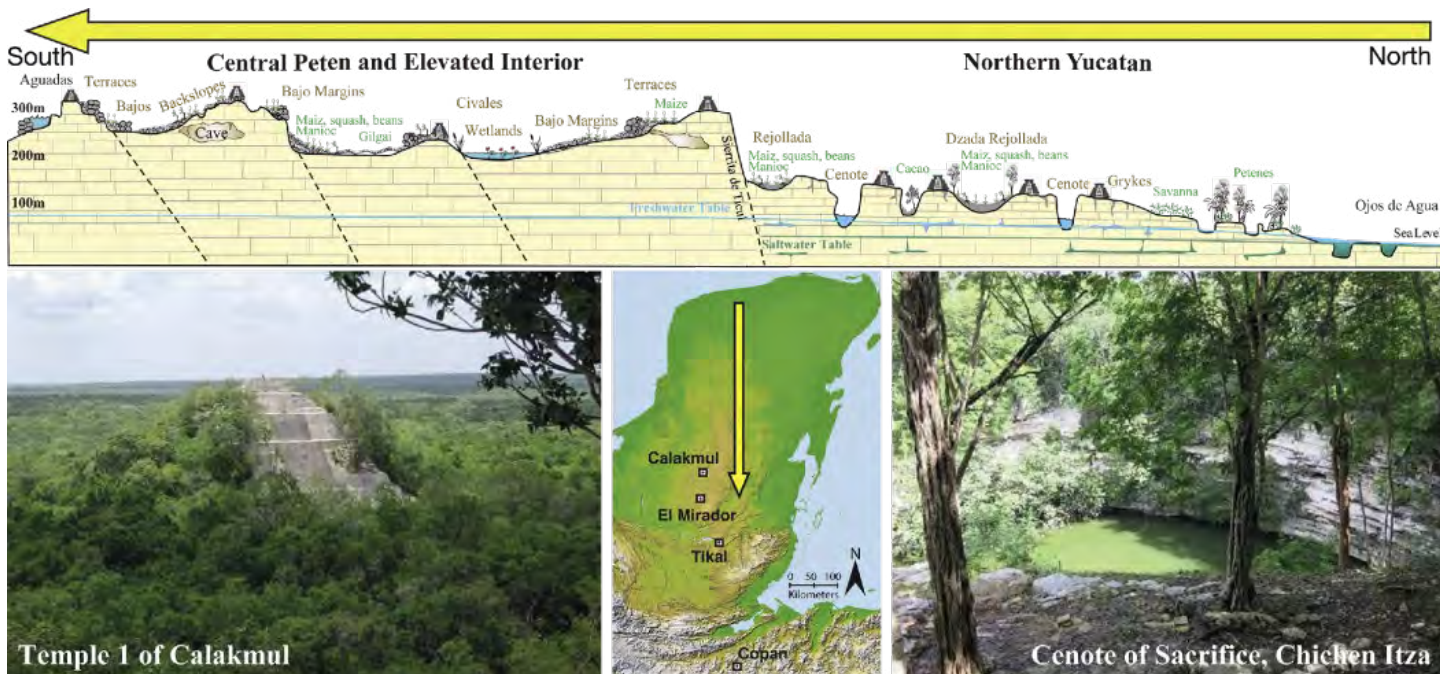


Figure 3. A simplified schematic of the hydrological systems across the Maya Lowlands. Figure from Luzzadder-Beach et al. 2016 (<https://doi.org/10.22498/pages.24.2.66>). (CC BY 4.0).

## The Current Landscape at Nueve Cerros: The Northern Transversal Strip

Geographically, Nueve Cerros is today part of the Northern Transversal Strip, a region in Guatemala that runs from east to west, delimiting the northern Peten Lowlands and the southern Highlands. In post-World War II Guatemala, the population of the Highlands experienced high population pressure, forcing families to move further north in Alta Verapaz, Guatemala, along the shores of the Chixoy River. By the 1970s, an oil pipeline was being built along the Northern Transversal Strip, through which the exploitation of oil sources became easier, along with the construction of a highway (Grandia 2012). This coincided with the Civil War (1960-1996) and thus with a great increase in military presence and revolutionary forces. By 1990, the Northern Transversal Strip received an increased number of migrants including subsistence farmers, cattle ranchers, and laborers for exploiting the oil resources (Smith 1990). Many of these migrants

were taking advantage of resettlement programs or fleeing violence from their homelands. More specifically at Nueve Cerros, the site area has been occupied by multiple groups. The salt works were controlled by the Akalah Ch'ol, the cultural descendants of the urban Maya of the Classic Period Southern Lowlands, at the time of Spanish arrival but have since been under control by Highland Maya populations, Spanish priests and soldiers, ladino landowners, urban municipalities, and foreign oil companies (Woodfill 2019). After heavy exploitation by the oil, maize, and beef industries, the landscape today is primarily settled by Q'eqchi' *milpa* (horticultural corn) farmers who came from the Highlands, African palm industries, and cattle ranchers. Because of this, much of the land is cleared and deforested, with the salt dome and nearby hills being the few remaining forested areas left.

## Collecting Ethnographic Data: Q'eqchi' Farmers at Nueve Cerros

Odum's work at Nueve Cerros has focused on the current landscape and ethnographic research among the communities in this region. Specifically, Odum conducted multiple interviews with *milpa* farmers in the Tierra Blanca region of Nueve Cerros between 2017 and 2018. These interviews were conducted to understand current water management practices, specifically potability, waste, and access. In addition, from May 2017 to the present, William Odum has served as community development coordinator and cultural anthropologist for the Salinas de los Nueve Cerros project, specifically working with Q'eqchi'

communities in the area. The ethnographic work is applied in nature and is aimed at aiding and advising sustainable development initiatives among the communities in the region. This work has consisted mainly of research on issues pertaining to water and health, building community wells, and collaboratively engaging with other infrastructural and daily necessities. Odum conducts this research and labor through his position as an advisor for a locally run NGO, ADAWA, that is dedicated to the general development of the region's communities and has been partnered with the Nueve Cerros project since its early

years. Odum's community development work also included extensive participant-observation with *milpa* farmers on evaluating the current state of water management of the region. Odum has worked with 29 different communities

assessing general themes of well-being, but has gravitated toward a focus on the most pressing issues: water contamination, management, and access.<sup>[1]</sup>

## Ethnographic Results

The results of this initial study to understand current water management practices at Nueve Cerros showed a strong analogical relationship between Q'eqchi' land-use practices and ancient Maya settlement decisions and modifications. As we will explain in the following sections, the use of groundwater as the primary source of potable freshwater for the majority of the population is prioritized among the Q'eqchi' and was highly valued in the past, based on the locations of many small depressions in the north. In addition, usage of springs and seasonal streams in the deep river valley also plays a role in opportunistic fish procurement.

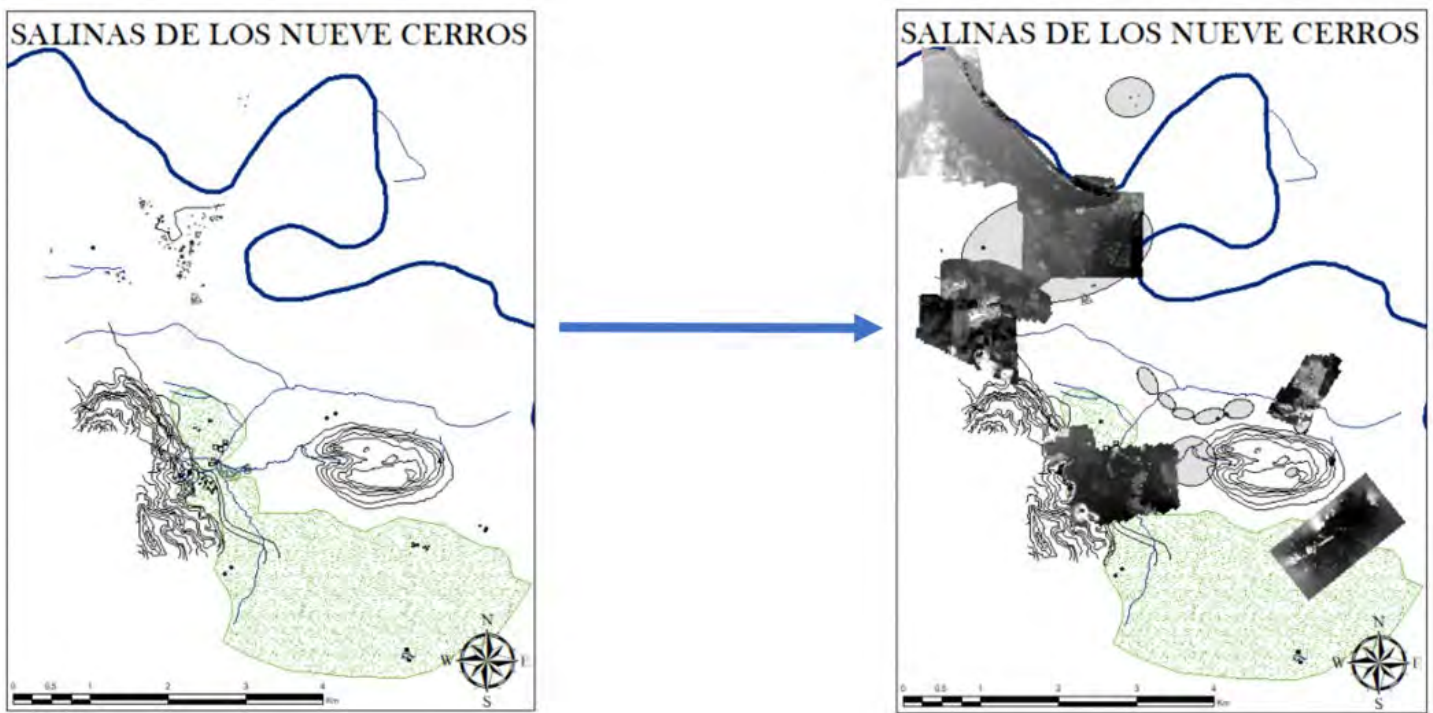
Currently, the situation in the region is bleak, with approximately half of the families lacking access to a well or a reliable water source. Furthermore, many families' wells dry up during the dry season, which lasts approximately two months. The wells that do maintain low water levels during the dry season are mostly filled with surface water that is contaminated by latrines and other sources of pollution. Those without access to these wells often use nearby streams in the forest, stagnant collection pools in *milpa* fields, or various sources in the surrounding communities. Although there are plenty of streams around Nueve Cerros, many of them are polluted with trash, dead animals, pesticides, and other pollutants. Communities near two of the

major rivers, the Chixoy and the Icbolay, acquire water from these sources even though they know about the high level of contamination. Although some families do use this water for consumption, usually boiling it, many just use it for gray water purposes such as washing clothes and dishes and bathing. Nonetheless, this water causes harmful effects to the population including dish contamination and rashes from the clothing. In response to these issues, Odum has worked with the local NGO to increase awareness of water filters. Families with access to well water are healthier and have an easier time carrying out household labor such as cooking and washing clothes and dishes. In a demonstration sponsored by the project, Odum brought a bucket-sized water filter to the excavation site for the workers to expand awareness of water filtration. After filtering and drinking water from the improvised wells constructed out of the depressions, the residents became excited at the possibility to expand their innovation beyond graywater purposes. This marked an enthusiasm and level of engagement that is necessary for collaborative and sustainable solutions to issues such as water contamination. The use of these ancient depressions creates a situation unique to this village. Thus, locating water features, ancient or current, helps our ethnographic goals and aids our archaeological research questions.

## Collecting Archaeological Data: Surveying the Current Nueve Cerros Landscape

While Odum's focus has been on community development and the ethnography of water and the Q'eqchi', Rivas focused on the *watery* landscape of Nueve Cerros. Between 2015 and 2018, Rivas carried out field surveys to look for water features within Nueve Cerros. Specifically, we searched for water features that may be closely associated with the architectural mounds found at the site, and natural features that the Q'eqchi' may use. We used a Trimble GeoX (6000 series) GPS to map depressions, streams, and springs. Rivas undertook the reconnaissance at the site with local Q'eqchi' Maya, assisting in finding water features. The Trimble allows data to be collected as points, lines, or polygons. Most features were mapped using the line feature, which allows users to map the area while walking. Points were also

used to complement the line data. Photographs of different features, including streams, wells, and small depressions, were also taken. In addition to field surveys, during the 2018 summer field season, project director Brent Woodfill and Rivas conducted drone surveys and processing of the Tierra Blanca region, as well as other important areas of the archaeological site including the epicenter and the salt production zone. The survey was conducted using a DJI Inspire 2 drone, with a Zenmuse X5S camera for aerial photography. All photographs were processed using Agisoft Photoscan Professional, which converts the aerial images into a point cloud, digital elevation model (DEM), and ortho-mosaiced photographs (Figure 4).



*Figure 4. Original map of Nueve Cerros (right) and overlaid drone images (left). Map courtesy of Alexander E. Rivas.*

## Discoveries from the Field Surveys: Ancient and Modern Landscape Management

Depressions and ancient reservoirs were found through field surveys and aerial photography throughout the Nueve Cerros region, and many more were revealed through drone surveys. However, on-the-ground mapping was crucial in understanding current uses of depressions and streams in the region.

In the southwest area of the Tierra Blanca region, many current farmers have built wells for their

personal family use. Three of these wells were in fact small depressions in the landscape in areas next to archaeological mounds and features. When we asked the farmers who made these wells and how they designed them, they told us they had noted water collection here and had assumed it was created or used by ancient populations. Indeed, these depressions were probably used as groundwater wells in the past, with groundwater flowing through year-round. Today, these wells



*Figure 5. Reuse of ancient depressions or wells with a trench dug connecting the two wells and evidence of a filtration system set up. Image courtesy of William G. B. Odum.*

are minimally constructed, with one of them modified for a filtration system. In this case, one of the farmers dug out two depressions that were near each other enough for groundwater seepage to occur. A trench was dug connecting the two, leading water from the higher elevation to the well at the lower elevation. In addition, the water was filtered through a wooden plank held in place by stones along the sides. This wooden plank acts as a sluice gate and as a preventative measure to avoid silting and running dry too quickly, to direct gray water runoff, and to act as a constructed berm (Figure 5). This system replicates a much smaller-scale and simplified version of a reservoir filtration system at the ancient site of Tikal, Guatemala (Scarborough et al. 2012). In the Tikal case, siltation tanks and sluice gates were used for the control of water resources in the epicenter of the large polity.

Currently, the landscape at Nueve Cerros, especially the Tierra Blanca zone, is dominated by *milpa* farming of maize. Many of the ancient mounds are not covered by forest overgrowth, but rather by corn plants. With corn crops as their main form of income, the Q'eqchi' exploit as much of the land as possible, planting in all areas surrounding them, excluding the modern roads and the immediate surroundings of their houses. The only areas that are not used for planting corn are in the drainage areas such as the swamps, in the springs, and in the streams. The streams are seasonal but many retain enough water during the dry season to obstruct *milpa* farming. However, even in some low-lying swampy areas, many farmers dig trenches to deal with run-off and to keep crops from flooding.

During August, between the end of the dry season and the start of the rainy season, these

streams begin to fill with water and start to meet with the Chixoy River more frequently. Higher water levels allow for fish and aquatic animals to disperse, which makes it more difficult to fish. For this reason, people fish more during the dry season. However, the erratic weather patterns cause the streams to fill up one day and begin to dry out the next. This causes an abundance of in-stream fish, and possibly other aquatic animals, to enter the streams and become trapped for days or possibly weeks in people's backyards. This is even marked by a large increase in vultures along floodplains and swamps where fish are caught in dried-up streams. The Q'eqchi' here often take full advantage of this situation. Dozens of people can be seen grabbing fish and depositing them into 10 kg sacks along the streams after a heavy rain. These are seasonal streams that act almost as natural fish weirs, with receding water coming from the changes in the weather and the seasons and with fish channeling to dried locations.

Currently, during the rainy season it is too difficult to canoe the Chixoy River. The waters are too erratic and strong to allow paddling. However, during this season, smaller peripheral streams are filled and water reaches to the confluences of the Chixoy. The streams become navigable, with enough width and depth for canoes to easily go through. During flooding and on rainy days, the current inhabitants in the area use the streams—sometimes with no other option—to travel to different plots of land as an alternative to traversing through the *milpa*. These alternative routes suggest that canoe travel like this could have been employed during the Classic Period as well, with the Maya using streams as intra-site routes during floods and rainstorms.



## The Aerial Landscape Perspective of Nueve Cerros

The ancient site of Nueve Cerros probably covered over 50 sq km including extensive areas to the north of the Chixoy River. Thus far, we have collected 8.2 sq km of aerial photographs, with many of the images coming from the northern Tierra Blanca zone. Although we still do not have a full picture of the broad built Nueve Cerros landscape, these preliminary results allow us to look at land-use and settlement strategies of the ancient commercial population and some current Q'eqchi' farmscapes in Tierra Blanca.

In one of the ancient architectural groups, at least 10 depressions were detected, one large water tank, a probable pond, two probable low swampy areas, and at least 21 mounds or architectural features. This specific group is situated along an elevated, fossilized levee with two rather large streams located to the south. Small depressions and wells have been studied elsewhere in the Maya Lowlands and are often interpreted as possible locations for potable water extraction for ancient communities (Weiss-Krejci and Sabbas

2002; Johnston 2004; Brewer 2018). Excavations of a few of these depressions showed stratigraphic evidence of a high water table that in fact currently fills with water during the rainy season. Contemporary farmers who own these parcels have told us that before the intensive *milpa* farming, when these areas were forested, water would stay in some of the larger depressions year-round. In addition using the ancient depressions as their own wells, Q'eqchi' farmers also dammed one of the streams and dug for welled water, using only planks of wood to regulate flow and more efficiently retain water (Figure 6).

It is likely that during the Classic Period the Maya were not conducting slash-and-burn farming at an intensive level, with farming being relegated to specific sections of the site. Currently, the cornfields are planted over much of the ancient mound architecture, which surely would not have been the case in the past. The water catchment strategies, however, may have been very similar. The presence of multiple depressions in the

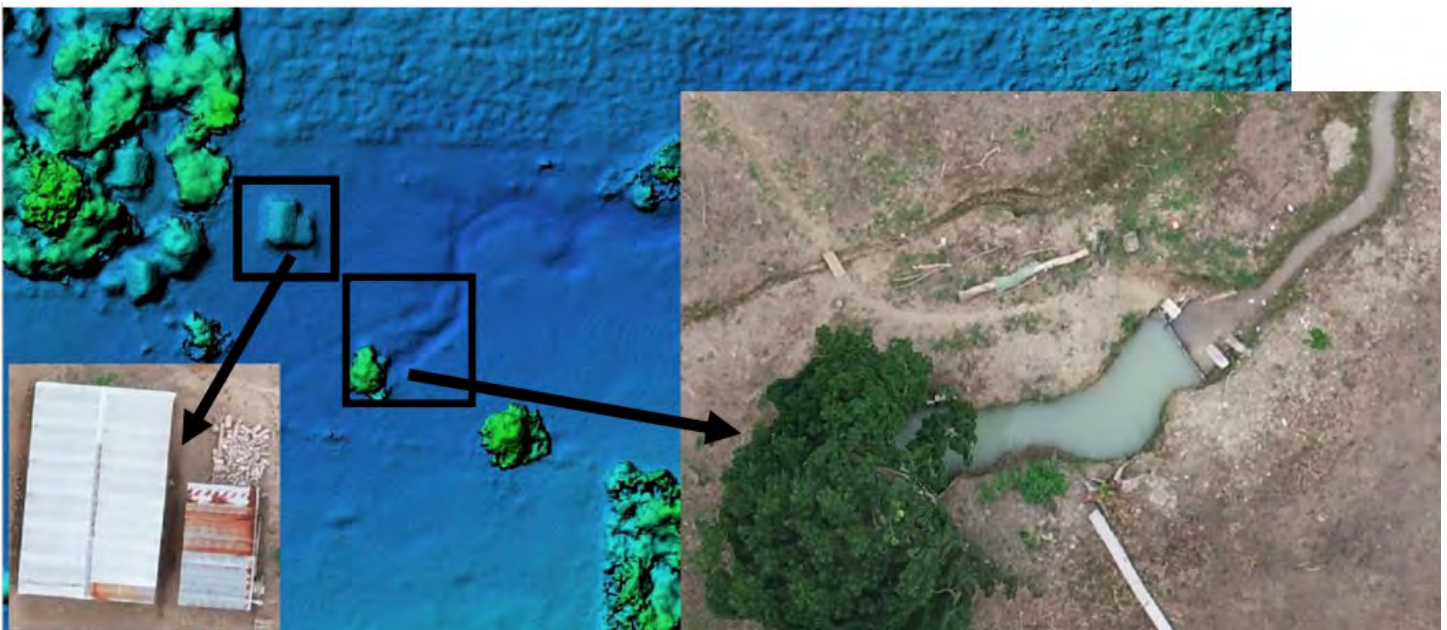


Figure 6. DEM and Orthophoto images of modern Q'eqchi' houses and storage areas and evidence of a dammed seasonal stream. Figure courtesy of Alexander Rivas.

northern Tierra Blanca zone, near residential architecture, suggests that inhabitants at the site may have primarily used dug wells for groundwater usage. The prolonged droughts were a factor

in the Lowland collapse of major Maya polities, but with alternative access to groundwater, ancient Nueve Cerros was able to persist.

## Conclusion

Combining ethnographic and archaeological methods has proven useful in the Transversal region of the Southern Maya Lowlands and will continue to have potential with research on contemporary and ancient water management. Employing applied ethnographic methods in the context of archaeological investigation stands to benefit both subfields and the communities that are involved. The changing adaptive strategies of the Q'eqchi' Maya during both the dry season and rainy season have potential implications for how the ancient Maya may have utilized their landscapes. The transition between the two seasons is also of importance for the opportunistic strategies that become available to the Q'eqchi'. Hypothetical considerations such as these must be anchored in ethnographic investigation to accurately assess the potential for and extent of analogy between contemporary and ancient water management practices.

Conversely, the knowledge of these practices has also served to be useful in the project's applied initiative to aid in the region's struggle for expanding access to potable water by influencing plans to assess the issue. Introducing bucket-sized water filters to purify graywater in these re-opened depressions as we've described offers a solution that stands to be as resilient and effective as it is distinct because of how it is rooted in the imagination, creativity, and agency of community members.

These data were recorded in the context of an archaeological project. The original focus of

this project was to understand the purposes of the ancient depressions. Combined with ethnographic research by Odum, this led to further discovery of how residents imagine and interact with their surroundings, which in turn opened new possibilities for integrated, community-led solutions to major water issues between the local residents and us, the researchers. This was only possible due to the focus of the archaeological survey on water features across the landscape. This study stands as a testament to the potential for mutual benefit between researchers and the local populace.

Water management studies in the Maya Lowlands have a long history of research. They have been multidisciplinary, ranging from focuses on iconography and epigraphy, paleo-environment, artifact analysis, and increasingly to a spatial, landscape, and GIS focus. This article provides a multi-scalar approach to the strategies developed by the ancient Maya as well as by the current Q'eqchi' Maya at Nueve Cerros. Our methods have the potential to provide new insights into Maya planning and sustainable practices that could have accounted for the thriving of a long-term population. In addition, this combination has proven to offer new perspectives and approaches that can help applied anthropological research to engage with its participants and informants and geographical context differently. This study is an example of how local populations and researchers can simultaneously work together and lead to higher efficacy and more discoveries for everyone involved.

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## Footnotes

[1] The ethnographic data collected by William Odum has Institutional Review Board (IRB) approval, which is necessary for conducting research involving human subjects.

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