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An Ethnoarchaeological Study of the Cisterns in Oranjestad, Sint Eustatius, Netherlands Antilles

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AN ETHNOARCHAEOLOGICAL STUDY OF THE CISTERNS IN ORANJESTAD, SINT EUSTATIUS, NETHERLANDS ANTILLES

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ABSTRACT

St. Eustatius is a small Caribbean island in the Netherlands Antilles with a semi-arid climate and few natural fresh water sources. In the 17th and 18th centuries the Dutch developed this little island into a world trade center with a large European and African population sustained by the cultural adaptation of cistern use for the supply of fresh water.

The purpose of this study is to examine the cisterns of St. Eustatius as they were an adaptive strategy on the part of the Dutch settlers on the island in the 17th and 18th centuries, and to examine this segment of material culture by using a rich inter-disciplianry approach using ethnographical, historical and archaeological methods.

Though the cisterns of Oranjestad do not appear to be uniquely or distinctively Dutch, the cultural background of the Dutch colonists is suggested in their choice of cisterns to meet the needs for fresh water for a densely populated urban area which they created on the island. The similarity in form and materials of the cisterns of St. Eustatius with cistern structures found on other Caribbean islands is representative of a more pan-Caribbean culture. However, the use of cisterns and the combination of indigenous and imported materials in their construction illustrates the ingenuity and adaptibility of the Dutch people and their culture.

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INTRODUCTION

On the 25th of April, 1636, a small group of colonists from the Dutch province of Zeeland arrived on the Caribbean island of Sint Eustatius, thereby marking the beginning of the Netherlands' role in the island's history and their increasingly important influence in the Western hemisphere as a whole. The island, the colonizers found, was small, a mere 11 square miles, with fertile volcanic soil, a deep bay, a dry climate, and few accessible natural fresh water sources. To ensure the success, security and development of the new colony, the inhabitants needed to develop means of water collection and storage, resulting in the building of cistern structures, an adaptation still in use by the inhabitants of the island to this day.

Zeeland and the other low coastal provinces of the Netherlands presented a sharp climatic and geographical contrast to the environment of the Sint Eustatius colony. With polders holding back the ever powerful and threatening sea, the Dutch people over time ingeniously learned to reclaim land and to live with the ever-present threat and occurrence of floods and consequent destruction.

With the water table just below the ground surface in the Netherlands, fresh water was problematic, and although wells could be quickly and efficiently built, they were subject to contamination by seawater and urban pollutants. The solution to the problem on Sint Eustatius of fresh water availability was the development of large underground

cisterns, large enough to hold water for domestic and agricultural use, and strong enough to withstand continuous use and the deleterious effects of a tropical climate.

Used extensively throughout European colonies around the world (Ayisi 1990, Personal communication), cisterns were an elemental material aspect of colonization and were used in areas where water sources are scarce or nonexistent, or unreliable because of seasonal variability. In Ghana, for example, colonial peoples used cisterns as a supplement to river water in the face of fluctuations of water flow between the rainy and dry seasons (Ayisi 1990, Personal communication). The Dutch colonists of St. Eustatius used cisterns as a material response to the challenge of providing fresh water on a small island which did not have natural fresh water sources. The purpose of this study is to examine in detail this elemental aspect of the colonial and present material culture of the island that has never before been extensively examined, and thereby contribute to the elucidation and preservation of the cultures, past and present, of St. Eustatius and other cultures found throughout other areas of the world.

This study will examine the cisterns of Oranjestad, the capital and communal center of St. Eustatius, in an effort to gain insight into the cultural adaptation of the Dutch and other colonists in the Caribbean as they met the challenge of a basic human need: water collection and water control to sustain life. The use of cisterns on St. Eustatius met this challenge in several important ways. Firstly, the technology and materials used in their construction, stone, brick, and

mortar, were so efficient and readily available that they continued to be used in cistern construction well into the first quarter of the twentieth century when cheaper and more malleable concrete was substituted. Secondly, traditional cisterns, and the concrete and iron cisterns that eventually replaced them, are still cleaned, maintained and used as they were in colonial times. Thirdly, the present inhabitants of St. Eustatius are inheritors of the historical legacy of the island. The elderly segment of this population offer highly valuable insight into the use, construction, and materials of the traditional cistern structures.

The objectives of this study are four-fold; firstly, to describe the basic cistern types found in Oranjestad, St. Eustatius in terms of their materials, construction and use including (1) obtaining detailed information concerning the basic structure of cisterns in terms of materials and construction, (2) gathering data on cistern use, maintenance and general behavior associated with water use in Oranjestad, and (3) recording the changing construction and function of cisterns in Oranjestad today. Secondly, this study will attempt to make inferences on colonial cistern and water use using oral sources from the island's inhabitants and historical materials. Thirdly, this study will examine cultural strategies and adaptation to the environment and geography in terms of cistern construction and location. Finally and integrally, this study attempts to examine a segment of material culture by using an interdisciplinary approach using ethnographical, historical and archaeological methods. The research objectives of this investigation into

Oranjestad's cisterns are to gain insight into cistern construction and use using ethnographic data to make meaningful inferences about cisterns of the colonial period, and to make information available for archaeological and anthropological research where cisterns are found both in archaeological and contemporary contexts. It is also the goal of this research to preserve the knowledge associated with historical cistern construction and use and to record this information as it relates to the cultural history of St. Eustatius and to other cultures past and present.

Chapter I consists of a summary discussion of the ethnoarchaeological approach, as it is outlined by Ian Hodder, and discusses its application in this study. Chapter II discusses the climate and history of the island of St. Eustatius. Chapter III discusses the origins of cisterns and examines the cisterns of Oranjestad in terms of form, function, materials, construction, and methods of water collection and extraction. Chapter IV attempts to place the use of cisterns in their historical and cultural context in a discussion of Dutch culture and behavior.

CHAPTER I

THE ETHNOARCHAEOLOGICAL APPROACH

Ethnoarchaeology is a method of research which attempts to establish relationships between those things which are archaeologically visible and behavior which can be said to be archaeologically "invisible". It is, then, a method which combines ethnography with archaeological method and theory to gain insight into cultural process. First defined as a research method by J. W. Fewkes in 1900, ethnoarchaeology became a distinct area of research during the New Archaeology movement of the 1960's and 1970's. It was used as a research method by such archaeologists as Michael B. Stanislawski, Ian Hodder, Lewis Binford, Richard Gould, and others. Though the ethnoarchaeological approach is somewhat controversial in its application by archaeologists, the use of this approach in the study of the cisterns of Oranjestad falls within the framework of Stanislawski's definition. In his work ethnoarchaeology is defined as the collection of original ethnographic data in order to aid archaeological interpretation (Stanislawski 1974).

The three basic goals of ethnoarchaeology as outlined by Hodder are (1) to make cross-cultural generalizations about human behavior; (2) salvage relevant information from forms of society which are fast disappearing; and (3) to develop ethnographic analogies concerning the principles which relate material patterning to adaptive and cultural contexts (Hodder

1982:38-40).

Within the last two decades, ethnographic analogy has emerged as an highly important method of archaeological research, offering valuable insight into past cultures and cultural process. "In general, a positivist attitude towards ethnographic analogy is still held by many or most American archaeologists, who see in such specific historical analogies, the only way of reconstructing the particularistic qualities of past cultures" (Willey and Sabloff 1980:205). Ethnographic analogy has also established an important place in the realm of historical archaeology, with an interdisciplinary approach including studies in folklore, material culture, ethnohistory, and cultural geography, expanding the field of research in the context of culture and culture process in the framework of the colonial period.

In terms of ethnographic research in a broad archaeological sense, M. Brown, III states, "Archaeological field work should not only involve the observation of actual behavior and the investigation of cognitive domains, but the eliciting of information about past behavior as well. In other words, provisions should be made within archaeology for the oral history and folklore of material culture, particularly in the context of modern, industrial societies" (in Schuyler 1978:278).

The use of ethnographic data in the research of Oranjestad's cisterns is appropriate and of particular value due to the great lack of documentary sources available concerning the history of St. Eustatius, and the fact that cisterns have been in continuous use since the early

colonization of the island. Most importantly, ethnographic data is available from individuals who built and used historical cisterns, using traditional construction methods and materials. Because of the combination of all these factors, ethnoarchaeological study of cisterns on St. Eustatius can offer insight and inferences into past colonial behavior, adaptation, and culture process.

Methodology

The island of St. Eustatius offers great opportunities for archaeological and ethnographic research. With approximately 1700 inhabitants, the Statian people are open, friendly and accommodating to outsiders. The main body of research in this study is derived from direct observation, the recording of cistern structures and the gathering of ethnographic data as well as the use of historical sources. The data collected for this study was gathered on St. Eustatius in 1989 during the ninth summer field season of the College of William and Mary's Archaeological field school under the direction of Dr. Norman F. Barka. Dr. Barka, and Dr. Eric Ayisi have conducted archaeological and ethnographic research on St.Eustatius and the field school has conducted various excavations and ethnographic projects resulting in numerous papers, theses and dissertations that illustrate St. Eustatius' varied and abundant cultural resources.

Along with the ethnographic data collected throughout the field season from a variety of sources, a total of 26 Statians between the ages of 13 and 87 were interviewed about water use on the island and about cistern construction and

materials. The most informative segment of the population were the elderly people who provided valuable insight into the construction and use of historic cisterns, as well as the introduction of modern concrete cisterns and water pumps.

The survey was concentrated within the town of Oranjestad as this is where most of the cisterns on the island are still extant. Most of the cistern structures of the Lower Town are in ruin or have vanished over time. Of 358 cisterns located throughout the town of Oranjestad, only two major types are discernible, historical/traditional cisterns (78% of all the cisterns), and modern concrete cisterns (22%). A survey sample of 50 structures, examined in detail, reflects the overall percentages. The data for each individual cistern examined was entered on a survey sheet which included cistern dimensions, materials, function, location, method of water collection and drawings for each cistern (See Appendix A). Cursory examination of all 358 cisterns and the fifty cisterns examined in detail, revealed two basic types of cisterns based on their material and structural attributes. Representative samples of these types were photographed, measured and drawn in detail. A brief look at wells is also included in this study as they pertain to the colonial adaptation on the island and to the development of cisterns.

Each individual cistern and well is plotted on a map of the town of Oranjestad (Appendix B) with each cistern assigned an identification number corresponding to the outline of the town used by the College of William and Mary's architectural survey. On this map, Oranjestad was broken

down into 49 separate numbered sections, with each structure within each area given a letter. For those cisterns unassociated with a specific structure, the letters 'ZZ' were used.

With only a few wells extant on St. Eustatius, most households and businesses have an associated cistern, adding up to over 358 cisterns, and this number, added to numerous cisterns dispersed about the island associated with the ruins of forts, warehouses, plantations, and factories, total perhaps well over 500 cisterns altogether on the island. Due to time limitations, a complete survey of all the cisterns on the island was not possible, though personal observation of cisterns outside of the survey area were made.

The structures in the survey were examined at random throughout Oranjestad. The 50 were chosen by their accessibility and their condition, and in an effort to obtain at least one cistern from each of the 49 city sections. Due to restrictions in time, 50 cisterns were judged to be the maximum number samples that could be recorded and studied in detail within the time allowed. Because of the cisterns' continuity of materials, form, and use it was determined that a detailed study of all cisterns in Oranjestad was not necessary for an accurate study of cistern materials, forms, and use in Oranjestad.

From the survey, analogies can be made about cistern construction and use in other climatic, geographical, and cultural areas where cisterns are found in the context of European colonization throughout the world. Cisterns similar in appearance and function are found on the islands of St.

Maarten, Saba, and St. Kitts, and are presumed to be found elsewhere as well.

CHAPTER II

ENVIRONMENT AND HISTORY OF ST. EUSTATIUS

Geography

Nestled in the Windward Island chain, St. Eustatius is located between St. Kitts to the southeast, Saba to the northwest and St. Maarten to the north (Fig. 1). Born of volcanic action, St. Eustatius is characterized by a low mountain range in the north, and the crater of an extinct volcano, the Quill, on the southern end of the island. In the crater a lush rain forest flourishes with banana trees, vines and primeval cotton trees towering from the crater floor. Shy iguanas, soldier crabs and other exotic fauna can be found along the trails that wind around the rim and throughout the crater. Separating the Quill and the dry northern peaks is the cultivation plain, with fertile volcanic soil, which slopes off to the Atlantic on one side and ends on the other side in crumbling cliffs at the Caribbean. Comparatively much drier than the lush crater of the Quill, it is here that goats, sheep, donkeys and cattle graze freely on grass and thorny bushes throughout town and in and around small garden plots and sugarcane fields.

Oranjestad is concentrated on the Caribbean side with Fort Orange perched on cliff's edge and overlooking the sea. The town is interspersed with narrow streets which for most part slope downward towards the cliffs' edge. The houses are nestled tightly together along the streets with fruit trees, such as Mango, Gennep, and breadfruit, overhanging the houses

and small yards. The older houses are primarily made of stone and brick or concrete foundations with wooden walls, while the new ones are made of cinder or concrete blocks. Both historical and modern concrete cisterns can be easily seen in yards as one walks along these streets. There are 400 houses within 49 blocks in the town of Oranjestad. The total area of Oranjestad measures approximately 2.5 square miles. The Lower Town stretches along the narrow strip of shore beneath the cliffs. A single road cuts through the Lower Town from the Upper Town and ends at the island's long shipping pier. It was here in the Lower Town that St. Eustatius linked world markets in the eighteenth century, a virtual warehouse for trade between Europe, the Americas, Africa and beyond.

Climate

With an average year-round temperature of 27°C the island of St. Eustatius is dominated by constant trade winds blowing in from the Northeast and East averaging 4.6 miles/second. During the months of September through November, maximum rainfall occurs with 132.8 mm average accumulation for the three month period. The minimum amount of rainfall occurs with 44.2 mm accumulation. The annual average for rainfall is 1,072.7 mm with a monthly average of 89.4 mm (P.B.S.A.,1989: 21-23).

During heavy rainfall water temporarily flows through various washes about the island that flow into the sea. Rainwater also flows down through the streets of Oranjestad. Because of the warm climate and seasonality of the rainfall

and lack of natural permanent fresh water sources, such as streams and fresh water lagoons, cisterns on St. Eustatius were a necessary adaptation for water collection and storage during the dry seasons.

History

St. Eustatius, despite its small size, relatively barren topography and lack of fresh water sources, was destined to become one of the world's richest ports and instrumental in the shaping of world events. Located between the trade routes linking South and North America, the Dutch West India Company exercised a tradition of free trade throughout the Western Hemisphere, maintaining neutrality in the face of European nations' struggles for economic and military dominance.

Often called the Golden Rock, the Island's naturally deep and sheltered Oranjestad Bay on its Caribbean side could protect hundreds of ships from the stronger winds and waves of the Atlantic Ocean. Reaching out into the Bay, wharfs linked ships' cargo with the Lower Town's warehouses, tightly situated along the shoreline and several stories high. Built of brick, cobblestone, mortar and wood, these warehouses were often loaded to the roof with precious commodities such as tobacco, guns, cotton, ceramics, silks, wine, and many other goods whose traffic was unhindered by the Dutch merchants' policy of "free ships, free goods" (Tuchman, 1988: 19). "As a free port, Eustatius had reaped the profits both as market place and as store house, where goods waiting sale or transshipment could be safely housed against predatory

foreign fleets in search of loot" (ibid.: 20).

Determining that the security of St. Eustatius and free trade rested on its very economic accessibility and importance for all sea trading nations, the island was never heavily fortified to insure its security against large scale military aggression by rival European nations. As a result, possession of the island witnessed frequent if only brief occupation by the English and French navies throughout the seventeenth, eighteenth and beginning of the nineteenth century. Beginning in 1666 possession of the island changed hands a total of 17 times before finally remaining under Dutch protection in 1818 and continuing to the present day (Hartog, 1976).

At the outbreak of the American Revolution, St. Eustatius was at the pinnacle of its economic prosperity and trading prowess (van den Bor, 1981). With the American forces blockaded by British warships off the Colonial coast, St. Eustatius proved to be a vital link for rebel supplies and communication with the European continent. Threatened with embargoes and possible martial retaliation, the Dutch government continued to transport to the struggling colonies the needed arms, powder, and supplies and offer sanctuary for American frigates. For the Dutch government it was not so much a question of political sovereignty, as much as it was a commitment to economic autonomy (Tuchman, 1988: 6-8). On November 16, 1776, the Dutch commitment to unregulated free enterprise was symbolized in a brief ritualized moment, marking the beginning of a newly emerging free nation, and in turn, the beginning of the end of the Golden Rock's Golden

Age.

On November 16, 1776, the American frigate, the Andrew Doria, sailed calmly into Oranjestad bay; from her mast flew the flag of the newly formed Continental Congress. The customary artillery salute was fired from her hull, with a return cannon salute echoing back from behind the walls of Fort Oranje. This ritualized act was to become the first acknowledgment by a foreign government of the sovereignty of the thirteen United States. With this brief symbolic act, the victory of the American Revolution was to be realized in the years to come, with the assurance that critical supplies would reach the rebels, sustaining their struggle and eventually ensuring their victory at Yorktown seven years later. "Eustatius' salute was of no great importance except for what it lead to. By intentionally encouraging, in defiance of its own government, the Dutch trade in military armament to the Colonies, the Governor assured the continuance of shipments from St. Eustatius, a critical factor in saving the American Revolution at its frail beginnings from starvation of fire power" (Tuchman, 1988: 7).

By 1781 the tide of the Revolutionary War had turned and the struggling new nation of American merchants, planters and frontiersmen was presenting Great Britain with the reality of a lost colony. Precious supplies and correspondence, slipped through British blockades, were funneled through the free trade warehouses on St. Eustatius, and were critical to change the tide of the war. On January 27, 1781 British Admiral George Brydges Rodney was ordered to take his fleet to St. Eustatius, wrest the island from the hands of the

Dutch and terminate the flow of supplies to the Colonists. One week later Rodney's forces captured the island without a struggle.

Rodney's consequent occupation and pillage of St. Eustatius had two-fold consequences on the outcome of history. Firstly, Rodney crushed the economy of St. Eustatius, dispelled the Jewish population, captured American servicemen there and dispelled all French nationals. The loot totaled £3,000,000. (Tuchman, 1988: 97). Secondly, Rodney's preoccupation with St. Eustatius impacted the outcome of the battle at Yorktown, Virginia and helped bring about the American-French victory and consequently the success of the American Revolution. While Rodney and his forces remained on St. Eustatius the following months dining and dividing their booty, Lord Cornwallis at Yorktown would find himself short of men and supplies and out of time. Once again St. Eustatius had been instrumental in influencing the course of history.

Although Rodney plundered the island, St. Eustatius would briefly recover economically following the war years. However, attention and profits soon shifted to American ports. After a brief revival in the 1790's following Rodney's withdrawal from the island, the island continued economic decline with only brief economic surges of economic recovery in the nineteenth century in sisal and sugar industry. (For a more detailed discussion of the history of St. Eustatius refer to Tuchman [1988], Attema [1976], Hartog [1976], and Kandle [1985]).

In the year 1790 there were 8124 inhabitants on St.

Eustatius. 2341 of these people were white, 643 were freed blacks and 5140 were slaves (Hartog, 1976: 45). Throughout the island were small plantations, vineyards, and gardens. Small herds of domestic animals, including cattle, horses, sheep and goats ran about for food and were used for transportation. To sustain the plants, animals and people on the small frontier colony, a reliable water system was needed; one that would securely sustain basic needs, especially during the dry season, stifling summer months and during times of drought.

Because St. Eustatius possessed little in the way of readily accessible natural fresh water sources the year round, unlike other neighboring Caribbean islands such as St. Kitts, Dominica, and Guadalupe, rain water would need to be efficiently and effectively collected and stored to maintain the island's large bustling population and sustain their water needs through the dry seasons. The answer to the colonists' basic need for water came in the form of cisterns, monuments to the ingenuity of their designers, and structures which have outlived the tenancy of their builders.

CHAPTER III

THE CISTERNS OF ORANJESTAD, SINT EUSTATIUS

The Cisterns of Oranjestad

St. Eustatius' long and colorful historical legacy is reflected in the great abundance of archaeological resources and historical architectural structures, such as forts, plantations, mansions, churches, and cisterns. The variety of artifacts excavated over the past nine years by the College of William and Mary's field school, have brought to light the extent of the wealth and prosperity of the Statian colonists during the Golden Era of the eighteenth century. In terms of the great richness of historical artifacts and structures found today on St. Eustatius, it can deservingly retain the title of the "Historical Gem of the Caribbean".

The cisterns of St. Eustatius are located throughout the island with two essential types extant, both of which are still commonly used by the Statian people. The first type is the historical or traditional arch cistern made of traditional and indigenous materials and characterized by a brick arch covering. The second type is the modern twentieth century concrete cistern, usually flat-topped, made of poured concrete and rebar or iron rods. A sub-type of modern cistern is also found, made of concrete and metal sheeting. The study will also look briefly at the few remaining wells of St. Eustatius as these are relevant to the discussion of cisterns.

From the survey it was discerned that 72% of the

cisterns in Oranjestad are of the historical type and 16% are of the modern type. However, it is interesting to note that on an island with limited fresh water sources only 62% of the town's cisterns were currently in use.

The average distance between cisterns and their associated buildings varies greatly. The average distance is 21.9', with 8% of the cisterns located under the associated building, and 10% directly against the building. The cistern's location in terms of compass direction to their associated building show little deliberate planning. From the survey sample it was discerned that 28% of the cisterns were located to the north of the building, 22% to the south, 24% to the east, and 6% to the west. There may be a conscious correlation between the low percentage of cisterns located to the west of the building, with the need to avoid the heat of the afternoon sun from warming the water in the cistern.

Cistern Origins

During the sixteenth, seventeenth and eighteenth centuries, cisterns were widely used throughout Western Europe, especially in densely populated, low-lying areas close to the sea, and far from abundant fresh water sources; a few of these population centers included Venice, London, and Amsterdam (Quennel 1934). Because of the geography of the Netherlands, fresh water sources were often difficult to maintain and water was obtainable only from shallow wells, cisterns, murky canals, or slow-moving rivers. As in the

city of Venice, water was frequently brought in by boat from other areas and wells were often contaminated by surging seawater (Braudel 1979:228).

The word "cistern" comes from the Latin word "cista" meaning "chest" (Webster's New World Dictionary 1987:113). Early cisterns in Europe were made of lead, wood, and brick, with brick cisterns becoming more common after the eighteenth century (Hartley 1964: 135). In The Wells of Williamsburg, I. Noel Hume illustrates such a cistern built of compass, or wedge shaped bricks that "abutted against each other throughout their full lengths, and once seated on the curb could not be dislodged" (Noel Hume 1969:24). Cast lead cisterns were widely used throughout England in the eighteenth century. Large lead sections were sand-cast and then soldered together to form the cistern structure (Quennel 1934:93). Cisterns in western Europe were used well into the nineteenth century until large scale urban plumbing came into being. Early water pipes were made from bored elm trunks about six inches in diameter with lead and ceramic pipes replacing them by the end of the seventeenth century (ibid.). In 1845, in the city of Liverpool, a man named H. Banner expressed the need for cisterns as a solution to the water problems ailing the citizens. "If an elevated cistern be provided, a branch pipe from this cistern into each cottage will give an unceasing supply. In Kent place (in Liverpool) are 54 houses each having a pipe from a capacious cistern, and the tenants enjoy the comfort of water always laid on" (Hartley 1964:138).

The use of maintained, sealed cisterns would have had advantages over the use of wells. With a cistern, water is collected from rainfall and then stored underground where it would remain cool and fresh. A well, on the other hand, was susceptible to whatever managed to seep into the water table in urban and rural areas, including privy and industrial waste. In 1877 a magazine in New York printed that "the cess-pool, the privy-vault, the pig-pen, the barn-yard, the place selected for the deposit of laundry and sink water, are frequently grouped about the well and become centers of deposit, in which filth accumulates from year to year, causing the saturation of the soil in constantly increasing areas, so that the neighboring well, which at first may have furnished water which was perfectly pure, in time begins to receive the the soakage of these accumulations" (in Noel Hume 1969:31).

Perhaps the development and use of cisterns over the extensive use of wells on St. Eustatius was a conscious strategy on the part of the Dutch colonists who originated from one of Europe's most densely populated urban areas and were aware of the potential hazards of water contamination in a densely populated area. The use of cisterns could have ensured a clean, reliable source of water for the island's population of merchants, slaves, and livestock, and one which was securely protected from the impurities of close-quarter habitation. By keeping cisterns on a household level they also reduced the risk of contamination to which community level water sources were subject. The household water source

was not only more secure, but convenient. In nineteenth century Alexandria, Virginia, "for ease of access and dependability of supply, the household well seems to have been the preferred water source for families who could afford one. Location of the well under the house in a basement would have protected the water source, made it conveniently near and would have made fetching water in inclement weather an easier task...The same considerations for construction and location of wells apply to cisterns" (Shephard 1988:4).

No prehistoric cisterns have been found at this time on St. Eustatius, however, the existence of prehistoric cisterns in nearby Central America presents some intriguing questions about the origins of early Dutch cistern construction on St. Eustatius. It may in fact be possible that the Native American groups inhabiting St. Eustatius in prehistoric times utilized cisterns to collect and store water. Among the Chontal Indians on the Xicalango peninsula, Western Campeche, two types of underground cisterns were developed which date from the Late Classic Period and later. The first type of "chultun", or cistern, consisted of a cavity carved directly into solid limestone bedrock and able to hold approximately 3000 liters of water collected from roof run-off or an above ground plaster platform. The other type of "chultun" consisted of a cylindrical hole cut into the ground and lined with successive layers of lime mortar. These "chultuns" have largely been replaced by concrete cisterns since the 1940's (Matheny 1971).

The Historical Cisterns of Oranjestad

In order to meet the challenge of water scarcity on St. Eustatius, the early colonists realized that structures were needed that could effectively collect and store the runoff from the heavy tropical rains that swept across the island, rains that were characterized by heavy accumulation during the monsoon seasons of late summer through November. These structures would also need to be efficient enough to store water to last through the dry seasons of winter and spring when rainfall is minimal.

Cisterns appear to have been used early in the colonization of the island. In 1666 De Rochefort, an inhabitant of St. Eustatius, wrote:

> There are no Springs in this Island; but there are now few Houses but have a good cistern to supply that defect: There are also Store-houses so well furnish'd with all things requisite to life, and the accommodation of the Inhabitants, that many times they have the wherewith to pleasure their Neighbors (Davies (in) Kandle 1985:29).

The historic cisterns examined in Oranjestad and outside of the controlled survey sample were found to be remarkably consistent in form and materials (see Cistern Attributes Tables 1 and 2). The historical cisterns were usually rectangular in shape. Two cisterns in the survey had an oblong ovular shape, their corners having been rounded. The average length of the historical cistern in the sample was 20.2′ with the largest cistern measuring 36.9′, and the smallest 10.8′. Six percent of the historical cistern structures were found located underground with only the

opening above the ground surface. Further historical cistern measurements are greatly hindered by the fact that uneven and varied ground levels around the structures prevent accurate and consistent measurement of cistern features. Variation in cistern size may be attributed to individual household size and water needs. The openings of the historical cisterns are located at the top of the arch to one end of the cistern and all are square or nearly square in shape, measuring 2'x 2' or 2'x 2.1' on the average. These openings are lined with a layer of brick or cut stone around the perimeter. A stone and mortar lid stop is often located at one end of the opening. All historical cistern openings still have, or show signs of having had iron pintels for strap hinges for a wooden lid. Thirty-six percent of the historical cisterns in the survey have steps leading up to the opening. Of these cisterns most had 2 or 3 steps.

The historical arch cistern is represented by cistern 6ZZCO4, which is located off Fraeschweg in Oranjestad (Figs. 10 & 11). This cistern has a large platform for water collection measuring 53.7'x 29.2'. The cistern itself measures 29.2'x 7.0'x 2.9'(height above ground). Though the immediate area around the cistern is outlined by architectural foundations, the cistern is not associated with a domestic unit or domestic use at this time. Rather, the cistern is currently used for watering livestock. On the south wall a plaque is inscribed with the initials of the makers and the year of its construction, 1924. This cistern is believed to be one of the very last traditional arched

cisterns built on St. Eustatius. Though still functional, the cistern is in a state of disrepair and plywood slabs cover the opening.

It is difficult to give average dimensions of the historical cistern type as the relation of the structure to ground level varies greatly and is a result of the landscape and not the cistern structure. Internal cistern measurements proved difficult to obtain due to the depth of the cisterns and the presence of locks on cistern lids. Many of the unused cisterns had debris on the cistern floor, also making accurate measurements difficult. Measurements were taken from twelve of the historical cisterns and an average depth of 10.7' was found. Allowing for a cistern cavity wall thickness of approximately 8", an average cistern cavity was found to be approximately 1,200 cubic feet (see Table 2 for individual measurements).

Cistern# 22BCO4 demonstrates a unique attribute with the construction of a painted human head made of plaster and stone as its lid stop. This is the only known cistern on the island with decorative attributes (Fig. 19).

The materials in traditional cistern construction are a blend of indigenous and Old World substances, some in their natural state, others altered by human technology. The basic materials found in traditional cisterns are brick, cut stone, cobblestone, and mortar. Figures 2 and 3 illustrate typical historical type cisterns in terms of materials. Figure 2 (26QCO2) uses a platform catchment for water collection. Figure 3 (42CCO1) is the Fort Oranje cistern which is covered

by a layer of plaster, and uses the roof water collection method. The average catchment size found in the survey measured 482.5 square feet, the smallest measuring 67.7 square feet, and the largest, 1568 square feet.

Tremendous quantities of European brick reached St. Eustatius during the colonial period as ships' ballast and were a common building material in the construction of houses, warehouses, churches, forts, and other structures. After the collapse of the Statian economy in the nineteenth century, much of the brick was dismantled and shipped to other islands. However, brick can still be found throughout the island today in large quantities testifying to the considerable importance it had as a building material during the colonial construction period. The predominant brick is yellow with red brick found in fewer but still considerable quantities. Several persons on the island have suggested that the clay in this brick originates from along river banks in the Netherlands, where, in fact, brick is still produced today. The brick used in the reconstruction of Fort Oranje in the 1970's was shipped to St. Eustatius from the Netherlands.

Cut stone can be found in cistern arch wall construction as well as in other forms of architecture, especially in street walls. A common cut stone found on St. Eustatius is a type known as "Bermuda stone", a porous limestone believed to have originated from Bermuda. Cut when wet, this stone increases in hardness as it dries. Cobblestone is found in great abundance along the island's shore and varies in size

from pebbles to boulders. The mortar used in cistern construction is made from indigenous materials and is also found in many architectural forms. It is quite durable to this day, though it is rarely produced now as the availability of cement replaced its use. More will be said about the making of mortar later in this paper.

Construction

The construction of traditional arch cisterns was an arduous task requiring much patience and many strong backs. It can be safely assumed that slave and animal labor were used during the colonial period for the transportation and setting of materials. The fact that slaves were used to construct the cisterns might account for the consistency of cistern construction and materials even after the abolition of slavery in 1863. On the island today, cistern construction, simultaneously accompanying house construction, is required not only by necessity but by law. The great number of historical cisterns still standing throughout the island and almost always directly associated with colonial architectural structures, suggests that this practice may have been common historically as well as in the present.

The cistern cavity was built underground with only the arch and its supporting walls emerging above the ground. According to informants who were builders of historical cistern structures early in the twentieth century, the first step was to excavate the cistern cavity, a laborious task in itself as the volcanic soil is hard and granular below the

subsoil layer. This was done with pick and shovel until the cavity reached the depth of approximately 13 feet and the walls and floor were perpendicular. Nearly all traditional cistern cavities are narrow elongated ovals in shape to accommodate the brick arch covering and to eliminate corners, expediting the cleaning of the cistern walls.

The next step after digging the cavity was to lay cobblestone evenly and tightly spaced along the floor of the cistern with a thick layer of mortar covering them. After the mortar hardened, the four walls were constructed by stacking cobblestone upon one another to the top between supported wooden forms and then heavily applying mortar between the cobblestones and over them. Supporting walls for the arch were then built at ground surface at both ends of the cavity using combinations of brick, cut stone and mortar with cut stone being the predominant material used. Arch shaped wooden forms were then place width-wise spanning the cavity, with brick and mortar rounding over the opening. Atop on end of the arch, a square or rectangular opening was left for access with buckets. At this opening hinged lids made of wood were fastened using forged iron pintles and long strap hinges. A lidded opening helped to reduce the chances of dirt, debris and animals falling into the cistern cavity. As today, locks may very well have been used to deter water theft. In cases where the cistern arch extends well above ground, steps of brick or cut stone were often built at the end where the cistern opening was so that access to the opening was possible. Small vents were also left in the base

of the ends of the cistern to prevent the build up of pressure in the event of excess rain. Without these vents it is claimed that the pressure of the water would crack the walls and arch and cause the cistern to leak or even break apart.

All along the length of one side of the base of the cistern arch, vents were left for water collection. Historically and, to a lesser extent today, platforms were built adjacent to the cistern to collect rain water, with the platform usually spanning the length of the cistern and sloping into the cistern side. This allowed direct water flow into the vents. The platforms appear to be built of the same materials as the cisterns with several layers of mortar covering the surface of the platform, creating a smooth durable surface.

The exterior of the arch and the interior walls and floors of the cistern cavity were also layered several times with mortar making the walls smooth and dense. Many of the older cisterns have a reddish tint to the interior walls, and when I inquired about this it was claimed that the red coloring was the remnant of an iron oxide based plaster that was imported from Switzerland and Germany and used in the making of the mortar. This iron oxide plaster is believed to have given the cistern walls a very hard and durable surface. (See Figure 6 for a profile of an historical type cistern construction and materials).

In Dorothy Hartley's book, Water in England, there is an excerpt from the Old Builder's Journal, printed in about

1780, which gives an account of cistern building in England that is useful for illustrating building techniques on St. Eustatius' of the same period and which is consistent with the ethnographic data.

> Build the outer wall of wet brick using soft mortar (for if the porous bricks were used dry, they might crack or stir when they became soaked). The inside wall should be set with a quick-lime mortar, so that the heat engendered will cement both together. If the cistern is to be stone-built the expanding quality of the dry brick dust seems to have been utilized, as the builder recommends a fourth part of dried powdered tile or brick dust mixed in with the mortar...The building of a waterproof cistern, capable of containing a considerable weight of water, was a very skilled job ((in) Hartley 1964:136).

Many of the traditional cisterns found throughout Oranjestad and the island at large are in remarkably good condition, reflecting the importance with which the Statians through time have held the cisterns, and testifying to their upkeep and continued use and durability of their materials and construction. The mortar used in the cisterns and other structures has proved to be a durable property in their construction, withstanding the effects of climate, use, neglect and time.

Mortar

The making of mortar, once a common practice, is now only rarely done and that mostly for the repair of the traditional cisterns and the making of stone ovens. Fortunately, several Statians interviewed who worked extensively building cisterns and grave markers of similar

brick arch construction, can relate the materials and procedures.

In an open area, wood is stacked lengthwise between support beams driven vertically into the ground. Crushed shell and coral that has been dried along the shore are stacked on top of the wood. Over the shell, another layer of wood is layered and above this layer a covering of green foliage is laid out. Finally, upon the greenery, rocks are laid across to compress the layers. The wood used is usually hardwood; thorny scrub trees, known as acacia, found growing wild about the island. The wood is then ignited and allowed to burn and smolder for about 24 hours. As the wood burns down and the upper layer of rocks compress the hot coral and shell below, sea water is sprinkled across the pile until the fire is out and the coral and shell are saturated. The result of this is "slacked lime" and is later mixed with sand and white cement to create mortar.

The slacked lime is left in its whole finished state until it is needed in construction. At this time blocks are cut from the mass and then hauled to the construction site. These stacked lime blocks were commonly found during the excavation of the Governor's Guest House during the the College of William and Mary's field school's 1989 season. These blocks are characterized by their bright white color, gritty and coarse texture and intrusions of pieces of shell and coral.

Though the change from traditional to concrete cisterns occurred in the first and second quarters of the twentieth

century, several Statians still living built traditional cisterns and made mortar, and offered valuable insight into the materials used in the construction of the old cisterns.

Modern Cisterns

Cisterns today are made from poured concrete with iron rebar rods woven in plywood forms before pouring. Though less durable than traditional cistern structures, the speed of their construction and the relatively cheaper cost of materials and labor have meant that these modern cisterns have replaced the traditional type in new construction, although the earlier forms are generally preferred and are consequently well maintained and reused. (Figures 7 & 8).

The modern concrete cistern is represented by 4OKCO1 and is located off of Van Ness Weg (Figs. 9 & 10; and Figs. 7 & 8). Rectangular in shape, this cistern measures 12.7'x 9.9'x 2.7'(height above ground) and is built of poured concrete with rebar rods. The water collection system is the roof runoff method and a gravity tank at the east end of the domestic structure creates water pressure by the electric pump located at the eastern end of the cistern. This cistern is well maintained by its owners and the water is of excellent quality.

The modern sub-type cistern, the metallic roof type, is represented by cistern 37FCO8 (Figs.13 & 14; and Fig.11). This cistern, located off of Bredeweg, is built of gabled concrete with zinc sheet roofing and measures 17.6'x 10.2'x 4.7'(height above ground). The water collection method is

roof collection from its associated dwelling as well as collection from the sloped zinc top of the cistern. Fine screens are used for water filtration. There is no gravity tank associated with this cistern and the pump is located on the north side of the cistern. This cistern has a plaque on the north side of the support wall with the maker's initials and its construction date, 1930. This cistern is believed to be one of the first ones built with concrete and is still well maintained and in excellent condition, with the water quality being very good.

Modern Cistern Construction

For every new house built on St. Eustatius a cistern must be included, and is usually located underneath or attached to the structure, the ceiling of the cistern being the structure's floor (Fig. 15). Cisterns built today are made from concrete cement, cinder blocks, cement blocks or varying combinations of the three materials. The concrete cisterns serve the same function as traditional arch cisterns, but they are generally built more quickly and cheaply, and desired for those economical considerations. Poured in sections supported by wooden forms, liquid concrete is poured into woven matrices of rebar rods, lashed together with wire. Vertical concrete pillars, or "pillows", are often built into concrete cistern cavities for extra support and to help minimize damage by internal wave surges during earthquakes. Concrete usually arrives from Puerto Rico or Santo Domingo every 8-10 months aboard ships and usually

amounts to about 10,000 bags per shipment.

According to builders and construction workers on St. Eustatius, the average modern cistern dimensions are approximately 12′ deep, 13′ wide, and 16′ long. However, cistern size seems to be directly effected by family size, income, and access to other water sources, and so there is great individual variation in these dimensions, according to contractors on the island. About four workers are needed to build a cistern over the course of 21 days with the aid of a backhoe. The average cost in 1989 for a new cistern was about 9,000 guilders.

Electric Pumps and Gravity Tanks

About fifteen or twenty years ago the introduction of electric pumps on St. Eustatius changed the ways in which water was used by Statians as it piped water directly into the house. Until that time water was still extracted with a bucket and rope. Small pumps cost the Statian approximately 85 guilders. Larger ones are around 800 guilders and are usually purchased and shipped over from St. Maarten. Although not every household on St. Eustatius has an electric pump for their cistern, they are widely found. The survey indicates that 32% of cisterns use an electric pump (Fig. 11). Fourteen percent of those households that use an electric pump, also use gravity tanks for water pressure, the other 20% use electric pumps where the water pressure is created by the pump itself. Though more expensive, the use of gravity tanks is a preferred method for the creation of

water pressure as they can still be used when the electricity goes out.

Gravity tanks, in association with a pump which brings the water up from the cistern, hold water above the house and are used to create water pressure for plumbing systems. Built of concrete and rebar rods, gravity tanks are seen throughout Oranjestad and the island and are characterized by their long supporting legs which hold up a concrete tank (Fig. 16).

Modern cistern systems mostly use plastic pipes to carry water from the troughs about the roof to the cistern cavity. These pipes are installed with strainers and "catches" to trap and filter debris in water runoff before it reaches the cistern. With the introduction and maintenance of these water purifying techniques, the water in concrete cisterns maintains its purity and the cisterns seldom need thorough cleaning.

Water Collection

Historically, the platform water catchment system was widely used for domestic cisterns (Figures 2 & 18). It was common for barbed wire or a fence to be built around the platform to keep domestic animals from fouling the platform and thus the water supply. The water from heavy rains was directed by the slope of the platform into the vents along the length of the cistern. Today roof catchment systems are almost always used for domestic cisterns and fenced off platforms are uncommon (Figures 3 & 17). Where these platforms are still functional and well-maintained,

associated cisterns are usually used only for domestic animals rather than for household use, however, cisterns can be found today that utilize both roof runoff and platform water collection strategies (Figure 18). From the cistern survey, 24% of the cisterns still used, utilize the catchment method of water collection, while 60% use roof collection exclusively, and 4% utilize both methods. All of the modern cisterns on the island use the roof method of water collection.

As one walks about the streets of Oranjestad, it becomes evident that most domestic structures have elaborate eaves troughs under their roofs for water catchment, often winding around the entire circumference of the house. It is within these troughs that water is collected from the roof and piped into the cistern. It is not uncommon to find traditional arch cisterns with the platform vents sealed and a pipe running from the opening in the top of the cistern up to the roof. With the use of screen filters, roof collection is widely accepted on the island as the safest and most efficient form of water collection.

The benefits of roof water collection over catchment water collection was realized in Europe by the eighteenth century. In 1724 in London a law was passed obligating all home owners to install eaves troughs and down spouts on their buildings (Quennel 1934:94). Rain water collected from roofs with eaves troughs was a cleaner and more efficient method of water collection than the catchment method.

Water is also often collected in other forms or

containers on St. Eustatius, with troughs emptying into barrels, 50 gallon drums, and even into large coarse Iberianware vessels (Figure 17). This water is commonly used for human consumption, for gardens, and for domestic animals.

Maintenance and Repair

The maintenance and repair of cisterns during the colonial period was and is today an important strategy for the security of safe and sufficient fresh water sources. Ethnographic data can be used to make inferences concerning the historical maintenance and repair of cisterns and their advantages for the collection and securement of fresh water. Hartley cites sources which show that even as early as the fifteenth Century in Europe people were aware of the dangers of standing water: "Many things doth infect and putryfye and corrupteth the ayre, as the influence of sondry steues, standying waters, stynkyng mystes and marshes..." (A. Boorde (in) Hartley 1964:136). By being underground, the water is kept cool, helping to preserve its freshness and purity. A well maintained cistern is firmly covered at the opening and secured with a padlock. Though crime is rare in the small familiar community of Oranjestad, water theft is not entirely uncommon. Secured fresh water is a high priority among the island's inhabitants and of central importance and concern.

When one opens the lid and peers into a well maintained cistern, the water is clear and deep with hundreds of guppie-like fish which can be seen surfacing and feeding on tiny particles. Though no one can recall the origin of these

fish, they serve a valuable function as tiny purifiers by eating the insects and plants that make their way into the cistern cavity.

Every two to five years, household cisterns are thoroughly cleaned inside and out. At a suitable time, when the water table in the cistern is low, the remainder of the water is emptied and stored. When the cavity is emptied, family members or hired hands are lowered inside and with a flat shovel or spade the bottom is thoroughly scraped, cleaned and finally swept. When this task is finished, the water is then poured back into the cistern which is then allowed to completely refill when the next rainshower occurs.

A crack in a cistern can quickly deplete a family's water reserve. When a crack is detected, the cistern is emptied to a level below the crack and the wall is allowed to dry thoroughly . Around the cracked area a pick is used to puncture holes around the plaster of the damaged area. Plaster made from mortar, or cement is then applied in and around the crack, the pick holes acting as anchors for the new plaster. After the new plaster has dried completely, the cistern is refilled.

Wells

The basic difference between a cistern and a well is that cistern walls are plastered and sealed and water is artificially diverted into the cavity, whereas the brick walls of a well are left unsealed allowing water to seep into the cavity from groundwater or a spring. In urban areas

where population is dense this can heighten the potential for contamination of the well water. There are several wells located in Oranjestad, their origins and dates unknown. "Due to the island's geological characteristics, the wells are very deep (about 40 meters), and some of them have high salinity values, making their use very restricted. The productivity of the wells has not been determined by the surveys; consequently their contribution to water supply can not be assessed" (P.B.S.A. 1988:62). Furthermore, "the problem is heightened in the urban area of Oranjestad, where the greater population density intensifies the process of soil pollution and increases the likelihood of contamination of the water supply, especially that of the well" (ibid.:85).

One of the wells, 29ACO1, located off of De Ruyter Weg, is capped with a concrete top and is very deep. The skeleton of an iron windmill stands over the well, out of use for about fifteen years. This well is for public use with a pump which brings the water up through pipes to a gravity tank equipped with a faucet. Every morning people gather with buckets at the faucet to collect needed water for home use, gardens and livestock. The faucet is located in the public butcher square.

There is one working windmill well on St. Eustatius at this time, located off Van Tonningenweg, however, windmills were more common before the introduction of electric pumps. It is of general opinion on St. Eustatius that the use of windmills to pump water was a more efficient way to pump water as it is cheaper to use wind power and there is no

danger of blackouts causing water loss as happens with electric pumps.

At the corner of Brede Weg and Kapel Weg, structure 28ZZCO2 (Fig. 12) is a well built of brick, cut stone and mortar. The well is in a state of disrepair and the water is green, murky and unfit for consumption. Circular in shape, the well measures 10.8′ across with the rim measuring 1.1′ wide and 1.9′ high from the ground surface. There are no known structures associated with this feature.

As the P.B.S.A. developmental survey of 1988 indicates, the use of wells on the island is limited and cisterns are the most important means of water collection and storage. Although there is variety in the ways in which cistern and well materials were manipulated in their construction, their basic forms in the categories of types are very consistent. The durability of cistern structures is reflected in the abundance of traditional forms still found and used on St. Eustatius, and their efficiency in form is clearly apparent in the lack of form variations before the introduction and accessibility of concrete cement. The numerous traditional arched cisterns still in use and associated with twentieth century structures also strongly suggest numerous and consecutive settlement in limited areas. An example of this behavior is represented in cistern structure 1ZZCO2, where a modern house built in the 1980′s directly utilizes the cisterns of the eighteenth century mansion structure ruins.

CHAPTER IV

CULTURE AND BEHAVIOR

Dutch Colonial Culture

The cisterns of St. Eustatius represent a highly efficient material and behavioral adaptation by the Dutch colonists which allowed a considerable population to effectively colonize a landscape that offered very little in the way of fresh water resources. The cisterns also reflect the innovation and resolution of the Dutch colonizers who arrived on St. Eustatius over 350 years ago.

The Dutch colonists who settled and later built St. Eustatius into a world market place, brought with them a great cultural legacy. From their small low-lying, water-soaked stretch of land on the Northern coast of Europe, the Dutch overcame insurmountable odds as they reclaimed land from the sea, and overcame, in 1648, eighty years of war and occupation by the Spanish Empire. The Dutch mercantile empire was to stretch to every corner of the globe, from Asia, Africa, North and South America, trading in everything from sugar to silks, timber to tobacco. "At the time of de Graaff's salute [1776], his fellow-countrymen had already registered and passed the peak of dynamic accomplishment in almost every realm of endeavor--in hydraulic engineering to make their own land habitable, in the longest successful revolt for political independence sustained against the greatest imperial power of the age, in flourishing commerce, business and banking, in maritime enterprise covering the

oceans, in the supreme art of the Golden Age of Rembrandt, in everything but government, where they contented themselves with a paralytic system that would not have been tolerated by a primitive island of the Pacific. For all these qualities-- positive and negative-- the Dutch were the most interesting people in Europe" (Tuchman 1988:23).

The Dutch colonization of St. Eustatius in a sense symbolizes the accomplishments of the Golden Age, by the adaptation to the island's acrimonious landscape, by the great variety and quantity of the goods that passed through its warehouses, and by its commitment to free trade, even in the face of threats by larger and more powerful European nations. The Dutch were well prepared for the challenges that were required for the successful and prosperous settlement of St. Eustatius. The basic need for fresh water was met with the construction of the cistern, an old idea adapted to life in the New World.

Colonial Water Use

The behavior associated with colonial water use differs significantly from today's with our flush toilets, showers, and laundry machines which use quantities of water far in excess of the amount of water used in previous centuries. With the introduction of these modern conveniences on St. Eustatius in recent years and with the advent of the electric pump, the island's water supply has come under severe strain, even though the current population is considerably less than that during the colonial period, numbering 1,764 in 1985 (P.B.S.A. 1988:5.1), compared to 8,124 in 1790 (Hartog

1976:45). The drinking of fresh water as a beverage was rather uncommon in European cultures until the twentieth century when sophisticated plumbing, filtration systems, and microbiology came into being, ensuring safe, readily available drinking water on a large scale (Hartley 1964).

Regular bathing and clothes washing was also not exceedingly common during the colonial period, rather, "ideas concerning personal hygiene and household needs, involved both what was considered necessary by the individuals in a household and what was convenient" (Shephard 1988:3). The Dutch, however, were nowhere near being a "dirty" people. Cleaning house and the washing of stoops, sidewalks and streets were common everyday occurrences in seventeenth and eighteenth century Holland, as they are today (Schama 1988). The Dutch were quite proficient in successfully living in densely populated urban areas, traditions well suited to life on the small island of St. Eustatius. Of every day life in seventeenth century Holland, Simon Schama states:

> The steps in front of the house, the path leading to the house, if any, and the front hall were all to be washed every weekday early in the morning. On Wednesdays, the entire house was to be gone over. Monday and Tuesday's afternoons were devoted to dusting and polishing reception rooms and bedrooms. Thursdays were scrubbing and scouring days, and Fridays were assigned to the inevitable job of cleaning the kitchen and cellar. Besides the standard chores, dishes had to be scrupulously washed after each meal, and the household laundry done each day (Schama 1988:376).

Fresh water supplies were also needed for cooking and for the preparation of tea and coffee, beverages the Dutch people consumed with zeal. "Unlike tobacco, which was much

praised for its medicinal properties, tea remained immune from any *odium theologicum*. In fact its most ardent enthusiast, Cornelius Bontekeo, thought that no harm could come of it, however how much was drunk. Eight to ten cups a day he thought the minimum for one's health, and fifty to two hundred cups perfectly reasonable" (ibid.: 172).

Gin, wine, and, moreover, beer were the staple beverages of Dutch society in the seventeenth and eighteenth centuries, with beer being commonly consumed with breakfast and available in many varieties from breweries throughout the Netherlands. Mineral water was also consumed, imported from German cities in the Westerwald district like Rhens and Broubach and from the town of Spa in Belgium (Nienhaus 1981:493-99). A great many salt-glaze stoneware jugs and jug fragments have been excavated by the William and Mary field school over the past 9 years with some being plain and others stamped with the manufacturer's seal (Figs. 20 & 21). Among these jugs excavated are a considerable number of bottles marked "Weesp", strongly suggesting their origins from the Brewery located in this small town outside of Amsterdam. "Weesp, Hoorn and Gouda beers all enjoyed their partisans, though under Frederick Henry the allegedly superior quality of Rotterdam water boosted the claims of its local ale to supplant Delftse as the best of Holland. Given the universality of ale as breakfast beverage, as well as tavern drink, the eulogies heaped on it by virtually all medical authorities and popular writers, much was at stake in this local rivalry" (Schama 1988:192).

Two "drip-stones", belonging to the Lampe family on St.

Eustatius, provide further insight into colonial water consumption. Carved from limestone blocks and shaped like urns, drip-stones were used as water filters to purify water for drinking. Water is continuously poured into the drip-stone cavity as the water permeates through the porous limestone into a container placed below it. With time the water dissolves holes at the base of the drip-stone, and the drip-stone has then to be replaced.

In the year 1792 a Dutch visitor to St. Eustatius wrote a letter to a friend back in Holland concerning the importance of fresh drinking water on the island:

> The people here are all very good and liberal. They drop in on their friends freely and always find quantities of drink. One takes what one will and either goes away or says "I'll stay and eat." This is always taken well. When parties are given they are always more brilliant than in Europe. They think nothing of a turtle worth 3 or 4 johannesses, and other things in proportion. Madeira wine is drunk here like water. You'll find here the best European wines in all cellars. You can drink terribly here, and sometimes I think well of that. Consequently I take the precaution of drinking a lot of water with my wine, which the doctors say is prudent...(Zimmerman (in) de Hullu 1919 (in) Kandle 1985:181).

On St. Eustatius in 1790, of the 8,124 inhabitants living there, 5,140 were slaves (Hartog 1976:45). In order to sustain so large a slave population and work force, a secured and steady supply of water would have been needed. Livestock on the island would also have been in need of large supplies of fresh water, as would any ship that stopped in the Bay if the ship's water supply was low or fouled.

Although the population of St. Eustatius far exceeded

that of the present during the colonial period, the use of cisterns for fresh water supply was apparently an efficient, substantial and effective adaptation to life on the island. The difference in water use made the sustenance of such a large population possible.

Modern Water Use

The basic concern for secure and sufficient fresh water supply today on St. Eustatius is of central and foremost concern, as many of the Statians will tell you. The knowledge and traditions of water use are ones passed down the generations, and until the introduction of modern concrete cement in the first quarter of this century, the methods of cistern construction remained the same as during the colonial period as is suggested by the continuity of form of the traditional cisterns.

The specifics of cistern use vary from household to household, some cisterns being better maintained than others and the preference of boiling water before drinking is also a choice on the individual level. It is required by law, however, that every new house or business built has a cistern in its plan; either a reused traditional arched or modern concrete cistern.

Water transportation is still often done with the use of buckets loaded onto donkeys, but a "water truck" owned by the Statian government will deliver water for a 15 guilders charge. "This method entails high operating and maintenance costs and an ongoing dependence on the efficiency of transport. The techniques of handling and distribution that

are involved do not guarantee that the water delivered is of acceptable quality" (P.B.S.A. 1988:64). Cistern openings secured with a padlock are quite common, as water "borrowing" is not an uncommon problem. A large government cistern helps people who have no cisterns, or whose cisterns are low. Also water may be distributed by the various church groups from the Churches' cisterns, or it may be purchased from neighbors. Water shortages occur from time to time, especially during dry seasons. Wout van den Bor records that in 1976 66.8% of the households on St. Eustatius acquired their water directly from cisterns; 6.4% bought their water; 26% acquired their water elsewhere; and .8% acquired their water by a combination of bought water and water acquired elsewhere (van den Bor 1981:296).

Elderly Statians often express the concern that the younger generation is not as water conservation conscious as it should be. The advent 15 or 20 years ago of the electric pump made water more accessible and easier to use by bringing it directly into the house. There is also a consensus among many of the elders of St. Eustatius that the climate has become increasingly drier in their lifetimes, with decreases in the amount of annual rainfall over the decades. With the increase of modern water-needing appliances and conveniences made possible by plumbing and the the electric pump, the water problem may yet get even more critical as people divert water needed for agricultural and livestock production to household use.

> Studies carried out by the UN give an estimated daily consumption of 20 to 50 liters per capita during dry periods, an amount that is considered well below normal levels. If we take into

> account the demand generated by agricultural production, the requirements of water in the island reach levels that are difficult to meet with the existing infrastructure. This situation leads to rationing, and to a decrease of consumption below minimum levels in agricultural activity during periods of scarcity, thereby hindering production in this sector urgently needed to reduce dependence on imports (P.B.S.A. 1988:62-64)

If St. Eustatius is to grow in terms of economic development, given the rate of modern day water usage and demand, the water problem must be solved and new sources of water found. The island of St. Maarten has introduced desalinization equipment in recent years and is successfully replacing cisterns. However, the equipment is expensive and too costly for St. Eustatius at this time. Recent drilling for water wells has had some success and intense drilling in the future is being considered. The existing cisterns and wells alone will not be able to meet the demands of a resurging Statian economy and population expansion, and so the island's plans for expansion and economic growth are uncertain at this time. The 1988 P.B.S.A. survey summarized a United Nations study which recommended the following suggestions for meeting the problem of increased demand on the existing water supply:

- establish a water authority having a proper administrative and institutional framework;

- increase the rainwater catchment area serving government reservoirs;

- interlink most, if not all, reservoirs, retaining gravity flow;

- introduce water treatment (chlorination) and water supply quality control;

- establish safe yields for all existing dug

> wells before exploiting alternative water resources;
>
> - subsequently conduct an exploratory well-drilling program to establish quantity and quality of groundwater available;
>
> - create irrigation water sources that are independent of the potable water supply.
>
> - introduce [the] use [of] easy to construct, (sic) low-cost ferrocement tanks for private use.
>
> - install new pumps and pipes, and purchase new water tankers and other support vehicles (P.B.S.A. 1988:5:26).

The colonial Dutch strategy of the use of cisterns to meet the demand for adequate fresh water in an environment with few natural fresh water sources was effective and efficient given the way in which water was used in colonial times. However, cisterns alone can now no longer meet the demands for water created by new technology and its effects on the behavior associated with modern water use.

CONCLUSION

The study of the cisterns of Oranjestad is important because their use and their very existence are significant to the understanding and elucidation of Dutch culture and adaptation to the Caribbean environment during the Colonial period. Emerging from a European landscape meager in terms of natural resources and land mass, the Dutch were well prepared to meet the challenges of settling St. Eustatius. Originating from structural designs in Europe, the island's cisterns are a blend of Old and New World ideas and materials and were well suited to supplying the inhabitants of the island with plentiful and secure fresh water resources where little existed. Cisterns were practical not only in the sense that they effectively stored rainwater, but they also kept it relatively free of contamination over long periods of time.

To meet these challenges for fresh water, each household or plantation had its own cistern built, thereby eliminating the threat of epidemic disease by the contamination of large community scale water sources. Cisterns in urban areas were also safer because the dangers of waste and toxins seeping into the watertable, as in the case of wells, was minimized. With the durability of cistern structures and the importance of their maintenance, individual cisterns were reused over years and generations strongly suggesting that the settlement patterns of households were spatially concentrated. The existence of modern houses utilizing the traditional cisterns

and the percentage of historical cisterns still in use strongly suggests their continuity and durability.

The form and materials of historical cisterns remained consistent until the introduction of concrete structures in the twentieth century. Cistern size was generally limited by structural design as a wider cavity would severely compromise the strength of the brick arch. Arch cave-in appears to be the most common cistern damage especially in the larger cisterns. However, the cistern could be enlarged lengthwise to increase water volume, such as two cisterns outside the survey area located at the eighteenth century French battery on Signal Hill and at Crook's Castle in the Lower Town which both had elongated cavities. Observations suggest that when larger quantities of water were needed, rather than increasing the size of a cistern structure, additional cisterns were built. This appears to be the case at the Governor's Mansion ruins where two cisterns were built adjacent to one another. It can be inferred from ethnographic data that historical cistern size variations are reflective of individual household need--the larger the family unit and water need, the larger the cistern built.

Because all of the inhabitants of St. Eustatius do not own their own cistern, it can be inferred that cistern ownership reflects a higher social status, as the cost of building a cistern is high. Outside of town, the eighteenth century Governor's mansion, now in ruins, possessed two large cisterns. Today, in order to possess a cistern, it must either be built, or land with an already existing cistern must be purchased at a cost higher than land without a

cistern on it. While a large majority of eighteenth and nineteenth century buildings and houses have fallen into severe disrepair or have vanished altogether, their associated cisterns generally remain and continue to be used by the present inhabitants of Oranjestad; for example, one of the cisterns of the ruined Governor's mansion continues to be used by the nearby modern household.

Further, the importance of the function of cisterns (to collect and hold fresh water) is reflected in their upkeep and maintenance, and in the fact that while most household are not locked, many cisterns are, thereby securing the individual household's water supply. Unlike community cisterns or wells, individual household cisterns offer fresh water close at hand and readily available to the family. The water is also under the direct protection and supervision of the household, allowing the family a certain amount of autonomy. It may be inferred that the household water supply was of central concern during the colonial period as it is today. The importance of the cistern historically may also be reflected in and account for the similarity in form and materials of the burial crypts of the old Dutch cemetaries of the island. This similarity could be a valid topic of research for further material culture studies on the island.

The historical cistern forms and materials were well suited for their function as is evidenced by the fact that they remained virtually unchanged until the first quarter of the twentieth century. There is little evidence of alterations in historical cistern design, rather, differences between the historical cisterns are minimal and attributable

to individual builders and natural variations in the materials used in cistern construction. Even though the materials of cisterns built today differ from the historical cisterns, the basic structural concept, function, and maintenance of cisterns, as well as attitudes about them, can be inferred to have been much the same as in the colonial period because water is a most basic element of life and it is obtained in the same way today as in the colonial period.

By detailed recording of the cisterns of Oranjestad, along with the ethnographic data and historical sources available, we can glimpse a segment of Dutch colonial life of St. Eustatius, the provision and use of water. The success of the colonists in meeting this challenge is reflected in the successful maintenance of a large population on the island during the Golden Era and the continued use of the cisterns of St. Eustatius by its inhabitants today.

The inhabitants of St. Eustatius today face a new problem in terms of fresh water supply. With the increase in water using modern conveniences, the stress on the water supply has geatly increased despite the island's lower population in comparison with that of colonial times. If the island is to resurge in terms of economic development and population increase, the problem of fresh water sill needs to be solved. For these challenges of water sources to be met, changes will need to made in water supply. These may take the form of exploration for new wells, increase in the number of government reservoirs, the use of de-salinization methods, and the repair and reuse of unused cisterns.

In other parts of the world where fresh water supplies

are limited or strained, the use of cisterns could be explored as a suplimentary water conservation method. In the Southwestern United States cistern use could offer a substantial water supplimentary strategy where increased population and agriculture has put severe strain on the areas rivers and finite groundwater sources.

Though there is nothing in the study to indicate that there is anything distinctively Dutch about the historical cisterns of St. Eustatius, the cultural background of the Dutch colonists is suggested in their choice of cisterns to meet the needs for fresh water for a densely populated urban area which they created on the island. The similarity in form and materials of the cisterns of St. Eustatius with cistern structures found on other Caribbean islands is representative of a more pan-Caribbean culture. However, the use of cisterns and the combination of indigenous and imported materials in their construction illustrates yet again the ingenuity and adaptibility of the Dutch people and their culture. In effect, the utilization of productive and innovative adaptive strategies, whether inherently Dutch or not, is uniquely characteristic of Dutch culture itself. The use of cisterns by the colonial Dutch on St. Eustatius was a successful adaptive strategy which ensured their success in the West Indies.

Cistern Attributes I (Table 1.)

Cistern#	Type	Condition	Status	Dry/Wet	Function	Place	Shape	Materials	Lid Material
28ZZCO1	hist	fair	unused	dry	?	S	rctangl	B,CS,M	-
37GCO1	hist	good	used	wet	domestic	N	oval	B,CS,M	zinc
22FCO1	hist	fair	used	wet	domestic	S	rctangl	B,CS,M	wood
37CCO2	hist	good	unused	dry	?	N	rctangl	B,CS,M	zinc
42CCO1	hist	good	used	wet	admnstr	E	rctangl	B,CS,M	wood
37ZZCO3	hist	good	used	wet	domestic	N	rctangl	B,CS,M	wood
27ZZCO1	hist	good	unused	dry	?	-	rctangl	B,CS,M	-
14ZZCO1	hist	fair	used	wet	domestic	-	rctangl	B,CS,M	iron
15ICO1	hist	good	used	wet	church	E	rctangl	B,CS,M	zinc
43ACO1	modern	fair	unused	dry	domestic	N	rctangl	PC,CTB	zinc
43BCO2	modern	good	unused	dry	domestic	E	rctangl	PC,CB	-
43CCO3	hist	good	used	wet	domestic	N	rctangl	B,CS,M	-
15DCO2	hist	fair	unused	?	domestic	S	rctangl	B,CS,M	zinc
28ZZCO2	well	poor	unused	wet	?	-	round	B,CS,M	-
37ECO4	mod.sbt	good	used	wet	domestic	S	rctangl	PC,CTB,Z	-
22LCO2	hist	good	used	wet	domestic	N	rctangl	B,CS,M	wood
13ZZCO1	modern	poor	unused	dry	domestic	N	rctangl	PC	-
4ZZCO1	hist	good	used	wet	?	-	rctangl	B,CS,M	wood
36ICO1	hist	good	used	wet	domestic	N	rctangl	B,CS,M	wood
26QCO2	hist	good	used	wet	?	N	rctangl	B,CS,M	wood
26ZZCO3	hist	good	used	wet	commercl	E	rctangl	B,CS,M	wood
37MCO5	hist	good	used	wet	domestic	E	rctangl	M,CS,M	wood
1ZZCO1	modern	good	used	wet	domestic	S	rctangl	PC	wood
26MC06	hist	good	used	wet	library	N	rctangl	B,CS,M	wood
17DCO4	hist	good	used	wet	commercl	E	rctangl	B,CS,M	wood
17ZZCO2	hist	fair	unused	dry	?	S	rctangl	B,CS,M	-
17ZZCO3	hist	fair	unused	dry	?	-	rctangl	B,CS,M	-
29ACO1	well	good	used	wet	public	S	rctangl	PC,CTB	wood
38JCO2	hist	fair	unused	dry	domestic	N	rctangl	B,CS,M	-
40KCO1	modern	good	used	wet	domestic	S	rctangl	PC	wood
41CC02	hist	good	used	wet	domestic	E	rctangl	B,CS,M	wood

Cistern Attributes I (Table 1.)(cont'd)

Cistern#	Type	Condition	Status	Dry/Wet	Function	Place	Shape	Materials	Lid Material
41DCO3	hist	good	used	wet	domestic	E	rctangl	B,CS,M	wood
34ZZCO1	hist	fair	used	wet	?	-	rctangl	B,CS,M	-
43FCO6	hist	good	unused	wet	domestic	N	rctangl	B,CS,M	wood
9ZZCO1	hist	fair	unused	dry	domestic	E	rctangl	B,CS,M	-
9NCO1	well	fair	unused	dry	?	N	cone	B,CS,M	-
34ZZCO2	modern	poor	unused	dry	?	-	rctangl	PC	-
37FCO8	mod.sbt	good	used	wet	domestic	E	rctangl	PC,Z	wood
39GCO1	hist	good	used	wet	domestic	S	rctangl	B,CS,M	wood
7BCO4	hist	fair	used	wet	public	S	rctangl	B,CS,M	-
6ZZCO4	hist	good	used	wet	livestck	-	rctangl	B,CS,M	wood
35ZZC01	hist	poor	unused	dry	?	-	oval	B,CS,M	-
35ZZCO2	hist	poor	unused	dry	?	N	rctangl	B,CS,M	-
22BCO4	hist	good	used	wet	domestic	S	rctangl	B,CS,M	wood
1ZZCO2	hist	fair	used	wet	domestic	E	rctangl	B,CS,M	zinc
14ICO5	hist	good	used	wet	domestic	E	rctangl	B,CS,M	wood
36CCO1	hist	good	used	wet	domestic	W	rctangl	B,CS,M	wood
36DCO2	hist	fair	unused	wet	?	E	rctangl	B,CS,M	-
36ECO3	hist	fair	unused	wet	?	W	rctangl	B,CS,M	wood
26KCO5	hist	good	used	wet	business	W	rctangl	B,CS,M	wood

KEY:

E-east, N-north; W-west; S-south
B-brick
CS-cut stone
M-mortar
PC-poured concrete
CTB-concrete block
CB-cinder block
Z-zinc

Cistern Attributes II (Table 2.)

Cistern#	Dist/bldg	Ext. LxWxH	Arch Circum	Depth	Openg.LxW	Steps	H20 Collection	H20 Extraction
28ZZCO1	16.4ft	15.2 x 7.6 x 2.6	10.2	-	1.5 x 1.6	0	-	-
37GCO1	12.7	22.5 x 6.2 x 4.0	8.9	-	3.3 x 3.4	3	C	M
22FCO1	29	18 x 5.8 x 1.6	6.5	11.8	2.2 x 2.2	0	C	M
37CCO2	Adjacent	21.8x10.4x 4.9	9.2	12	1.6 x 1.6	4	C	M
42CCO1	5.6	24.9 x 9.4 x 5.1	9.4	-	2.2 x 2.2	6	R	P
37ZZCO3	-	17.2 x 5.6 x 3.2	6.2	-	2.2 x 2.2	2	C	M
27ZZCO1	-	19.4 x 6.4 x 1.8	8.5	13.7	1.6 x 1.6	0	C	M
14ZZCO1	-	13.9 x 7.6 x 2.4	10.2	-	1.5 x 1.7	1	?	M
15ICO1	3.2	36.9 x 5.7 x 1.3	7.1	-	-	0	R	P
43ACO1	10.8	5.6 x 3.4 x 1.4	na	11.3	1.2 x 1.1	0	R	M
43BCO2	3.4	6.1 x 4.1 x 1.4	-	11.9	1.5 x 1.1	0	R	M
43CCO3	9.3	20.5 x 9.0 x 4.0	11.2	-	2.0 x 1.7	1	R	M
15DCO2	4.4	20.1 x 9.0 x 3.9	5.3	-	1.6 x 1.6	0	R	M
28ZZCO2*	-	10.8 x 1.1 x 1.9	na	-	d=9.2	0	na	M
37ECO4	5.8	15.9 x 8.7 x 5.9	na	-	2.4 x 2.4	0	R	M
22LCO2	Adjacent	3.2 x 3.0 x 1.0	-	-	2.0 x 2.0	1	R	M,P
13ZZCO1	Adjacent	5.9 x 3.9 x 1.3	na	-	1.4 x 1.2	0	R	M
4ZZCO1	Adjacent	33.3 x 8.2 x 3.6	9.1	-	-	3	C	M
36ICO1	Under	21.6 x 5.2 x 1.8	7.6	-	1.5 x 1.5	0	R	M,P
26QCO2	53.5	23.2 x 6.4 x 1.7	9.1	-	2.1 x 2.1	2	C	M
26ZZCO3	30	23.3 x 6.7 x 1.4	10.0	-	2.1 x 2.1	2	C	M
37MCO5	19.3	19.4 x 6.5 x 1.2	7.2	-	-	0	C,R	M
1ZZCO1	8.0	17.4x13.2 x4.4	na	-	2.3 x 2.4	0	R	M,P
26MC06	9.2	23.6 x 7.7 x 3.3	9.7	-	2.2 x 2.1	3	R	M,P
17DCO4	1.1	23.6 x 7.4 x 4.2	8.9	-	1.7 x 1.6	0	R	M,P
17ZZCO2	-	14.7 x 6.8 x 2.2	8.4	9.8	1.5 x 1.5	0	C	M
17ZZCO3	-	15.5 x 6.3 x 2.8	7.7	12.7	2.1 x 2.1	1	C	M
29ACO1*	-	14.2x14.4 x4.2	na	-	-	0	na	P,GT, (W)
38JCO2	1.8	17.2 x 7.1 x 1.5	7.8	10.2	1.9 x 1.9	0	C	M
40KCO1	6.5	12.7 x 9.9 x 2.7	na	-	2.6 x 2.6	0	R	P,GT
41CC02	1.5	10.8 x 4.3 x 2.4	7.4	8.6	1.5 x 1.7	0	R	M

Cistern Attributes II (Table 2.) (cont'd)

Cistern#	Dist/bldg	Ext LxWxH	Arch Circum	Depth	Openg.LxW	Steps	H20 Collection.	H20 Extraction
41DC03	Under	?	?	10.8	2.0 x 1.8	0	R	M
34ZZC01	-	12.4 x 6.9 x 2.8	9.2	-	2.0 x 2.2	2	C	M
43FC06	-	19.8 x 7.5 x 3.1	10.0	-	2.0 x 2.0	0	R	P,GT
9ZZC01	10.9	15.1 x 6.2 x 2.1	8.2	9.7	2.4 x 2.2	0	?	M
9NC01*	13.6	d=11.0	na	na	2.4 x 2.2	0	na	M
34ZZC02	-	4.6 x 3.9 x 1.0	na	-	1.2 x 0.8	0	R	M
37FC08	Adjacent	17.6x10.2x 4.7	na	-	2.3 x 1.0	0	R	P
39GC01	-	23.5 x 6.8 x 4.8	7.8	-	2.3 x 2.2	4	R	M
7BC04	Under	? x 8.0 x 2.5	?	-	2.2 x 2.1	3	R	M
6ZZC04	-	29.2 x 7.0 x 2.9	8.2	-	2.1 x 2.1	0	C	M
35ZZC01	-	17.6 x 9.4 x 3.5	?	7.4	-	0	?	M
35ZZC02	5.4	16.8 x 7.7 x 4.3	9.9	9.4	2.0 x 1.9	0	R	M
22BC04	6.2	19.5 x 7.0 x 4.5	9.5	-	2.2 x 2.2	0	R	P, GT
1ZZC02	27.5	21.6 x 7.1 x 3.4	9.6	-	4.0 x 3.8	1	R,C	M, P
14IC05	10.8	17.6 x 7.4 x 2.8	6.5	-	1.8 x 1.7	2	R	P, GT
36CC01	5.4	Underground	?	-	2.3 x 2.0	0	R	P, GT
36DC02	6.2	Underground	?	-	2.0 x 1.8	0	R	M
36EC03	4.0	Underground	?	-	1.9 x 1.9	0	R	P, GT
26KC05	6.9	23.4 x 7.1 x 2.6	8.1	-	2.1 x 2.1	1	R	P

KEY:

*= Well; d= diameter
C= Catchment
R= Roof
M= Manual
P= Pump
GT= Gravity Tank
W= Windmill

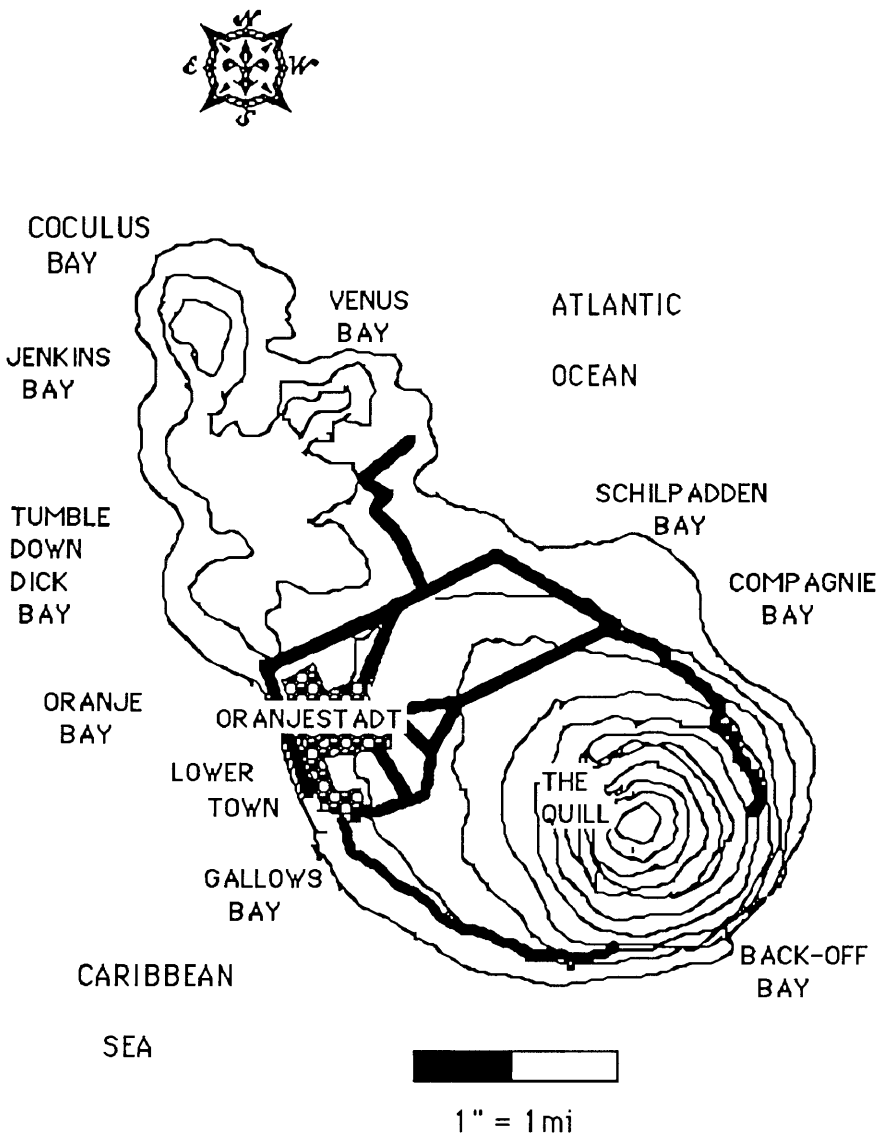


FIGURE 1

THE ISLAND OF SINT EUSTATIUS

THE NETHERLANDS ANTILLES

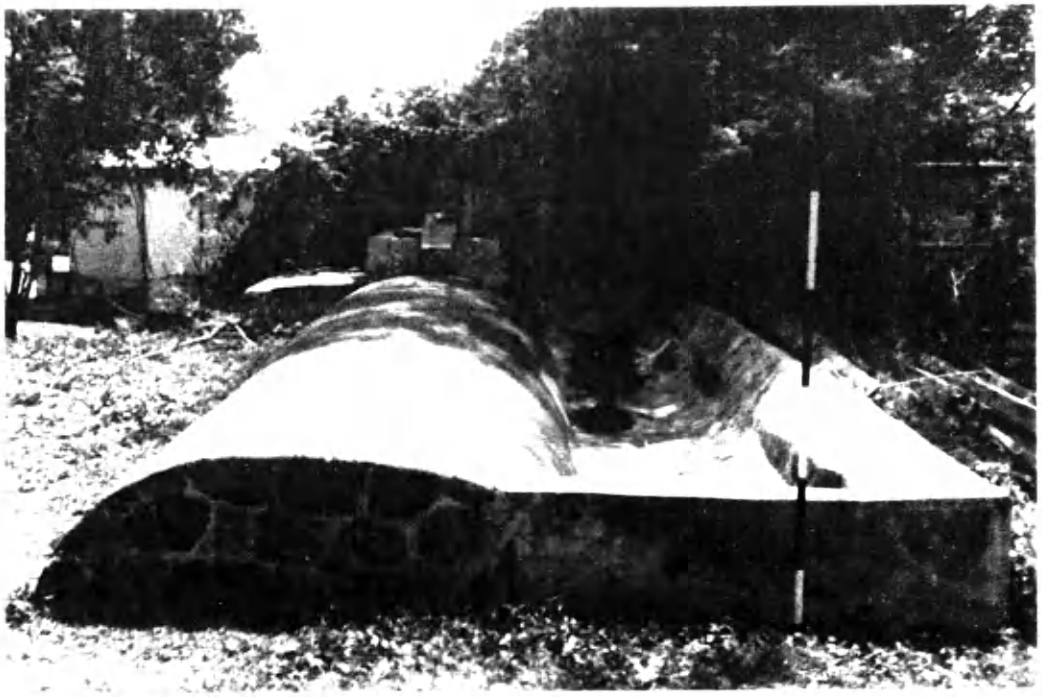


FIGURE 2 HISTORICAL CISTERN 26QC02

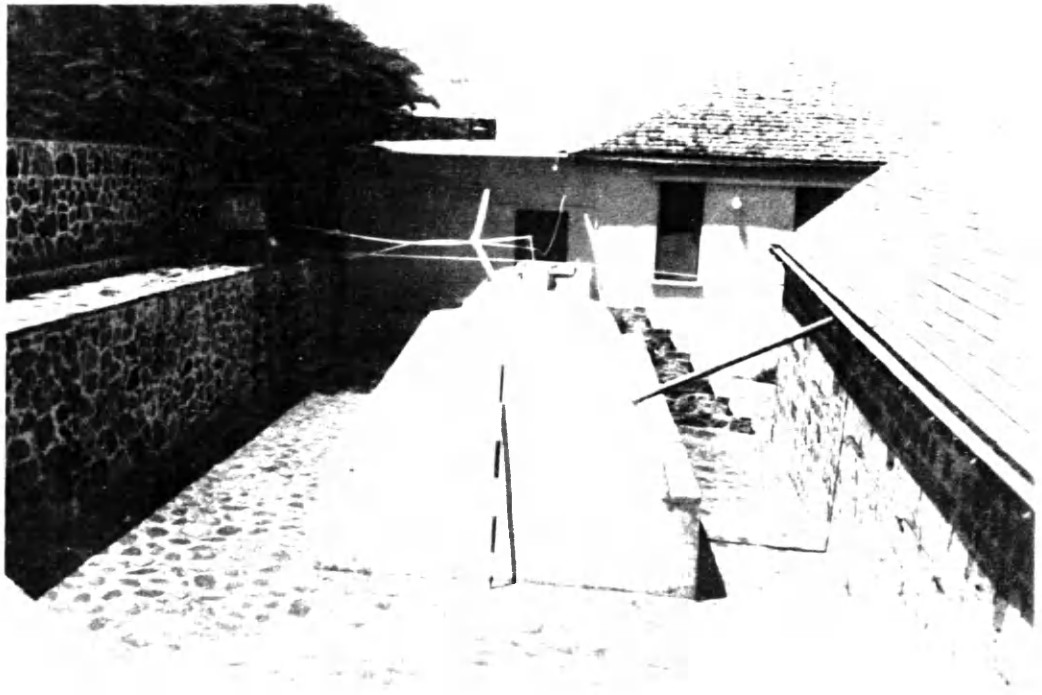


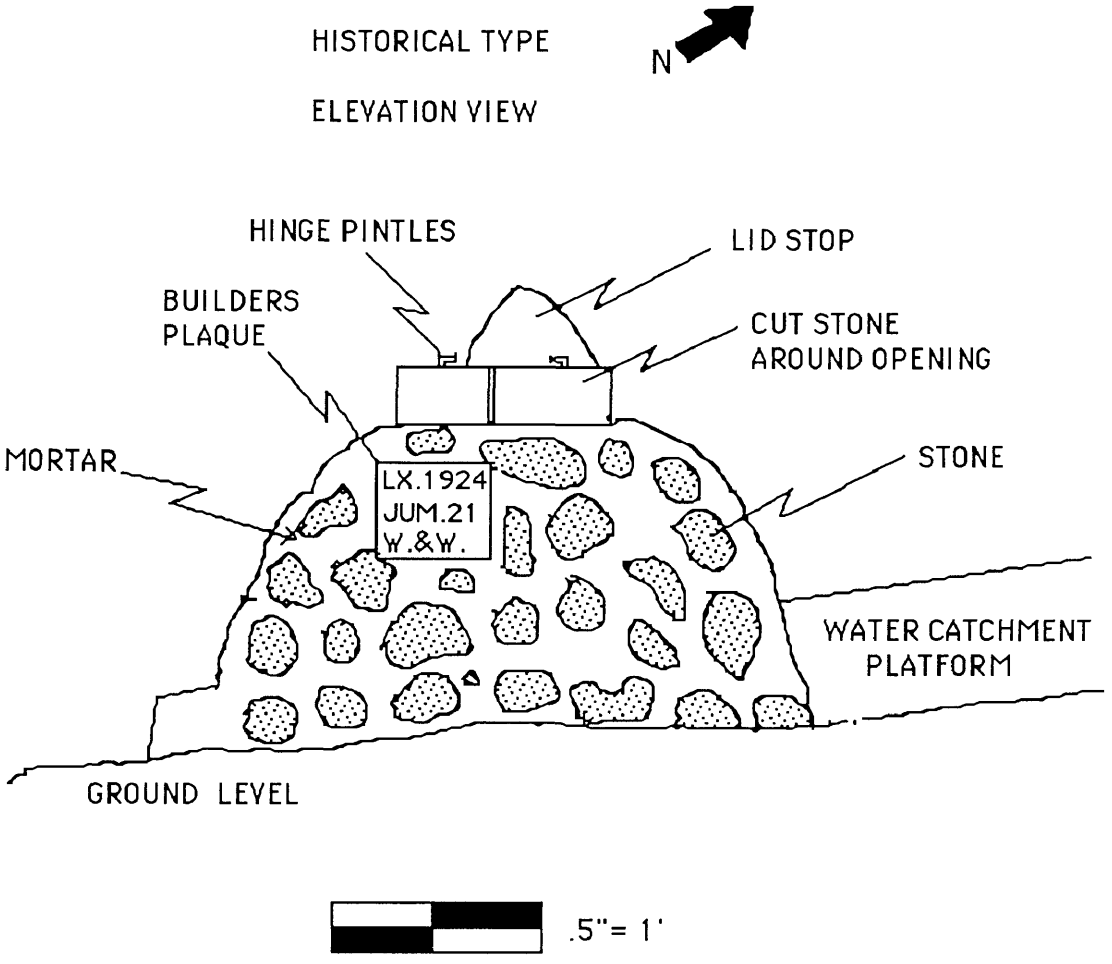
FIGURE 3 HISTORICAL CISTERN 42CC02

FIGURE 4

CISTERN 6ZZC04

HISTORICAL TYPE

ELEVATION VIEW



OPEN FIELD

Figure 5

CISTERN 6ZZC04

HISTORICAL TYPE

PLAN VIEW

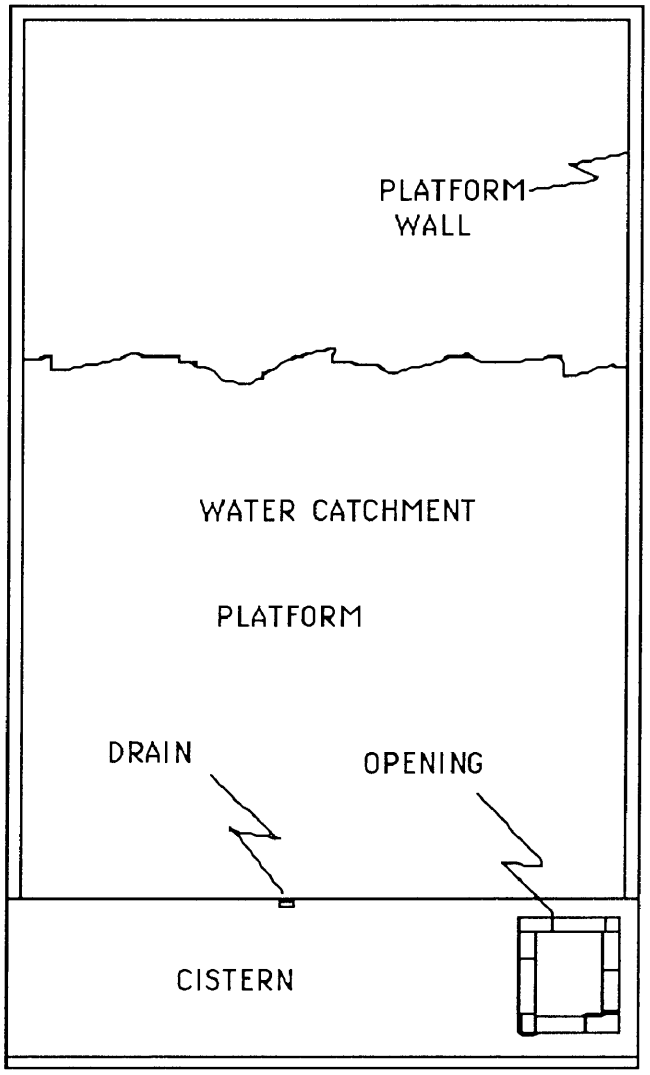
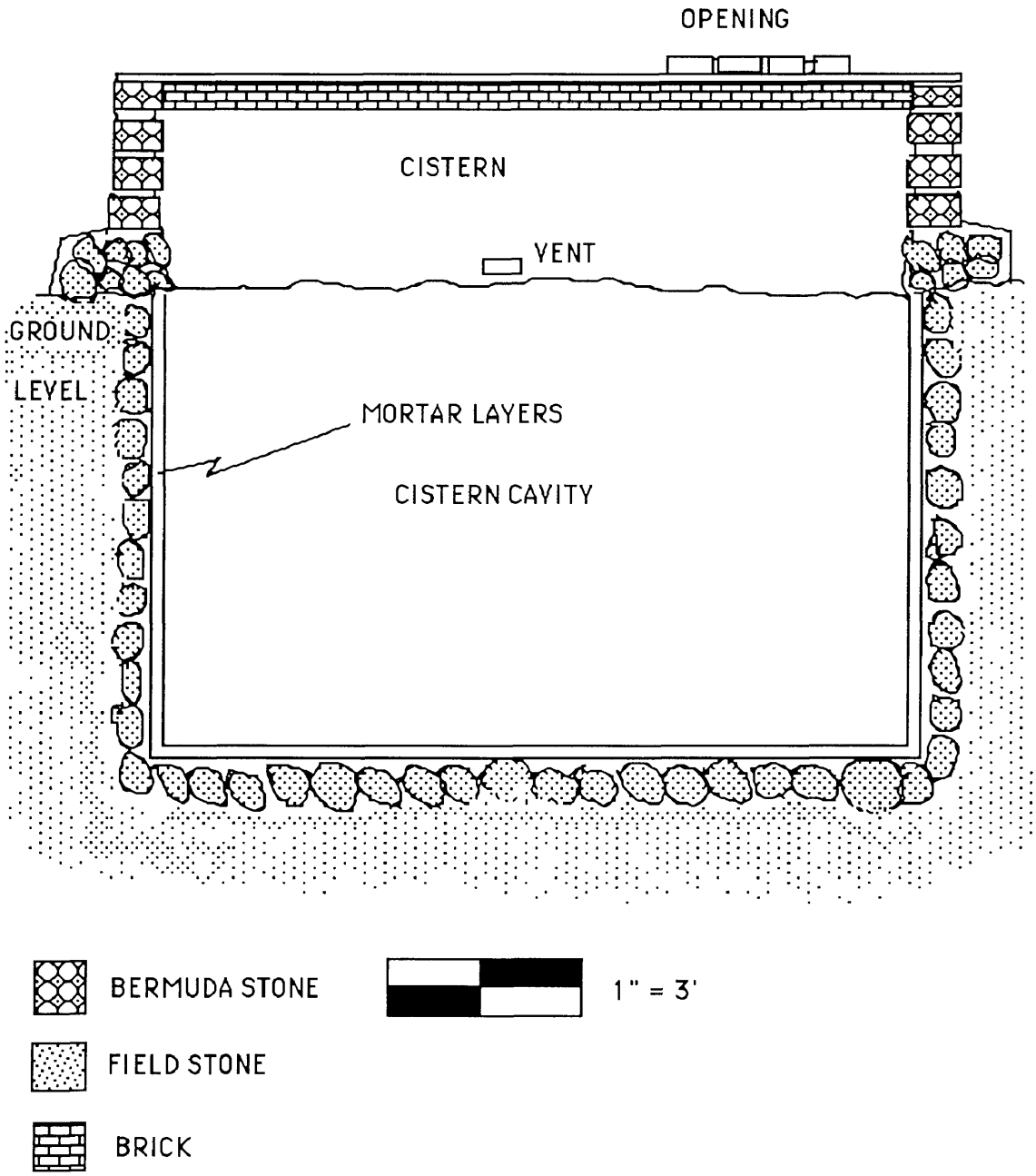


FIGURE 6

CISTERN 9ZZC01

HISTORICAL TYPE

SECTION VIEW



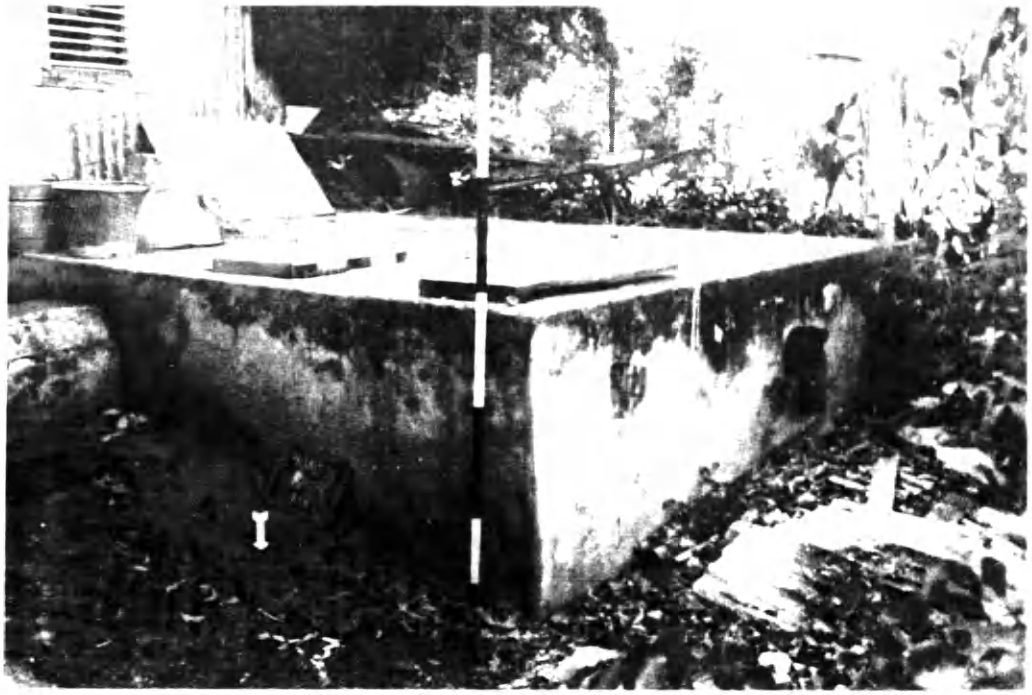


FIGURE 7 MODERN CISTERN 40KC01

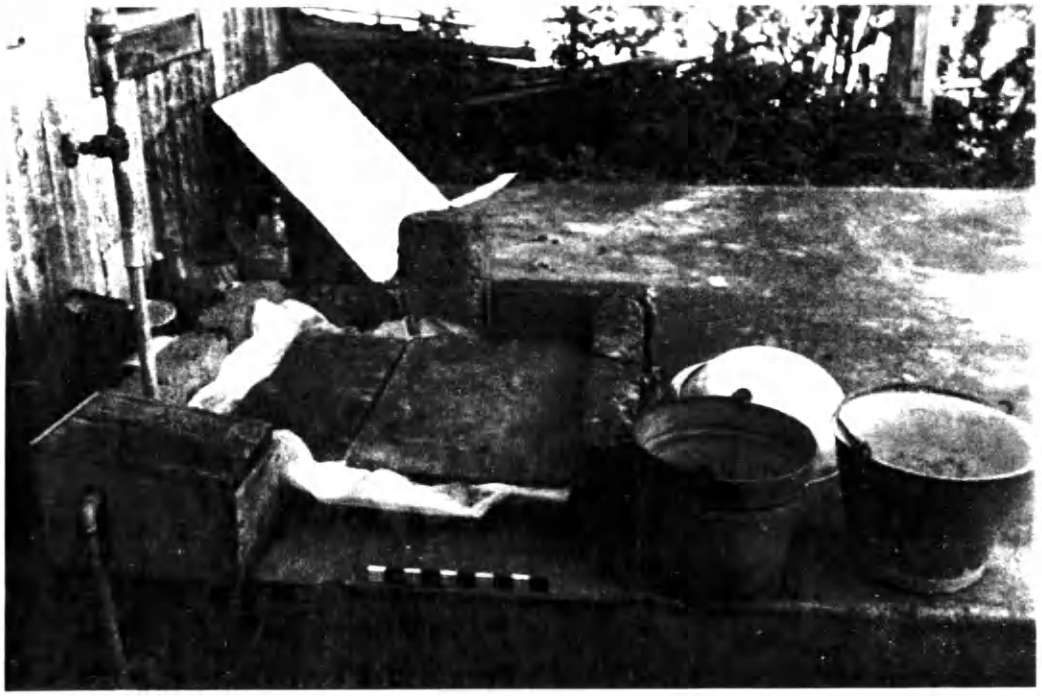


FIGURE 8 MODERN CISTERN 40KC01

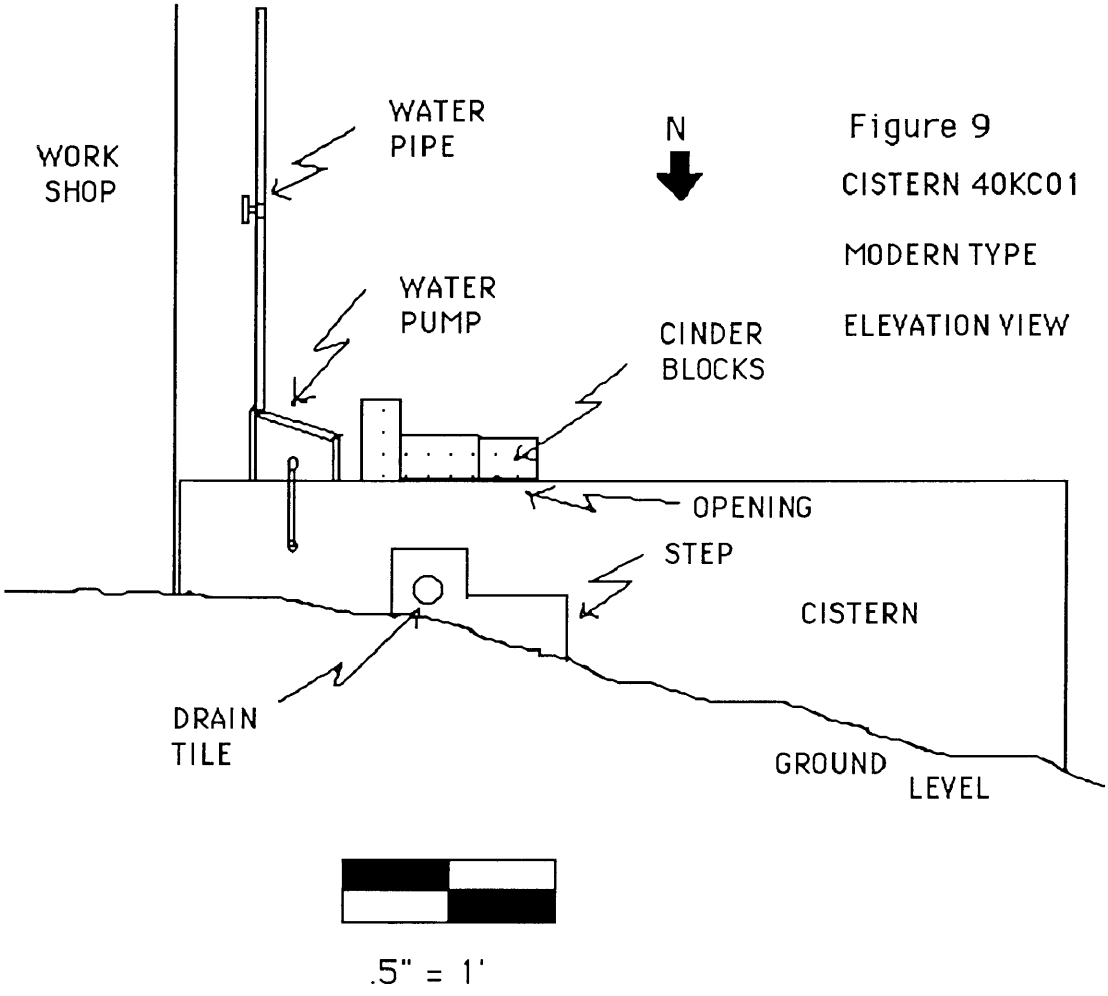


Figure 9

CISTERN 40KC01

MODERN TYPE

ELEVATION VIEW

Figure 10

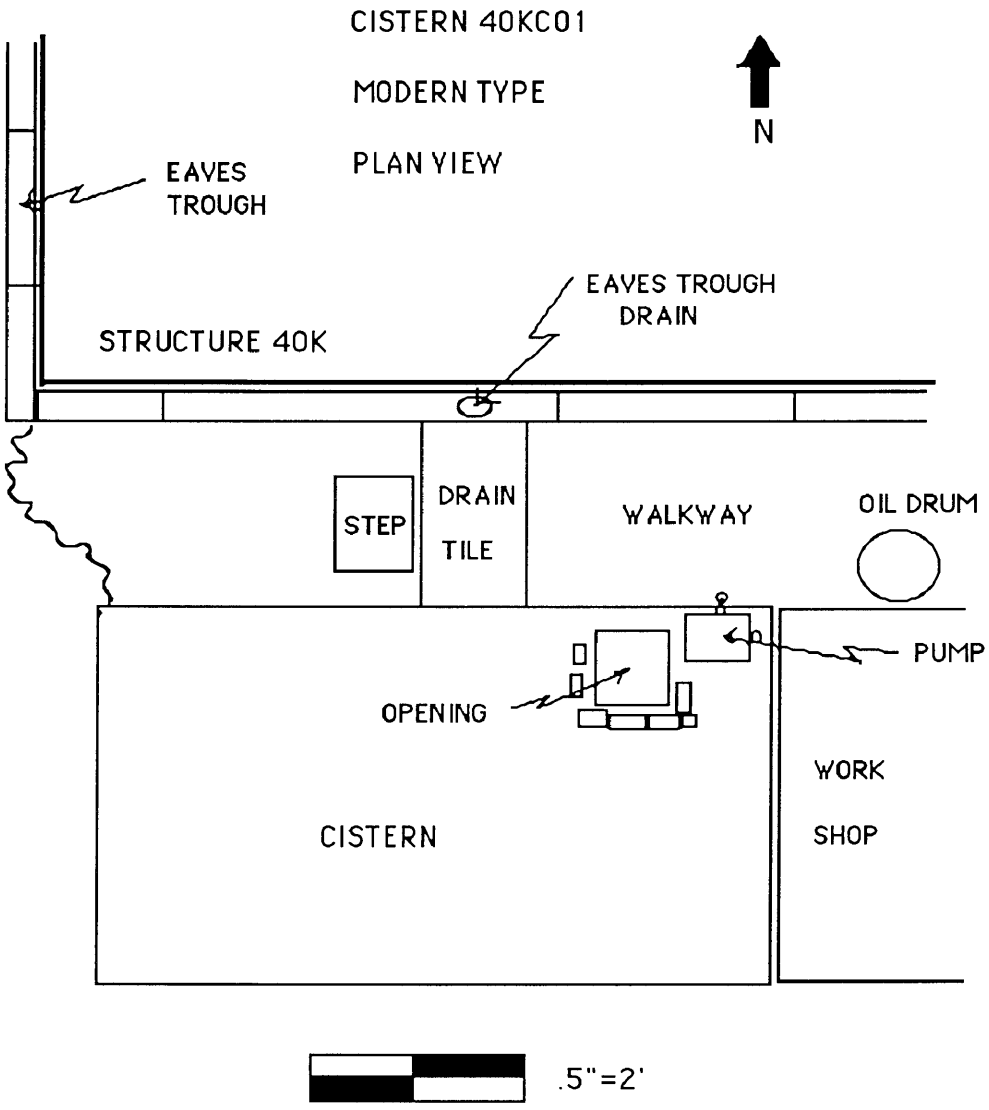

CISTERN 40KC01
MODERN TYPE
PLAN VIEW
N
EAVES TROUGH
EAVES TROUGH DRAIN
STRUCTURE 40K
STEP
DRAIN TILE
WALKWAY
OIL DRUM
PUMP
OPENING
WORK SHOP
CISTERN
.5"=2'

FIGURE 11 MODERN SUBTYPE CISTERN 37FC08

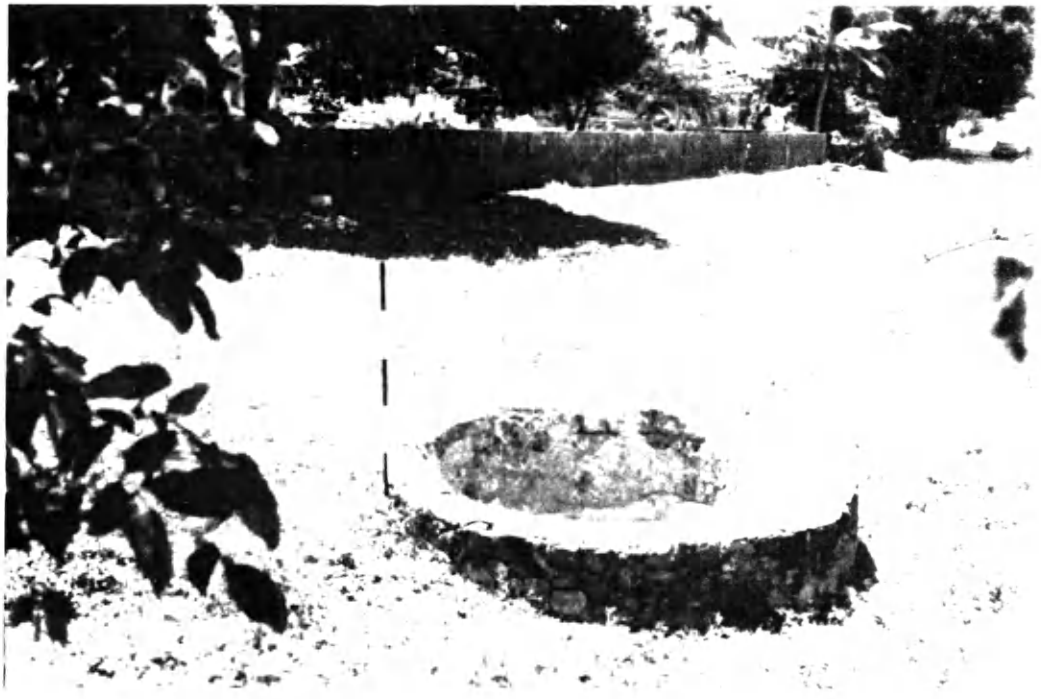
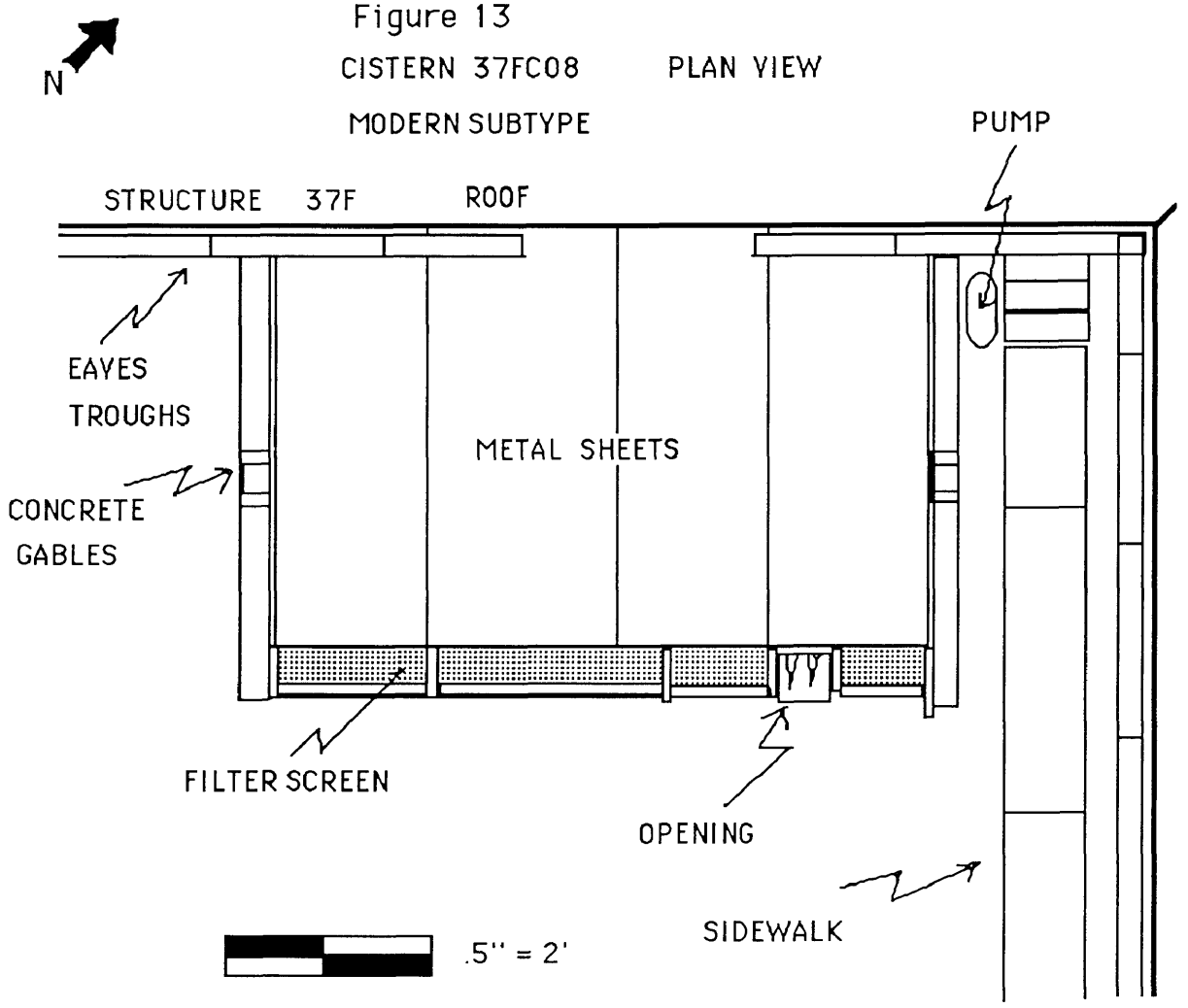


FIGURE 12 WELL 28ZZC02

Figure 13

CISTERN 37FC08 PLAN VIEW

MODERN SUBTYPE



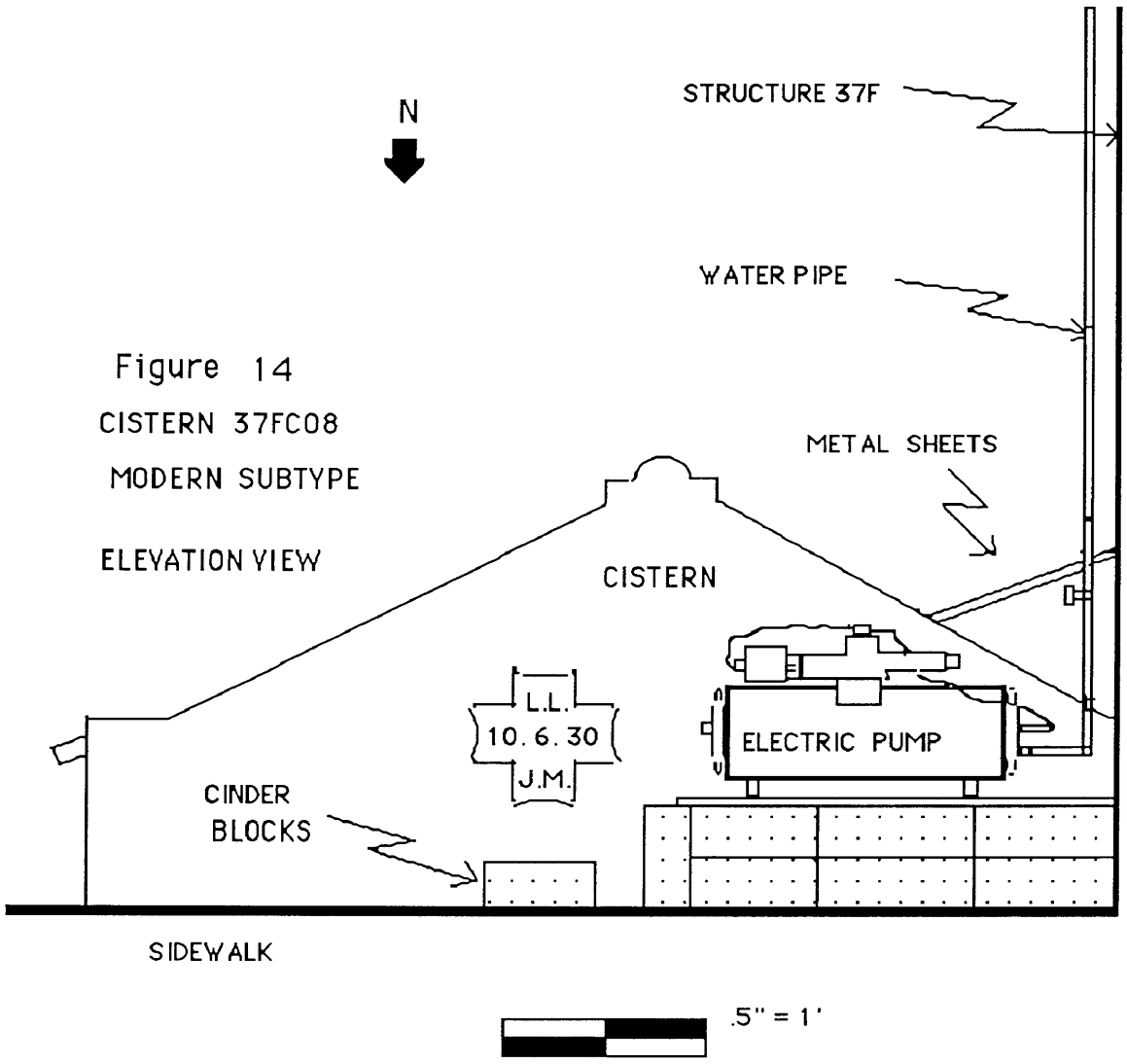


Figure 14

CISTERN 37FC08

MODERN SUBTYPE

ELEVATION VIEW

FIGURE 15 MODERN CISTERN

ASSOCIATED WITH HOUSE CONSTRUCTION

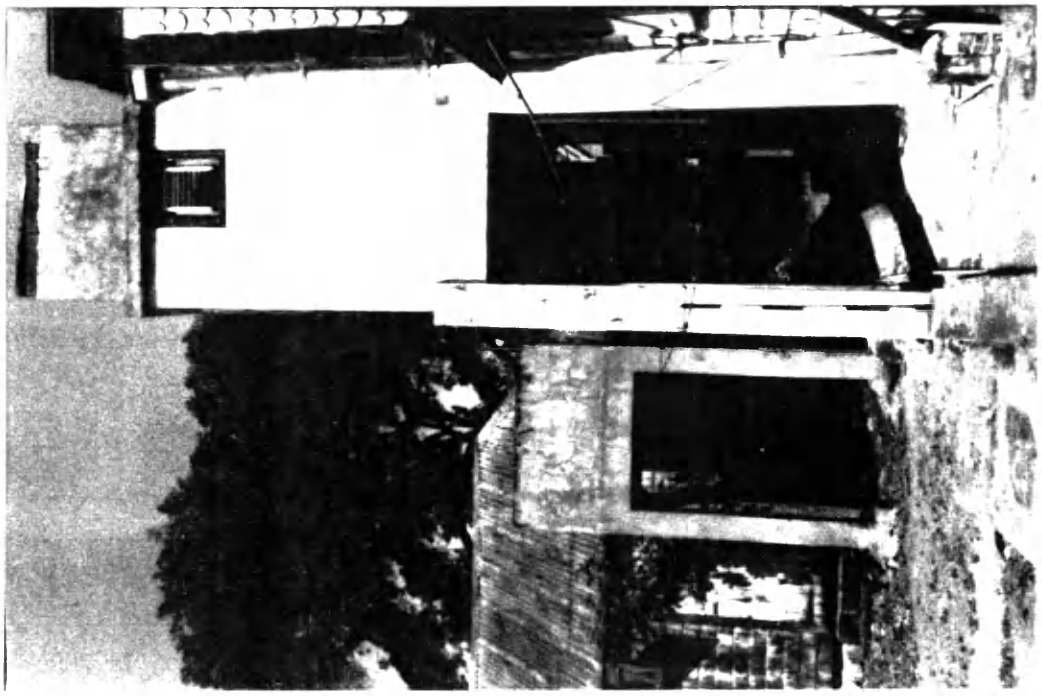


FIGURE 16 GRAVITY TANKS

FIGURE 17 ROOF WATER COLLECTION

CISTERN 37MC05

FIGURE 18 ROOF AND PLATFORM

WATER COLLECTION CISTERN 1ZZC02

FIGURE 19 "BOOEY MAN"

CISTERN 22BC04

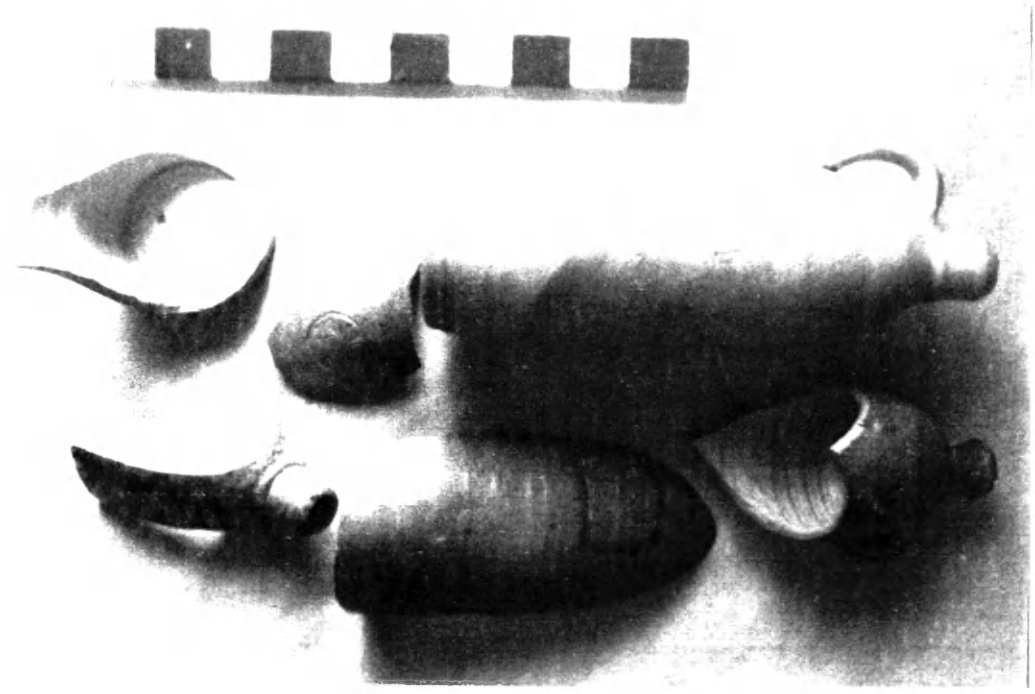


FIGURE 20 STONEWARE BOTTLES

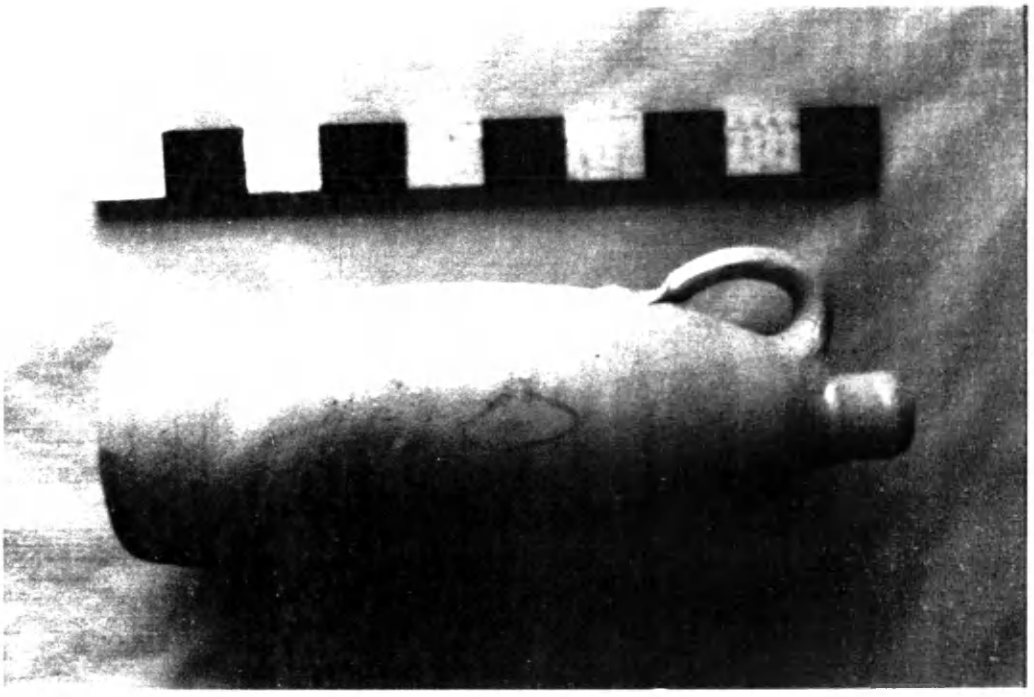


FIGURE 21 STONEWARE BOTTLE DETAIL

APPENDICES

Appendix A is the Cistern Field Survey Form used to record the data collected in the field. It has been reduced by 64% for reproduction purposes.

Appendix B consists of the Town Plan of Oranjestad showing blocks, house letters, and associated cistern structures. The map was reproduced in six parts and reduced 64%.

WILLIAM AND MARY CISTERN SURVEY
SITE FORMATION

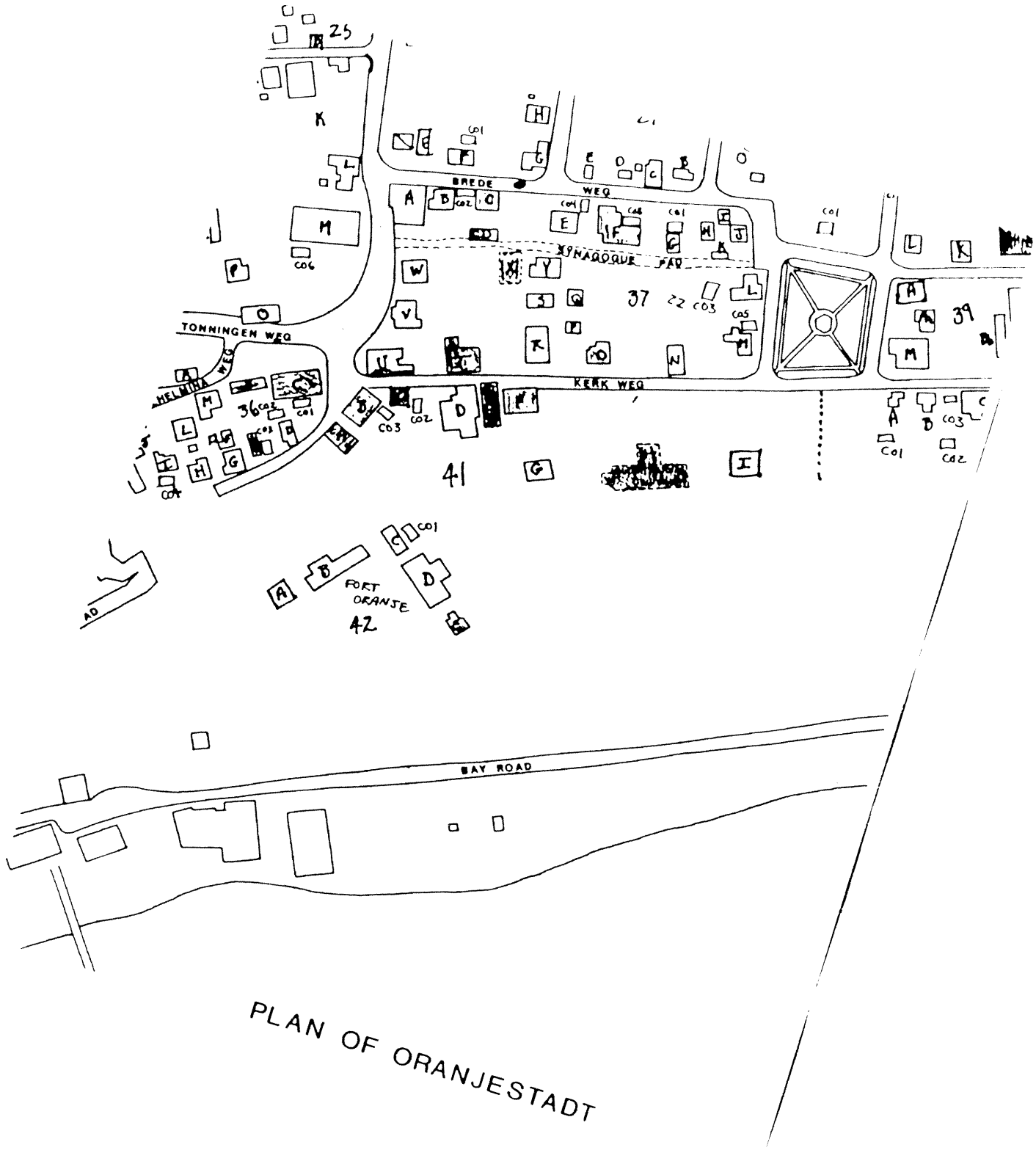
CISTERN NUMBER: STYLE/TYPE
ADDRESS
OWNER
CONDITION: poor fair good; used unused; dry wet
FUNCTION: domestic industrial agricultural other:
PLACEMENT IN RELATION TO BUILDING: south east west north
DISTANCE FROM BUILDING: feet
SHAPE, EXTERIOR: oval square rectagular other:
MATERIALS: brick cut stone cobble cinder block poured concrete
concrete block other:
EXTERIOR DIMENSIONS: length width height
arch circumference other
INTERIOR DIMENSIONS: length width depth volume
other
OPENING: square rectangular round other:
length width diameter circumference
type of lid
material: brick cut stone cobble cinder block poured concrete
concrete block other:
STEPS: present absent; number of steps ;material
TYPE OF WATER COLLECTION: roof catchment other:
size of catchment ;material (catchment)
METHOD OF WATER EXTRACTION: manual pump windmill gravity
ALTERATIONS/MODIFICATIONS

TYPE OF ASSOCIATED BUILDING

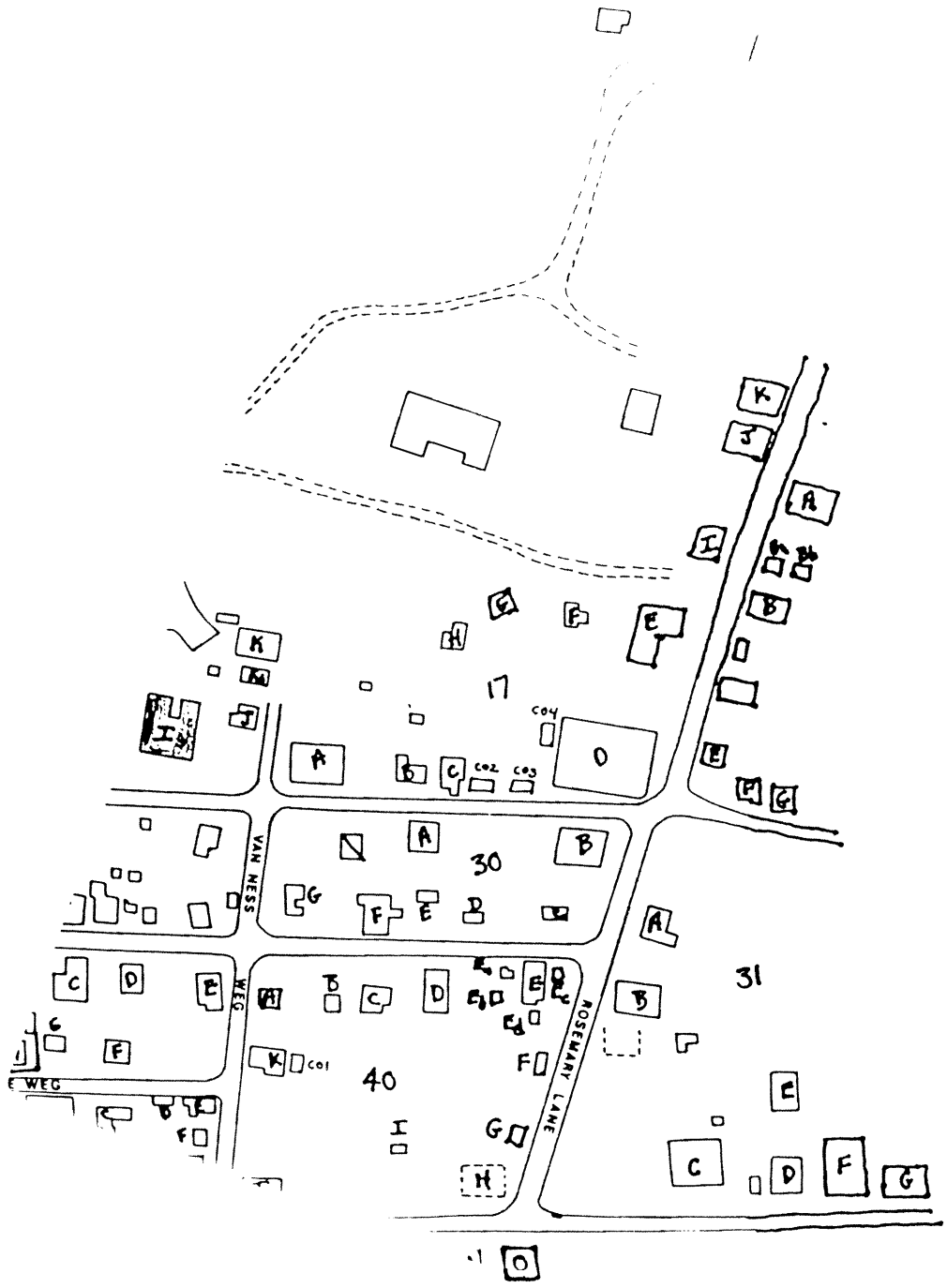
COMMENTS

SKETCH (include north arrow)

RECORDED BY R.Harper DATE / /1989 DRAWING NUMBER
PHOTO NUMBER: COLOR BLACK/WHITE



PLAN OF ORANJESTADT


K
J
A
I
B
G
H
F
E
17
C04
K
J
I
A
B
C02
C03
D
E
F
G
VAN NESS
A
B
30
G
F
E
B
A
31
C
D
E
WEG
B
C
D
E
F
6
F
K
C01
40
F
ROSEMARY LANE
B
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I
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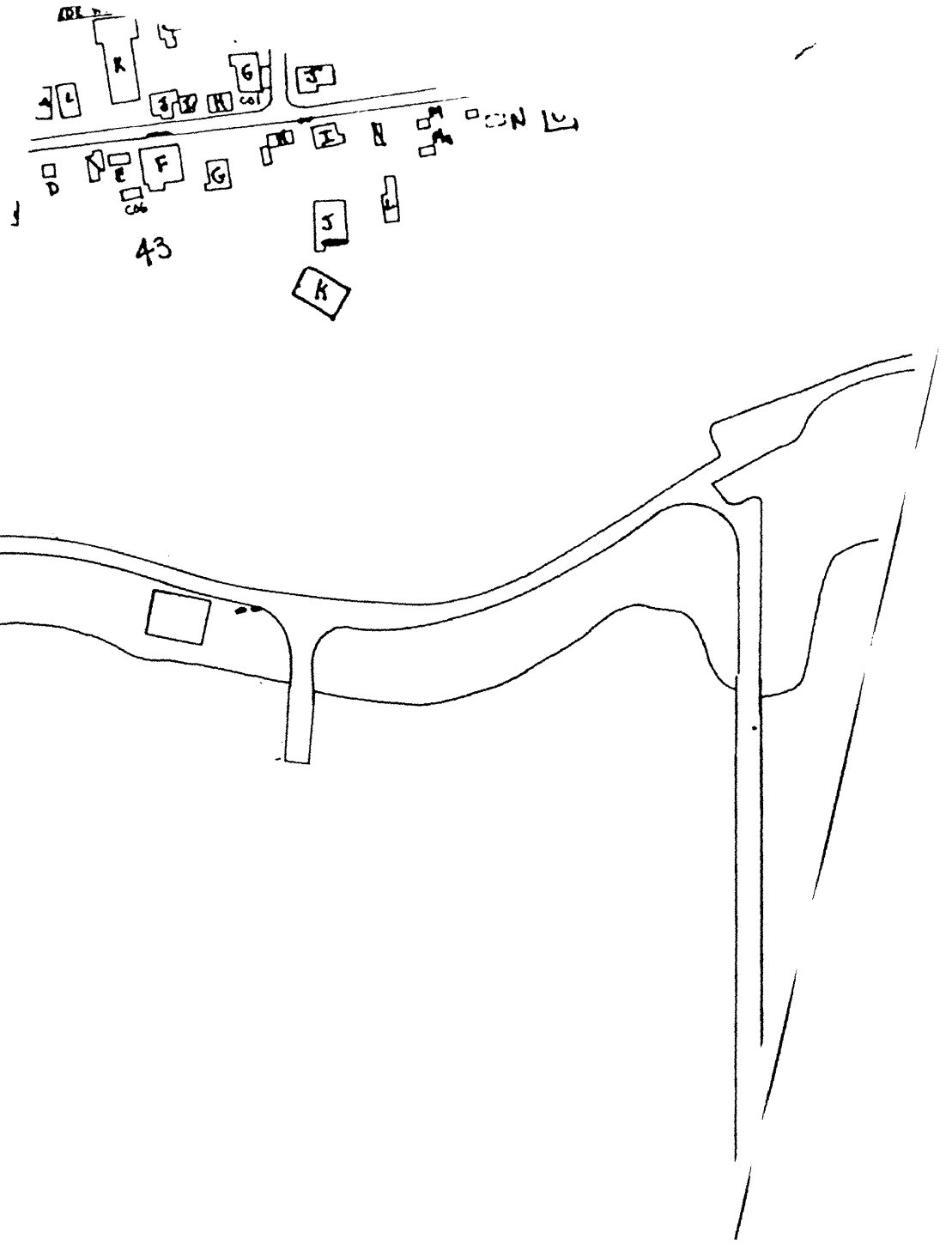
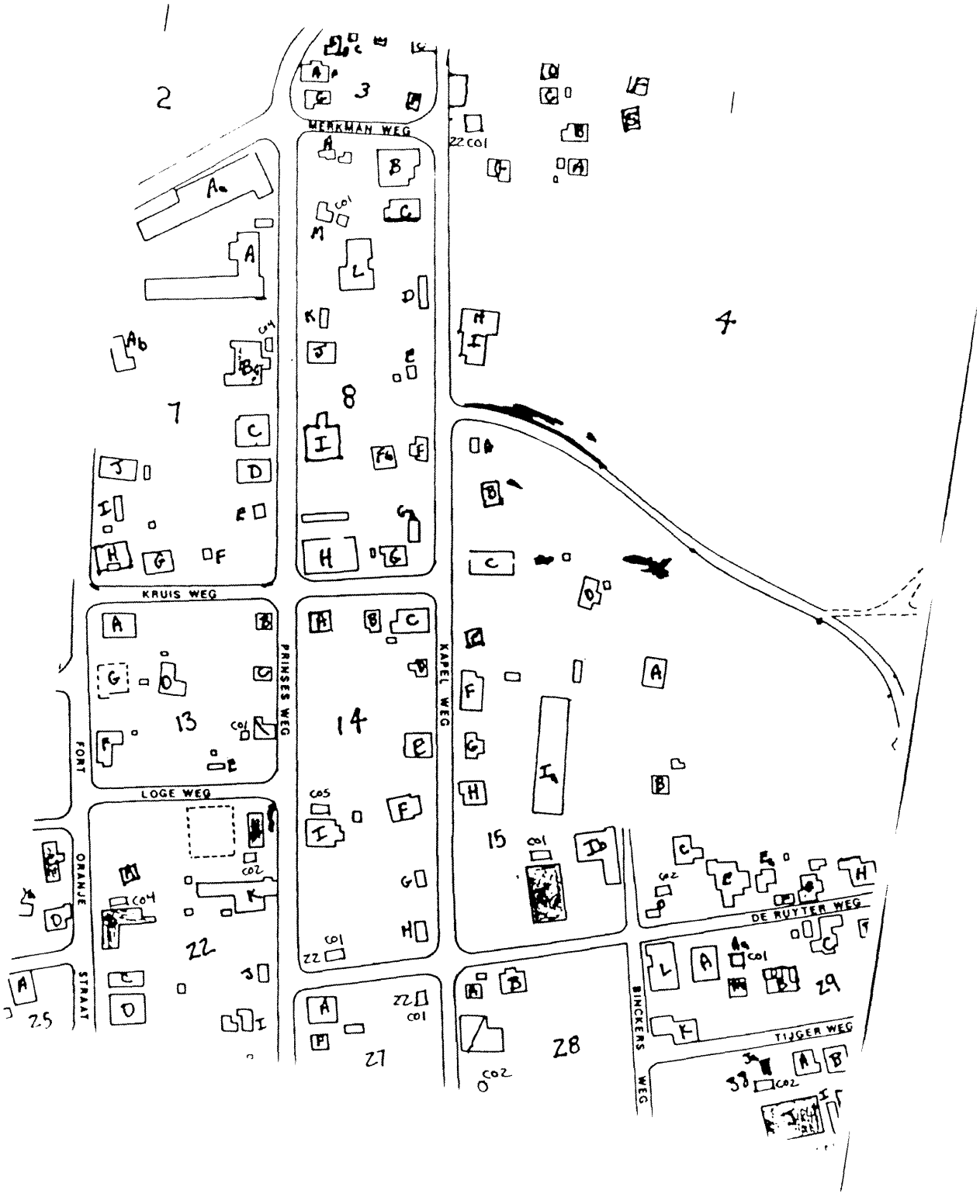
WEG
O


K
G
J
L
F
E
D
G
J
K
43


MERKMAN WEG
KRUIS WEG
PRINSES WEG
KAPEL WEG
FORT
LOGE WEG
ORANJE
STRAAT
DE RUYTER WEG
BINCKERS WEG
TIJGER WEG
22 CO1
1
2
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8
13
14
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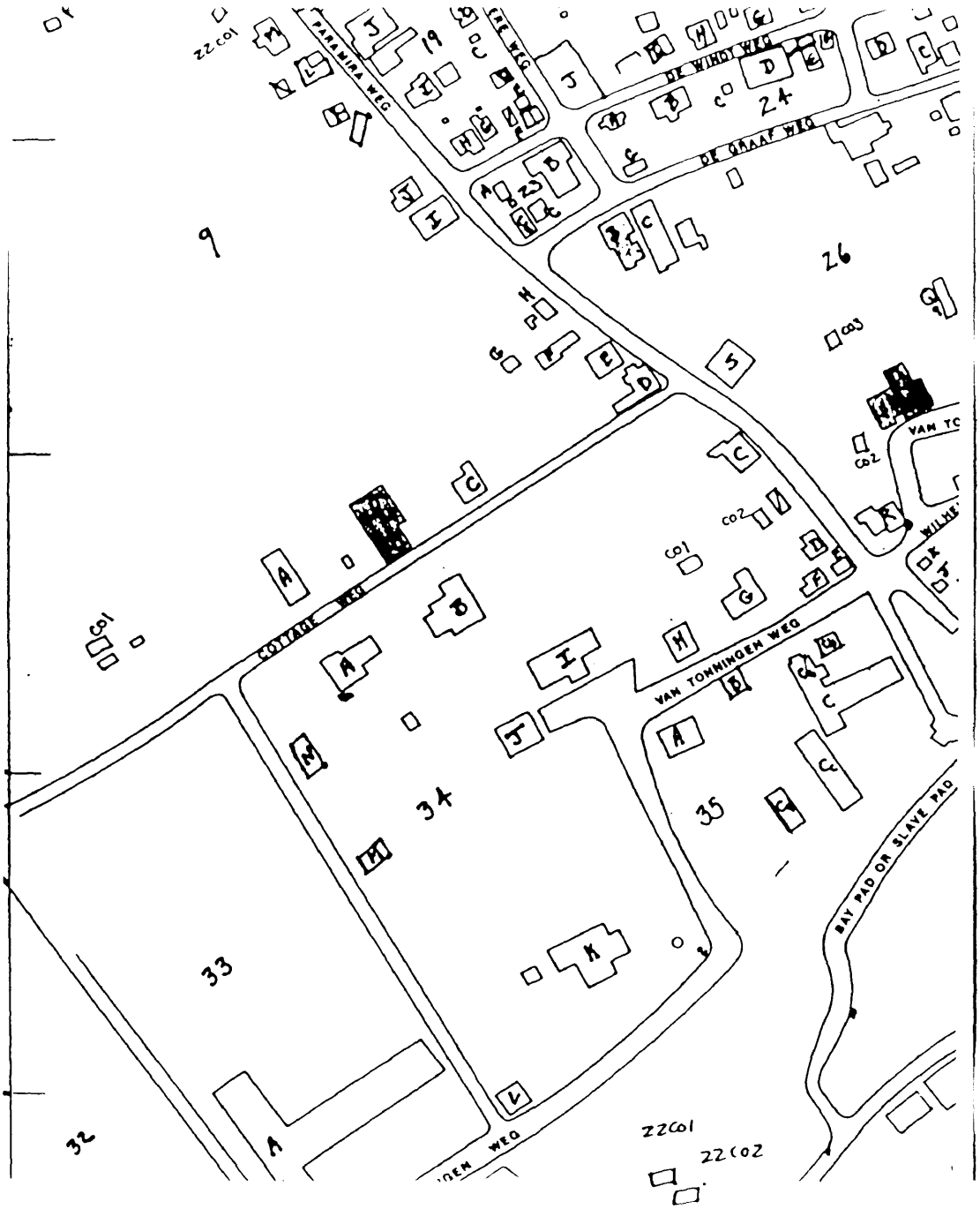
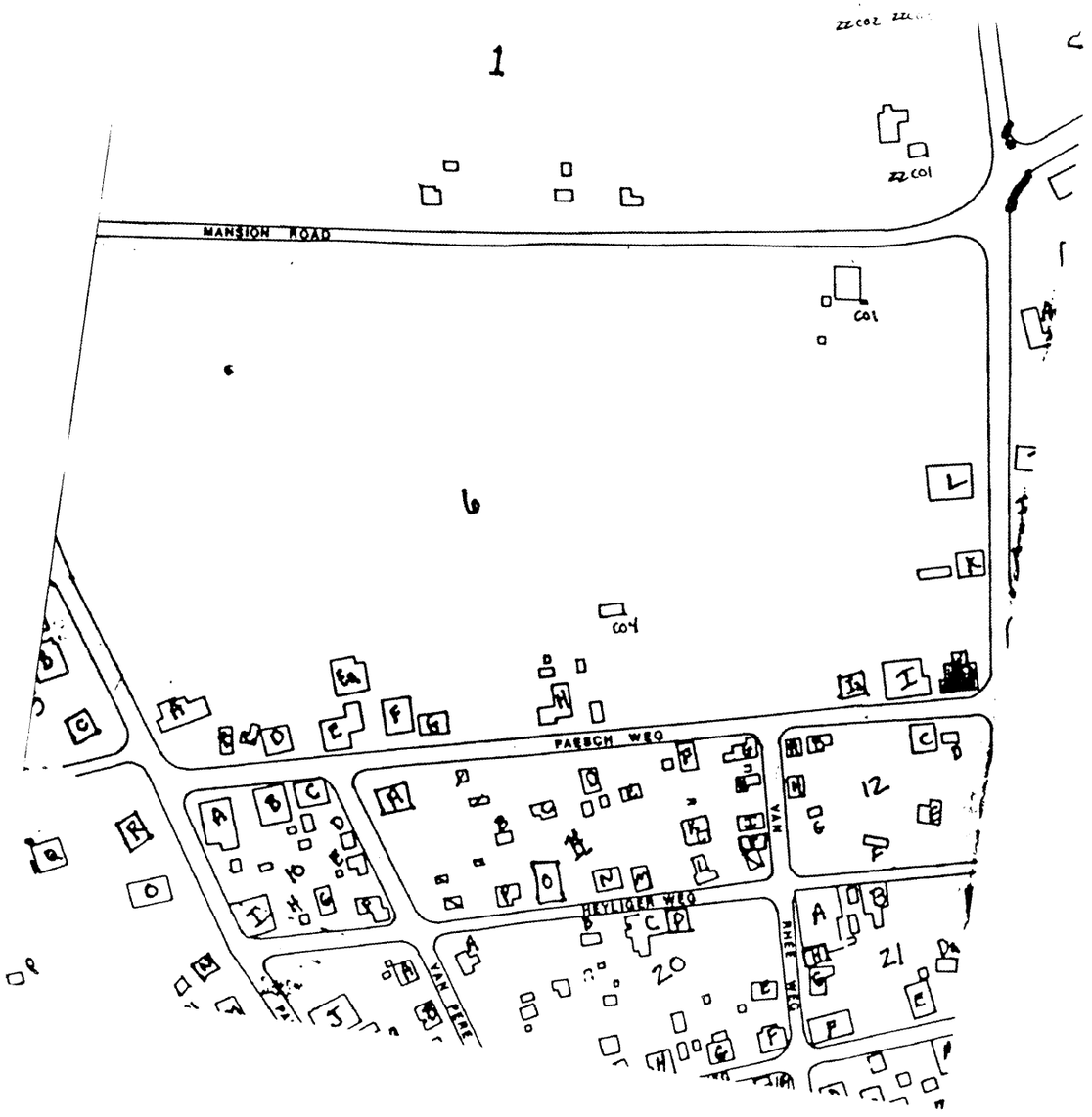
27
28
29
30


ZZ001
PARAMIBA WEG
DE WIND WEG
DE GRAAF WEG
9
19
24
26
COTTAAR WEG
VAN TONNINGEN WEG
34
35
33
32
BAY PAD OR SLAVE PAD
ZZ001
ZZ002


1
ZZCO2
ZZCO1
MANSION ROAD
CO1
6
CO4
PAESCH WEG
HEYLIGER WEG
VAN PEKE
12
20
21

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