

Investigating water supply at Saqsaywaman

A literature review of Incan water and drainage at Saqsaywaman

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For Richard Miksad in Completion of Independent Study CE4995

On my honor as a student, I have neither given nor received unauthorized aid on this assignment.

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ABSTRACT

Saqsaywaman is an Incan ruin that began construction in the 1440s and was deconstructed by the Spanish after the failed Inca Rebellion of 1536; only three megalithic walls remain. In 2009, portions of the wall crumbled due to excess water runoff from a recently installed, impermeable clay layer, just above the damaged portion (Figure 1). The goal of Miksad's research is to prevent further damage by returning the site to its original drainage state using traditional Inca engineering practices. In order to determine the original drainage function at the site, this paper reviews first-hand accounts and research relating to the function of water at Saqsaywaman.

INTRODUCTION

Most information relating to Saqsaywaman can be found in first-hand accounts, excavations from the 1930s, and detailed geographic and historic analyses in the 1960s and 1970s. Saqsaywaman (also referred as Sacsahuamán¹) was built in the 1440s by the 9th and 10th Inca Kings². Saqsaywaman sits just north of the city of Cuzco, serving at the head of the puma that represented the city's layout. The function of Cuzco in Incan times was "never a city in the European sense...[only housing] royalty and nobility and religious shrines, [lacking] markets or centers of commerce. Commoners and foreigners were not permitted to live there and had to leave the city each night...housed in satellite communities surrounding Cuzco (McEwan, 2006, p. 76)". See Figure 2 for a layout of the site.

While it is now thought of as a "temple, depository, and stronghold", most of the Spanish texts refer to it as the fortress (*la fortaleza*) of Cuzco (Dean, 1998, p. 162). During the Inca Rebellion of 1536, when Manco Inca attempted to regain the city of Cuzco from the Spanish, the Inca used Saqsaywaman's walls and high vantage point as a fortress, almost gaining a victory of the Spanish in a ten-month siege (MacQuarrie, 2006, pp. 193-229). Researchers are still uncovering information about the site and its functionality, especially with regard to water.

A spring at the top of the hill is referred to in first hand accounts but no evidence of a spring has been recorded recently. Garcilaso de la Vega refers to a spring whose source is kept secret by trusted members of the Inca court (de la Vega, 1612, p. 468), and the central tower is repeatedly referred to as a reservoir (Hemming, 2010, p. 72); yet as a fortress, MacQuarrie writes "Saqsaywaman had one glaring weakness: it had no source of water (p. 226)". This paper investigates references to the spring at Saqsaywaman, as well as other information related to water and drainage at the site.

Most of what is known about Inca heritage is gleaned from first hand accounts from Inca and Spanish conquistadors and missionaries. The Inca had a long oral tradition and no written language; stories were passed from generation to generation and often changed depending in support of different leaders (McEwan, 2006, pp. 60-62). Gleaning the truth from Inca history lies in finding commonalities in the stories. Each story has its own bias, which makes comparing the stories, context, and sources against each other in this literature review important.

¹ "Saqsaywaman" is the term used by native language of indigenous Peruvians; "Sacsahuamán" is the Spanish term, this paper uses "Saqsaywaman" although referenced maps or documents may have other spellings.

² The construction of Saqsaywaman is disputed as to which king designed and constructed the site, as well as the length of construction and construction process (de Gamboa, 1570).

FIRSTHAND ACCOUNTS

As the site was deconstructed in 1536, few first hand accounts of the site pre-conquest are available today. The most comprehensive Inca history was written by Garcilaso de la Vega, the son of an Incan princess and Spanish conquistador, who was born in the Inca capital of Cuzco in 1539. As a young man, de la Vega left Perú for Spain, and towards the end of his life spent four years chronicling the stories from his Incan and Spanish relatives as well as his own first hand experiences. His work, the *Royal Commentaries of the Incas* is comprised of seventeen books, totaling over 1,500 pages of history. The book was written in Spanish by de la Vega in 1612 and the author is using a version of the book translated into English by Harold Livermore in 1966.

Garcilaso de la Vega: First visions of Saqsaywaman

De la Vega refers to Saqsaywaman in Book Seven of Part I as the “fortress of Cuzco”. Regarding irrigation and drainage, he writes that the 10th Inca King Yupanqui developed irrigation channels and built numerous terraces, and focused on building the temple of the Sun (Coricancha) and the fortress at Cuzco (Saqsaywaman), which his father the 9th King had planned. De la Vega describes the site before its destruction and references a spring:

“Within [a] triple row of walls there is a long narrow space containing three strong towers arranged in an elongated triangle as the site requires. The chief of these towers, which was in the middle, was called Moyoc Marca “the round fortress,” for it was circular in shape. Within it was a spring with a copious supply of excellent water brought underground for a long distance. The Indians do not know hence it comes nor by what route. The tradition of such matters was kept secret by the Inca and the members of the supreme council. It was in this tower that Inca kings lodged when they went up to the fortress of repose (pp. 468-469).” (see Figure 3)

Garcilaso de la Vega also refers to a series of underground tunnels, which are not commonly referred to in reports written in English:

“The towers went as far below ground as they did above it. There were tunnels between them so that one could pass from one to the others below ground as well as above it. The tunnels were made with great skill. There were so many underground passages, large and small, twisting and turning in all directions, with so many doors, all of the same size, but some opening on one side and some on the other, that anyone entering the maze soon lost his way and was at a loss to find the way out (p. 469).”

Documents about the Inca Rebellion of 1536

In the novel *The Last Days of the Inca* Kim MacQuarrie ties together many first hand accounts into a chronological narrative. Regarding the Inca Rebellion at Saqsaywaman she writes in depth of the battle strategies from both the Spanish and the Inca. Hinting at underground tunnels she writes that “Villac Umu, and his general, Paucar Huaman, meanwhile, continued to direct the defenders from somewhere deep within the complex of buildings (p. 226)”; regarding water she wrote that “Saqsaywaman had one glaring weakness, however: it had no source of water (p. 226)”. The references about the battle at Saqsaywaman come from two sources: *Los Gobernantes del Perú*³ and *Relación del Sitio del Cuzco*⁴. The first is available only

³ *Relación de los Sucesos del Perú con Motivo de las Luchas de los Pizarros y los Almagros, hasta la Pacificación Realizada por el Licenciado La Gasca*, in Roberto Levillier, *Los Gobernantes del Perú*, Vol. 2 (Madrid: 1921), 391-395

⁴ *Relación del Sitio del Cuzco y principio de las guerras civiles del peru hasta la muerte de diego de almagro, 1535 a 1539*, in *Colección de Libros Españoles Raros o Curiosos*, Vol. 13 (Madrid: 1879), 9.

in print and has more detailed information on the siege, the latter is available online and refers to the rebellion at Cuzco:

“...at dusk [the conquistadors] went to tear down the walls to vacate the field [in front of Saqsaywaman], and break wall supports and fill holes and very large caves, and smash ditches where the enemies transport water to irrigate land, because horses could not take the field, then from dawn until dusk, the fighting returned (p. 20).”

While the writing vaguely touches on the function of water near Saqsaywaman, it indicates that elsewhere in firsthand documents may lie clues to function of water for the site. An example of the difficulty in translating these documents is that sixteenth century Spanish varies from modern Spanish, for example in this translation, “oyos” meaning “holes” is “hoyos” in modern Spanish (see Appendix A for full text). In addition to the documentation that MacQuarrie uses, more information was found in an online archive of a series of letters regarding smaller Inca Rebellions in the 1780s:

“From Urcos [a city in eastern Perú] the brother of Tupac-Amaru, Diego, left for the part of the stream, with determination to drag all the people of the Catea, Paucartambo, the provinces of Calca and Urubamaba, to enter Cuzco through the water box of the fort⁵ (p. 22).”

The “fort” in reference to Cuzco usually refers to Saqsaywaman and the “water box” is an unknown reference. Entering Cuzco from a stream from Urco, a city southeast of Cuzco, leads through a modern-day water treatment facility and the opposite side of the city from Saqsaywaman. The “water box” may refer to the treatment facility or it may refer to water storage at the site of Saqsaywaman.

While research on Saqsaywaman has traditionally been on construction methods and anthropological artifacts found near the site, the function of water has not been widely researched. Some of the same documents informing strategy and the story of the Inca Rebellion of 1536 and future rebellions at Cuzco may hold clues to the historic water function, the existence of a spring, and subsequent drainage practices.

⁵ From a letter written on January 10, 1781 in *Relación histórica de los sucesos de la rebelión de José Gabriel Tupac-Amaru, en las provincias del Perú, el año de 1780*: “De Urcos se despidió el hermano de Tupac-Amaru, Diego, para la parte de la quebrada, con determinación de arrastrar toda la gente, la de Catea, Paucartambo, provincia de Calca y Urubamba, para entrar en el Cuzco por la caja del agua por la fortaleza” (p. 22)

MODERN ANALYSES

Until the early 20th century, Saqsaywaman represented the Spanish conquest of the Inca. The Spanish not only took the Inca site in 1536, but also deconstructed the site and used the stones of the towers and tunnels to construct Spanish churches and buildings in the city of Cuzco (Dean, 1998). It wasn't until the 1930s when a rising tide of *indigenismo*, the political practice of involving indigenous people in government decision making, renewed interest in Saqsaywaman as a symbol of the Inca at the height of their power and no longer of the Spanish conquest (Dean, 1998, p. 172).

The ruins of towers, spring, and tunnels of Saqsaywaman

In 1932 Luis Valcárcel conducted the first archaeological expeditions at Saqsaywaman, remarking that the most important find was the foundations of the three towers:

“Only the bases of these magnificent monuments were discovered. The first tower [Muyuc Marca] was in the form of a cylinder, its base contained in a rectangle. The notable thing about it was that, in the central part, there was a deposit for water, from which the water was distributed by canals. The base of the tower has three concentric circumferences with the following diameters: 9.34, 15.0 and 22.2 meters (about 30, 50, and 75 feet). The base of the tower of Sallac Marca is a rectangle 21.8 by 10.2 meters (about 75 by 33 feet). There is evidence of several stores, and in the central part two platforms can still be seen. The tower of Paucar Marca has fallen into the worst ruin and only traces of it remain (*The Monuments of the Inca*, Hemming, 2010, p. 72).”

The verification from a modern source in addition to de la Vega's firsthand accounts indicates that there was some sort of water storage, and as the reservoir was atop a hill, that a spring or a sophisticated rainwater collection system existed to fill the water tank. When MacQuarrie stated that Saqsaywaman “had no source of water (p. 226)” during the Inca Rebellion of 1536, it is likely that the water supply had simply been used beyond its ability to regenerate, supported by Hemming stating that “the native commanders decided that there were too many defenders in Sacsahuamán, whose water supply was running out (p. 77)”. Both sources state that lack of water is what weakened the Inca, which indicates that either the source of water was simply diminished beyond capacity or the water source was inadvertently or purposefully obstructed during or prior to the siege.

It is unlikely that the Spanish obstructed the water supply given that “native levies (Inca troops) secretly occupied the great fortress [of Saqsaywaman], without resistance since the Spaniards had failed to garrison it (Hemming, 2010, p. 72)”. Given that de la Vega describes the spring as a secret guarded by high-ranking Inca, and that MacQuarrie refers to soldiers being directed from “somewhere deep within the complex of buildings (p. 226)” where de la Vega states that “tunnels went as far below ground as they did above it (p. 469)”, it is likely that soldiers as well as water were directed to the top of the hill via the underground tunnels, which are presently inaccessible.

The failure to properly blockade the site indicates that the Spanish had no knowledge of the underground tunnels or water supplies, and that the lack of water was simply an overload of the water supply's refill capacity⁶. Assuming the water use reached overcapacity, studies can be done to determine the approximate flow rate of the water supply, as the approximate volume of

⁶ Further research should be done to verify the level of Spanish knowledge of the underground tunnels and water supplies. If there was an advertent obstruction of water on behalf of the Spaniards on record, then the source of water may be identified and yield more clues to Incan water and drainage engineering techniques.

the water tower is known, as is the timeline of water depletion and the draw of water from the site as a fully stocked fortress⁷. Finding an approximate fill rate would give more information to the type of water supply and potentially give clues to finding the source of water.

Existing water function of the area

While the study of water at Saqsaywaman is often overshadowed by the interest in its megalithic walls and construction myths, drainage systems and irrigation canals have been discovered at an near the site. Modern excavations revealed an excellent drainage system of the three terrace ramparts, with “thirty-six finely cut channels lead rainwater off the middle level rampart alone (Hemming, 2010, p. 67).” The grade and construction of these drainage ports are the focus of a study by Joseph Torp and Richard Miksad in the summer of 2013.

The site across the plaza just north of Saqsaywaman, the Rodadero, has many Incan fountains and canals (McEwan, 2006, p. 76):

“Below the slides [of Rodadero] is an amphitheater of niches surrounding a pool or altar. This was one of the many discoveries of the excavations started in 1968. Their other great surprise was to reveal a series of agricultural terraces and canals, all of fine Inca masonry, that rose to cover the entire western end of the hill (Hemming, 2010, p. 72)” (see Figure 4)

More information regarding the study of Rodadero and Saqsaywaman can be found in a short series of Journals on Saqsaywaman beginning in 1967. Located in Dumbarton Oaks, the first journal includes articles in Spanish on the erosion, soil mechanics, and water runoff of the site. These studies are the source of 1-meter topography maps used in the author’s previous study of drainage modeling. See the Appendix B for a list of relevant articles in the journal.

CONCLUSION

Despite deconstruction attempts by the Spanish in the 16th century, the megalithic walls of Saqsaywaman have endured four hundred years. Until the early 20th century, Saqsaywaman was regarded as a symbol of Spanish and Christian dominion over the pagan Incas; a large cross overlooks the site and stones from Saqsaywaman were used to construct Spanish churches and the buildings of the city of Cuzco (Dean, 1998). With the rising tide of *indigenismo*, the policy of including indigenous populations in government decision-making, a renewed interest in Saqsaywaman as a heritage site and symbol of Incan strength prompted archaeological investigations in the 1930s and 1960s (Dean, 1998).

Archaeologists discovered foundations for three towers which, one of which was said to have housed a spring, as well as drainage channels leading rainwater off the ramparts (Hemming, 2010). While the existence of a spring and tunnels are well documented, the deconstruction of the site left little for archaeological investigation, and most of the tunnels are inaccessible. Further review of literature and archeological investigation to discover the source of the springs may bring new insights into Incan water engineering. The purpose for this information is to inform design considerations for an historically accurate canal at the site to prevent further damage from excess water runoff.

⁷ Conquistador Sancho estimates that “[Saqsaywaman] could contain five thousand Spaniards (Hemming, p. 68)”. While this number is an eyeball estimation from the 1600s, it can be verified through firsthand text about the battle at Saqsaywaman. *The Conquest of the Incas* by John Hemming (1970) is a good source in English recounting the battle of Saqsaywaman.

Currently the site is a protected park under the Instituto Nacional de Cultura and is a subject of study at the University of Virginia, Department of Civil and Environmental Engineering. In 2009, a portion of the third wall collapsed from excess water runoff caused by an impermeable clay layer placed by archaeologists over one quarter of the site to protect artifacts. Richard Miksad with the University of Virginia leads the Inca Program which is traveling to Saqsaywaman in August, 2013 to investigate methods to alleviate the excess runoff by returning the site to its original drainage design, protecting the site and preserving the culture.

ACKNOWLEDGMENTS AND THE UNIVERSITY OF VIRGINIA INCA PROGRAM

The University of Virginia under the leadership of Richard Miksad, Professor of Civil and Environmental Engineering, has worked with Kenneth Wright of Wright Paleohydrologic Institute in researching water engineering and Incan sites, recently presenting their study of hydraulic engineering of the Incamisana site at Ollantaytambo. This research has been supported by the Instituto Nacional de Cultura of Cusco, Perú, Andrew Earles and Kenneth Wright with Wright Water Engineering, and Kevin Floerke of the Cotsen Institute of Archaeology.

As part of the University of Virginia engineering team, which aims to alleviate water runoff damage at Saqsaywaman, the author is currently researching historic and modern day water use and drainage to inform treatment of the site. This paper investigates literature that gives clues to the historic water function of the site. To view Jeffers' modern-day flowpath models refer to "Using ArcGIS to model modern and historic drainage patterns to restore original drainage at Saqsaywaman in Cusco, Perú" (Jeffers, 2013); for drainage canal design refer to "Controlling water runoff: protecting the cultural heritage site of Saqsaywaman, Perú" (Lohr, 2013).

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APPENDIX A – FULL TEXT QUOTE FROM RELACION DEL SITIO DEL CUZCO

Relacion del Sitio del Cuzco y principio de las guerras civiles del Perú hasta la muerte de diego de Almagro, Guerras del Perú: “Villahoma, que era el caudillo y Capitan general, tuvo cuidado de ganar la fortaleza apoderandose en ella, paresciéndole que como la tuviese la ciudad estaba sin resistencia. El Inga en todo este tiempo estaba tres leguas de aqui haciendo proveer de gente para el combate. Como las casas fueron del todo quemadas, los indios podian andar por encima de las paredes, que, como con los caballos no los podian ofender, andaban muy a su salvo; de manera que de dia ni de noche los cristianos no descansaban , porque en anocheciendo salian a derribar paredes para desocupar el campo, y deshacer albarradas y cegar [h]oyos y cavas muy grandes, y romper acequias por donde los enemigos traian agua para encharcar las tierras, porque los caballos no pudiesen salir al campo, luego, en amaneciendo hasta que anochecia, tornaban a pelear.” (p. 20)

[Translation] *Record Of the Site of Cuzco and early civil wars of Perú until the death of Diego de Almagro, Wars of Perú:* “Villahoma, who was the leader and Captain-General, was careful to win the fortress by seizing it, deeming the city to be without resistance. The Inca, during all this time, were three leagues from here providing people for combat. As the houses were completely burned, the Indians could walk over the walls, which, with horses we could not aggress, except by walking; so that day and night the Christians were not resting, because at dusk they went to tear down the walls to vacate the field, and break wall supports and fill holes and very large caves, and smash ditches where the enemies transport water to irrigate land, because horses could not take the field, then from dawn until dusk, the fighting returned.” (p. 20)

APPENDIX B – SAQSAYWAMAN JOURNAL RELVANT CONTENTS

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4. - Marco geografico de saccsayhuaman: Por Jorge de Olarte Estrada.... 43

7. - la fortaleza de saccsayhuaman: Por Luis A. Pardo.... 89

(p. 18) plan de trabajo - obras de conservacion.-estudio.-limpieza.-noviembre de 1967

...

2) levantamiento topográfico con curvas de nivel a 1 m. de distancia por zonas y en conjunto.

...

7) Estudios de escorrentía del agua.

8) Erosión del terreno.

9) Estudio de la mecánica del suelo.

--Patronato Departamental de Arqueología del Cuzco. (1970). *Revista Saqsaywaman* , 1 (1).

[English Translation]

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4. - Setting geographic of Saccsayhuaman: By Jorge de Olarte Estrada 43

7. - The strength of Saccsayhuaman: By Luis A. Pardo 89

(p. 18) Work Plan - Conservation.-Sudies.-Cleaning Works.-November-1967

...

2) survey with contours at 1 m. areas away from and together.

...

7) Water runoff Studies.

8) soil erosion.

9) Study of soil mechanics.

--Departmental Board Archaeology of Cuzco. (1970). *Saqsaywaman Journal*, 1 (1).

FIGURES



Figure 1: Collapsed portion guarded by roof with impermeable clay layer (above-left) (Miksad, 2012)

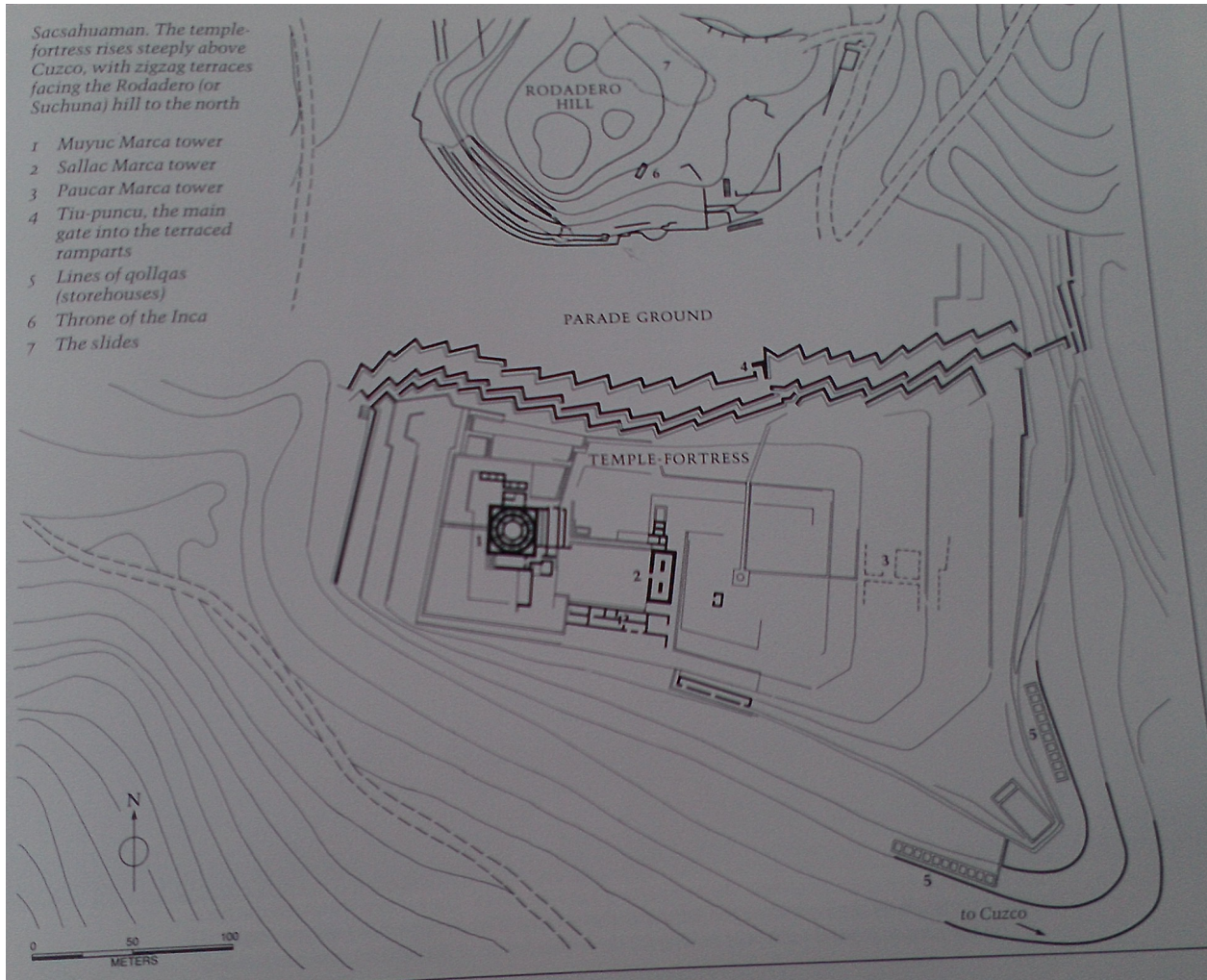


Figure 2: Saqsaywaman site layout from (Hemming, 2010)



Figure 3: *Monuments of the Inca*, The foundations and water supply of Muyuc Marca, the round tower



Figure 4: Retaining walls on the south-western side of Rodadero Hill (Hemming, 2010, p. 75)