CHAPTER 6
NRHP EVALUATION OF DRAINAGE PUMPING STATIONS NOS. 1, 3, 4, 6, AND 7 AND OF THE NEW ORLEANS DRAINAGE SYSTEM

Engineering Description of the New Orleans Drainage System

Background. New Orleans is located in a crescent-shaped bend of the Mississippi River, lying between the river to the south and Lake Pontchartrain to the north. To the east of the city is Lake Borgne, which connects to the Gulf of Mexico. Land near the river has an elevation several feet above sea level, and there are natural and artificial levees separating the land from the river. From the natural river levees, the land slopes toward Lake Pontchartrain, with elevations falling below sea level closer to the lake. Bayou Metairie and Bayou Bienvenue, both with natural levees rising to some five feet, originally crossed the area that is now encompassed by the city. In the nineteenth century, navigation canals that bisected the city from Lake Pontchartrain almost to the river were excavated.

At the time of the design of the New Orleans drainage system (1895), the land on the lake side of the city was mostly swamp, beginning about halfway between the river and the lake. Most of the inhabited area of the city was close to the river, and drainage consisted of open ditches extending from the slightly elevated land near the river to the swampy area behind the city. The available pumping machines appeared similar to riverboat paddlewheels and pushed the rain water into outfall canals. Drainage was slow, and the flow very polluted because there was no treatment of sewage. Flooding was frequent, and the area below lake level could not be developed. Such was the general situation when the New Orleans Mayor and City Council decided that something should be done to dramatically improve drainage. In 1893, an advisory board of engineers was appointed to plan a comprehensive drainage system for the city. In 1895, the plan was submitted to the City Council and adopted. The 1895 Drainage Plan presented a unique solution to New Orleans' drainage problem, which included natural conditions probably unparalleled anywhere in the world. This drainage system is still operational today, utilizing the major plan features and operating principles of the 1895 plan.

Design Constraints. The were many constraints imposed on the design of the system. The foremost constraint was the necessity of designing a system that would drain land below sea level, and convey the drained water to a discharge point at or above sea level. The subtropical climate and rain pattern of New Orleans dictated that the system handle minor daily rainfall and storm rainfalls of several inches, falling at the rate from three inches per hour to nine inches per hour in a single storm. The system would have to contend with several navigation canals crossing the area. There were only three possible outlets for the water. All of them were located at elevations higher than the land to be drained.

Then too, a major constraint upon the system designers was the foresighted recognition that the system should cause as little pollution to Lake Pontchartrain as possible. There were elevated residential camps in both Lake Pontchartrain and Lake Borgne, and these lakes were an important source of seafood for the city. Normally, the first few moments of a rainfall wash a heavy pollution load into any drainage system. Fortunately, the problem of polluting Lake Pontchartrain would be minimized by the development of a sewerage system for the major part of the city, which was begun almost simultaneously with construction of the drainage system.

Naturally, cost was an important consideration to the designers of the drainage system, as was the feasibility of construction. Lack of information plagued the designers. No significant rainfall and runoff statistics were available, nor were statistics available on infiltration characteristics of the various soils within the area. As much information as could be obtained in a short time was used by the Drainage Commission in their calculations, but they wisely decided that provision

be made for much increased flows in the future. Increased flows would occur both as the system was built over time and as the city grew in population and development.

As better information was obtained, the system was modified and expanded, but the original concept did not change. Some of the performance constraints recognized after the initial design of the drainage system were derived from new data on severe rainfalls, and recognition of the possibility of extreme lake tides caused by hurricanes.

The topography of the city was significantly changed in the 1930s, when the city was expanded to Lake Pontchartrain. Large areas adjacent to the lake were filled to several feet above sea level. This changed the drainage flow towards the center of the city. The original plan exhibited substantial foresight in that this problem could be solved without changing the overall system plan. In addition, the pumps initially installed in the several drainage stations soon proved inadequate to the capacities required by the developing city of New Orleans. An entire family of pumps was developed which was capable of handling large flows, lifted to low heights, for discharge.

In summary, the design constraints imposed upon the New Orleans drainage system included both inalterable natural laws and dynamic conditions. Meteorological and hydrographical knowledge has grown since the system was designed, and drainage demand and capacity have increased. The concept and design of the original system, however, remain identifiable and valid.

System Description. The New Orleans drainage system as designed in 1895 (Figure 6) was a combination or overlay of two systems; one acting during light daily rainfall, and another operating during heavy storm rainfall. Because of the pollution potential during small flows, such as is caused by light rainfall, the drained water was collected throughout the city and directed to an outfall at Bayou Bienvenue, which connects to Lake Borgne. Lake Borgne connects directly with the Gulf of Mexico, so this outfall avoided the pollution of Lake Pontchartrain. Water draining from the surface was collected into a system of closed and open canals, leading to pumping stations. These intermediate lift pumping stations (Pumping Stations Nos. 1, 2, 3, and, as proposed, 4) would lift the water into one main canal, which ultimately emptied into Bayou Bienvenue, and subsequently, into Lake Borgne. Acting in series, the first intermediate lift station (Station No. 1) would lift the water from its inflow or suction basin and pump it into the Main Canal. The water would flow by gravity from the lift elevation of the pumping station discharge through the main canal toward the second station (Station No. 2). As the water flowed from the discharge basin of one station to the suction basin of the next, it would be augmented by flows from local canals. This combined flow would then be lifted by the next pumping station in the series (Station No. 3), and discharged to run by gravity to the final intermediate station (Station No. 4, proposed but never built), also augmented by local inflows. Finally, the water would be pumped from the main outfall station (Station No. 5) into the Bayou Bienvenue. In order to cross the two major navigation canals into the city, it was necessary to build siphons under these canals. These were not difficult design items.

In the event of heavy storms, the flow pattern would change. Flow from the upper portion of the city would be rerouted at Drainage Pumping Station No. 1 and discharged into an outfall canal leading to Lake Pontchartrain. This storm water was deemed not to be heavily polluted and not significantly damaging to the lake perimeter. Each station lifting water into the main canal was designed to have the ability to divert its major storm flow into a discharge outfall canal leading to Lake Pontchartrain. The stations pumping into the relief outfall canals (Station Nos. 3, 6 and 7) were placed in locations roughly halfway between the developed portions of the city and the lake. This resulted in a better canal configuration and efficient discharge. These discharge canals have a unique design between the intermediate lift and outfall pumping stations. Because the daily flow is opposite to the storm flow, the bottom slopes back to the intermediate lift stations on the main canal.

The Main Canal of the New Orleans drainage system runs along Broad Street and Florida Avenue. One notable feature of the Main Canal is that it is essentially a flat canal, with only minor slopes from one station to the next. The canal elevation drops only about five feet between stations. All low points of the canal at the suction basins of the intermediate lift stations are at an elevation of approximately 3 ft Old Cairo Datum (-18.26 ft. mean sea level or NGVD, new geodetic vertical datum).

It is interesting to note that consideration could not be given to discharging into the Mississippi River because, at times, the river could be as high as 37' CD (15.74' NGVD). With the ground sloping upward towards the river, this would have created impossibly high demands on any pumping equipment handling the high rates of flow produced in rainstorms.

Several extensions and alterations of the drainage system have been required. The first and foremost was the replacement and augmentation of the original pumping machinery with higher-capacity units. The pumps available in the 1890s provided much greater pumping capacity, within the developing drainage system, than had the earlier drainage machines. However, within a decade and a half of the design of the system, it was evident that the original pumps were of insufficient capacity. Superior pumps were designed by Albert Baldwin Wood, a Mechanical Engineer with the Sewerage and Water Board. The Wood horizontal screw pumps have been designated National Historic Engineering Landmarks. The drainage system would fully meet its design promises only after the development of the Wood pumps.

In the 1930s, the landfill adjacent to Lake Pontchartrain added new drainage problems, and the system had to be enlarged. As New Orleans grew, land usage changed throughout the city. Originally the development level of land in the city had been classified as dense, medium, sparse, or rural, each with a different rate of runoff utilized to calculate drainage requirements. For example, 300 acres with a slope of 0.003 ft/ft would have a runoff of 455 cfs if development was designated as dense, 370 cfs if medium, 290 cfs if sparse, and only 11 cfs if rural. Since the original design of the drainage system, almost all of the city has come to be characterized by dense or medium development, with consequent greater demands on the system. In the 1920s, a large canal, the Inner Harbor Navigation Canal (or Industrial Canal), was dredged directly across the Main Canal, so a siphon had to be built under this canal.

Engineering Descriptions of Drainage Pumping Stations Nos. 1, 3, 4, 6 and 7

Drainage Pumping Station No. 1. The pumping equipment at Station No. 1 consists of two 12' Wood screw pumps rated at 550 cfs, which were installed in 1915; three 14' Wood screw pumps rated at 1,000 cfs, which were installed in 1930; two smaller vertical shaft screw pumps rated at 250 cfs installed in 1965, which replaced two similar-sized pumps that were installed prior to the station's opening in 1904; one 30" Wood constant duty screw pump, which was installed in 1912; and one vertical constant duty pump installed in 1965. The six Wood pumps are the most significant engineering objects at the station. These pumps were designed by Albert Baldwin Wood, who is recognized as an important figure in the history of American engineering for his pump designs. Associated with these pumps are the auxiliary equipment such as vacuum pumps for priming (starting) the main pumps, switchgear for starting and operating them, and other minor features. The electrical motors driving these pumps operate on 25 cycle electrical current. The current is created by a generating station which is part of the larger drainage system or, in emergencies, by a frequency converter station. The need for such low operating frequency is due to the inherently low operating speed of the pumps.

Drainage Pumping Station No. 3. The pumping equipment at Station No. 3 consists of two 12' Wood screw pumps rated at 550 cfs, installed in 1918; three 14' Wood screw pumps rated at 1,000 cfs, installed in 1931; and two pairs of horizontal centrifugal constant duty pumps, each pair rated at 80 cfs and installed ca. 1930. The five Wood screw pumps are the most significant

engineering objects at the station. Associated with the Wood pumps are auxiliary equipment such as vacuum pumps for priming the main pumps, switchgear for starting and operating them, and other minor features. As is the case at Station No. 1, the Wood screw pumps at Station No. 3 operate on 25 cycle electric current, which is generated by a central generating station. In an emergency, a frequency converter station connected to Entergy generators can be utilized for current supply.

Drainage Pumping Station No. 4. The pumping equipment at Station No. 4 consists of two horizontal centrifugal pumps rated at 320 cfs, installed 1945-1946; one Worthington 14' screw pump rated at 1,000 cfs, installed ca. 1960; two Allis-Chalmers 14' screw pumps, rated at 1,000 cfs, installed in the 1960s; and one vertical trash pump for constant duty, rated at 80 cfs, installed 1963-1964. The screw pumps are later variations of the basic Wood screw pump design and operate in a similar fashion. These main pumps have auxiliary equipment such as vacuum priming pumps, switchgear, and other minor features associated with them. This station has more modern 60 cycle current supply for all pumps.

Drainage Pumping Station No. 6. The pumping equipment at Station No. 6 consists of two 12' Wood screw pumps rated at 550 cfs, installed in 1916; four 14' Wood screw pumps rated at 1,000 cfs, installed in 1930; three Worthington 14' screw pumps, one rated at 1,000 cfs and two rated at 1,050 cfs, installed 1986-1989; four vertical centrifugal constant pumps rated at 250 cfs, installed 1985-1988; and two vertical centrifugal constant duty pumps rated at 90 cfs, installed ca. 1930. The Worthington screw pumps are later variations of the basic Wood screw pump design and operate in a similar fashion. The six Wood screw pumps are the most significant engineering objects at the station. Associated with the Wood pumps are auxiliary equipment such as vacuum pumps for priming the main pumps, switchgear for starting and operating them, and other minor features. As is the case at Station No. 1, the Wood screw pumps at Station No. 6 operate on 25 cycle electric current, which is generated by a central generating station. In an emergency, a frequency converter station connected to Entergy generators can be utilized for current supply. The pumps at this station installed during the 1980s have more modern 60 cycle current supply.

Drainage Pumping Station No. 7. The pumping equipment at this station consists of one 12' Wood screw pump rated at 550 cfs, installed in 1917-1918; two 14' Wood screw pumps rated at 1,000 cfs, installed in 1931; three vertical centrifugal pumps rated at 250 cfs, installed 1898-1900 (not in use); one vertical constant duty pump installed in 1911 (not in use); and two constant duty vertical trash pumps rated at 70 cfs, installed in 1931. Associated with the Wood pumps are auxiliary equipment such as vacuum pumps for priming the main pumps, switchgear for starting and operating them, and other minor features. Two of the Wood screw pumps at Station No. 6 operate on 25 cycle electric current, which is generated by a central generating station. One of the 14' Wood screw pumps at Station No. 7 operates on 60 cycle current.

The three vertical centrifugal pumps at Station No. 3 are the only examples in the system representing the original pumping technology utilized in initial construction of the system and drainage pumping stations, 1897-1903. As such, these three pumps and the three Wood screw pumps are the most significant engineering objects at the station.

Architectural Descriptions of Drainage Pumping Stations Nos. 1, 3, 4, 6, and 7

Drainage Pumping Stations Nos. 1, 3, 6, and 7 were all designed ca. 1895-1899 as part of the construction proposed for the Drainage Plan of 1895. Certain aspects of the stations were not constructed as originally designed. In particular, Stations Nos. 1, 3, and 6 were not built in the physical locations proposed in 1895.

In the 1895 Drainage Plan, Drainage Pumping Station No. 4 was proposed for a location at the intersection of Lafayette and Florida Avenues. Station No. 4 was not built at this location.

Instead, a station designated Drainage Pumping Station No. 4 was designed in the late 1930s and constructed in 1945-46 at Prentiss Avenue and the London Relief Outfall Canal. Thus, the architecture of Drainage Pumping Station No. 4 is unrelated to that of Stations 1, 3, 6, and 7. In the following architectural description and discussion of the stations, Stations Nos. 1, 3, 6, and 7 are discussed together as well as separately.

Drainage Pumping Stations Nos. 1, 3, 6, and 7. Drainage Pumping Stations Nos. 1, 3, 6, and 7 (along with Station No. 2, and the now-demolished Algiers station, Drainage Pumping Station No. 8) were nearly identical structures when they were built between 1897 and 1902. All except the Algiers station were originally eight bays long, and all have been extended longitudinally at least once. These extensions have been made in a manner which reproduces the original construction so well that it is difficult to find the point of change between building episodes. Slight differences in brick and mortar color must be used to visually define the extensions. The original eight-bay units can be identified by foundation stones, carved with the date "1899" and the name of the chief engineer, B.M. Harrod, among the others credited with the system's construction. The stones are identical on all stations except for the name and number of the station engraved at the top.

Drainage Pumping Stations Nos. 1, 3, 6, and 7 are visible to the public from their southern or city-facing facades. Three of the stations, Nos. 1, 3 and 6, present an imposing presence in their neighborhoods which effectively monumentalizes the pumps within and emphasizes the meaning and importance of the drainage system to the city of New Orleans. Station No. 7 is less visible because it is wedged between a railroad embankment and the U.S. Interstate-610 overpass within City Park. The eastern end of Station No. 7 can be seen from a nearby picnic ground. Stations 3, 6, and 7 cannot be viewed readily by the public from the north or lake side. The outfall side of the Metairie Relief Outfall Canal and the London Outfall Canal are open canals, bordered by floodwalls on top of levees. These floodwalls effectively prevent access to the outfall canals and mask the stations from pedestrian viewing. Drainage Pumping Station No. 7 is at the end of the Orleans Outfall Canal. The discharge basin side of this station is visible from the I-610 overpass bridge, but this is a vantage point where pedestrian access would be unusual if not impossible. The discharge basin of the Station No. 7 is visible from the levee of the Orleans Outfall Canal, but the greater part of the Station is obscured from view at this point by the I-610 overpass.

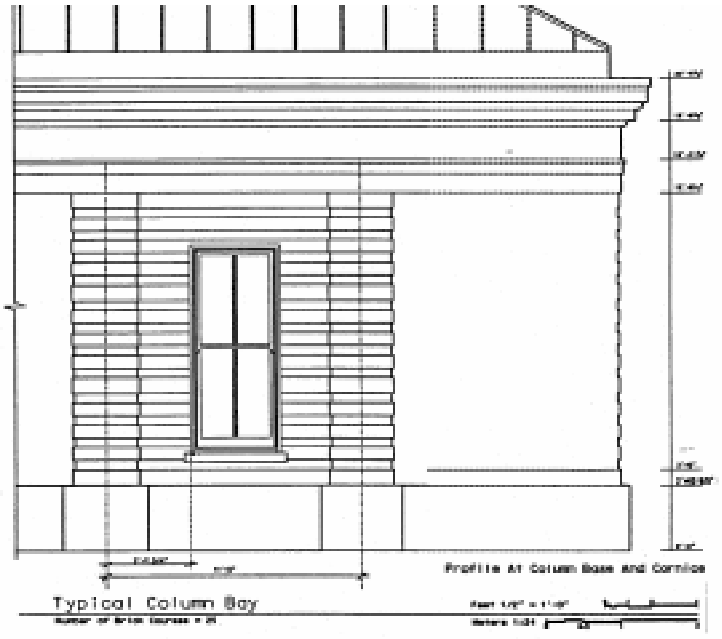

Figure 83. Typical column bay, Drainage Pumping Station No. 6. The bay proportions are uniform for Drainage Pumping Stations 1, 3, 6, and 7 (from Historic American Buildings Survey 1992).

Stations Nos. 1, 3, 6, and 7 are utilitarian brick sheds with steel trusses spanning the interior, and hip roofs with monitors on the ridge. All originally had decorative terra cotta crests on the monitor ridges. The exterior wall design shows a remarkable application of the classical language of architecture. The walls are divided into bays by rusticated or banded pilaster-like wall segments, formed of projecting and receding brick courses (Figures 83 and 84). At the top, the pilasters meet an entablature defined by projecting and receding brick courses. These

Figure 84. Drainage Pumping Station No. 1. View of east facade, showing brick depth and projection.

Figure 85. Drainage Pumping Station No. 1. View of upper portion of east facade of building, showing pilasters, wall, and entablature, quarter-round bricks at transition to cornice, and decorative cast-metal false keystone on window.

step out to imitate the fascia of an Ionic architrave, recede into a flat zone for the frieze, and then join a quarter-round molded course as a transition to the copper cornice (Figures 85 through 88). Ornamental cast copper squares are placed in the frieze just above the banded pilasters (Figures 86, 88, and 89). The wall and pilaster bases project from the walls and pilasters, and the top course of this projection has end-laid bricks with beveled top edges (Figure 90). Originally, Stations 1, 3, 6, and 7 all had decorative terra-cotta crests on the monitor roof peak (Figures 91 and 92).

The bay divisions reflect internal workings. Behind each banded pilaster stands a projecting brick pier topped by a "capital" built of stepped-out brick courses. Above the capitals are, or were in some cases, metal abaci supporting the steel girders which run the length of the building to guide the traveling cranes utilized for moving machinery. The subtle architectural intentions on the exterior walls became even more purposeful and apparent when seen in the context of the monumental Central Power Station No. 1 (now Sewage Pumping Station D) (Figure 93), constructed

Figure 86. Drainage Pumping Station No. 1. View of upper portion of southeast corner of building, showing projection of fascia brick courses and decorative metal castings.

Figure 87. Drainage Pumping Station No. 1. View of upper portion of southeast corner of building, showing special round bricks, corner treatment of architrave, and quarter-round brick course below cornice.

Figure 88. Drainage Pumping Station No. 1. View of roof on eastern side of building, showing decorative terra-cotta crest on monitor. The joint between the 1899-1904 masonry and 1915 construction is visible above the central pilaster.

Figure 89. Drainage Pumping Station No. 1 View of west side of south facade, showing door and shuttered transom window.

Figure 90. Drainage Pumping Station No. 1. View of east facade pilaster base, showing course of beveled bricks.

Figure 92. Drainage Pumping Station No. 1. View of the monitor roof peak at the northern end of the building, with terra-cotta crest and finial.

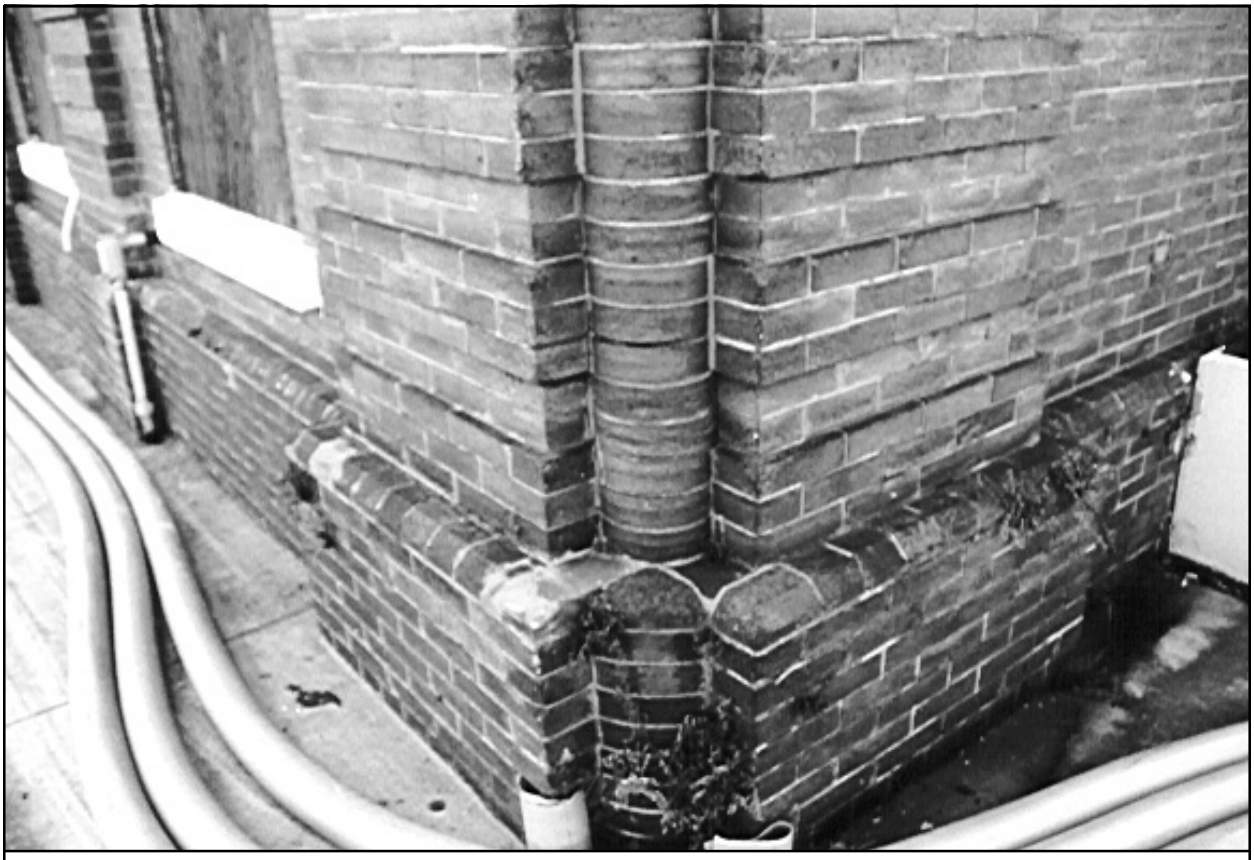

Figure 93. Drainage Pumping Station No. 1. View of lower portion of northwest corner of building, showing special round bricks and pilaster bases at corner.

at the same time as Drainage Pumping Stations Nos. 1, 3, 6, and 7. This original system power station is now part of the sewerage system, not the drainage system. The smaller pumping stations read as architectural offspring of this large and particularly well proportioned structure, with its pediment over the central three bays and the same adaptation of the classical orders, in brick, to articulate the walls. The same foundation stone inscriptions occur on the Central Power Station except for an earlier date (1898). The Central Power Station was designed by an architect familiar with eighteenth century French architecture or its academic representations. It is one of the finest classical designs in the city.

Drainage Pumping Station No. 1. Drainage Pumping Station No. 1 is a nineteen bay one-story utilitarian brick shed with monitor (now blocked) on a hipped roof. It is ennobled by excellent proportions and by a remarkable translation of the classical language of architecture — from rusticated pilasters and full entablature and cornice — into the same brick as the rest of the wall (Figures 85 through 88). The architrave has fascias made by slight projections of ascending brick courses (Figures 86 through 88). There are quarter-round molded or cut bricks making the transition to the cornice (Figures 86 and 88). Such detailing shows the hand of a knowing designer, probably the drainage system's engineer, Benjamin Morgan Harrod (1837-1912).

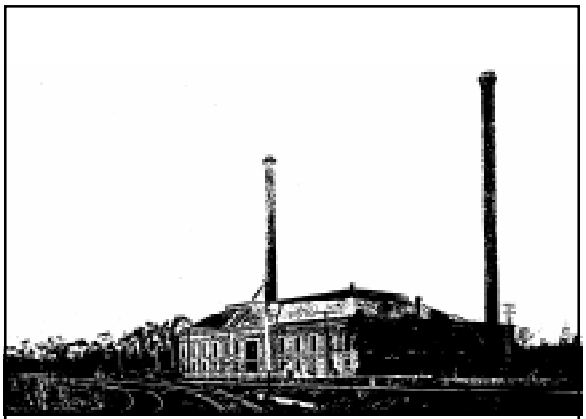

Figure 93. The Central Power Station (No. 1), built 1897-1899 (courtesy of the Sewerage & Water Board of New Orleans.

Drainage Pumping Station No. 3. Like Stations Nos. 1 and 2, Drainage Pumping Station No. 3 is particularly visible from heavily traveled Broad Street. The three work together in series to visually articulate the drainage system as a sequence of elements. Station No. 3 was built in three stages (1901-1903, 1917, and 1930-1931) with the original eight bays in the center of the current structure The view from Broad Street of the two westernmost bays of the main facade is partially blocked by the narrow, two-story, concrete control annex structure. According to drawings dated October 1994, the building at that date still had operable monitor windows, slate main and monitor roofs, with decorative terra cotta cresting on the former. At present there is a seamed copper roof covering the monitor roof and main roof. Unlike the interiors of Stations Nos. 1, 6, and 7, the interior of Station No. 3 has a line of blue glazed bricks between the lower part of the wall, faced with brown glazed bricks, and the upper part of the walls, faced with red brick.

Drainage Pumping Station No. 6. Construction of Drainage Pumping Station No. 6 began in August 1897. The south or city-facing long facade is partially visible to the public. Originally the station was more visible from the south, prior to the construction of the dramatic trash-screen rake mechanism in the 1980s (Figures 55 and 56).

The original eight bays are the center portion of this long building, which was constructed in four stages. Additions to the original building were made in 1914-1915 and 1928-1930, consistent with the original design and construction. A two-story addition of 1986-1989 changes the proportion of the walls to the roof, but adapts the brick wall system reasonably effectively (Figure 58). The early parts of the interior of this station do not have the usual stepped brick "capitals" between the interior piers and the steel beam crane track seen in Stations 1, 3, and 7.

Like Drainage Pumping Station No. 7, the monitor of Station No. 6 was set within the hipped roof in such a way that the ridge of the lower, main roof joins, or is near, the eaves of the monitor roof, thus blocking the monitor glazing on the two narrow ends of the building. The monitor is now enclosed in seamed copper roofing and the main roof, also clad in seamed copper roofing, has lost the terra cotta cresting. Drainage Pumping Station No. 6 is the best site for public interpretation of the drainage system and pumping stations because it is so large, the vicinity is free from vehicle traffic, and because the trash screen rake mechanism is so engaging.

Drainage Pumping Station No. 7. Construction of Drainage Pumping Station No. 7 began in 1897 and was completed by 1900. The eight bays making up the western portion of the structure can be identified by the foundation stone on the southwest corner as the original part of the building. The station is now eighteen bays long (Figures 61 through 64). As is the case with Station No. 6, the monitor ends were set within the hipped roof, not on it (see description of Drainage Pumping Station No. 6, above) (Figures 65). The monitor is covered with plywood, and the roof has been clad in composition shingles.

Other than the alteration of the monitor, this station is, perhaps, the best preserved of all the early stations with many all-wooden windows, doors, and, remarkably, an early double-leaf wooden vehicle doorway with elaborate metal hinges (Figures 66). This is the only original vehicle door observed at Stations Nos. 1, 3, 6, and 7. Although Station No. 7 is in an unpleasant location between the I-610 overpass and a railroad embankment, the east end of the building faces Marconi Drive and can be seen from a picnic ground situated beneath the overpass.

Drainage Pumping Station No. 4. The building is constructed of stucco-covered concrete block with a sheet metal roof. It once had wooden sash windows, which have been blocked, and roofing of composition shingles. The building was constructed 1945-1946. A different architectural approach underlay the design of this station than that of Stations Nos. 1, 3, 6, and 7. It makes no attempt to look like the older pumping stations in materials, massing, or any other aspect of the design. Engineering features of this station also produce an appearance radically

different from the stations designed in the 1890s. Most dramatically, the greater part of the pumping machinery at this station is not enclosed within the fabric of a building, reducing the architectural relevance and impact of the relatively small station building.

Drainage Pumping Station No. 4 is a purely utilitarian building without distinguishing architectural features. It is out of character with the earlier architectural excellence of the original Drainage Pumping Stations (Nos. 1, 2, 3, 6, and 7).

Evaluation of the Integrity of Drainage Pumping Stations Nos. 1, 3, 4, 6, and 7

As seen above, Drainage Pumping Stations Nos. 1, 3, 6, and 7 were all constructed in the same style during the period 1897-1902. While all of the structures have been expanded, these longitudinal extensions have been consistent with the original design to the point that it is often difficult to distinguish the older construction from the new. The result is that the architectural character of these structures has been maintained over time despite alterations, and the structures still convey a strong sense of their past associations. Thus, Drainage Pumping Stations Nos. 1, 3, 6, and 7 all exhibit architectural integrity:

> A property important for its expression of architectural design and construction technology is eligible if the principal features of its design and construction are sufficiently intact to convey that significance [National Park Service 1982:39-40].

In addition, all of the pumping equipment at Stations Nos. 1, 3, 6 and 7 is maintained in excellent condition. The pumps possess a high degree of integrity; there have been no repairs to the main pumping equipment which has altered their original condition. Then too, the maintenance procedures necessary to keep the auxiliaries up-to-date with present standards also have not affected the integrity of the Wood pumps. Finally, Drainage Pumping Station No. 7 is unique in the system for having its original ca. 1897-1899 250 cfs vertical centrifugal pumps and motors, representing the original main pumping equipment of the New Orleans drainage system. Thus, Drainage Pumping Stations Nos. 1, 3, 6, and 7 all possess engineering integrity.

Drainage Pumping Station No. 4, as noted above, lacks the high level of architectural excellence exhibited by the other four stations. In addition, it has undergone substantial renovation, in that the windows have been covered over. Thus, Station No. 4 does not possess architectural integrity. The pumps at Drainage Pumping Station No. 4 do exhibit integrity in that they have been maintained in their original condition since the time of their installation. However, it should be noted that the pumps in and of themselves are not significant; no Wood pumps are present at this station.

Evaluation of the Integrity of the Drainage System

As we have seen, expansion of New Orleans both in terms of area and population has placed increasing demands upon the drainage system since its original design in 1895. Nonetheless, the concept and design of the original system remains identifiable and functional today. As such, the New Orleans drainage system is not only a historically significant engineering complex, but because it remains fully operational, it is a working museum of drainage progress.

Under the National Park Service's (1982:5) definition, the New Orleans drainage system can be classified as a district:

> A district is a geographically definable area… possessing a significant concentration, linkage, or continuity of sites, buildings, structures, and/or objects united by past events or aesthetically by plan or physical development.

Elements of such a district might include the drainage stations themselves, as well as the associated pumps, piping systems, canals, and power stations. Because the importance of the system includes its organic, evolving character which is necessitated by steadily increasing demands on drainage as well as the interrelationships of the elements, the district would include elements that in and of themselves might not be eligible for inclusion on the National Register, or that could not be considered contributing elements to the district other than that they are functionally interconnected with the system. However, for the purposes herein, the focus of our assessments of integrity and of significance (below) is the status of Drainage Pumping Stations Nos. 1, 3, 4, 6, and 7 and their associated canals as contributing elements to a drainage system district.

As discussed above, Drainage Pumping Stations Nos. 1, 3, 6, and 7 all possess both architectural and engineering integrity, and along with Station No. 2, were all constructed in the same architectural style. Unlike these structures built during the period 1897-1902, the more recent Drainage Pumping Station No. 4 lacks architectural integrity. While the pumps at Station No. 4 are in their original condition, they lack significance in and of themselves. Thus, Station No. 4 can not be considered a contributing element to a drainage system district on the basis of either architectural or engineering merit, despite the fact that it possesses engineering integrity.

As indicated in Chapter 4, none of the major canals in the drainage network are in their original condition. All of the major drainage canals have been altered to some degree, by deepening, reshaping, relining, covering, or re-covering since construction began on the system in 1897. This repair, redesign, and improvement of the drainage canals, which have continued up to the present and will very likely continue into the future, have been a functionally necessary result of the increasing drainage demands of the city.

In terms of the canals which are directly connected with suction and discharge basins of Drainage Pumping Stations Nos. 1, 3, 4, 6, and 7, the Metairie Relief and Relief Outfall Canal, the Upper Protection Canal, the Palmetto Canal, the Washington Avenue Canal, the Orleans Relief Canal, The Florida Avenue Canal, the London Avenue Outfall and Outfall Relief Canal, the Prentiss Avenue/Calhoun Avenue Canal, and the Broad Street Canal between General Taylor and Drainage Pumping Station No. 1 have all been widened or deepened to increase their drainage flow capacity within the last 50 years (Mr. Young Lee, personal communication 1996). Thus, these canals only possess integrity of location. However, because improvement to drainage is the primary function of the evolving drainage system, these canals' integrity of location, which preserves and illustrates the interrelationships between the stations, is sufficient for the purposes of a drainage system district:

> All properties change over time. The retention of integrity depends upon the nature and degree of alteration or change. It is not necessary for a property to retain *all* the physical features or characteristics that it had during its period of significance. However, the property must retain the essential physical features that enable it to convey its past identity or character and therefore its significance [National Park Service 1982:40].

However, that portion of the Broad Street Canal between Drainage Pumping Station Nos. 1 and 3 has not been modified within the last 50 years (Mr. Young Lee, personal communication 1996). Construction was begun on the Main Canal-Broad St. Canal elements of the system in 1897, and the Broad St. Canal has been modified and enlarged by several construction episodes. The last major modification of the Broad St. Canal (with the exception of modifications to the suction and discharge basins at Stations Nos. 1 and 3) occurred in the period 1938-1940. Thus, this portion of the Broad Street Canal, in addition to possessing integrity of location, exhibits integrity of design, materials, and workmanship for the period prior to World War II, although it has been altered since its original construction.

The National Park Service states:

> In order for a district to have integrity as a whole, the characteristics that make the district significant must be intact. The majority of the components that make up the district's historic character must possess integrity even if they are individually undistinguished. *The relationships among the components must be substantially unchanged since the period of significance*, and the majority of components within the district must be historic [National Park Service 1982:40-41; emphasis added].

In terms of the drainage pumping stations and associated canals under consideration here, a drainage system district has integrity as a whole. The original design of the system is clearly evident and still functioning. Because they possess integrity of location, the canals illustrate the interrelationships of the elements of the system. Furthermore, four of the five drainage pumping stations exhibit both architectural and engineering integrity.

It is recommended below that Drainage Pumping Stations Nos. 1, 3, 6, and 7, are individually significant in terms of association (Criterion A), architecture (Criterion C) and engineering (Criterion C). In addition, it is recommended that the drainage system as a district is significant under these same criteria, and that Stations Nos. 1, 3, 6, and 7 are contributing elements to this district.

Statement Of Associative Significance (Criterion A)

New Orleans began construction of its present-day drainage system, including Drainage Pumping Station No. 1, 3, 6, and 7, between 1897 and 1904. In doing so, city administrators were not only addressing dire local needs for adequate drainage and flood protection, but following a national trend which held city officials responsible for the well-being of their citizenry. A corollary of this was the development of public utilities systems throughout American cities in the late-nineteenth and early-twentieth centuries.

The establishment of the New Orleans drainage system and its subsequent improvement through the engineering genius of A.B. Wood not only provided adequate drainage for the then-developed portions of the city, they permitted the city to expand. Mortality rates for the city's inhabitants dropped as a result of improved health; improved drainage decreased the mosquito population. Further, the construction of the drainage system stimulated the establishment of sewerage and water systems for the city.

Thus, the New Orleans drainage system as a whole is associated with the theme of settlement and expansion of the city. However, to be considered eligible for listing on the National Register under Criterion A,

> …[a] particular property should be a good representative of the theme and of the specific event or events. To be a good representative, it must have strong associations with the event or events and it must possess integrity [National Park Service 1982:17].

Drainage Pumping Station Nos. 1, 3, 6, and 7 are good representatives in that they were among the first stations constructed in the drainage system. In addition, and perhaps more importantly, the first 30", 12', and 14' Wood screw pumps were installed at Station No. 1, and they are still in place and in use today. Additional 12' and 14' Wood screw pumps are located in Stations Nos. 3, 6, and 7. Then too, Drainage Pumping Station No. 7 still has its original ca. 1897-1899 250 cfs vertical centrifugal pumps and motors, which represent the original main pumping equipment of the New Orleans drainage system. Finally, the stations exhibit the quality of integrity. Drainage Pumping Station Nos. 1, 3, 6, and 7 are therefore individually eligible for nomination to the

National Register under Criterion A. Because they are individually eligible under Criterion A, Drainage Pumping Stations Nos. 1, 3, 6, and 7 are also contributing elements to a drainage system district under Criterion A.

In comparison to Stations Nos. 1, 3, 6, and 7, Drainage Pumping Station No. 4 is not a good representative of the theme of settlement and expansion of the City of New Orleans. It was constructed at a later date than the other four stations, and both the equipment and architecture of the station are unremarkable. Thus, Drainage Pumping Station No. 4 is not eligible for inclusion on the National Register of Historic Places in and of itself under Criterion A. Within the context of a drainage system district, Station No. 4 would be a contributing element under Criterion A only in that it is functionally interconnected with the remainder of the system.

Similarly, the canals associated with the five drainage pumping stations under consideration here cannot be considered good representatives of the theme of settlement and expansion of the City of New Orleans. All are undistinguished in and of themselves, and all but a portion of the Broad Street Canal have been modified within the last 50 years. In addition, that portion of the Broad Street Canal which has not been modified since 1938-1940 is not in its original condition. Therefore, they are not individually eligible for the National Register under Criterion A. However, within the context of a drainage system district, all would be contributing although individually undistinguished elements under Criterion A because they possess integrity of location, and thereby illustrate interrelationships of system elements:

> A district is different from the other categories of historic properties because a district may be significant as a whole even though it may be composed of components — sites, buildings, structures, and objects — that lack individual distinction. A district's identity results from the grouping of features *and from the relationships among those features* [National Park Service 1982:25; emphasis added].

Statement of Architectural Significance (Criterion C)

Drainage Pumping Station Nos. 1, 3, 6, and 7 are individually and as a group significant for their architectural excellence. As architectural entities, they embody distinctive characteristics of a "type, period, or method of construction," that being an early-twentieth-century New Orleans drainage station. As such, they "enhance our understanding of the class of resources of which [they are] a part" (National Park Service 1982:22). They, along with Station No. 2, all exhibit similar architectural style and detail; they are distinguishable as a unified group of buildings. Stations Nos. 1, 3, 6, and 7, as well as 2, were probably designed by a local architect of considerable merit who was chief engineer of the drainage system, as well as an engineer of national reputation at the time the stations were constructed.

While no signed drawings or other sure means of attribution for the pumping and central power station designs have appeared to date, it is reasonable to assume that they were drawn by the chief engineer of the Drainage Commission, Major B.M. Harrod. Harrod was both an engineer and an architect. At the time Drainage Pumping Stations 1, 3, 6, and 7 were designed, Harrod was practicing architecture with his former employee, Paul Andry. The firm of Harrod and Andry had just completed the first buildings of the new Tulane University campus in the mid-1890s. The drainage station designs are consistent in character with the Tulane buildings and with the few glimpses we have of Harrod's earlier work. When writing about himself, Harrod most often referred to himself as an engineer. When written about by others, Harrod was considered a distinguished engineer with a national reputation. Moreover, Harrod left a substantial body of architectural work which as yet has remained largely unstudied.

Although we do not know a great deal about the work of this Harvard-educated Louisianan, he was clearly a man of excellent talents in both architecture and engineering. He appeared

as an architect in Notarial Archive contracts in 1866, and continued in that capacity for a good ten years. His work included both residences and warehouses, as well as the school for the Hebrew Education Society, and the Confederate Monument to mark a mass grave for 600 soldiers at Greenwood Cemetery. During the late-1880s and early-1890s, he served as city engineer, designing a fire station which was built several times throughout the city. As the senior member of the design firm of Harrod and Andry, he won the competition for the first three buildings of the new Uptown Campus of Tulane University, Gibson Hall and the two orange brick buildings behind it, F. Edward Hebert Hall and the Richardson Building. The sensitive dimensioning of molding profiles on the last two structures is similar in effect to the brick detail on the drainage pumping stations.

Thus, Drainage Pumping Station Nos. 1, 3, 6, and 7 are individually eligible for the National Register of Historic Places because of the excellence of their design and their integrity. They, along with Drainage Pumping Station No. 2, which was constructed during the same period and in the same style, would therefore be contributing elements to a drainage system district on the basis of architectural significance.

By contrast, Drainage Pumping Station No. 4 is not significant in terms of architectural merit. Drainage Pumping Station No. 4 is a purely utilitarian building without distinguishing architectural features. It is out of character with both the earlier architectural excellence of the original Drainage Pumping Stations and the newer buildings of the Sewerage and Water Board, which have utilized some of the materials and evocative details of the earlier buildings. Similarly, because of its lack of architectural distinction, Drainage Pumping Station No. 4 would not be a contributing element to a drainage system district on the basis of architectural significance.

The canals associated with Drainage Pumping Stations Nos. 1, 3, 4, 6, and 7 are also without architectural distinction. Furthermore, all but a portion of the Broad Street Canal have been modified within the past 50 years, so they only exhibit integrity of location. They are neither individually significant in terms of architecture, nor can they be considered contributing elements to a drainage system district on the basis of architectural significance.

Statement Of Engineering Significance (Criterion C)

The New Orleans drainage system is unique in that it operates, for the most part, below sea level and in a subtropical rainfall environment. This drainage system is made possible by the use of a series of pumping stations. Drainage Pumping Station No. 1 is the first lift station in a system of series lifts which carry drainage water from the city to a discharge area. Conduit pipes collect the water from street drains and convey it to the pump suction basin by the effect of gravity. The station lifts the water several feet and discharges it into a canal, which leads to another gravity canal, which eventually leads to the outfall stations. Drainage Pumping Station No. 5, not considered in detail in this report, discharges the dry weather flow into Bayou Bienvenue. Drainage Pumping Stations Nos. 3, 4, 6, and 7 are lift stations which discharge the drainage water during storm flow into the outfall relief canals which flow directly into Lake Pontchartrain.

Table 3 indicates the pumping equipment at Station Nos. 1, 3, 4, 6, and 7 and the years of their installation The 12' Wood pumps at Drainage Pumping Station No. 1 have been named American Engineering Landmarks. These pumps were designed by Albert Baldwin Wood, who is recognized as an important figure in the history of American engineering for his pump designs. Wood pumps are also present in Drainage Pumping Stations Nos. 3, 6, and 7, however, Station No. 4 does not include any original Wood pumps. In addition, the three vertical centrifugal pumps at Station No. 3 are notable in that they are the only examples of the original pumping technology utilized in the system during the period of its construction. These, pumps however, are no longer in use.

Table 3. Pumps in Drainage Pumping Stations Nos. 1, 3, 4, 6, and 7.

Drainage Pumping Station No.	Pump Type	Pump No.	Size	CFS	Electrical	Year Installed	Pump Mfgr.
D.P.S. 1	Wood screw	A	12'	550	25 Hz	1915	Nordberg Mfg. Co.
D.P.S. 1	Wood screw	B	12'	550	25 Hz	1915	Nordberg Mfg. Co.
D.P.S. 1	Wood screw	C	14'	1,000	25 Hz	1930	Dibert-Bancroft-Ross
D.P.S. 1	Wood screw	D	14'	1,000	25 Hz	1930	Dibert-Bancroft-Ross
D.P.S. 1	Wood screw	E	14'	1,000	25 Hz	1930	Dibert-Bancroft-Ross
D.P.S. 1	vertical	1	5'	200	25 Hz	1965	
D.P.S. 1	vertical	2	5'	200	25 Hz	1965	
D.P.S. 1	constant duty	1	3'	40	25 Hz		
D.P.S. 1	constant duty (Wood screw)	2	30"	30	25 Hz	1912/1913	
D.P.S. 3	Wood screw	A	12'	550	25 Hz	1918	Nordberg Mfg. Co.
D.P.S. 3	Wood screw	B	12'	550	25 Hz	1918	Nordberg Mfg. Co.
D.P.S. 3	Wood screw	C	14'	1,000	25 Hz	1931	Dibert-Bancroft-Ross
D.P.S. 3	Wood screw	D	14'	1,000	25 Hz	1931	Dibert-Bancroft-Ross
D.P.S. 3	Wood screw	E	14'	1,000	25 Hz	1931	Dibert-Bancroft-Ross
D.P.S. 3	r & l constant duty	1	30" x 63"	80	25 Hz	ca. 1930	
D.P.S. 3	r & l constant duty	2	30" x 63"	80	25 Hz	ca. 1930	
D.P.S. 4	vertical	1		320	60 Hz	1945-1946	
D.P.S. 4	vertical	2		320	60 Hz	1945-1946	
D.P.S. 4	screw	C		1,000	60 Hz	ca. 1960	Worthington
D.P.S. 4	screw	D		1,000	60 Hz	1960s	Allis-Chalmers
D.P.S. 4	screw	E		1,000	60 Hz	1960s	Allis-Chalmers
D.P.S. 4	constant duty [trash pump]			80	60 Hz	1963-1964	
D.P.S. 6	vertical	1		250	60 Hz	1985-1988	Patterson Pump Co.
D.P.S. 6	vertical	2		250	60 Hz	1985-1988	Patterson Pump Co.
D.P.S. 6	vertical	3		250	60 Hz	1985-1988	Patterson Pump Co.

Table 3, Continued.

Drainage Pumping Station No.	Pump Type	Pump No.	Size	CFS	Electrical	Year Installed	Pump Mfgr.
D.P.S. 6	vertical	4		250	60 Hz	1985-1988	Patterson Pump Co.
D.P.S. 6	Wood screw	A	12'	550	25 Hz	1916	Nordberg Mfg. Co.
D.P.S. 6	Wood screw	B	12'	550	25 Hz	1916	Nordberg Mfg. Co.
D.P.S. 6	Wood screw	C	14'	1,000	25 Hz	1930	Dibert-Bancroft-Ross
D.P.S. 6	Wood screw	D	14'	1,000	25 Hz	1930	Dibert-Bancroft-Ross
D.P.S. 6	Wood screw	E	14'	1,000	25 Hz	1930	Dibert-Bancroft-Ross
D.P.S. 6	Wood screw	F	14'	1,000	25 Hz	1930	Dibert-Bancroft-Ross
D.P.S. 6	screw	G	14'	1,000	60 Hz	1986-1989	Worthington
D.P.S. 6	screw	H	14'	1,050	60 Hz	1986-1989	Worthington
D.P.S. 6	screw	I	14'	1,050	60 Hz	1986-1989	Worthington
D.P.S. 6	constant duty	1	30" x 63"	90	25 Hz	1930	Hardy-Tynes Mfg. Co.
D.P.S. 6	constant duty	2	30" x 63"	90	25 Hz	1930	Hardy-Tynes Mfg. Co.
D.P.S. 7	Wood screw	A	12'	550	25 Hz	1917/1918	Nordberg Mfg. Co.
D.P.S. 7	Wood screw	C	14'	1,000	25 Hz	1931	Dibert-Bancroft-Ross
D.P.S. 7	Wood screw	D	14'	1,000	60 Hz	1931	Dibert-Bancroft-Ross
D.P.S. 7	constant duty [not in use]	[1]			25 Hz	1911	Camden Iron Works
D.P.S. 7	constant duty [trash pump]	2	30" x 63"	70	25 Hz	1931	Hardy-Tynes Mfg. Co.
D.P.S. 7	constant duty [trash pump]	1	30" x 63"	70	25 Hz	1931	Hardy-Tynes Mfg. Co.
D.P.S. 7	vertical [not in use]	4		250	25 Hz	1898-1900	E.P. Allis Co.
D.P.S. 7	vertical [not in use]	5		250	25 Hz	1898-1900	E.P. Allis Co.
D.P.S. 7	vertical [not in use]	6		250	25 Hz	1898-1900	E.P. Allis Co.

The primary consideration in determining the significance of engineering objects is the extent to which the design concept, or the methods of manufacture and application, represent a technological advancement. It is an affirmation of the engineering significance of the Wood pumps in Stations Nos. 1, 3, 6, and 7 that they are still in use and still represent technological state-of-the-art. In addition, all of the equipment at Stations Nos. 1, 3, 6, and 7 is maintained in excellent condition. Thus, the pumps possess a high degree of integrity.

Drainage Station Nos. 1, 3, 6, and 7 are each individually eligible for nomination to the National Register of Historic Places as engineering structures because they exhibit the quality of integrity, and because they both embody the distinctive characteristics and are each a good example of a particular type of engineering structure (drainage pumping station) and a period of construction (early-twentieth century). Although all of the stations contain smaller pumps that have replaced older pumps of similar size and function, the Wood pumps all retain their historic configuration and pattern of organization. Also, the Wood pumps present in the stations are significant objects in and of themselves. The National Park Service defines an object as:

> …a thing of functional, aesthetic, cultural, historical, or scientific value that may be, by nature or design, movable yet related to a specific setting or environment [National Park Service 1982:7]

The 12' Wood screw pumps and the 14' Wood screw pumps in Stations Nos. 1, 3, 6, and 7, and the one 30" Wood constant duty screw pump in Station No. 1, are all objects of historical significance because of their age and functional importance. Thus, both Stations Nos. 1, 3, 6, and 7 as engineering structures, and the Wood pumps as objects would be contributing elements to a drainage system district in terms of engineering significance.

Drainage Pumping Station No. 4 is not eligible on the basis of engineering significance. The station was constructed in 1945-1946 and has been modified to an unusual plan since original construction. The engineering features of the station are neither characteristic of post-World War II New Orleans drainage pumping stations nor are they technologically innovative. The station is not therefore considered to be good example of a particular type of engineering structure and a period of construction. It would not be a contributing element to a drainage system district in terms of engineering significance.

The canals associated with Drainage Pumping Stations Nos. 1, 3, 4, 6, and 7 also lack engineering significance. As noted previously, all but a portion of the Broad Street Canal have been modified within the past 50 years, so they only exhibit integrity of location. They are neither individually significant in terms of engineering, nor can they be considered contributing elements to a drainage system district on the basis of engineering significance.

Levels Of Significance

In terms of association, the New Orleans drainage system and Drainage Pumping Stations Nos. 1, 3, 6, and 7 are of local significance. The system was responsible for dramatic improvements to the health and living conditions in the city, and it enabled expansion of the city. Stations Nos. 1, 3, 6, and 7 are among the original components of this system.

In terms of architecture, the New Orleans drainage system and Drainage Pumping Stations Nos. 1, 3, 6, and 7 are of local significance. The original stations were all built to high architectural standards in the same style, and they form an identifiable, unified group. They were likely designed by New Orleans architect and engineer, Major B.M. Harrod.

In terms of engineering, the New Orleans drainage system and Drainage Pumping Stations Nos. 1, 3, 6, and 7 are of local significance. The great achievement of the system is that through

the use of the pumping stations, the system is able to drain a city situated primarily below sea level and that receives subtropical rainfall levels. Stations Nos. 1, 3, 6, and 7 were among the first pumping stations opened, and as such, are an integral component of this engineering achievement. Similarly, the Wood pumps within these stations are of local significance, and the 12' Wood Screw Pump at Station No. 1, which has been named a National Engineering Landmark, is of national significance because of the important technological achievement represented by this pump, the first of Wood's 12' screw pumps to be installed.