The Waters of Lakam Ha

A Survey of Palenque's Water Management

By Kirk D. French

The presence of fresh water is inviting for any civilization, but for the Maya, it was symbolic as well. The *Popol Vuh* refers to a place in which the waters are flowing out of the mountains. "The channels of water were separated; their branches wound their ways among the mountains" (Tedlock 1985:74). Palenque's natural topography creates a series of watery mountains with 56 recorded springs within the site boundary. A place such as this must have been emblematic to the ancient Maya.

During the survey conducted by the Palenque Mapping Project (PMP), the presence of many water management features became evident. These included aqueducts, bridges, dams, drains, walled channels, and pools. The Palenqueños built such features in order to manage the numerous perennial springs located throughout the site. With the direction of Edwin Barnhart, I identified and recorded Palenque's water management to the best of my ability.

The Water Systems

The watercourses in Palenque generally run in a northerly direction. Beginning in the mountains, the spring fed streams flow toward the plains of Tabasco. The 56 known springs supply 9 separate watercourses that move through the site's interior. The arroyos

are home to Palenque's many different water management features. A list of definitions used in the identification of each feature is as followed:

Aqueduct – a covered channel for conveying water either under or above ground.
Drain – a small covered channel for removing water.
Bridge – a structure spanning a watercourse or arroyo to afford passage.
Walled Channel – a watercourse or arroyo managed with walls of cut stone.
Pool – a small manufactured body of confined water.
Dam – a barrier of stone to obstruct the flow of water.

With the presence of such a large number of water management features and springs a classification system was needed. Each feature and spring has been assigned a specific name and number. The name conveys the group of structures associated with the feature as well as its type. The number refers to the features location within the group of structures. The number system runs south to north and west to east; the same direction as the water flow. For example, an aqueduct located in the southwest corner of the Picota Group would carry the name P-A1.

P	-	A	1
Picota Group	-	Aqueduct	Position

The abbreviations for the water features are as followed:

A = Aqueduct
D = Drain
B = Bridge
P = Pool
C = Walled Channel
DM = Dam
S = Spring

The watercourses are separated by name and will be discussed in full. I will begin explaining each stream at its source or entry into the site. A detailed description of the

arroyo and its features will be given as we move with the flow of water. The description of each stream will terminate upon its exit from the site boundary. The waterways are in order of appearance, from west to east.

A. The Arroyo Diablo (Map A1)

Water Feature	Dimensions	Length	Elevation
Walled Channel			
D-C1		7m	191.00m

Springs	Architecture	Perennial	Elevation
D-S1	No	Yes	191.51m
D-S2	No	Yes	188.17m
ES-S1	No	No	162.26m
ES-S2	No	Yes	152.75m
4 springs	**0 with architecture**	**3 perennial**	

The Arroyo Diablo begins at 220 meters in elevation and stretches 610 meters down Palenque's western border. The initial 316 meters of the arroyo remains dry during the summer months. The Diablo's first perennial spring, D-S1, marks the temporary termination of the parched arroyo. A few meters to the north of the spring, evidence of a walled channel exists. The wall, D-C1, extends for approximately 7 meters and is in poor condition. Similar to other architecture found in the west, the stones used in the construction of the wall are extremely large in size. As the stream winds forward it passes the second spring, D-S2. A local farmer who lives in the vicinity has modified the spring by partially damming the flow of water with small stones. The Diablo becomes a trickle as it flows further north. Soon, the small arroyo once again becomes dry. At this point, the channel grows in depth and width, suggesting it is a major waterway during the rainy season. The Diablo remains dry and absent of water management features as it exits the site boundary.

B. The Picota Stream (Map B1)

Water Feature	Dimensions	Length	Elevation
Aqueducts			
P-A1		46.7m	189.90m
P-A2		3.67m	189.99m
Pools			
P-P1	7.2m x 2.84m		187.87m
P-P2	7.8m x 4.8m		186.23m
Drains			
P-D1		7.14m	
Dams			
N-DM1		4m x 2m	179.38m

Springs	Architecture	Perennial	Elevation
P-S1	No	No	235.94m
P-S2	Yes	Yes	196.44m
P-S3	No	Yes	192.65m
P-S4	No	Yes	191.24m
P-S5	Yes - P-P1	Yes	187.87m
P-S6	Yes - P-P2	Yes	186.23m
P-S7	No	No	187.91m
L-S1	No	Yes	132.49m
L-S2	No	Yes	117.72m
L-S3	No	Yes	125.49m
L-S4	No	Yes	116.86m
L-S5	No	Yes	116.64m
L-S6	No	Yes	116.69m
L-S7	No	Yes	106.49m
14 springs	**3 with architecture**	**12 perennial**	

The Picota Stream is Palenque's most complex water system. The watercourse received its name from Palenque's only standing stela, mapped by Franz Blom in 1923 (Blom 1925:184). Beginning with a plethora of springs in and around the Picota Complex, the stream stretches 675 meters through the western portion of the site while experiencing a 99-meter decline in elevation. After a series of spectacular cascades, the Picota collides with the Piedras Bolas Stream, and together they exit the site boundary some 90 meters later.

Figure B 1 – A view of P-A1's exit.

The Picota Stream is fed by a total of 14 separate springs, 12 of which are perennial. The three springs that create the headwaters of the Picota are P-S2, P-S3, and P-S4. P-S2 has been modified with cut stones stacked in a crude circle. The stones create a small pool approximately 1 meter in diameter. As the waters from the three springs merge together they enter P-A1, the Picota's first water feature (see Map B2). P-A1 travels 7 meters beneath a structure and is then joined by P-A2. P-A2 is delivering water from a small pool-like feature located 4 meters to the west of P-A1. The waters join together continuing 18 meters through P-A1 in a northerly direction at an elevation of 189 meters. The aqueduct then takes a 90-degree turn west, followed by a wide turn back to the east, where the water is then released into its natural channel. P-A1's exit is magnificent example of Palenque's architectural beauty (Fig. B1).

The Picota Group's best-preserved pool is P-P1, situated 10 meters to the west of P-A1. Positioned on an east-west plane, P-P1 measures 7.2m x 2.8m and is approximately 3 meters in depth. The pool is similar in size, shape, and design of those found in the Piedras Bolas and the Ach'. It is difficult to assess the function of the pools without excavation. Spring P-S5 is situated in the southwest corner and serves as one of the Picota's perennial water sources. The overflow drain, P-D1, transports the water to

Figure B 2 – The interior of P-D1.

P-A1 and is positioned in the southeast corner. P-D1, measuring 30cm x 30cm, is fully functional and in excellent condition (Fig. B2). P-P2 is located just to the west of P-A1's exit. It resembles P-P1 in design, but preservation is poor. The dimensions of P-P2 are roughly 7.5m x 4.5m. Spring P-S6 is found in P-P2's southwest corner.

As the Picota Stream continues in a northeasterly direction it creates the borders between the Picota and Escondido Group, as well as the Nauyakas and Lemones Group. Upon entering the Nauyakas Group a dam-like feature emerges. N-DM1 measures approximately 4m x 2m and acts as a dam by obstructing the flow water. Following the passage of N-DM1, the Picota Stream widens and begins to drop in elevation more abruptly. Soon the Picota enters the cascades where it joins the waters of the Piedras Bolas and together they decorate one of Palenque's most pristine areas of forest. It is in this area where many of the Picota's springs are located. A total of 7 springs are found emerging from the karstic earth in and around the Leon Group. The presence of such a high number of perennial springs only adds to the area's beauty.

C. The Arroyo Piedras Bolas (Map C1)

Water Feature	Dimensions	Length	Elevation
Aqueducts			
PB-A1		6.35m	189.28m
PB-A2		6.66m	181.98m
PB-A3		9.75m	180.00m
Pools			
PB-P1	5.25m x 2.75m		180.97m
PB-P2	3m x 3m		179.93m
Drains			
PB-D1	30cm x 50cm	4.5m	
PB-D2		9.75m	

Springs	Architecture	Perennial	Elevation
PB-S1	No	No	188.00m
PB-S2	Yes - PB-P1	Yes	180.97m
PB-S3	No	Yes	176.70m
MR-S1	No	Yes	157.73m
MR-S2	Yes - terrace	No	163.43m
G-S1	No	Yes	112.05m
6 springs	**2 with architecture**	**4 perennial**	

The source of the Piedras Bolas is unknown because the arroyo extends beyond the site boundary to the south. The seasonal arroyo enters the site periphery at an elevation of 238 meters. With the presence of three aqueducts, two pools, and two drains, the Piedras Bolas appears to have been managed quite extensively during the Classic period. A lengthy stretch of the stream is littered with a massive amount of cut stones, suggesting a possible walled channel. The Piedras Bolas travels 610 meters through the site, where it then, as stated earlier, combines with the Picota at the edge of the Palenque escarpment and jointly cascades north into the plains.

The most unique water management feature found in Palenque is PB-A1, located at an elevation of 189.28 meters. This is the first aqueduct that the Piedras Bolas

Figure C 1 – A view from inside PB-A1. Notice the decrease in size of the chamber.

Figure C 2 – PB-A1's exit.

Figure C 3 – PB-A1 is located just to the left of the cascades.

encounters as it flows north from the mountains. The true entrance to PB-A1 is unknown, but a collapse of roof stones revealed its interior. The main chamber of PB-A1 measures 1.20m in height by 80cm in width. This chamber of the aqueduct extends 4 meters from the collapsed roof. At this point, the aqueduct abruptly decreases in size by entering another chamber measuring 46cm x 46cm (Fig. C1). The smaller chamber then continues for 2.5 meters before terminating (Fig. C2). Today, due to the collapse, very little water passes through PB-A1. The majority of the water flow has been forced to the west of the aqueduct (Fig. C3). During the rainy season a massive quantity of water surges through the Piedras Bolas. When fully functional, PB-A1 would have created a considerable amount of water pressure. The act of forcing a square meter of

water into a square half-meter chamber generates water pressure. The purpose of having water pressure at this location is unknown. It could have been used to take water up and out of the arroyo to a residential group or possibly to create a fountain.

After exiting PB-A1, the Piedras Bolas winds between the Xinil Pa' and Piedras Bolas Groups. The next water feature, PB-D1, is associated with structure X19. PB-D1 originates at the edge of the structure and flows west toward the Piedras Bolas. Its complete length is unknown because only a small section is exposed due to collapse. The drain is situated 70cm below the surface and measures 50cm x 30cm. Positioned perpendicular to PB-D1 is PB-A2; this aqueduct is functional but its source is unknown. By peering south into PB-A2 from its exit, there appears to be a wall that should be blocking the flow of water (Fig. C4). It is hypothesized that the aqueduct does not end at the wall, but rather takes a 90-degree turn to the west and brings water from the Piedras Bolas. Project members searched for an entrance into PB-A2 from a westerly direction but found no such evidence.

Figure C 4 – The interior of PB-A2.

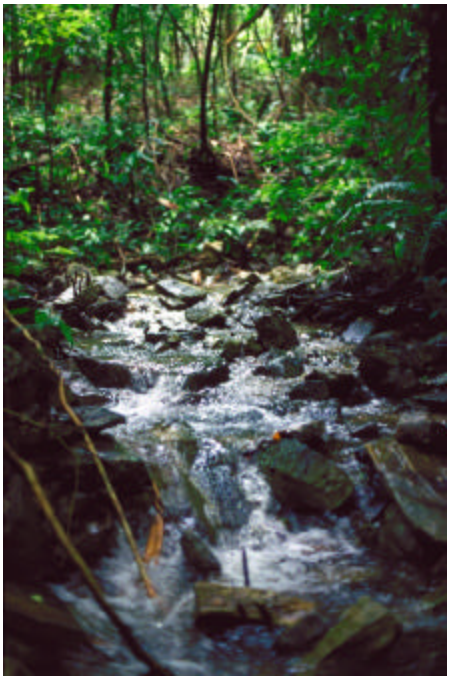

Figure C 5 – The Piedras Bolas is littered with cut stone.

Without excavation it is difficult to learn of PB-A2's origin. Upon exiting the aqueduct, the water joins, or rejoins, the Piedras Bolas. It is here where an excessive number of cut stones are found strewn throughout the bed of the stream (Fig. C5). This is suggestive of a previous walled channel. The stone debris continues for approximately 80 meters. A small tributary then joins the Piedras Bolas.

The origin of the tributary is PB-S2, located 125 meters to the west of the Piedras Bolas. Similar to P-S5, PB-S2 is found in the southwest corner of a pool (see Map C2). The pool, PB-P1, is like the Picota's P-P1 in construction and appears to function the same way (Fig. C6). The overflow drain, PB-D2, is designed to bring the water from PB-P1 to PB-P2. The drain is 9.75 meters in length and fully intact. Although the water from PB-P1 flows into PB-P2 today, it does without the overflow drain. The water from PB-S2 has found a path of least resistance by eroding the northeast corner of PB-P1 and naturally tunneling into PB-P2. The water then enters PB-A3 and flows east toward the Piedras Bolas. The aqueduct, PB-A3, extends for 9.75 meters before releasing the water into the natural tributary.

Figure C 6 – A view of PB-P1. The overflow drain is on the left edge of the photo.

As the Piedras Bolas continues northward it forms the boundaries of the Lemon Group and Moises Retreat. The Piedras Bolas receives an abundant amount of water

supplied by spring MR-S1. This perennial water source is one of Palenque's most plentiful springs. At this juncture, the Piedras Bolas merges with the Picota and together they spill over the precipice.

D. The Arroyo Motiepa (Map D1)

Water Feature	Dimensions	Length	Elevation
Aqueducts			
MT-A1	4.5m x 1.5m		189.17m
Dams			
MT-DM1	8.18m x 1m		189.91m

Springs	Architecture	Perennial	Elevation
MT-S1	No	Yes	188.14m
E-S2	Yes - terrace corner	Yes	187.48m
E-S3	No	Yes	178.99m
GE-S1	Yes - wall	Yes	171.80m
JO-S1	Yes - JO97	No	167.71m
ME-S1	No	Yes	135.08m
ME-S2	No	Yes	133.97m
7 springs	**3 with architecture**	**6 perennial**	

The Arroyo Motiepa is similar to the Piedras Bolas in that its origin is unknown. It enters the site boundary at an elevation of 216 meters. The Motiepa is fed by seven springs, six of which are perennial. The stream spans a distance of 800 meters to the north before leaving the site. Throughout its course it assists in creating boundaries for the Encantado Group, Encantado South, Xinil Pa', Group E, Moises Retreat, Group J, Motiepa Group, and Motiepa East Group.

Figure D 1 – Water flowing over MT-DM1.

There are two major water management features located on the Motiepa Stream. First, the water collides with Palenque's finest dam, MT-DM1 (Fig. D1). The dam

measures 8.18 meters in length, 1 meter in width, and roughly 1 meter in height. Today, MT-DM1 remains operational by slowing the flow of water in the Motiepa. The second feature is MT-A1, located 8 meters northwest of MT-DM1 (Fig. D2). This feature is given the title aqueduct for lack of a better term. MT-A1 is at an elevation of 189.17 meters and measures 4.5m x 1.5m. Due to heavy calcification, positive identification is difficult. Large cut stone slabs create the roof of the structure. By standing atop the aqueduct the sound of rushing water can be clearly heard. The source of the water from within is unknown. However, the water does exit through two small holes found on its west side. These holes were presumably drains at one time, but the dense calcification makes clarification difficult. Spring MT-S1 is located approximately 1 meter to the west of MT-A1.

Figure D 2 – Notice the heavy calcification forming on all sides of MT-A1.

As the Motiepa continues through the site it becomes sterile of cultural modification. While traveling northward it is joined by the waters from E-S2, E-S3, GE-S1, and JO-S1, before cascading over the Motiepa Falls. This area has become popular for the backpacking traveler within the last 5 years. The Motiepa then passes between the Motiepa Group and the Motiepa Group East prior to crossing the Camino Real. Immediately after the trail, the water cascades once more, and falls into Pakal's Pool--yet another area that is well liked by recent travelers.

E. The Takin Ha Stream (Map E1)

Water Features	Dimensions	Length	Elevation
Walled Channel			
J-C1		Roughly 50m	159.00m

Springs	Architecture	Perennial	Elevation
E-S1	No	Yes	228.52m
J-S1	No	No	175.66m
J-S2	Yes - wall	No	173.71m
J-S3	No	Yes	165.73m
J-S4	No	Yes	158.71m
J-S5	No	No	166.32m
6 springs	**1 with architecture**	**3 perennial**	

The Takin Ha is the only watercourse in Palenque that originates solely from within a residential group. Three separate spring-fed arroyos meander through Group J before merging together as one and exiting the site. This is Palenque's shortest waterway, measuring roughly 300 meters in length. The split arroyo located in the far east side of Group J is managed by J-C1. The exact dimensions of these walls are unknown due in part to their poor condition.

F. The Arroyo Otulum (Maps F1 & F2)

Water Features	Dimensions	Length	Elevation
Walled Channel			
OT-C1		96.5m	
Aqueducts			
OT-A1		58.5m	187.50m
OT-A2		19.40m	110.83m
OT-A3		13.60m	110.83m
Bridges			
OT-B1	10.25m x 10.25m		173.80m

Springs	Architecture	Perennial	Elevation
CV-S1	No	No	260.03m
ST-S1	No	No	212.12m
OT-S1	No	Yes	210.49m
OT-S2	No	Yes	208.73m
OT-S3	No	Yes	193.16m
MS-S1	No	Yes	101.29m
6 springs	**0 with architecture**	**4 perennial**	

The Otulum is Palenque's longest and most precious stream. Its perennial waters flow through the site's center by way of an extraordinarily constructed aqueduct. Subsequent to passing under Palenque's only fully functional bridge, the Otulum tumbles over an incredible series of cascades. These waterfalls are home to the Queen's Bath, a popular swimming hole for tourists and locals alike. The water then runs into a pair of aqueducts before exiting the site's boundary.

Before the perennial waters of the Otulum begin, a seasonal arroyo climbs to an elevation of 240 meters to the south. Springs OT-S1 and OT-S2 are the true headwaters of the Otulum. The stream meanders in a northerly direction forming the natural boundary of the Cross Groups western edge. At this point, a seasonal tributary extending from the Schele Terraces joins the Otulum. The stream collects more water at OT-S3 before entering the walled channel, OT-C1 (Fig. F1).

Figure F 1 – The Otolum flowing through OT-C1.

The OT-C1 stretches 97 meters before entering the OT-A1. It is believed that during Classic times, this walled channel was actually an aqueduct. Maps of Palenque created by early explorers illustrate that the Otulum did not flow through OT-A1. Blom states that the aqueduct was "blocked by its fallen roof"(Blom 1925:173). The collapse forced the Otulum to flow just to the east of the aqueduct and cut a "new" streambed. Blom's map clearly shows the diversion of the stream began at the same location where the walled channel begins today (Map 3.8). During the 1950's, archaeologists began to clean out the debris and rebuild the walls. After the collapse was cleared, the water from the Otulum split in two directions. The stream once again flowed through the aqueduct but continued to flow into its "new" channel. It was not until 1985 that archaeologists decided to block off the side flow of the Otulum and force all of the water back into the aqueduct. The "new" channel was filled with earth. Today the channel appears to have never existed.

The PMP has discussed the possibility that OT-A1 had at one time extended further south to the edge of OT-C1, but the dimensions of the channel are too wide to support a corbelled arch. It is possible that the workers from the 1950's were forced to build the walled channel wider than its original foundation due to erosion. Excavations within the Otulum would help in verifying this theory. Evidence revealing a more narrow foundation for the channel would suggest that OT-A1 extended another 97 meters to the south.

Figure F 2 – An interior view of Palenque's most beautiful aqueduct, OT-A1. Notice the stone support beams found in the corbelled arch.

The intact section of OT-A1 is in beautiful condition and carries the Otulum 58.5 meters beneath the floor of the plaza (Fig. F2). It resides at an elevation of 187.50 meters. There is evidence of three separate construction phases of OT-A1. The earliest building phase of the aqueduct extends from the exit, south approximately 40 meters. This section is OT-A1's best-preserved area consisting of large cut stone support beams found in the corbelled

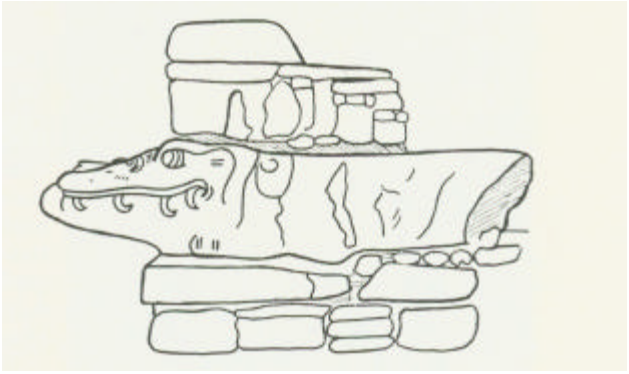

Figure F 3 – The carved alligator found at the exit of OT-A1. Frans Blom sketched this representation in 1923.

arch. The second phase stretches roughly 10 meters and is absent of the support beams. The vault on the east side is suffering by showing signs of collapse. OT-A1's third phase extends the remaining 8 meters before the entrance, but appears to have continued another 10 meters prior to the collapse. This is uncertain because it is here that the distance between the walls becomes too great to support a corbelled arch. It appears that the Maya of Palenque continued lengthening the aqueduct by continuing construction to the south.

After exiting OT-A1, a wall on the east side continues for 27 meters. The water then passes an extraordinary work of art. Positioned 1 meter above the flow of water sits an enormous alligator effigy (Fig. F3). It measures 3.44m in length, 1.10m in height, and 86cm thick, or about 3.50 cubic meters. When the Otulum was fully maintained by the Maya and clear of all debris the water level would have been substantially higher. This is also true throughout the rainy season. During those times the alligator would appear to be floating atop the waters of the Otulum.

Figure F 4 – Palenque's only fully functional bridge, OT-B1.

The stream snakes slightly eastward, passing the ball court and approaches the Otulum Bridge (Fig.

Figure F 5 – The vaulted channel that allows for water passage beneath the bridge.

Figure F 6 – The interior of OT-A2. To the left please notice the exit of OT-A3.

F4). OT-B1 measures 10.25m x 10.25m and is in superb condition. The tourist and workers use the bridge on a daily basis. The water passes through a corbel-arched opening directly in the middle of the bridge (Fig. F5). The passage is about 1 meter in width. As the water runs under the bridge it prepares to cascade over the falls and into the Queen's Bath. After cooling off the visitors, the water topples through a multiple number of small pools that have been nicknamed the Butterfly Falls.

At an elevation of 110 meters the stream gathers in a small and shallow natural pool. The water then enters a set of parallel aqueducts (see Map F3). OT-A2 has been obstructed from view by a large tree that grows directly atop the entrance. The Otulum waters still manage to find their way into the aqueduct. OT-A2 travels north at a bearing of 27 degrees for 19.4 meters before exiting into the natural streambed (Fig. F6). The second aqueduct, OT-A3, is heavily calcified and partially collapsed. Although damaged, the majority of the water flows through this feature. Both aqueducts have similar dimensions averaging 1.10 meters in height, and 80cm in width. The

Figure F 7 – One of the niches found at the entrance of OT-A3.

entrance of OT-A3 contains a set of peculiar niches (Fig. F7). One is located on the west wall while the other is facing it on the east wall. It is possible that they served as a holding device for a sluice gate of some kind. Following the niches, the aqueduct becomes badly damaged. The water continues through OT-A3 at a bearing of 27 degrees for 13.6 meters. At this point the aqueduct changes direction with a rapid curve to the west. OT-A3 feeds into OT-A2 and the waters rejoin, exiting together as one (Map 3.9). The Otulum then passes under the road and through the Museum Group and departs the site in a northeasterly direction.

G. The Arroyo Murcielagos (Map G1)

Water Feature	Dimensions	Length	Elevation
Walled Channel			
M-C1		13.5m	136.77m
M-C1		81.00m	132.99m
Dams			
M-DM1			183.83m
Bridges			
C-B1		4m	163.52m

Springs	Architecture	Perennial	Elevation
M-S1	No	No	238.58m
M-S2	No	No	190.14m
M-S3	Yes – wall	Yes	181.58m
3 springs	**1 with architecture**	**1 perennial**	

The Arroyo Murcielagos begins at an elevation of 305 meters, the highest in the site. As it stretches 980 meters through the eastern region of the ruins, it drops an incredible 200 meters in elevation before reaching the plains to the north. Its southern section runs to the east of El Mirador (Fig. G1). This area consists of steep canyon walls and treacherous cliffs.

The water flow in the southern region is seasonal. Judging by the dense

Figure G 1 – A view of El Mirador from the Palace.

levels of calcification found on dry cascades, the stream almost certainly runs the majority of the year. Spring M-S3, the Murcielagos' only known perennial water source, begins just to the west of Group C at an elevation of 181.58m. This spring is in proximity to a dam-like feature. M-DM1 measures 3.5m x 3m and appears to serve as a water catchment device. Today, the majority of the water flows to the west of M-DM1.

As the arroyo winds forward it travels beneath a modern bridge that enables tourists to visit Group C. Immediately following the bridge the stream cascades down 7 meters to the base of C-B1. This was probably Palenque's finest bridge. Prior to its collapse it measured roughly 3.5 meters in height and contained a corbelled arch measuring 2.3 meters in width. Project artists', Heather Hurst and Alonso Mendez, are creating a reconstructive measured drawing of the bridge at this time. C-B1 connected the Cascade Group with Group C.

The Cascade Group seems to be built atop calcified cascades. Due to the location of the group, this construction suggests that the ancient Maya of Palenque closed this section of the falls by directing all water into the present Otulum stream. This redirection of water made it possible for them to build the Cascade Group and Group B.

Next, the Murcielagos Stream cascades again, and descends into Jackie's Pool. It then flows through, M-C1, a series of partially intact canal walls extending some 130 meters toward the plains. At this point, the Murcielagos cascades a final time before flowing under the modern road and exiting the site boundary.

H. The Arroyo Balunte (Map H1)

Water Feature	Dimensions	Length	Elevation
Aqueducts			
B-A1		11.48m	103.31m
Walled Channel			
B-C1		5.5m	102.03m

Springs	Architecture	Perennial	Elevation
B-S1	No	Yes	114.48m
Z-S1	No	Yes	100.90m
Z-S2	No	Yes	100.68m
X-S1	No	Yes	103.73m
X-S2	Yes - B-A1	Yes	103.62m
5 springs	**1 with architecture**	**5 perennial**	

Figure H 1 – The interior of X-A1.

The Arroyo Balunte begins at an elevation of 208 meters separating Group C and the Ch'ul Na Group. The arroyo remains dry as it snakes between the Lik'in, Zutz', and Xaman Groups. B-S1 is the Balunte's first perennial spring and is located at 114 meters in elevation. Before entering X-A1 (Fig. H1), the streams only aqueduct, the Balunte is joined by a small perennial tributary fed by spring X-S1. These two watercourses enter the 11.48-meter aqueduct and together they continue in a northerly direction. Once inside X-A1, the stream collects more water from spring X-S2.

This spring was previously housed in its a corbelled chamber that is connected to the east wall of X-A1. The chamber was probably about 1.5 meters in length, but this is difficult to know due to its total collapse. After leaving X-A1, the stream passes through X-C1, a section of a walled channel that extends 5.5 meters to the north. Soon the Balunte merges with a series of small drainage ditches and eventually leaves the site by flowing under the modern road.

I. The Arroyo Ach' (Map I1)

Water Feature	Dimensions	Length	Elevation
Aqueducts			
AC-A1		33.00m	164.37m
Pools			
AC-P1	5.25m x 5.25m		113.54m

Springs	Architecture	Perennial	Elevation
AC-S1	No	No	178.42m
AC-S2	No	Yes	120.40m
AC-S3	Yes - AC-P1	No	113.54m
MB-S1	No	Yes	105.85m
MB-S2	No	Yes	106.99m
5 springs	**1 with architecture**	**3 perennial**	

The Arroyo Ach' serves as much of Palenque's eastern boundary. Beginning at an elevation of 198 meters, the Ach' stretches through the site for 554 meters. As the arroyo continues north it passes its first seasonal spring, AC-S1. The first water management feature emerges some 110 meters further downhill. In this area the topography becomes relatively flat with the absence of a streambed. The arroyo reemerges some 33 meters to the northeast. Upon closer inspection, evidence of architecture was found at the point of disappearance and return of the arroyo. This strongly suggests the existence of a collapsed aqueduct beneath the surface of the Ch'ul Na Group. Without excavation, the reality of AC-A1 is merely hypothesized.

The arroyo remains seasonally dry during its first 386 meters. The Ach' collects water from its first perennial spring, AC-S2, at an elevation of 120 meters. As the stream flows toward the north it passes Palenque's fifth pool, AC-P1. Measuring 5.25m x 5.25m, AC-P1 is in good condition. The walls are intact but the floor is littered with

thick sedimentation. The earth inside the pool remains saturated and muddy during the dry season. This suggests the presence of a weak perennial spring located within the pool. The pools P-P1, P-P2, and PB-P1 were all constructed atop a spring as well. As the stream continues it creates the borders for the Xaman and Ach' Groups. And like all the watercourses in the eastern portion of the site, the Ach' maintains a northerly direction and exits the site by flowing beneath the modern road.

Conclusions

The information given in the previous chapters is pivotal in understanding the site of Palenque. The city's Mayan name was Lakam Ha, meaning "Big Water" (Schele 1998:23). With a total of 56 known springs dotted throughout the mountains, this area is truly big water. Aside from the numerous springs, the site receives 2166mm of rainfall annually (see Fig. J1). Like other sites in Mesoamerica, Palenque experiences a four-month dry season. The reduction in rainfall from January-April would not have seriously affected the ancient Palenqueños due to the 41 known perennial springs within the site's boundaries. Evidence to support this theory is in the absence of water storage features. After an extensive 3-year survey, not a single reservoir was found. Water management at many Maya Lowland sites was devised for the purpose of storage. Palenque's water management dealt with moving an abundance of water throughout the city in an efficient and productive manner.

Tikal was a city that was plagued with a scarcity of water. Located in the Peten of Guatemala, Tikal is without a perennial water source. In order to sustain and support a growing population the Maya devised inventive ways of capturing and storing water. They constructed large reservoirs fed by clay lined drainage ditches. The runoff from

human-modified watersheds drains into, and easily fills the reservoirs (Scarborough 1991:659). Tikal's 6 major reservoirs would fill with water during the rainy season. Once filled, the reservoirs would supply the city throughout the four-month dry season. Other sites in the Maya area, such as Caracol and La Milpa, designed similar catchment reservoirs in order to sustain life.

With 9 separate perennial watercourses flowing throughout the city of Palenque, scarcity of water was rarely an issue. The availability of water afforded Palenque the opportunity to develop a unique system of water management that was unlike those found in other Maya Lowland sites. Channelization was the method of choice by the Palenqueños.

While the Maya of other Lowland sites were creating ingenious ways of capturing water, the Palenqueños were inventing new ways of conveying it. One creative way in which they did so was with PB-A1. Earlier I explained the probable design of the first example of Maya water pressure. The abundance of rushing water found in Palenque gave architects the advantage of invention.

The architects at Palenque were also given the chance to transform structures into watery mountains. They did so by building architecture directly atop or in close proximity to springs. There are 12 known examples of this throughout the site. Springs P-S2, P-S5, P-S6, PB-S2, MR-S2, E-S2, GE-S1, JO-S1, J-S2, M-S2, X-S2, and AC-S3 are all associated with architecture.

Palenque was not without dilemmas caused by water. Built on a narrow escarpment, surrounded by steep hills, sheer cliffs, and deep arroyos, Palenque was plagued with a scarcity of livable terrain. The flat topography that did exist in the site

was usually burdened with a waterway. The residents of Palenque constructed a large number of subterranean aqueducts in order to create areas large enough to maintain normal civic life within a major Maya center. These aqueducts covered preexisting streams. By doing so, they increased the area of land within the site. The OT-A1 is a prime example; the aqueduct creates unity between the Main Plaza and the Cross Group.

Palenque's water management is a subject that is in need of more attention. I have done my best to present the data collected by the Palenque Mapping Project. In the future, I hope to pursue further investigations into Lakam Ha's water system. A test-pitting program in and around Palenque's water management features would most definitely shed new light on the subject.

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