MASTER DRAINAGE PLAN
PHASE I
ST. BERNARD PARISH

GRANT NO. NA-80-AA-D-CZ014

STATE PROJECT NO. 714-03-40

JOB NO. 80307

1981

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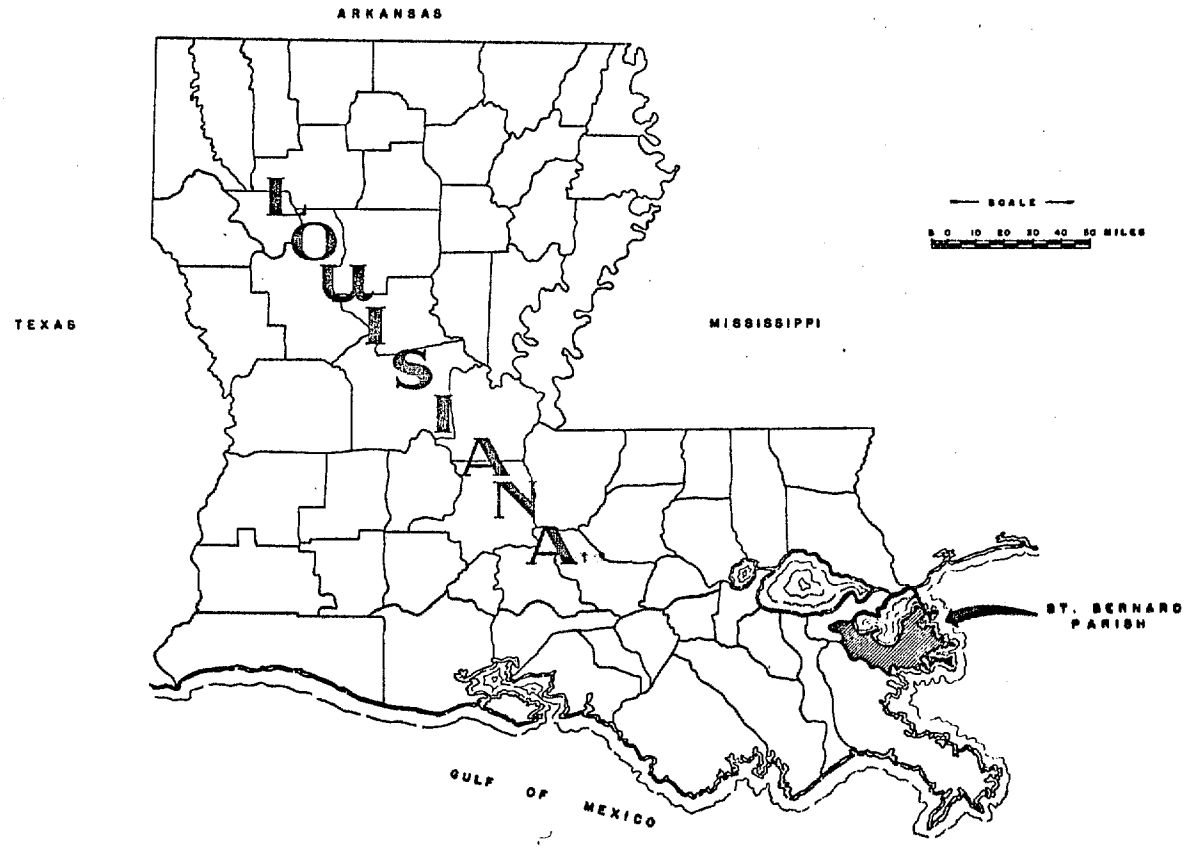
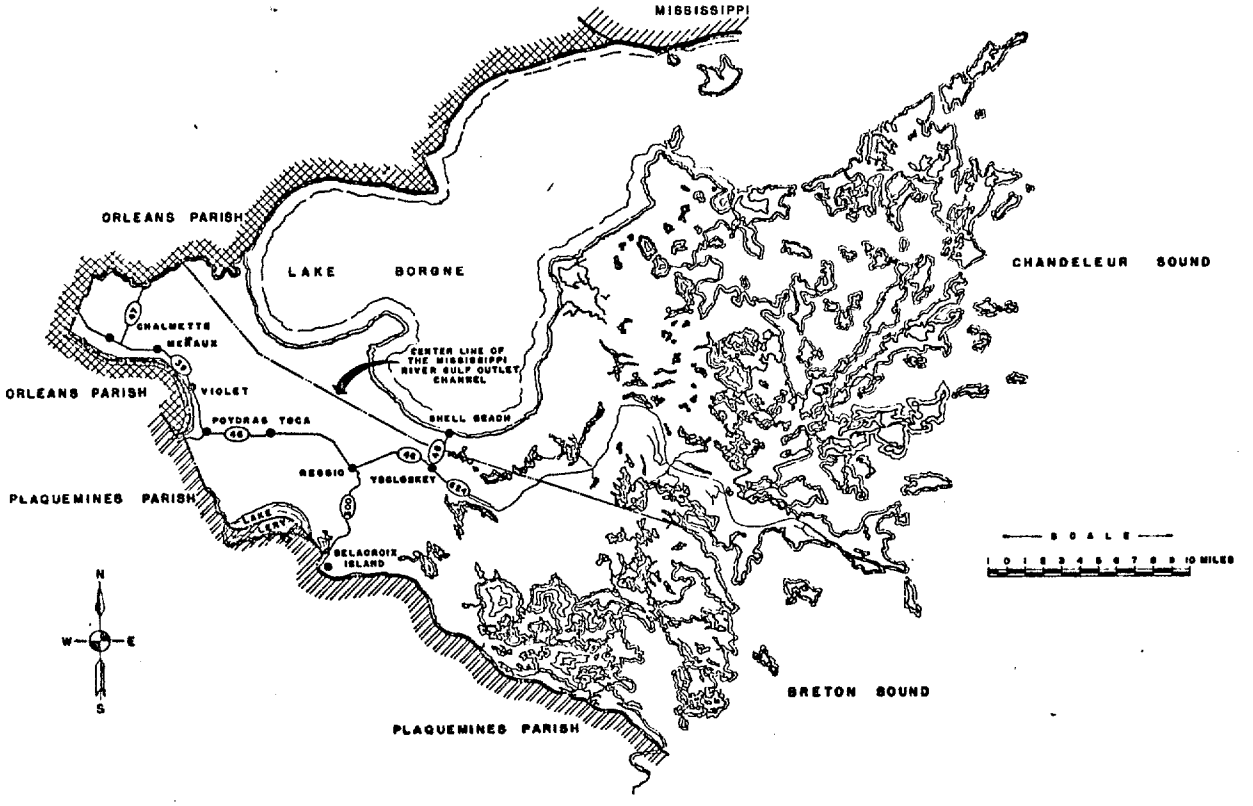
ared by:

P. Desselle & Associates

Engineers





ST. BERNARD PARISH

MASTER DRAINAGE PLAN

PHASE I

Prepared For

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ACKNOWLEDGEMENTS

Earl P. Desselle & Associates wish to express their thanks to all who have contributed to this Master Drainage Plan and in particular to the following:

U. S. Corps of Engineers
La. Department of Highways
La. Department of Public Works
Lake Bornge Levee Board
St. Bernard Parish Planning Commission
St. Bernard Parish Police Jury
St. Bernard Parish Engineer
Eugene Estopinal & Associates Engineers
J. J. Krebs and Sons Engineers
Foley Judell Beck Bewley and Martin Bond Attorneys
Reality Construction Company
Lake Contractors
Boh Bros. Construction Company
A. J. Englande, Engineer

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FORWARD

Man is shaped by the dynamic interplay of natural elements and human culture. He is both nourished and threatened by the environment. He, like all other creatures, must adopt to the ever-changing conditions of his environment.

The need for Master Improvements Plans, such as the Costal Energy Impact Program (CEIP) grows from a need to accommodate forces of change in human experience. The government sector of St. Bernard Parish must plan in order to gain some degree of security within changing parish processess. While man can control some changes, other he cannot. For example, by alotting for the Master Drainage Plan and constructing accordingly, he can to some degree alter his environment. By conserving and preserving things of value, he can seek to plan for forces of changes. On the other hand, man is powerless against changes from tornodos, hurricanes and other "Act of God" which confronts the St. Bernard Parish area. He can, however, anticipate and lessen the adverse effects of these devistations by evacuation in "known" deficient drainage areas. He can also attempt to implement stable means of drainage in areas which can be suitable altered and improved. Proper governmental

management is a conscious effort to understand, direct, and prepare for changes in the environment. As such, some form of this preparation is essential for survival.

Public Government decisions are made each day which ultimately enhance or detract from the quality of like in each parish. People do not intentionally lower the quality of life in their parish--quite the contrary. Loss of valuable natural and cultural features is usually an unanticipated by-product of activities leading to the accomplishment of other preceived needs. One function of drainage management then is to point out existing and potential conflicts between activities in an attempt to resolve them.

The present development pattern within St. Bernard Parish has exhibited an over-all lack of disposition and provision for an adaquate drainage system. This is more the result of the history, topography, climate and population growth rather than an oversight in planning. All of these things must be placed within the context of the whole. Further problems will be incurred, however, unless remedial and positive action is taken. The establishment and funding of this Master Drainage Plan is, indeed, an absolute, assertive step in the proper direction. It is also consistent with the regional comphrehensive planning process. Any action undertaken should be based on the major drainage plans contained herein.

Due to the above mentioned factors especially the intense, rapid population growth coupled with the ever increasing demand for more developed land in the St. Bernard Parish area, the need for more proficient drainage is apparent. The expansion of urbanized life styles must be accompanied by the expanding of primary services of these services is the implementation of adequate storm water drainage.

The following Master Drainage Plan designated "COSTAL ENERGY IMPACT PROGRAM" will review previous and existing problems, as well as, generate feasible solutions for these problems.

Often the solution for an existing problem is never procured because studies become too engrossed and entangled in the problem itself; rather that the solution to the problem.

This report contains the results of the extensive, initial Phase I area drainage plans plus statistical information on occurpancy, socio-economic, demographic, topographic, hydrological resource, and population data. The subject report and statistical information was assembled through the utilization of engineering, drafting, clerical, supervisional, and research procedures.

Drainage management requires an understanding of social and natual processes. Action, based on ideas, or concepts, about said drainage problems can lead to changes in environmental and physical features. These concepts are the theoretical base for planning, design, impact assessment, and in fact all such existing experience.

I. HISTORY

Little is known about the early history of what is now St. Bernard Parish. Evidence does exists, however, that the territory was inhabited by groups of Muskhogean Indians, of which the tribe best remembered in American history were the Choctaw who lived north of Lake Pontchartrain.

The recorded history of St. Bernard Parish commenced when De Bienville transferred the seat of government from Mobile to the site of the City of New Orleans. Until 1762, the Parish was governed by the French. During this period many names such as Feret, Bienvenue, De la Ronde, Lacoste, Chalmette, and Villere' became associated with the area and contributed greatly to the history of Louisiana. In 1762, Spain ceded France's claim to Louisiana and governed until 1803. At this time two planters in the Parish, Mendes and Solis were successfully cultivating sugar cane. Later, another parish planter, Mr. Coiron, successfully cultivated ribbon cane. On December 20, 1803, the Territory of Louisiana was officially transferred to the United States.

Orleans was subdivied in 1807 by an act dated March 31. The boundaries followed largely those which had been used by the Spanish in dividing the area into "ecclesiastical" parishes. Thus St. Bernard received its name and general boundaries in 1807; however, boundary changes were made in 1809, 1811, 1817, 1842 and 1875.

Although it is referred to as the Battle of New Orleans almost the total altercation was conducted in St. Bernard Parish. On December 14, 1814, five small American gunboats protecting the water approaches to New Orleans were captured and 2,000 British troops were landed at Fisherman's Village. On December 23, the British troops camped at the Villeres' Lacoste and De la Ronde Plantations. Through a stroke of luck Major Villers escaped from the British forces and was able to warn Andrew Jackson. Jackson attacked immediately, but because of fog and darkness withdrew to the Chalmette and McCarthy Plantations where he placed his defenses behind the Rodriguez Canal. After several futile assults, the British launched a full frontal attach against the American position early on the morning of January 8, 1815. After two and one half hour the British had been decisively defeated with a total loss of 2,000 men, whereas the American had suffered 13 killed, 39 wounded and 19 missing. By the end of January the last of the British troops had dissipated.

On April 12, 1861, the first gun of the Civil War was fired at Fort Sumper by order of Major General P. G. T. Beauregard of St. Bernard Parish. This shot signaled the beginning of the end of the proto-type plantation economy which had endured and continued to be dominant in St. Bernard Parish. The transformation was gradual: from plantations to general small farms, to predominantly truck farms. Fishing and trapping became a significant force in the Parish's economy and remains so today. Unquestionably, St. Bernard was predominantly an agricultural parish and continued as such until approximately 1920 when the first indications began to appear that new irrepressible forces were about to be exerted on the economy of the Parish.

II. THE CULTURAL SETTING

Rich resources and an important water transportation network have made St. Bernard a desirable place to live. Long before European settlement, Indians populations thrived here. Because of the unique physical features of the costal zone, man has been forced to adapt certain aspects of his lifestyle to the structure of the land. To some extent, he also has had to modify the land in order to live here. In early times, this entailed clearing and draining land and building levees. While early settlers may not have understood the ecological significance of the swamps and marshes, they knew them as valuable sources of fish, game, and timber. The people of St. Bernard developed distinctive cultural patterns based in part on their heritage from other parts of the world and in part on their relationship to the new environment.

Modern times marked rapid changes in the land and people. In addition to earlier interest in agriculture and wildlife, modern man developed the need for large quantities of subsurface materials, such as ground water, petroleum, gas, and salt. He began to use the area for its industrial and manufacturing potential. Farming has been greatly industrialized, requiring less land and fewer people. As a result, many people shifted from agriculture to other means of livelihood. Modern development necessitated extensive modification of the landscape, including the building of large urban areas, large-scale extraction of water, and construction of sewerage disposal plants, pipelines, navigation canals, and port

facilities. Earlier physical constraints on development have had to be solved in order to provide for the increased population. Urban areas are changing so rapidly that much of their original character is being forfeited to the needs and lifestyles of modern urban St. Bernard.

Suburban and rual areas face similar conditions. In addition to dwindling opportunities for small-scale economic activity and the social impacts of sprawling urbanization, modification of the landscape to meet the needs of modern agribusiness has changed the patterns of rural living. Modification of the environment to accommodate expanding suburbs has increased the potential for flooding, subsidence, and saltwater intrusion into valuable drinking supplies. These changes have brought unexpected environmental side effects which do not always work to the advantage of human population.

The cultural heritage and potential of St. Bernard Parish is as rich as its physical resources-it is also as vulunerable. The relationship between man and land which began in pre-historic times is even more important today with our expanded population needs. History reveals that some uses of the lands are incompatible with others or with the environmental setting. This does not necessarily mean that the needs and objectives of those uses are incompatible, but that wise decisions are required to make them a productive and compatible part of the environment. Some changes are irreversible. Planning can help people to realize the physical and cultural choices they have and the way in which they will be affected by those

choices. We are obliged to try to make the choices which will insure the continuation and creative development of our culture in harmony with the environment.

III. LOCATION AND GENERAL DESCRIPTION

St. Bernard Parish is located in southeastern Louisiana between 89 and 90 degrees west longitude and 29 and 30 degrees north latitude. The Parish is east of the City of New Orleans near the enter of the northern border of the Gulf of Mexico. Approximately two-thirds of the Parish is surrounded by water.

Its bordered on the north of Orleans Parish and Lake Borgne, on the east by the Chandeleur Sound, on the south by Breton Sound, and on the west by Plaquemines Parish and the Mississippi River. The Parish is bisected the Mississippi River Gulf Outlet which provides a short route between the Port of New Orleans on the River and the Gulf of Mexico.

St. Bernard is a part of the New Orleans, Louisiana Standard Metropolitan Statistical Area (SMSA) which also includes the parishes of Jefferson, Orleans, and St. Tammany.

Located in the Mississippi Alluvial Plan, St. Bernard ranges in altitude from approximately five feet below sea level to about 15 feet above and forms the crest of the artifical levees along the Mississippi River. The alluvial plain, composed of marshy delta land, flat brush-covered plains, innumerable bayous, canals and ditches, was built up of thousand of years through a continuous process of inundations and silt piling.

The highest elevations along the River slope off nearing sea level between one and two miles from the river's levees. Other areas slightly above sea level are located along the various bayous and canals especially Bayous Bienevenue, Terre Aux Boeufs, Le Loutre, and their tributaties. The plus elevations bordering these streams continue narrowing as they near the larger bodies of water of Breton Sound, Mississippi Sound, Chandeleur Sound and Lake Borgne.

Phase 1

Phase 1 of the study is inclusive of St. Bernard Parish and extends along the left bank of the Mississippi River downstream of New Orleans from the Orleans Parish line to Paris Road, a distance of 2.8 miles. It extends from the Mississippi River back to the Florida Walk Canal and to the Forty Arpent Canal, both of which are parallel to the river. The natural slope of the land is away from the river, with elevations ranging from 10 feet above sea level to as low as 5 feet below sea level at the above named canal. The canals were formed as borrow pits for a continuous levee to protect the subject area from flooding by tidal stages.

Located in the western area, due to the higher elevation formed by the natural levees. Although the majority of St. Bernard Parish is curiously near or insubstantially below mean sea level, the groung elevation at the natural levees is approximately 6½ to 7½ feet above mean sea level.

IV. CLIMATE

Atomspheric and climatic factors are major forces in the St. Bernard Parish Drainage System. The Parish is influenced by the warm, moist, gulf maritime air mass and by the cool, dry contiental atmosphere. The interplay between these two systems as they fluctuate back and forth acroos the parish creates specific weather conditions. Rainfall, wind, and solar radiation combine to provide a humid, subtropical climate of long summers and short winters. The average daily temperature based on a 45 year period of record is 71°F. The average monthly temperature ranges from 52.9°F in January, to 86.4°F in August.

Solar radiation throughtout the year helps to account for the high biologic productivity of the marshes. The growing season is long and the days of killing frost. are few.

The outstanding drainage area of urbanized St. Bernard Parish is located in these marsh land areas. It is, therefore, an absolute requirement that this entire marshland area be protected by levees. Although these levees serve a specific purpose, they also contribute greatly to the flooding of urbanized areas. Percipitation is high and well distributed throughtout the year. The annual average being 62.42 inches with an average surface runoff of approximately 21.04 inches.

There are no definite rainy seasons; however, the highest normal monthly percipitation occurs in July and August, with the lowest normal monthly precipitation occurring in October and November.

Rainfall coupled with high solar radiation, provides necessary conditions for rapid plant growth. Nevertheless, in late summer and early fall, there is often a freshwater deficit in the Parish water balance. Evaporation, transpiration, and soil moisture recharge exceed precipitation during these times. As a result, salinity levels increase, and the water table is lowered. The impoundment of rainfall surpluses at other times of the year for gradual release and injection during drier months would partly offset the adverse effects of the water deficit.

Wind is an important factor in the control of drainage water levels; in many areas, it is more important than tides. Wind from the south projects water far into the bays, bayous, and lakes. Winds from the north, on the other hand, may depress water levels in marsh area.

The greatest atmospheric hazard in regards to drainage planning is a hurricane. Hurricanes strike the Louisiana coast on the average of once every 2½ years. Damage to natural and cultural drainage systems is often severe as high winds, tidal surge, and flooding devastate the low-lying area. During hurricanes a great deal of modification may take place. Barrier islands are breached, marshes are eroded, and in our saucer-like levee system the possibility of flooding becomes an almost certainty.

V. POPULATION - - TREND OF GROWTH

The most important asset of any region whether it be on a parish, state, national, or world level, is its people. Since populace attitude is so deeply weeded to the quality of life and human aspirations, it must be the product of the people of the area. Whatever a region was, is, and will be is determined by its people. Public government and management loses it meaning and effectiveness when totally programmed from outside the area in question, The said effectiveness is also lessened to a degree when formulation for implementing plans for improvements are taken from institutionalized groups not specifically from within the afflicted aggreation. The people from each section must identify the ends they seek, the things they value, and the intrinsic capabilities of that precise area.

The 1970 Census reported a total land area in St. Bernard of 514 square miles. With a 1970 population of 51,185, the Parish had 99.6 persons per square mile. A special census in 1976 showed an estimated population in St. Bernard of 61,895 persons, a density of 120.4 persons per square mile. Despite the low density of the population, particularly compared to neighboring Orleans Parish, with 3,012.5 persons per square mile, 91% of the population of St. Bernard was classified as urban at the time of the 1970 Census. Virtually all of the 1970 to 1976 increase was in the urbanized area of the Parish.

The total area of the Parish, including water and wet lands is considerably larger than the 514 square miles reported in the Census. The La. State Planning Office reports total area of St. Bernard as 1,525,201 acres or 2,386 square miles. This report was based upon a U.S. Geological Survey conducted in 1972.

There are no incorporated areas within the Parish, and the 1970 Census did not list any unincorporporated places in St. Bernard under the heading "All Incorporated Places Unincorporated Places of 1,000 or more" (Census Document PC(1)-A20). The following places in St. Bernard are shown on a U. S. Army Corps of Engineers map dated March 1975:

Arabi
Chalmette (The Parish Seat)
Meraux
Violet
St. Bernard
Toca
Reggio
Verret
Delacroix
Yscloskey
Hopedale

At the time of the first official census of the United States in 1810, St. Bernard Parish had an estimated population of 1,020. Until 1820, the rate of growth had surpassed the growth rate of the State. After 1820 the rate began to taper off and the Parish continued to be a declining percentage of the State population until 1930. The major reason for the decline was that most of the available land in St. Bernard was developed relatively early in the States' history, thus being agriculturally oriented the population

became stable. In a period spanning 1820 to 1930, the majority of the growth of Louisiana occurred in the northern and western sectors of the state.

Also during this same period 1820 to 1930, St. Bernard Parish actually encountered a population decrease occurred during three different decades. The first decrease occurred between 1830 and 1840 when several major storms and various agricultural readjustments forced migration to other areas. The second declination transpired between 1860 and 1870--a direct result of the Civil War. The war between the States and subsequent Reconstruction Period totally devasted the economy and curtailed its recovery. The result of this monumental set back was a 12.8% loss in population. The third decade of populace dwindling was in the time span between 1910 and 1920. The depression of 1912 forced the attraction of young persons of reproductive age into the armed services. This younger generation was also attracted to larger, more substantial communities by the enhancing prospect of good jobs and extended employment through an expanded national industrial economy.

One interesting focus point is the stability of population character which endured between 1860 and 1920. This 60 year span of time displayed the stability of the basic economy of St. Bernard Parish being based on agriculature, fishing, forestry, and trapping. In the period of time which was inclusive of the years of 1860 to 1920 the populace grew from 4,076 to 4,968. Simple mathematics shows that during this 60 year period the net gain of the

population was 892 persons or an average of about 15 person increase per year.

By 1930, the devistation effects of the depression had started to be realized. The year 1940 and World War II ignited an increasing rate of transition in the national economy from an agricultural permis to an industrial base. As the trend perpetuated, the parish of St. Bernard continued to play an ever increasing role in this transition, both as a residential section and as as industrial area for this urban expansion. This is reflected by an assessing 52.3% increase which occurred bewteen 1940 and 1950 . The largest increase was the 190.2% increase between 1950 and 1960 when energy exploration and production came into promience.

The perpetuation of population trends from the year 1960 through a projected population of the year 2000 is as follows:

ST. BERNARD PARISH
POPULATION PROJECTION THROUGH THE YEAR 2000

YEAR	POPULATION
2000	98,267
1990	85,438
1980	63,000
1976	60,628
1970	51,185
1960	32,186
1950	11,987

VI. TRANSPORTATION

Intraregional

Three state highway serve St. Bernard Parish. Highway 46 (St. Bernard Hwy.) and Highway 39 (Judge Perez Drive), are the principal east-west routes through the urbanized area. The north-south artery is Highway 47 (Paris Road), which connects at its southern terminus with the Chalmette Ferry across the Mississippi River into Orleans Parish, and to the north with the Interstate Highway 10 in Eastern New Orleans. Both St. Bernard Highway and Judge Perez Drive provide access to the New Orleans Central Business District (CBD).

Public transit in St. Bernard Parish is provided by St. Bernard Bus Company, with schedule operations on St. Bernard Highway and Judge Perez Drive, and express service to the Central Business District. Dial-a-bus services is available for outlying parts of the Parish.

Interregional

The New Orleans region offers an intergrated air, rail, highway and waterway network to service people and industry. New Orleans International Airport, located in Jefferson Parish, about 25 miles from the urbanized area of St. Bernard, is the fourth largest airport in the South, handling more than 4.4 million passengers and 92 millions pounds of cargo annually. There are 16 scheduled airlines operating from the airport, with service to major U.S. cities and parts of Central and South America, and Europe.

Interstate Highway 10, with access from St. Bernard via Paris Road or through the CBD, is a major east-west route direct providing access to interstate 55 and 59.

Eight major rail systems operating from New Orleans make direct connections with cities in a number of states. The movement of goods and materials to and from New Orleans via rail is handled expeditiously through the service rendered by an intracity switching line, the New Orleans Public Belt Railroad. This is a city-owned terminal switching railroad that connects to each of the eight truck lines.

A large number of motor freight lines are available to industry, including both interstate and intrastate common carriers. There are approximately ninety schedule steamship lines, both foreign, and domestic, with almost 5500 ship arrivals annually, operating from the Port of New Orleans to all principal ports of the world. Water routes include the Mississippi, the Gulf Intracostal Waterway and the Mississippi River-Gulf Outlet.

VII. INDUSTRY: EMPLOYMENT OPPORTUNITY IN ST. BERNARD PARISH

St. Bernard Parish has become one of Louisiana's leading industrial Parishes. The Kaiser Aluminum and Chemical Corporation's Chalmette reduction plant is one of the giants of American industry. The largest such plant in the country, it has a capacity of about 528,000,000 pounds primary aluminum annually, or more than 1½ times the amount the entire country produced before World War II. The plant, which is located on a 280-acre tract of land, includes some 87 buildings. Kaiser has a payroll of about $85,000,000.00 annually and regualr employment amounts to approximately 2830 persons.

Oil and gas installations are important industries in St. Bernard. Drilling and exploration workers, plus other energy related employees number between 17,300 and 17,500 persons in the Standard Metropolitan Statistical Area. A tremendous number of drill holes and stitch-like pipelines form a reticulation or network throughtout St. Bernard Parish.

Located in the Parish are the refinieries of Tenneco Oil Company and the Murphy Corporation. Tenneco's Chalmette Plant employs 615 persons and has a reduction capacity of 125,000 barrels per day. The plant of the Murphy Corporation is situated in Meraux and employs from 245 to 260 persons. It has a daily reduction capacity of 25,000 barrels per day fluid from the catalytic cracking

unit and 8,000 barrels perday alkylation. Both of these plants have their own shipping facilities on the Mississippi River.

In addition to these refineries, there are three distribution plants in the Parish. Chalmette is the site of Mobil Oil Company's Marketing terminal which supplies all the stations in the metropolitan New Orleans Area. Also located at Chalmette is the Humble Oil Company Plant which employs about 100 person in its packaging and distribution operations as well as the servicing and bunkering of vessels at the plant's dock facilities. Victory Oil Company's Arabi Plant distributes petroleum products throught Louisiana and Mississippi. It employs 50 persons.

Southern Natural Gas Company has an installation at Toca which includes a gas processing and cycling plant, a compressor station and district pipeline maintenance headquarters. Employment at the Toca installation is approximately 60 to 65 persons. One of the Parish's newest plants is the gas processing plant of Shell Oil Company. Located in Yscloskey, the plant was constructed at a cost of approximately $6,000,000.00 and employs about 70 to 80 persons. It was completed during 1962. The Shell Oil Company also has a process plant located in Toca which employs 25 persons.

Another large plant located in St. Bernard Parish is the Amstar Corporation. Formally known as the American Sugar Refinery, Amstar produces and distributes the world reknown Domino brand sugar. The plant has a melt capacity of over 6,000,000 pounds perday and employs between 925 and 950 employees. Started in 1909, Amstar is the largest

sugar refinery in the United States.

St. Bernard's other industries are numerous and varied. They include manufacturers of soap, machinery, wood products, tools, food processors and producers of dairy products. In the near future the Parish expects additional industries to take advantage of its nearness to the City of New Orleans, its ample land area suitable for industrial installations, its miles of available river frontage and its abundant oil, natural gas and water resources. During the years 1957-1961 capital investments of new and expanding industries amounted to a total of $50,204,148.00 in St. Bernard Parish.

In addition to industry, St. Bernard's economy includes numerous business and service firms. According to the Chamber of Commerce for the New Orleans Metropolitan Area (which includes St. Bernard Parish) retail sales in St. Bernard Parish have shown marked increases over the years as indicated by the following figures:

YEAR	RETAIL SALES
1940	$ 677,000.00
1950	3,020,000.00
1958	12,131,000.00
1959	13,860,000.00
1960	14,114,000.00
1961	13,585,000.00
1962	18,961,000.00
1970	39,136,000.00
1971	42,663,000.00
1972	44,927,000.00
1973	96,380,000.00
1974	120,088,000.00
1975	214,788,000.00
1976	138,939,000.00
1977	218,271,000.00
1978	167,244,000.00
1979	219.863.000.00

In short - retail sales of $677,000.00 in 1940 to a staggering $219,863,000.00 in 1979.

GRAND RECAPITULATION OF THE ASSESSMENT ROLL FOR THE PARISH OF ST. BERNARD

The assessed valuation of St. Bernard Parish has increased in previous years accordingly depicted by the following table which sets forth assessed valuation in the years:

Year	Assessed Valuation
1979	$122,015,244.00
1978	155,126,841.00
1977	91,269,204.00
1976	87,708,910.00
1975	85,988,042.00
1974	82,813,101.00
1973	80,375,016.00
1972	78,009,232.00
1971	73,414,665.00
1970	70,718,765.00
1969	69,341,750.00
1968	67,309,836.00
1967	66,352,778.00
1966	62,156,962.00
1965	60,056,085.00
1964	57,303,825.00
1963	42,677,966.00
1962	40,321,107.00
1961	39,515,474.00
1960	38,302.895.00
1959	35,683,248.00
1958	35,064,548.00
1957	32,794,118.00
1956	29,258,401.00
1955	26,961,416.00
1954	25,466,670.00
1953	22,713,220.00
1952	21,581,094.00
1951	19,178,467.00
1950	17,901,916.00
1949	17,635,408.00
1948	16,365,185.00

VIII. HYDROLOGIC FEATURES

As water moves around and across the earth's surface, it is affected by a number of processes, including evaporation, precipitation, runoff, collection by canals and bayous, and distribution. Collectively, these and other processes form the hydrologic cycle -- a cycle which moves water from land, river, and gulf into the atmosphere and back again. Hydrology is of great significance to the drainage development of St. Bernard.

Water passing through St. Bernard makes a transition from water collectors to water distributors. The Mississippi River is the most important of these distributors. As sediment - laden waters reach the Gulf of Mexico, they slow down and deposit their sediment load. The delta which forms at the mouth of the river or in embayments builds outward and upward in the Gulf. The river, under natural conditions, shifts its course over many years to follow shorter and steeper courses to the coast.

The rivers and bayous of St. Bernard Parish in their natural state overflow periodically, usually in the spring. This discharge introduces sediment and freshwater into bayous between the distributaries. In addition, to river flooding, runoff from rainfall may cause flooding within the bayous. There is a gradual movement of water from north to south through the swamps and from fresh marshes to the intermediate and brackish water marshes. The water increase in salinity as they near the Gulf. The flucatuating

exchange between gulf and river waters causes variation in salinity, nutrient flow, acidity, temperature, and oxygen content of the water. These factors, in turn, define plant and animal habitats and determine the biological productivity of the St. Bernard area.

The waters of the Gulf of Mexico are an important determinant of estuarine conditions and the distribution of sediments. Sea waters carry juvenile marine organisms and sediments into the estuary. Sediments various outlets are moved by wave and current action. The sediments of abandoned areas are gradually eroded and redeposited at other locations.

Besides the surface water activity, ground water availability and quality need to be considered. Developed areas require fresh water for most urban or industrial uses. The subsurface aquifers are often brackish or have high mineral content. Consequently, most areas in St. Bernard must rely on surface waters for drinking, cooling, and irrigation.

The potential impact on hydrologic systems is dominated by two concerns: change in hydrologic processes and change in water quality. Hydrologic processes may be altered by dredging pipelines and navigation canals, diking, draining, and the construction of locks. Water quality may be altered by thermal, industrial, and agricultural pollution. Such modifications may change the supply or quality of fresh water in marsh areas, causing impacts on vegetation, wildlife, and man which may be severely felt.

Given the dependence of all other features of the ecosystem upon water, hydrology must be viewed as a prime determinant of a drainage management system policy. While water has some capacity for the absorption and purification of wastes, trends show that this capacity is limited. In some cases, the damage done by inferior water quality or changes in fresh-water supply is irreversible.

The impacts described above indicate that there are levels of use which would apply to the different water bodies. Different types of water areas are capable of different types of modification.

People of the parish can identify those water bodies which can withstand different types and levels of activity as given below.

1. Low-level Activity -- areas of high sensitivity, such as drinking supplies, wildlife management areas, fisheries nursery areas.
2. Moderate-Level Activity -- outdoor recation, camps.
3. High-Level Activity -- navigation, disposal of treated waste, and runoff from developed areas.

While some bodies of water can adjust to change, all of them have upper limits to that ability.

IX. HABITAT OF WILDLIFE AND FISHERIES

Animals and fishes are extremely dynamic components of the natural environment. They are able to move over the range of their territory and to make limited adjustments to changes in habit. They, like plants, however, reside in areas whose characteristics are best suited to their needs. Thus, we may speak of wildlife associations in much the same way as we do of plant associations. The various wildlife populations fluctuate in accordance with the supply of food, number of predators, and environmental conditions. The food web is a phrase describing how animals eat plants and are in turn eaten by larger animals. Dead organisms are consumed by bacteria and animals which feed on carrion. A wildlife community which is functioning in a healthy manner displays the following characteristics:

1. High species diversity.
2. Diversity of functions within the community.
3. Population structure in blanace with food and shelter conditions.
4. A complex food web.

These characteristics enable the community to withstand some environmental stress and to avoid overtaxing available food and resource supplies. The following habitats are key features:

1. Gulf offshore
2. Beach spawning areas
3. Tidal passes

4. Intertidal marshes

5. Swamp

6. Natural levee ridges

Wildlife may be affected in many ways because of its dependence on all other components of the environment. Species can alter their surroundings in adjustment to external modification only to a limited extent. Any investigation of environmental impacts should include consideration of the following ways in which wildlife may be affected:

1. Changes in the support structure of water, soil, and air.
2. Changes in availability or quality of habitat.
3. Changes in the food chain or the supply of food.
4. Changes in population structure; destruction of newborns, etc.

These changes can result in the extinction or serious destruction of wildlife species. On the other hand, they may result in the growth of a species to the extent that the habitat can no longer support the new population. Habitats are often overtaxed under these circumstances, transforming a porductive habitat into a wasteland. Wildlife populations are more often adversely affected by habitat destruction than by temporary fluctuations in food supply or even environmental stress, such as a flood or hurricane.

Wildlife species are an important component of the biologic and economic balance of St. Bernard Parish. For this reason, it is important to recognize the condition of the wildlife species and habitats in the parish. The following categories

indicate the range of concern for the sensitivity of wildlife species:

1. Endangered species require maximum protection.
2. Critical species fill a particular economic or food need and require special management.
3. Important species in the food web are needed to maintain ecological balance.
4. Unhealthy and pest species require special management practices to avoid human illness and control over-population.

X. POTENTIALS FOR ECONOMIC DEVELOPMENT

Parts of the following supplemental information is excerpted from a report entitled "An Overall Economic Development Program."

Historically, St. Bernard Parish, Louisiana has undergone the transformation from a rural agricultural community to a urban industrial and commercial center; however, the staples of the economy have remained fairly constant. Due to the physical features of the region (1,290,000 acres of water - 570,000 acres of land), St. Bernard Parish can boast of one of the most productive estuaries in the world. Thus, it is apparent that the economy would be based on the sealife and fur-bearing wildlife of the area. In addition to the bountiful harvest of seafood and fur-bearing animals, the Parish can take advantage of the recreational and sporting potential that the sea offers.

The mineral industry in St. Bernard Parish offers various opportunities for expansion and further development. Though St. Bernard Parish is not as rich as other areas of Louisiana ($63.8 million in 1973); it does not offer an attractive base for secondary operations. Primarily, the versatile transportation potential (rail, water, and surface) and an experienced labor force.

To date, St. Bernard Parish has experienced a significant population growth. The population figure from the 1970 census was 51,185 while 61,895 persons were recorded as of a 1976 Special Census; however the capacity for planned growth has not been approached.

As a result of access provided by new and improved transportation corridors, the Parish now enjoys the potential of a limited amount of prime industrial and commercial properites. Unlike Jefferson Parish, the post-war urban sprawl has not affected St. Bernard; the community remains to be fully developed.

In its role as a bedroom community of a central city (New Orleans: 1960 Census - 627,525 -- 1970 Census - 593,471) St. Bernard Parish has manged to derive substantial benefit from New Orleans while retaining its own identity. Proximity to a large urban center offers a wide range of benefits; increased commercial activity, sophisticated social service delivery, art and culture, education opportunities, etc.. St. Bernard Parish is in the enviable situation of enjoying the opportunities afforded to a large urban city while at the same time retaining the presence and manageability of a small town.

An analysis of economic development must pronounce the community's potential as an entity in itself as well as its position in the region. St. Bernard Parish is particularly interesting in that its economic development has been spurred on by its proximity to New Orleans, though it exhibits unique culture and economic activities not shared with Orleans Parish, ie., rural spanish speaking native communities and fishing/trapping villages 60-70 miles from New Orleans.

On the regional level, St. Bernard Parish benefits from the diverse transportation systems servicing the New Orleans SMSA. That system includes a major air facility (Moisant International Airport) and a secondary facility (Lakefront Airport), integrated rail and water service as well as developed surface routes. In addition to the physical advantages of the region, New Orleans boasts of a rich historical background prompting a lucrative tourist industry. Though St. Bernard Parish has not taken full advantage of its own rich heritage, it has opened the door for development.

St. Bernard Parish has developed its natural resources to the extent local enterprises have the capability. Specifically, the seafood and fur industry has been open to development, however they remain available as a potential resource.

The oil and gas industry has established an infrastructure for the economic transportation of goods that could be taken advantage of if properly managed. The influs of new industry would further establish a development strategy.

In conclusion, St. Bernard Parish is approaching economic development as a means of enhancing the present economic base while attracting new interest. This Parish offers a great deal of raw resources to be refined, while inducing new activity through an attractive physical environment.

REMARKS:

Comprehensive and project planning are both a part of the drainage consideration. Comprehensive planning is used to study overall interrelationships of all types of land use, underground circulation, natural systems, and project impacts. It is the envelope into which project plans should fit.

Project planning considers various parts of the problem. It is used for specific proposals, including canals, levees, layout development, etc. Project planning is most beneficial when it fits into the framework of comprehensive planning.

Objective data is independent of cultural values and input. This includes the measured data of various forms, processes, and materials, as well as the technologies available for design and engineering. Physical opportunities and constraints upon use of situations may be determined by this quantitative information. All decisions should be based upon a thorough consideration of both subjective values, objective imformation, and any conflects which may exist between the two.

Each of the steps in the process have been introduced and discussed. With the Phase I as a base map, parish parameters are inventoried and evaluated, units are defined, goals for implementation of the units are developed, and techniques for implementing goals are outlined. The process is continued in a methodology for evaluating impacts caused by the development of a composity drainage facility. Taken together, the phases of this report illustrate a sound approach for making drainage decisions within St. Bernard Parish.

SECTION II

LOCATION AND DESCRIPTION

The Phase I Drainage Area comprises an area of approximately 3788 acres in St. Bernard Parish. It is bounded by the Bank of the Mississippi River, the St. Bernard - Orleans Parish Line, the Florida Walk Canal, and Paris Road. The natural slope of the land is away from the river, with elevations ranging from 10 feet above sea level to as low as 5 feet below sea level at the back levee.

STATE OF DEVELOPMENT:

Approximately one fourth of the area lies between State Highway No. 46 (St. Bernard Highway) and the River levee. This section occupies the highest land and is being developed predominately for industrial purposes. Nearly one half of the district has been developed as a residental area. Only ten percent of the land is undeveloped.

LAND USE STATISTICS

The breakdown of this acreage according to the Parish Zoning Ordinance is as follows:

Area	Acres
Light Industrial	12
Heavy Industrial	1,087
Neighborhood Commercial	176
General Commercial	386

Single Family Dwellings	1,450
Two Family	546
Multiple Family Dwellings	131
	3,788

There is approximately 423 acres of undeveloped land. These acres are 143 located in the General Commercial Area and 280 located in the Single Family Area.

There is approximately 159 acres of parks and 77 acres of playgrounds within the Phase I Drainage Area. 240 acres are located in the Heavy Industrial Area. One acre is located in the Neighborhood Commercial Area and 3 acres are located in the Two Family Dwelling Area. Located in the Single Family Dwelling Area there are 28 acres.

Below is a summary of the approximate land use acreage:

Light Industrial	12
Heavy Industrial	883
Neighborhood Commerical	175
Single Family Dwellings	1112
Two Family Dwellings	543
Multiple Family Dwellings	131
Parks	159
Undeveloped Land	423
Playgrounds	77
	3788

Within the 3,788 acres there is approximately 578 acres of streets and highways.

EXISTING DRAINAGE CONDITION

This area is drained by a total of six canal leading to the Florida Walk Canal. Five of these canals extend to the Highway No. 46 and drain the Highway and the River Levee, one extends to Highway No. 39 (Judge Perez Drive). Runoff flows from five canals by gravity to the Florida Walk Canal and is pumped over the levee by two pumping stations with the rated capacity of 700,000 G.P.M., or approximately 10 inches runoff in a 24 hour period, with Pumping Station No. 2 out the rated capacity is 500,000 G.P.M. or approximately 7 inches runoff in a 24 hour period, and are located on the Back Levee. Runoff flows from one canal is by gravity to the New Orleans Drainage system.

RAINFALL:

According to the records of the New Orleans Sewerage and Water Board the two most recent rainstorms recorded, which caused flooding occured on May 3, 1978 and April 13, 1980. The May 3, 1978 storm had 10.95 inches of rainfall, and the April 13, 1980 had 9.71 inches of rainfall.

Estimate of flood damages as complied by the St. Bernard Parish Planning Commission included the following items:

	May 3, 1978	April 13, 1980
Agriculture	*	$ 135,000.00
Private Homes	*	2,136,000.00
Mobile Homes	*	-0-
Public Bldgs.	$ 23,964.67	120,842.00
Business Bldgs.	*	-0-
School Bldgs.	*	55,000.00
Canal Crossings	1,341.85	31,000.00
Public Utilities	109,725.00	-0-
Roads	25,127.36	-0-
Debris Clearance	24,056.16	-0-
Miscellaneous	20,430.80	-0-
Totals	$204,645.84	$2,477,842.00

* Figures unavailable

REVIEW DATA:

In the preparation of Drainage Base Maps imformation was obtained from the U. S. Corps of Engineers, Louisiana Department of Public Works, Louisiana Department of Highways, St. Bernard Parish Engineer, other consulting engineers and our own files. From this information and field surveys maps were drawn showing street, street elevations, subsurface drainage systems, canals and pumping stations. Each map was drawn so as it would show minor drainage system to its discharge into a major drainage canal or ditch.

A map was made of the total area showing street, highways, subsurface drainage system and major drainage canals and ditches. This map was then subdivided into 76 different area according to each drainage flow pattern.

A network of twenty benchmarks was established throughout the Phase I Drainage Area and elevations were taken on all drainage canals and ditches except for Florida Walk Canal and Guichard Canal as these were available from the La. State Dept. of Public Works.

The 76 subdivided area and canals and ditches were than analyzied to determine each area problems and limits.

Each of these areas has a different flood problem due to the contour of the area, railroad track and highway elevations, street elevations, existing drainage systems, and slab elevations. Unfortunely those area with low street elevations and slab at ground level will probably experience flooding even with the implementation of the recommended improvements.

The rainfall records of the May 3, 1978 and April 13, 1980 storms, as recorded by the New Orleans Sewerage and Water Board, was reviewed and it was determined that using rainfall intensities for a 10 year storm (from Weather Bureau Technical Paper No. 25) and the use of the Rational Method of Design would determine peak flows which would show weakness in the existing drainage system.

After land use was analyzied the runoff factors and time of concentration were established.

The layout of the drainage system for this area is such that the peak flow from each of the Drainage Canals extending to the Florida Walk Canal will occur at about the same time. After full development of the entire area and proper improvements of the drainage system the combined peak flow to the Florida Walk Canal will range up to about 3600 cu. ft. per second. Except for rare storm the flow rate of this magnitude should be for only about an hour. A system designed

to dispose of storm runoff at a rate sufficient to relieve flooding from major storms within a period a few hours should be constructed as soon as possible.

GEOLOGY OF ST. BERNARD PARISH:

If the first settlers of St. Bernard Parish had known what their ancestors of today know they probably would have settled somewhere else. The soft and easily compacted sediment has inevitably brought on chronic environmental problems directly related to the local geology.

The Mississippi River Delta region of St. Bernard is quite young, geologically speaking, and the deltaic sediments are still soft and unconsolidated. Besides a building problem, land subsidence has accentuated another major envirommental problem--one with which we are all very familiar - flooding. The age old fight to keep St. Bernard Parish dry is made increasingly difficult as parts of the parish continue to sink farther below the level of surrounding waters. The danger of flooding varies from place to place.

(A) SUBSIDENCE

Subsidence, the relative lowering of the land surface with respect to sea level, is a natural consequence of deltaic sedimentation in St. Bernard Parish. Besides their drainage and development in the Parish also have caused the surface to subside.

According to Terzaphic (1943), land subsidence occurs as a result of three Principal causes:

(1) Primary consolidation is the reduction in volume of a soil mass caused by the application of a sustained load to the mass and due prinicpally to a squeezing out of water from void spaces of the mass.

(2) Secondary compression is the reduction in volume of a soil mass caused by the application of a sustained load to the mass and due to the adjustment of the interval structure of the soil mass after the water is squeezed from it.

(3) Oxidation of organic matter results in the reduction in volume of a soil mass as chemcial reaction occur which cause the organic matter to decompose into its mineral constitents.

(B) (1) DIFFERENTIAL SUBSIDENCE

Probable the greatest single problem has not been the general subsidence, but the difference in subsidence between houses on piles foundations and the surrounding ground surface. When houses or buildings are constructed using the slab-on-pilings technique, the foundation is usually stabilized, but the area surrounding the building continues to subside, thus producing differential subsidence. Some homeowners fill their yards with soil to compensate for their differential subsidence.

(2) HAZARDS AND DAMAGE

Major effects of subsidence have been widespread damage to water-lines, sewer-lines, natural-gas lines, streets, driveways, sidewalks, and structures. Recent case studies have revealed separation of house and

adjoining carports, negative skin friction of piles, cracked slabs, broken curbing, and other types of structural distress. The general difficulties are too numerous and the complete ramification of subsidence damage is too lengthly to present in this report.

As troublesome as subsidence-caused maintenance problem are, the greatest hazard in the marshland peat area is from natural-gas explosions. Gas and other utility lines are buried in the peat. The stress created by differental subsidence is sometimes enough to rupture gas lines. Residents of St. Bernard have thus far been fortunate in not experiencing such occurances. Since 1972, however, five homes have been destroyed by natural-gas explosions in Jefferson Parish.

(3) COPING WITH SUBSIDENCE

With St. Bernard Parish the problem of land subsidence ranges from severe to minimal. The prospective homeowners best defense against subsidence is to locate within areas with the least potential for subsidence. In the past information on subsidence potential has not been readily available, and, remarkable, present property prices seem to be minimally affected.

(C) FLOODING

Although the Police Jury, the Levee Board and other organazations through report such as this one have tried to make St. Bernard safe from the surrounding water, no one can guarantee that there will be no flooding.

Even with the best of controls localized flooding has occured. To minimize flooding, the parish has taken a tip from nature by building artificial levees and creating artificial crevasses to release floodwater.

Substantial efforts have been made to control flooding in St. Bernard Parish, but the mighty Mississippi River is difficult, perhaps ultimately impossible, to control, and the effects of a critical path hurricane are unknown. The survival and growth of St. Bernard Parish require and unending struggle to modigy and contain natual processes. What progress is made in their direction depends, in large part, on a knowledge of the geology of the Mississippi River Delta. *

DRAINAGE CONTROL ALTERNATIVE--PONDING

INTRODUCTION

Ponding or retention of surface runoff in ground surface depressions occurs naturally and by design. Many localities throughtout the United States design ponding facilities for flood protection, non-point source pollution control, and/or recharge of groundwater aquifers. Reduction in natural ponding due to land development results in increased runoff; thereby, taxing existing drainage facilities. This section considers the alternative of ponding for flood control in St. Bernard Parish.

* Source: Geolgy of Greater New Orleans: The New Orleans Society Inc., February 1980

CONCEPT

Ponding of excess runoff would be accomplished by the reinforcement of existing diking surrounding the proposed site and the insertion of Flood Control Structures through the existing Back Protection Levee. This would permit flood waters to flow into the ponding area when water levels in the drainage canal exceed an elevation of about -4 ft. (3 feet above the normal canal elevation). Flow would reenter the drainage canal through the same Flood Control Structures following rainfall subsidence and be subsequently pumped via normal procedure. The project would result in fresh water accumulation from approximately 3,800 acres being diverted into an uninhabited "dead swap" area instead of flooding residential landused areas of low elevation susceptible to flooding.

The ponding area would be comprised of a maximum of about 3,300 acres adjacent to the Florida Walk Canal. Reinforcing of the Old Jackson Protection Levee would be required as would dredging to deepen the proposed ponding area. It is estimated that this alternative could handle a 100-year storm (15"/24 hours) as compared to the existing system which is designed for a 10 year storm(10"/24 hours) and could be implimented relatively quickly by staging construction.

PERMITTING CONSIDERATIONS

The proposed ponding location is in a wetland area and therefore subject to regulatory assessment. A meeting with Dr. Linda Glenboski, botanist, and Mr. Mike Skougard, Chief of the Regulatory Assessment Section of the New Orleans Corps of Engineers was held at which it was indicated that the following permits would probably be required for the proposed project;

1. Section 10 of the River and Harbor Act of 1899
2. Section 404 of the Clean Water Act (PL92-500)
3. Coastal Use Permit in accordance with the Louisiana Coastal Resources Program and La. R. S. 49, Sections 213.1-213.21, the State and Local Coastal Resources Management Act of 1978 as amended.

An Environmental Impact Assessment and possibly an Environmental Impact Statement will be required prior to permit review. It should be noted that most concern and objections to the proposed project may be voiced by:

National Marine Fisheries Services

U.S. Fish and Wildlife Service

Environmental Protection Agency (reviews Corps permits)

Consensus of the meeting was that the project concept was worthy of more detailed evaluation, especially if the proposed ponding area was of low ecological value and mitigation measures would create and enhance wetlands value.

PRELIMINARY ECOLOGICAL EVALUATION

Two documents were employed to ecologically evaluate the proposed ponding site. These were Resource Management: The St. Bernard Parish Wetland, Louisiana by Coastal Environments, Inc. of Baton Rouge (Oct., 1976) and Coastal Zone Management Plan, St. Bernard Parish, Louisiana by Burk and Associates, Inc., New Orleans (March, 1979). Both reports indicate the project ponding area to be modified wetland characterized by a dead cypress swamp and brackish marsh in poor condition. The hydrologic pattern of this area is greatly modified by drainage and filling activities and hence, it does not function as part of the natural system. Deterioration has resulted in a nonproductive ecological unit of low fishing and trapping value and none to low waterfowl value. No arachaeological or historical sites are located in the area.

Source: A. J. Englande P.E., Phd.
Tulane University

LOCAL DRAINAGE PROBLEMS

See Drawing No. 3 for Location of Drainage Problems Areas

DRAINAGE AREA	LOCATION	DRAINAGE PROBLEMS	RECOMMENDATIONS
I A & I C	Angela to Hernandez Royal to St. Claude	Angela - Drainage blocked at St. Claude (ditch) and Jackson Barrack ditch, culvert too low to connect to St. Claude Drainage. Balance of Area: Existing culvert unable to handle flow-42" culvert under Fire Station too high (1.0 below Dauphine and Mehle) and open ditch between Royal and St. Claude can't handle the flow.	Angela Street: See drawing # 20. New culverts with catch basins from Dauphine to Judge Perez Drive. Rampart Street: New culverts with catch basins from Angela to existing 36" culverts. Royal Street: New culverts with catch basins from exsiting 36" to Aycock and Hernandez. Aycock Street: New culverts with catch basins from Royal St. to exsiting 24" at St. Claude. Hernandez Street: New culverts with catch basins from Royal St. to west Railroad Ditch.
	Angela - St. Claude to Judge Perez Drive	Open ditch unable to handle the flow.	
I B	Community and Center At St. Claude	Culverts under railroad and highway unable to handle flow from subdivision and industrial area.	See drawings # 20 and 22. Larger culverts under two railraod tracks, larger box culvert under St. Bernard Hwy. (La. 46).

DRAINAGE AREA	LOCATION	DRAINAGE PROBLEMS	RECOMMENDATIONS
I D	St. Claude School Area	Water ponds at rear of residents and school.	See Drawing # 20. New culverts with catch basins.
II A	Angela - Judge Perez to Rocheblave	Open ditch unable to handle flow, area low toward Rocheblave.	Angela Street: See Drawing # 21. New culverts with catch basins from Judge Perez to Rocheblave.
II B	Mehle, Esteban and Aycock from Judge Perez to Patricia	Low area, pumps too small, canal bank low.	Mehle Street: See Drawing # 21. New culverts with catch basins from Mehle to Angela on N. Prieur St. Esteban and Aycock: Additional catch basins. Aycock Street: See Drawing # 21. New culverts with catch basins from Aycock to west railroad ditch, increase capacity of existing pumping station. Patricia Street: See Drawing # 21. New culverts with catch basins from Angela to west railroad ditch.

DRAINAGE AREA	LOCATION	DRAINAGE PROBLEMS	RECOMMENDATIONS
II C	Mehle, Esteban, Aycock from Patricia to Rocheblave	Area very low, canal bank low.	Mehle, Esteban and Aycock: See Drawing # 21. New culverts with catch basins. Rocheblave: See Drawing # 21. New culverts with catch basins from Angela to new pumping station. New pumping station at West Railroad Ditch.
III A	Industrial Area	Eicke and Guerenger Canals unable to handle flow.	Eicke Canal at St. Bernard Hwy. Larger box culvert under St. Bernard Hwy. See Drawing # 20. Guerenger Canal at St. Bernard Hwy.: See Drawing # 22 and 24. Larger box culverts under St. Bernard Hwy. Along St. Bernard Hwy.: See Drawings # 22 and 24. New drainage ditch on river side of railroad tracks from Rowley Blvd. to new drainage canal at Pirate.
III B	Carolyn Park from St. Bernard Hwy. to Judge Perez Drive	Pumping station too small, area very low (below canal bank) canal bank failing.	Perrin Street: See Drawing # 22. Upgrading existing pumping station. Norton Drive: New culverts with catch basins to Guerenger Canal. Livingston Ave.: New Pumping Station.

DRAINAGE AREA	LOCATION	DRAINAGE PROBLEMS	RECOMMENDATIONS
IV A	Carolyn Court	Drainage to Rowley Blvd. unable to handle flow, area low.	Carolyn Court: See Drawing # 23. New culverts with catch basins from Carolyn Court to Rowley Blvd.
IV B	Carolyn Park from Patricia to Benjamin	Area low. Some drains needs cleaning, street failing on Benjamin at drains, local drainage problems.	Perrin Drive at Flordia Walk Canal: See Drawing # 23. Replace broken culverts.
V A	St. Bernard Hwy. to Judge Perez, Carolyn Park to Buccaneer Villa South	Undeveloped area, very low, pond water, some flow to Buccaneer Villa South.	At Pirate Drive: See Drawings # 24 and 25. New drainage canal from St. Bernard Hwy. to Florida Walk Canal.
VI A	Judge Perez to Florida Walk Canal, Carolyn Park to Buccaneer Villa North	Undeveloped area, very low, pond water, two drainage ditches from Patricia to Florida Walk Canal need cleaning.	Patricia Street to Florida Walk Canal: See Drawing # 25. Clean and reshape existing ditches.
VII A	Buccaneer Villa South Chalmette Subdivision	Buccaneer Villa South very low, culverts at ditch on bottom clogged, Creely Ditch too small to handle flow.	Pirate Drive: See Drawing # 26. Connect existing drainage system to new canal. Creely Ditch: Close culverts at St. Bernard Hwy., concrete line ditch, new bridges at Seventh and Eighth Streets.

DRAINAGE AREA	LOCATION	DRAINAGE PROBLEMS	RECOMMENDATIONS
VIII A	Buccaneer Villa North	Entire area drainage system holding water, area appears to be sinking, unable to verify some drainage culverts.	Buccaneer Villa North: See Drawing # 27. New pumping station at Jean Lafitte and Florida Walk Canal.
IX A	Portion of Chalmette Vista	Area low at canal, culverts at Fortification Canal clogged and at bottom of canal.	Thorton Street: See Drawing # 28. New culverts with catch basins. Old Hickory: New culverts with catch basins. E. Claiborne Square: New culverts with catch basins.
X A	Village Square	Broken culvert at Plymouth and Village Square East.	Plymouth Drive: See Drawing # 29. Replace broken culverts.
XI A	Pakenham and Jackson St. Bernard Hwy., to Judge Perez Drive	Open ditch clogged, tree lined street.	Pakenham and Jackson: See Drawing # 30. New culverts with catch basins.
XI B	St. Bernard Hwy. to Judge Perez Drive, Stander to Paris Rd.	Open ditches unable to handle flow.	New culverts with catch basins. See Drawing # 30.

DRAINAGE AREA	LOCATION	DRAINAGE PROBLEMS	RECOMMENDATIONS
XII A	Pakenham, Jackson from Judge Perez to Liberaux, Lloyds Town Subdivision	Culverts at canal clogged, one under, house, Lloyds Town drainage clogged, Geraldine and Park holding water-clogged, Jackson open ditch clogged unable to handle flow.	Jackson Blvd.: New culverts with catch basins, connect to all existing drainage system on Jackson Blvd. See Drawing # 31.
XII B	Judge Perez to Prosper Delille to Paris Rd.	Open ditches unable to handle flow.	Delille, Fenelon, Montesquieu from Judge Perez to Josephine See Drawing # 31. New culverts with catch basins.

MAJOR CANALS AND DITCHES

CANAL/DITCH	LOCATION	DRAINAGE AREA	PRESENT CAPACITY C.F.S.	DESIGN CAPACITY C.F.S.
West Railroad Ditch	Judge Perez Dr.	150	122	192
	Rocheblave	286	184	240
East Railroad Ditch	Judge Perez	48	173	115
	Florida Walk Canal	78	71	137
Eicke Canal	Patricia	258	966	318
	Florida Walk Canal	292	971	327
Guerenger Canal	Judge Perez	296	534	367
	Florida Walk Canal	341	1042	422
Pirate Canal	Judge Perez	551	-	706
	Florida Walk Canal	645	-	776
Creely Ditch	Blue Bird Canal	98	32	149
Fortification Canal	Blue Bird Canal	50	215	136
Blue Bird Canal	Chalmette Vista Canal	349	1021	415
Chalmette Vista Canal	Judge Perez	349	1883	465
	Florida Walk Canal	545	1796	739
Guichard Canal	Judge Perez	467	1800	485
	Florida Walk Canal	800	3000	576
Florida Walk Canal	0+00 to 21+70	3650*	1900	355
* Total area	21+70 to 97+00	-	2700	1800
	97+00 to 143+00	-	2800	1789

CANALS	RECOMMENDATIONS
West Railroad Ditch	Concrete line ditch from St. Bernard Hwy. to end. New Box Culverts at Judge Perez and Patricia. Upgrade existing pumping station. New pumping station at Roc eblave. New culverts with catch basins, new levee, both on west side of ditch. See Drawing No. 32.
East Railroad Ditch	New box culvert at Patricia. Remove existing driveway culverts. Concrete line ditch from Patricia to Florida Walk Canal. See Drawing No. 32.
Eicke Canal	New bridges at Patricia and Benjamin.
Guerenger Canal	New box culverts at St. Bernard Hwy. and Judge Perez Drive.
Pirate Canal	New box culverts under railroad tracks, St. Bernard Hwy., Judge Perez Drive, and Patricia. New canal from St. Bernard Hwy. to Florida Walk Canal. See Drawing # 34.
Creely Ditch	Close existing culvert under St. Bernard Hwy. Concrete line entire ditch. New bridges at Seventh and Eighth St. See Drawing No. 32.
Fortification Canal	Close existing culvert under St. Bernard Hwy. Concrete line canal from Eight Street to the Blue Bird Canal. See Drawing No. 32.
Blue Bird Canal	New bridges at Pakenham Drive. See Drawing No. 33.
Chalmette Vista Canal	New pumping station between Blue Bird Canal and Judge Perez. New box culvert under Judge Perez. See Drawing NO. 33.
Guichard Canal	Concrete line canal from Station 53+50 to Judge Perez Drive. See Drawing No. 33.

DEBRIS SCREENS

One of the problems encounted in the recent floods was the amount of debris collected at the two pumping stations. To help alleviate this problems screens should be constructed at all street crossing major canals. This would prevent the heavy build-up of debris at the pump and these screen could be maintained by ward maintenance crews.

This work should be constructed by maintenance force as funds and labor are available with a Phase IV priority.

CANAL BANKS

In many area canal banks are failing and the recommendation is to stabilize canal banks along residental area by concrete paving, metal sheet piling or wood bulkhead. At time of final planning design the Engineer should determine the best method for each canal.

This work should be constructed by maintenance force as funds and labor are available with a Phase IV priority.

CANAL CROSSING

Due to their efficient flow characteristics Bridges and Concrete Box Culverts are recommended for Canal Crossings. When construction time is the critical factor pipe

STORM WATER MANAGEMENT

A Storm Water Management Program which includes administration, technical, maintenance and legal means to evaluate, design and implement a strong drainage program should be implemented as soon as possible under a single agency to insure a efficient operation.

COST ESTIMATES

The Estimate cost is based on information available for similiar projects at todays's price but due to the fact that all of these projects will not be implemented at once the inflation factor is hard to predict and a more accurate estimate has to be made at time of construction from detailed Engineering Drawings.

To cover administration, legal, surveying, engineering, inspection and contingencies twenty (20%) percent is added to construction figure to obtain total cost.

PRIORITIES:

PHASE I : Projects which are feasible to begin at once and are vital to the drainage system.

PHASE II: Projects which are essential to the prevention of major flooding.

PHASE III: Projects which are necessary to prevent local minor flooding.

PHASE IV: Projects which require maintenance but are needed for a good drainage system.

The most important recommendation of the report is to have a detailed Engineering Study made, as soon as possible, on a Ponding Area to handle unusual heavy rainstorm.

The second most important recommendation is to have a single agency to administer all phase of drainage.

The third is to purchase at least three portable pumps to handle local drainage problems until such time as improvements are made to correct the problems.

LOCATION AND RECOMMENDATIONS	ESTIMATED COST			
	Phase I	Phase II	Phase III	Phase IV
Angela Street: New culverts with catch basins from Dauphine to Judge Perez Drive			174,245	
Rampart Street: New culverts with catch basins from Angela to existing 36" culverts.		31,680		
Royal Street: New culverts with catch basins from existing 36" to Aycock and Hernandez.			55,080	
Aycock Street: New culverts with catch basins from Royal Street to existing 24" at St. Claude.			79,680	
Hernandez Street: New culverts with catch basins from Royal Street to west Railroad Ditch.			238,800	
Community and Center at St. Claude: Larger culverts under two railroad tracks, larger box culvert under St. Bernard Hwy. (La. 46).	214,000			
St. Claude School Area: New culverts with catch basins.		60,720		
Angela Street: New culverts with catch basins from Judge Perez Drive to Rocheblave.		254,160		
Mehle Ave.: New culverts with catch basins from Mehle to Angela on N. Prieur St.		27,600		

LOCATION AND RECOMMENDATIONS	ESTIMATED COST			
	Phase I	Phase II	Phase III	Phase IV
Esteban and Aycock: Additional catch basins.		16,800		
Aycock Street: New culverts with catch basins from Aycock to west railroad ditch, increase capacity of existing pumping stations. (150 C.F.S.)		173,880		
Patricia Street: New culverts with catch basins from Angela to west railroad ditch.		71,280		
Mehle, Esteban and Aycock: New culverts with catch basins.		76,325		
Rocheblave: New culverts with catch basins from Angela to new pumping station. New pumping station at West Railroad Ditch. (240 C.F.S.)		644,000		
Along St. Bernard Hwy.: New drainage ditch on river side of railroad tracks from Rowley Blvd. to new drainage canal to Chalmette Ave. (400 C.F.S. East of Pirate; 200 C.F.S. West of Pirate)		57,600		
Perrin Street: Upgrading existing pumping station.		60,000		
Norton Drive: New culverts with catch basins basins to Guerenger Canal.		65,040		
Livingston Ave.: New pumping station.		240,000		

LOCATION AND RECOMMENDATIONS	ESTIMATED COST			
	Phase I	Phase II	Phase III	Phase IV
Carolyn Court: New culverts with catch basins from Carolyn Court to Rowley Blvd.			38,880	
Perrin Drive at Florida Walk Canal: Replace broken culverts.				11,520
At Pirate Drive: New drainage canal from St. Bernard Hwy. to Florida Walk Canal.	1,295,000			
Patricia Street to Florida Walk Canal: Clean and reshape existing ditches.				25,000
Pirate Drive: Connect existing drainage system to new canal.	5,000			
Creely Ditch: Close culverts at St. Bernard Hwy., concrete line ditch.	1,152,600			
New bridge at Seventh and Eighth Street			120,000	
Buccaneer Villa North: New pumping station at Jean Lafitte and Florida Walk Canal.		840,000		
Thorton Street: New culverts with catch basins.		6,500		
Old Hickory: New culverts with catch basins.		61,200		
E. Claiborne Square: New culverts with catch basins.		86,880		

LOCATION AND RECOMMENDATIONS	ESTIMATED COST			
	Phase I	Phase II	Phase III	Phase IV
Plymouth Drive: Replace broken culverts.				8,640
Pakenham and Jackson: New culverts with catch basins.			300,000	
St. Bernard Hwy. to Judge Perez Drive, Stander to Paris Road: New culverts with catch basins.			1,200,000	
Jackson Blvd. from Judge Perez to Liberaux: New culverts with catch basins, connect to all existing drainage system on Jackson Blvd.		400,000		
Delille, Fenelon, Montesquieu from Judge Perez Drive to Josephine: New culverts with catch basins.			1,600,000	

LOCATION AND RECOMMENDATIONS	ESTIMATED COST			
	Phase I	Phase II	Phase III	Phase IV
West Railroad Ditch:				
Concrete line ditch from St. Bernard Hwy. to end.		2,400,000		
New box culverts at Judge Perez and Patricia.		172,800		
Culverts across railroad tracks at Florida Walk Canal.	60,000			
New culverts with catch basins. New levee, both on west side of ditch.		480,000		
East Railroad Ditch:				
New box culvert at Patricia. Concrete line ditch from Patricia to Florida Walk Canal.		36,000 420,000		
Eicke Canal:				
New bridges at Patricia and Bnejamin.			144,000	
Guerenger Canal:				
New box culverts at St. Bernard Hwy. and Judge Perez Drive.	120,000			
Fortification Canal:				
Close existion culvert under St. Bernard Hwy.		384,600		
Blue Bird Canal:				
New Bridge at Pakenham Drive.			72,000	
Chalmette Vista Canal:				
New pumping station between Blue Bird Canal and Judge Perez (500 C.F.S.).	2,712,000			
New box culvert under Judge Perez Drive.				

LOCATION AND RECOMMENDATIONS	ESTIMATED COST			
	Phase I	Phase II	Phase III	Phase IV
Guichard Canal: Concrete line canal from Station 53+50 to Judge Perez.	390,000			
Entire Area: Portable Drainage Pumps (Three).	60,000			
Debris Screens (Eleven).				55,000
Canal Bank Bulk-head.				4,680,000
St. Bernard Hwy: Culverts, Catch Basins and swale.		768,000		
TOTALS	$ 7,199,525	7,835,065	4,022,625	4,780,160

FINANCING:

The different methods of financing drainage improvements projects are:

(1) By ad volerem tax bonds repaid from tax millage lenied against the assessment of all properties within the Parish. According to Foley Judell Beck Bewley and Martin, Bond Attorneys, the legal capacity of St. Bernard Parish to finance drainage improvements, based on current assessed valuation of the Parish of $130,173,999.00 is $13,017,000.00 of tax secured bonds. After deducting the $2,070,000.00 of outstanding bonds and the $3,300,000.00 of bonds which have been voted but not yet issued, the Parish could issue, with Voters approval, an additional $7,640,000.00 of tax-secured bonds. This amount would change as bonds are paid off and as assessed valuation changes:

(2) By Sales Tax Bond repaid from present sales tax. For each $1,000,000.00 of bonds that the Parish issured for drainage improvements the debt service requirements would be approximately $100,000 annually.

(3) By assessment Bonds for minor drainage improvements on street repaid from front foot assessments.

(4) By Implementing a equitable drainage service charge.

(5) By impossing a charge on all new development on a per lot basis.

(6) Grants from State and/or Federal Agencies.

The final decision on the method of financing drainage projects shall rest with the governing authority of St. Bernard and should be made at or near time of construction.

BENCH MARKS

VERTICAL CONTROL NET AND ELEVATIONS EVALUATION

This report is for a vertical control net and specific elevation evaluation in the area bounded by the Mississippi River Levee, the Orleans - St. Bernard Parish Line, the back protection levee and Paris Road.

Vertical control provided in this area by the National Geodetic survey consists of primary control lines 101 and 102 as shown on Enclosure 1.

The specific marks that are in or near the study area are shown on Enclosure 2 and 3 with arrows for identifications. All elevations are National Geodetic Vertical Datum of 1929 (N.G.V.D.) commonly called mean sea level (M.S.L.). Note that the elevation of each mark is given for each year that it was leveled to. It is obvious from this data that there has been a constant vertical movement throughout the area. Mark descriptions, Enclosures 4, 5 and 6, show these marks to be, for the most part, on the firmest ground available or on pilings. Table 1 shows a chart of selected marks and related vertical movement.

MARK	Change in elevation (13 yrs) 1938-1951	(13 yrs) 1951-1964	(7 yrs) 1964-1971	Latest vertical velocity ft./year
Folse	-	-0.236	-	-0.018'
Chalmette RM-1	-0.693'	-0.344	-	-0.026'
F-152	-	-0.344	-0.493	-0.070'
A-151	-	-0.243	-0.255	-0.036'
J-193	-	-	-0.197	-0.028'
K-193	-	-	-0.196	-0.028'
G-189	-	-	-0.229	-0.033'

Table 1

As revealed by Table 1, the marks that have the lowest vertical velocity are Chalmette RM-1, J-193 and K-193. Of these, the only mark to meet the criteria of low vertical velocity, modern value (leveled to in 1971) and within the study area is K-193. Therefore, it was decided to base the vertical net upon K-193 using the 1971 value as published by the National Geodetic Survey (N.G.S.) that value being +2.005' N.G.V.D.

A double run line of levels was then made from K-193 to A-151 (see Enclosure 5 & 6 for descriptions) for evaluation of consistancy. The run resulted in a closure of 0.010' giving a value of +10.271' to A-151. Comparing this with the 1971 published value of +10.404' shows a

difference in vertical movement of -0.133'. The expected difference in vertical movement is ((-0.036)-(-0.028)) .9 where -0.036 is the latest measured vertical velocity of A-151, -0.028 is the latest measured vertical velocity of K-193 and 9 is the number of years between 1971 and 1980. This results in an expected difference of -0.072'. Thereby proving that the vertical velocity of these two marks, relative to each other, is not consistant with the most recent measured values. Comparisons with this and other marks measured to in the course of the control net are shown in Table 2.

Mark	Projected Δ	Actual Adjusted Δ
Folse	+0.160'	-0.320
Chalmette RM-1	+0.032'	-0.366
F-152	-0.378'	-0.320
A-151	-0.072'	-0.147

Table 2

These comparisons show that any attempt to project the present elevation of any mark by a study of its past movement cannot be done because of great fluctuations in vertical velocity. Therefore, with the certain knowledge that there has been a large and unknown vertical change in the negative direction.

A single line of levels was then run from K-193 westward along Genie Street/Patricia Street to Kings Drive, north along Kings Drive to Hamlet Drive, west along Hamlet Drive/Hermitage Drive to Jean Lafitte Parkway, south along Jean Lafitte Barkway to Patricia Street, west along Patricia Street to Angela Street, south along Angela Street to St. Claude Avenue, east along St. Claude Avenue St. Bernard Hwy. to Paris Road and north along Paris Road tp K-193. An additional line was run from Paris Road along Judge Perez Drive westward to Angela Street. See Enclosure 7.

This established a three loop control net with 24 major control points of which 20 are temporary bench marks, 1 is a U.S. Corps of Engineers bench mark, and 3 are National Geodetic Survey (N.G.S.) bench marks.

Inspection of Appendix III shows that several turning points were taken at tops of curbs in the Buccaneer Villa North subdivision having values as low as -3.252' N.G.V.D. This is of significance in the light of the fact that the Lake Borge Levee Board maintains the drainage canal at an elevation of -7.12' N.G.V.D. thereby providing only 3.5' of drainage reservoir before storm runoff begins to back onto the streets in Buccaneer Villa North.

As part of the same elevations work, the Lake Borgne Levee Board canal gauge and tide gauge at the pumping station directly across the "40 arpent" canal from Buccaneer Villa North Subdivision was leveled to.

The gauge in the "40 arpent" canal showed a water elevation of -5.70' when actual water elevation was measured as-6.82'. The error shows that the gauge is 1.12' too low. At the same time, the tide gauge on the unprotected side of the pumps showed a water elevation of +1.40' when actual water elevation was measured at +1.03' showing the tide gauge to be 0.37' too low. Differences in head potential by gauge measurement was +7.10' when actual measurement showed head potential to be +7.85'. Head error by gauge readings is 0.75'

The area just north of the back protection levee is under water except at extreme low tide. Random elevations of water bottoms show average elevations of -1.5' N.G.V.D. which is 1.5' above selected streets in Buccaneer Villa North Subdivision. Areas of marsh land are generally +1' N.G.V.D.

REMARKS

The history of the study area and, indeed, the entire parish is one of continued and unpredictable subsidence. Because the bench marks set by N.G.S. are at points that are supported by deep pilings or are on ground that has a very low organic content, the subsidence for most of the marks is unaffected by the rapid surface subsidence caused by a water table reduction and decomposition of organic matter in the soils. These marks are, for the most part, only affected by the deep, slow and long term subsidence caused by a continued consolidation of several miles of material between the surface and "bedrock". Consequently, N.G.S. bench marks established in this area will begin to disagree by unacceptable amounts after only a few years. Temporary bench marks that are subject to surface subsidence will fall out of adjustment much more repidly. Therefore, it is recommended that the N.G.S. net be rerun as soon as possible and rerun every 5 years. Futher, the Parish should establish a TBM net tieing to the N.G.S. net and update this TBM net every 2 years. Only then will it be possible to chart the rate of subsidence, plan for major drainage projects and identify trouble areas.

The values of such TBM should be published. Any projects in the Parish should be required to use the TBMs for vertical control. This will greatly reduce the present problem of nonconformity of datum that results in incorrect water gauges, low subdivision streets, and general drainage confusion.

APPENDIX I

STATION	N.G.V.D. ELEV. IN FEET
K-193 (N.G.S.)	2.005
TBM 80-1	3.725
TBM 80-2	2.436
TBM 80-3	2.704
TBM 80-4	4.082
TBM 80-5	0.578
TBM 80-6	-1.347
TBM 80-7	-1.214
TBM 80-8	1.023
TBM 80-9	1.152
TBM 80-10	4.008
TBM 80-11	5.790
TBM 80-12 (U.S.C.E. A-1-A St. Claude)	0.593
TBM 80-13	3.151
TBM 80-14	3.185
TBM 80-15	4.516
F-152 (N.G.S.)	7.839
A-151 (N.G.S.)	10.257
TBM 80-16	6.506
TBM 80-17	2.510
TBM 80-18	0.242
TBM 80-19	2.244
TBM 80-20	0.672
TBM 80-21	0.802

APPENDIX II

STATION K-193 Elev. +2.005' N.G.V.D.

Mark is a U.S.C. & G.S. Disk at the W.D.S.U. Television Tower on Josephine Street at Tournefort Street. Disk is set in the top of the hexagonal concrete base to the tower on the south side and 34' west of the centerline of Tournefort Street. Disk is about 1' above ground level.

TBM 80-1 Elev. +3.725' N.G.V.D.

Mark is a square cut in the top surface of the concrete base to the "Spur" sign located at the southeast corner of Paris Road and Genie Street. Mark is 0.35' south of the north edge of the base and 0.70' east of the west edge of the base and about 2' above the level of the ground.

TBM 80-2 Elev. +2.436' N.G.V.D.

Mark is a cross cut on the upper surface of the concrete bridge for Patricia Street at Guichard Canal about 150' west of Pakenham Drive. Mark is located at the southwest corner of the bridge 0.18' north of the south edge and 0.16' east of the west edge and is level with the roadway.
(Note previous value used in construction of North Patricia Subd. +2.44' N.G.V.D.).

TBM 80-3 Elev. +2.704' N.G.V.D.

Mark is a cross cut on the top surface of the north concrete vehicle guard rail at the west end of the bridge over the canal between Kings Drive and Village Square West at Patricia Street. Mark is 20' west of the centerline of the canal, 0.36' south of the north edge of the guard rail and about 2.5' above the roadway.

TBM 80-4 Elev. +4.082' N.G.V.L.

Mark is a concrete nail driven into the mortor for the cinder block wall on the south face of the Vista Park Gym at Kings Drive and Victory Drive. Nail is one cinder block west of south door and is about 5' above the surface of the ground.
(Note this mark leveled to January, 1975, from U.S.C. & G.S. Disk Chalmette RM-1. Pub. 1964 resulting in a value of +4.46').

TBM 80-5 Elev. +0.578' N.G.V.D.

Mark is a square cut in the surface of the concrete floor to the St. Bernard Sewer Board Maintenance Building at Jean Lafitte Parkway and the "40 arpent" canal. Mark is located near the south wall and is 1.2' inside the pedestrian doorway about 2' west of the east jam.

TBM 80-6 Elev. -1.347' N.G.V.D.

Mark is a "L" cut in the top surface of the concrete bridge over the Guerengeh Canal (150' east of Cougar Drive) at Patricia Street. Mark is on the southwest corner of the bridge, 0.62' east of the west end and 1.65' north of the south edge of the bridge.

TBM 80-7 Elev. +1.214' N.G.V.D.

Mark is a square cut in the top of the north curb of Patricia Street at the Eickes Canal (between Center Street and Schnell Drive) culvert. Mark is 11.2' west of the centerline of the canal and 12.5' north of the centerline of Patricia Street.

TBM 80-8 ELEV. +1.023' N.G.V.D.

Mark is located on the top of the floor slab of the church on the corner of Aycock Street and Patricia Street. Rod was held on the top edge of the slab at the centerline of the side door that faces the intersection.

TBM 80-9 ELEV. +1.152' N.G.V.D.

Mark is located on the top of the floor slab of the "Come-N-Go" food store, #6600 W. Judge Perez Drive (corner of Angela Street and Judge Perez Drive). Rod was held on the top of the floor at the centerline of the double doors and 1.3' inside of the store from the doors.

TBM 80-10 ELEV. +4.008' N.G.V.D.

Mark is a square cut on the top surface of a narrow concrete walkway that is a part of the slab for the Peoples Bank on the corner of St. Claude Avenue and Mehle Street. Mark is 0.5' south of the north end of the bank and 0.95' west of the west wall of the bank.

TBM 80-11 ELEV. +5.790' N.G.V.D.

Mark is a cross-cut on the top of a concrete post forming a part of the foundation to the old Folse Ice House. Post is under the middle window of the north wall of the ice house and is about 3' above the surface of the ground.
(Note previous value of mark based upon 1964 value of U.S.C. & G.S. Disk Folse set at +6.11' in 1975).

TBM 80-12 ELEV. +0.593' N.G.V.D.

Mark is U. S. Army Corps of Engineers disk "B.M. St. Claude A-1-A" set 5.1' south of a power pole, 16' east of the centerline of the Eickes Canal (about 120' east of Center Street) and 30' south of the north end of a large culvert under St. Claude Highway.
(Note U.S.C.E. value for mark not known).

TBM 80-13 ELEV. +3.151' N.G.V.D.

Mark is the top of the floor slab for the building located at #7777 W. St. Bernard Highway. Rod was held at the centerline of the double doors on the exterior edge of the slab. Doors are the southernmost pair and about 60' north of the south end of the building.

TBM 80-14 ELEV. +3.185' N.G.V.D.

Mark is the top of the floor slab for the building located at #8601 W. St. Bernard Highway, corner of Chalmatte Avenue. Rod was held on the centerline of the double doors for the St. Bernard entrance at the exterior edge of the slab.

TBM 80-15 ELEV. +4.516' N.G.V.D.

Mark is the top of the floor slab for the Peoples Bank located on the corner of Madison Avenue and St. Bernard Highway. Rod was held on the centerline of the St. Bernard Highway entrance at the exterior edge of the slab.

F-152 ELEV. +7.839' N.G.V.D.

Mark is a U.S.C. & G.S. Disk set vertically in the northwest face and 11 feet northeast of the west corner of the St. Bernard Parish Court House, Pakenham Drive at St. Bernard Highway. Disk is about 1½' above the ground.
(Not history of this mark per N.G.S. is 1951, +8.996'; 1963, +8.652'; 1971, +8.159').

A-151 ELEV. +10.257' N.G.V.D.

Mark is a U.S.C. & G.S. Disk set vertically in the southwest face of the Meraux Elementary building 228' north of St. Bernard Highway, 81' east of Buffon Street and about 8 inches above concrete walkway. (Note N.G.S. history of mark is 1951, +10.902'; 1964, +10.659'; 1971, +10.404').

TBM 80-16 ELEV. +6.506' N.G.V.D.

Mark is centerline top of the southeastern most bolt in the concrete base for the "Spur" sign on the southeast corner of Judge Perez Drive and Paris Road.

TBM 80-17 ELEV. +2.510' N.G.V.D.

Mark is a square cut on the top surface near the south edge of the concrete base for a large steel power transmission pole on the south side of Judge Perez Drive about 150' west of Pakenham Drive. Mark is about 27' south of the south curb of Judge Perez Drive and is about 1.5' above the ground.

TBM 80-18 ELEV. +0.242' N.G.V.D.

Mark is a square cut in the top surface of the concrete base for the "Cinema Mall" sign. Mark is near the north end of the base and on the centerline of the sign. Mark is about 75' south of the south curb for Judge Perez Drive and about 0.5' above the surface of the parking lot.

TBM 80-19 ELEV. +2.244' N.G.V.D.

Mark is "T" cut on the top surface of the extreme southeast exterior corner of the Civic Auditorium, Jean Lafitte at Judge Perez Drive. Mark is at the base of the southeast pillar of the Auditorium. (Previous value +2.61' set January, 1975, per U.S.C. & G.S. Disk Chalmette RM-1, 1964 value).

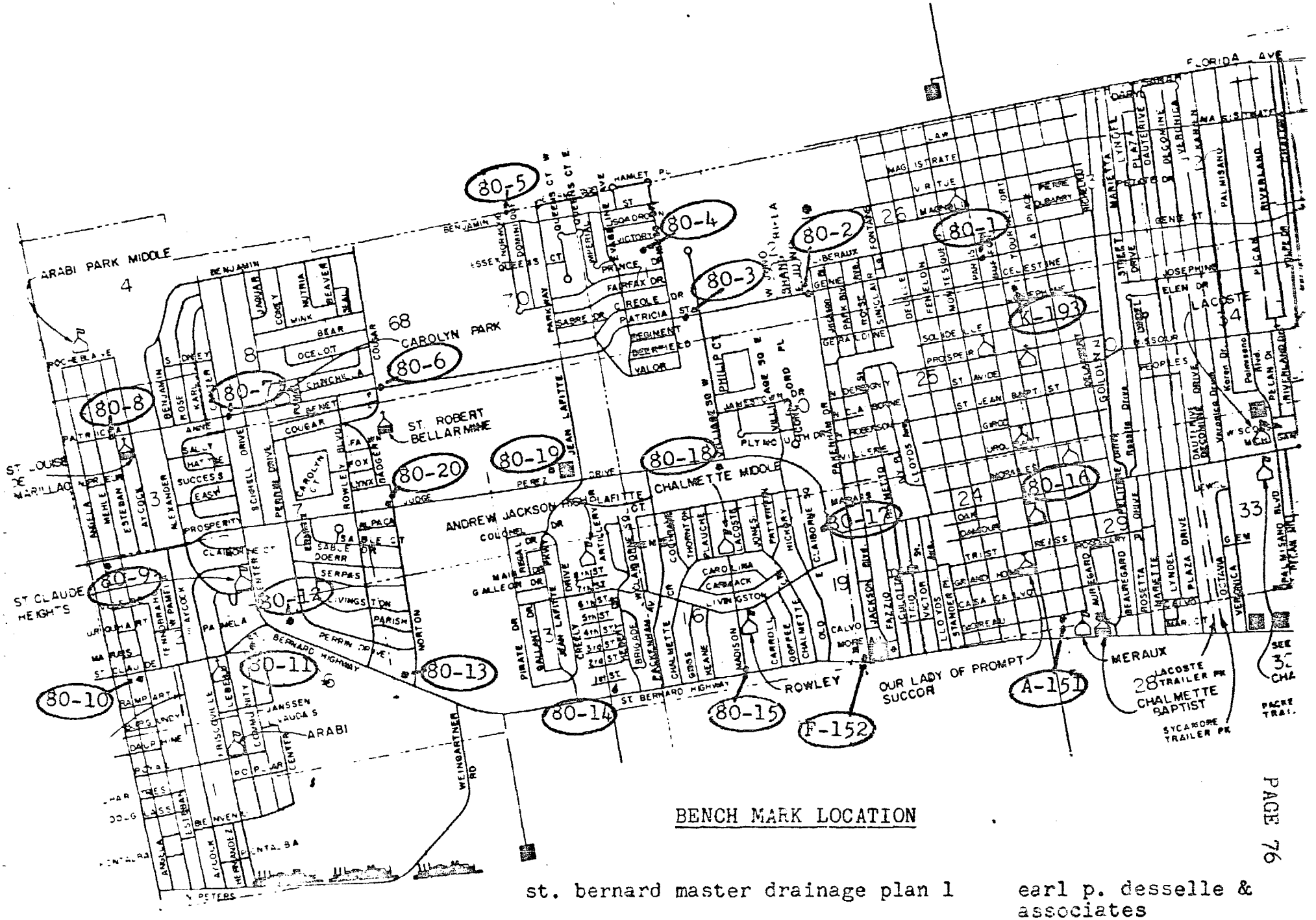
TBM 80-20 ELEV. +0.672' N.G.V.D.

Mark is square cut in the top surface of the concrete floor for #7639 W. Judge Perez Drive (Fire Station). Mark is on the exterior centerline front of the entrance foyer to the Fire Station.

TBM 80-21 ELEV. +0.802' N.G.V.D.

Mark is square cut in large concrete slab forming, in part, the foundation for the large "Gaylords" sign, #7330 Judge Perez Drive at Commercial Place. Mark is 12' east of the centerline of the sign and 1' south of the north edge of the concrete slab.

Source of information
Eugene Estopinal & Assoc.
Civil Engineers and Surveyors
September 12, 1980



BENCH MARK LOCATION

DESIGN STANDARDS

The Rational Method is expressed as:

Q = C I A
Q = Stormwater runoff in CFS
C = Runoff Coefficient
I = Rainfall intensity in inches per hour
A = Drainage area in acres

Flow Design Formula
use Manning's Equation

$$Q = \frac{1.486}{n} A R^{2/3} S^{\frac{1}{2}}$$

Q = Flow in Cfs.
n = Roughness Coefficient

A = Cross-sectional area in sq. ft.
R = Hydraulic Radius Ft.
S = Slope in Ft./ Ft.

$$V = \frac{1.486}{n} R^{2/3} S^{\frac{1}{2}}$$

V = Velocity in ft./sec.
n = Roughness coefficient
R = Hydraulic radius ft.
S = Slope Ft./Ft.

"n" Values
Concrete = 0.012
Earth = 0.03
Metal = 0.024

"V" Limits

Canal (a) Earth = 2-3 ft./sec.
(b) Concrete = 3-8 ft./sec.
(c) Culverts = 3-8 ft./sec.

Runoff Coefficient:

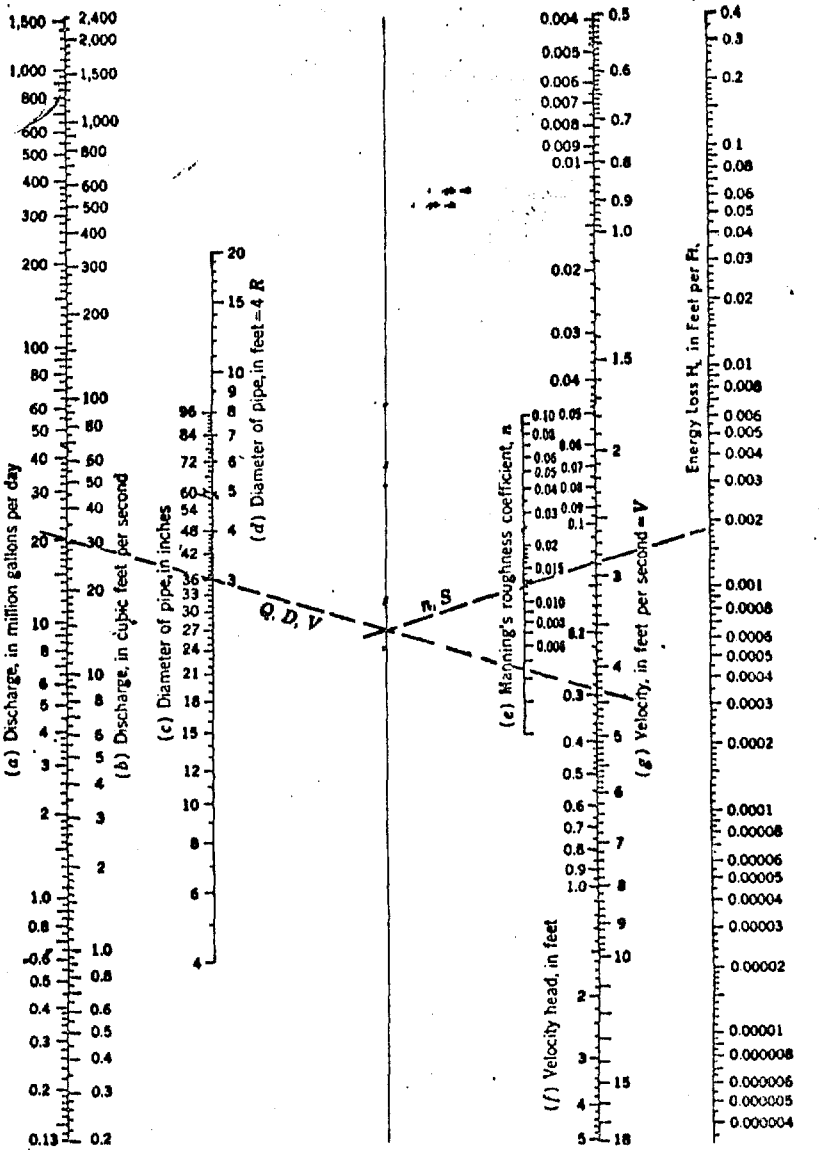
Parks = 0.2
Residental Area = 0.40 to 0.60
Commerical = 1.0
Industrial = 0.60 to 1.0

RAINFALL INTENSITY

10 Year Storms
New Orleans
from Weather Bureau Tech. Paper No. 25

Duration Minutes	Intensity In. Per Hour	Duration Minutes	Intensity In. Per Hour
5	8.1	40	3.8
6	7.8	41	3.8
7	7.5	42	3.7
8	7.3	43	3.7
9	7.1	44	3.6
10	6.8	45	3.6
11	6.6	46	3.6
12	6.4	47	3.5
13	6.3	48	3.5
14	6.1	49	3.4
15	6.0	50	3.4
16	5.8	51	3.4
17	5.7	52	3.3
18	5.5	53	3.3
19	5.4	54	3.3
20	5.3	55	3.2
21	5.2	56	3.2
22	5.1	57	3.2
23	5.0	58	3.1
24	4.9	59	3.1
25	4.8	60	3.1
26	4.7	70	2.8
27	4.6	80	2.6
28	4.6	90	2.4
29	4.5	100	2.3
30	4.4	110	2.2
31	4.3	120	2.1
32	4.3	130	2.0
33	4.2	140	1.9
34	4.2	150	1.8
35	4.1	160	1.7
36	4.0	170	1.6
37	4.0	180	1.6
38	3.9	190	1.6
39	3.9	200	1.5

TABLE A



Alignment chart for energy loss in pipes, for Manning's formula.
Note: Use chart for flow computations, $H_L = S$

Figure A

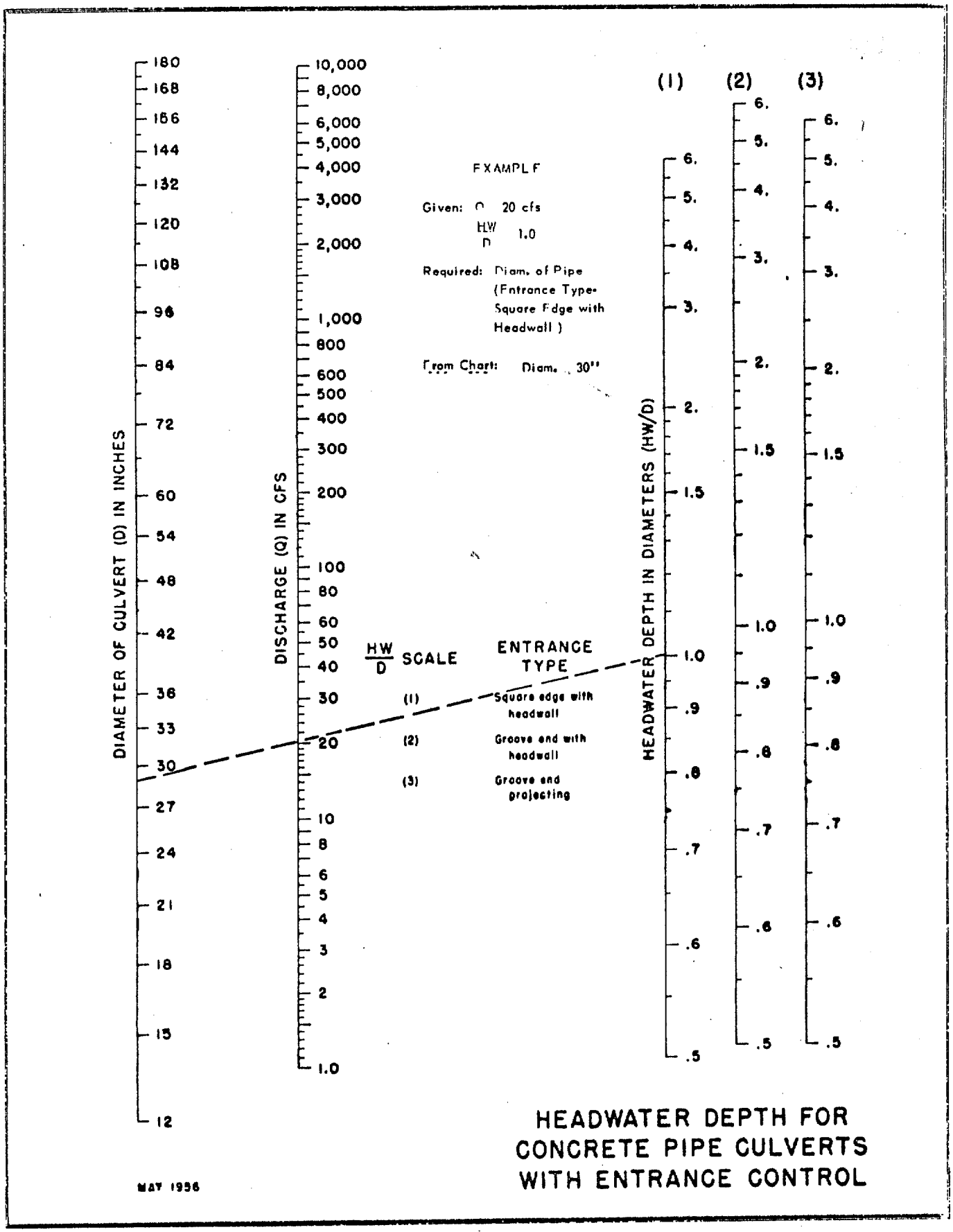

DIAMETER OF CULVERT (D) IN INCHES
180
168
156
144
132
120
108
96
84
72
60
54
48
42
36
33
30
27
24
21
18
15
12
DISCHARGE (Q) IN CFS
10,000
8,000
6,000
5,000
4,000
3,000
2,000
1,000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
8
6
5
4
3
2
1.0
EXAMPLE
Given: Q 20 cfs
HW/D 1.0
Required: Diam. of Pipe (Entrance Type- Square Edge with Headwall)
From Chart: Diam. 30"
HW/D SCALE
ENTRANCE TYPE
(1) Square edge with headwall
(2) Groove end with headwall
(3) Groove end projecting
HEADWATER DEPTH IN DIAMETERS (HW/D)
(1)
(2)
(3)
6.
5.
4.
3.
2.
1.5
1.0
.9
.8
.7
.6
.5
MAY 1956
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH ENTRANCE CONTROL

Figure B

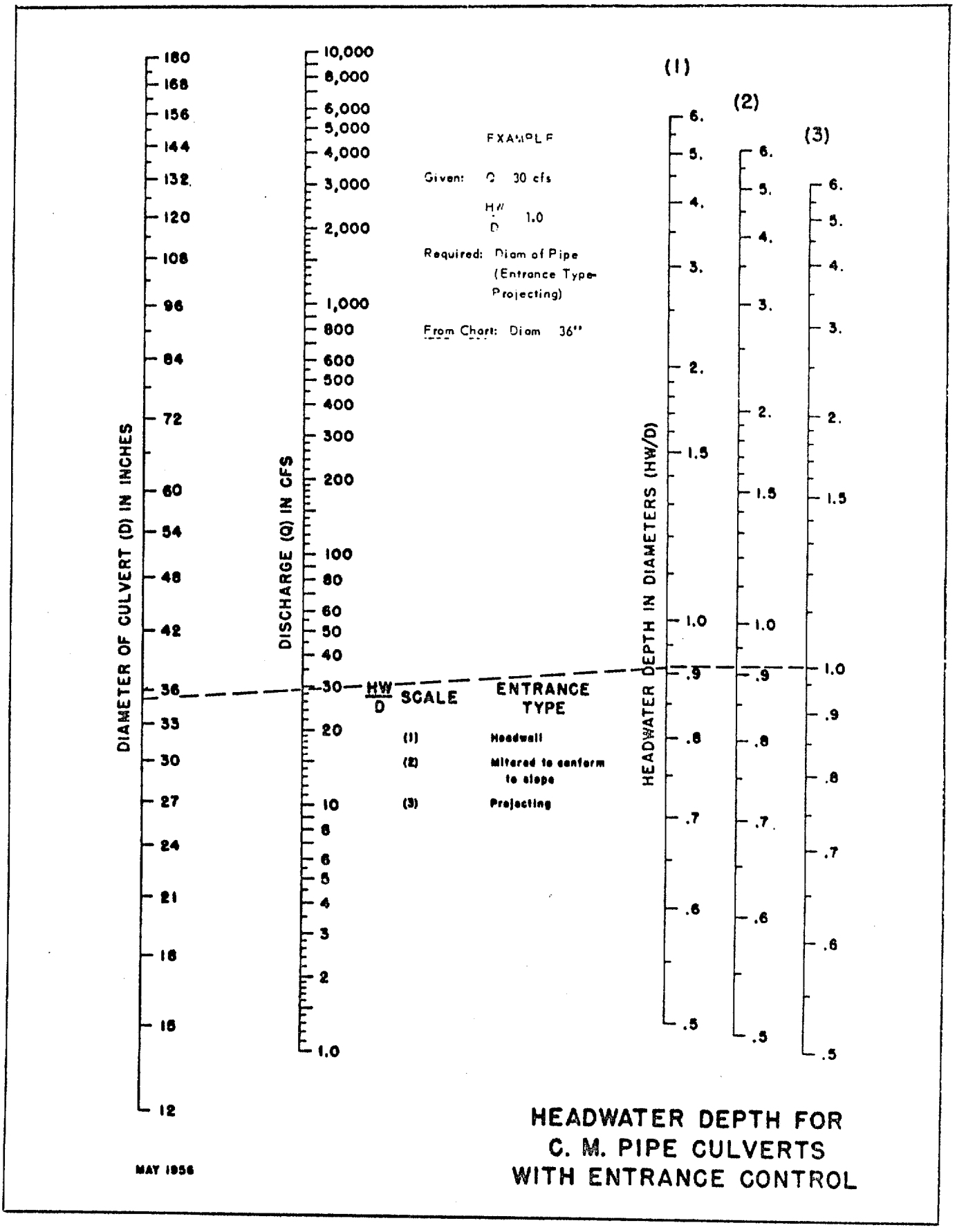

DIAMETER OF CULVERT (D) IN INCHES
180
168
156
144
132
120
108
96
84
72
60
54
48
42
36
33
30
27
24
21
18
15
12
DISCHARGE (Q) IN CFS
10,000
8,000
6,000
5,000
4,000
3,000
2,000
1,000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
8
6
5
4
3
2
1.0
EXAMPLE
Given: Q 30 cfs
HW/D 1.0
Required: Diam of Pipe (Entrance Type-Projecting)
From Chart: Diam 36"
HW/D SCALE
ENTRANCE TYPE
(1) Headwall
(2) Mitered to conform to slope
(3) Projecting
(1)
(2)
(3)
HEADWATER DEPTH IN DIAMETERS (HW/D)
6.
5.
4.
3.
2.
1.5
1.0
.9
.8
.7
.6
.5
MAY 1956
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH ENTRANCE CONTROL

Figure C

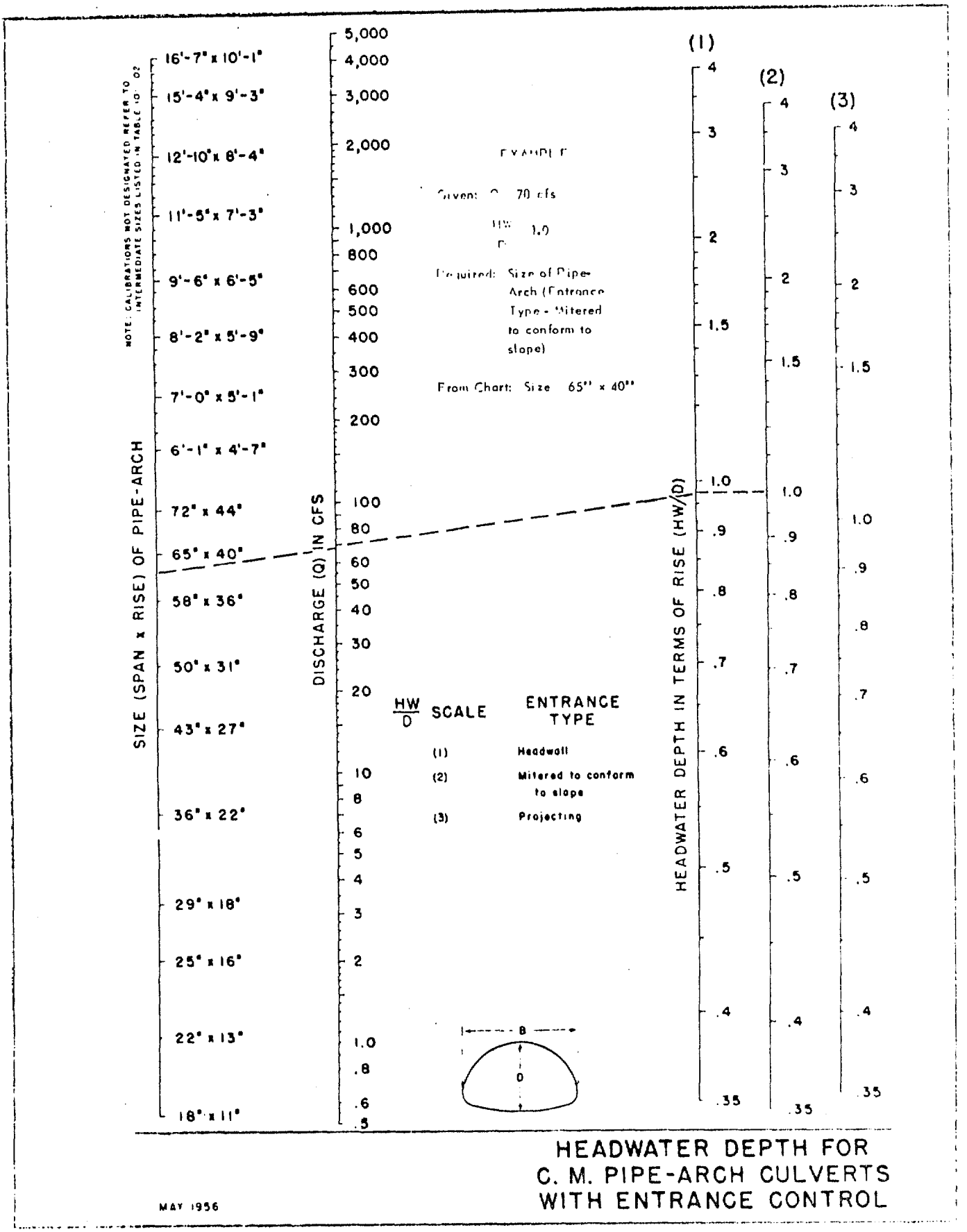
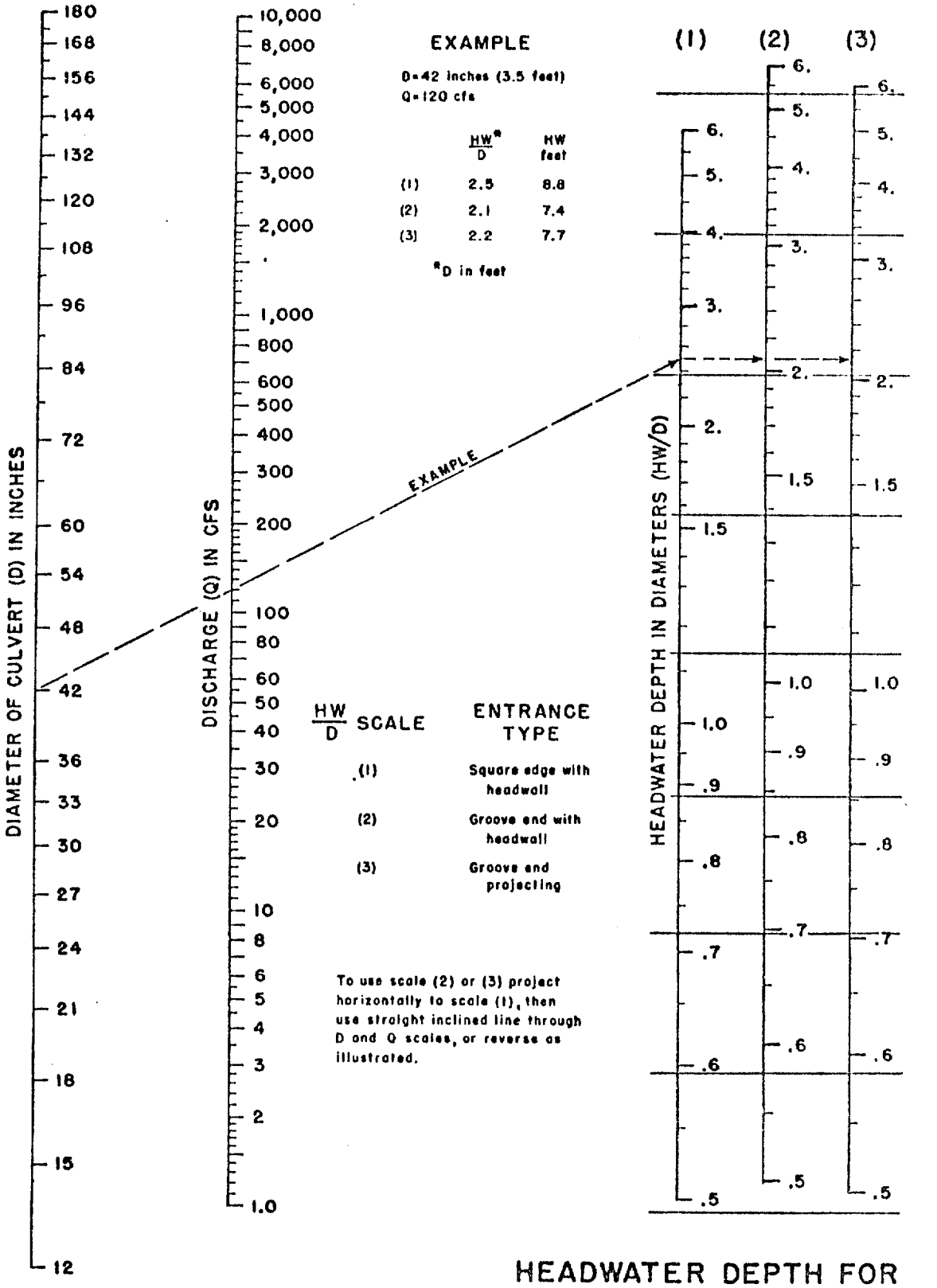

NOTE: CALIBRATIONS NOT DESIGNATED REFER TO INTERMEDIATE SIZES LISTED IN TABLE 10-02
SIZE (SPAN x RISE) OF PIPE-ARCH
16'-7" x 10'-1"
15'-4" x 9'-3"
12'-10" x 8'-4"
11'-5" x 7'-3"
9'-6" x 6'-5"
8'-2" x 5'-9"
7'-0" x 5'-1"
6'-1" x 4'-7"
72" x 44"
65" x 40"
58" x 36"
50" x 31"
43" x 27"
36" x 22"
29" x 18"
25" x 16"
22" x 13"
18" x 11"
DISCHARGE (Q) IN CFS
5,000
4,000
3,000
2,000
1,000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
8
6
5
4
3
2
1.0
.8
.6
.5
EXAMPLE
Given: Q = 70 cfs
HW/D = 1.0
Required: Size of Pipe-Arch (Entrance Type - Mitered to conform to slope)
From Chart: Size 65" x 40"
HW/D SCALE
ENTRANCE TYPE
(1) Headwall
(2) Mitered to conform to slope
(3) Projecting
B
D
(1)
(2)
(3)
HEADWATER DEPTH IN TERMS OF RISE (HW/D)
4
3
2
1.5
1.0
.9
.8
.7
.6
.5
.4
.35
MAY 1956
HEADWATER DEPTH FOR C. M. PIPE-ARCH CULVERTS WITH ENTRANCE CONTROL

Figure D

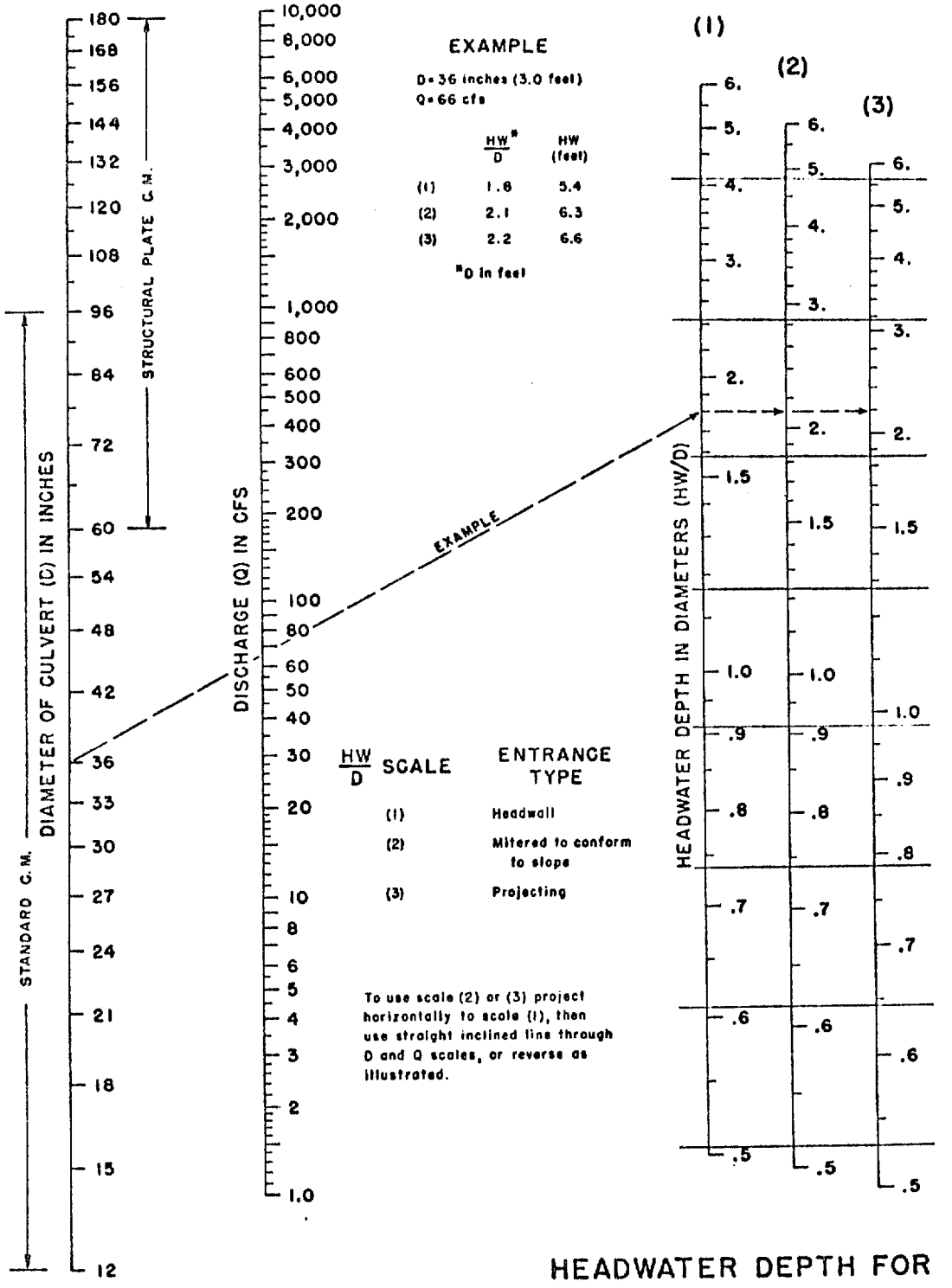


HEADWATER SCALES 283
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

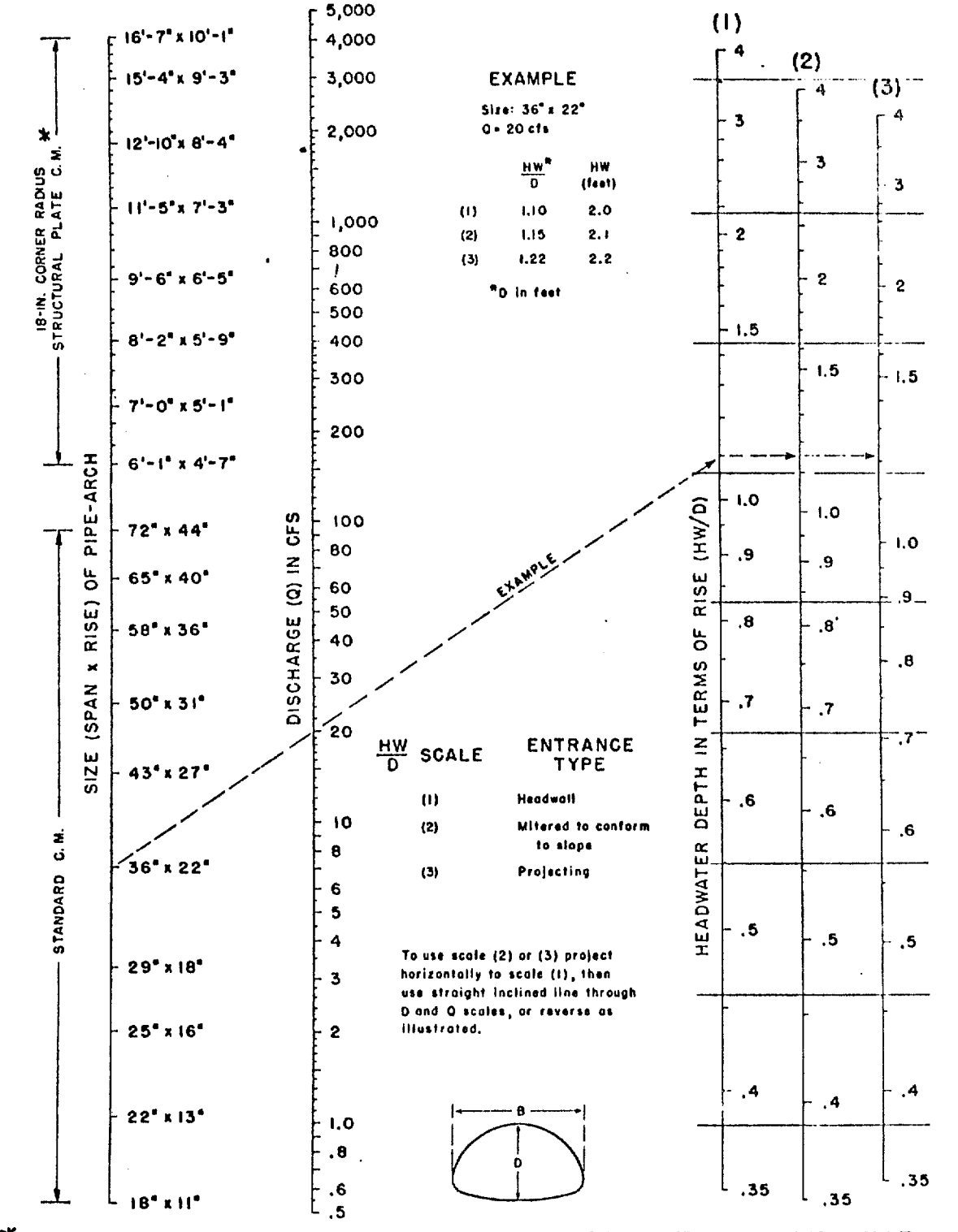
Figure E



BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

Figure F

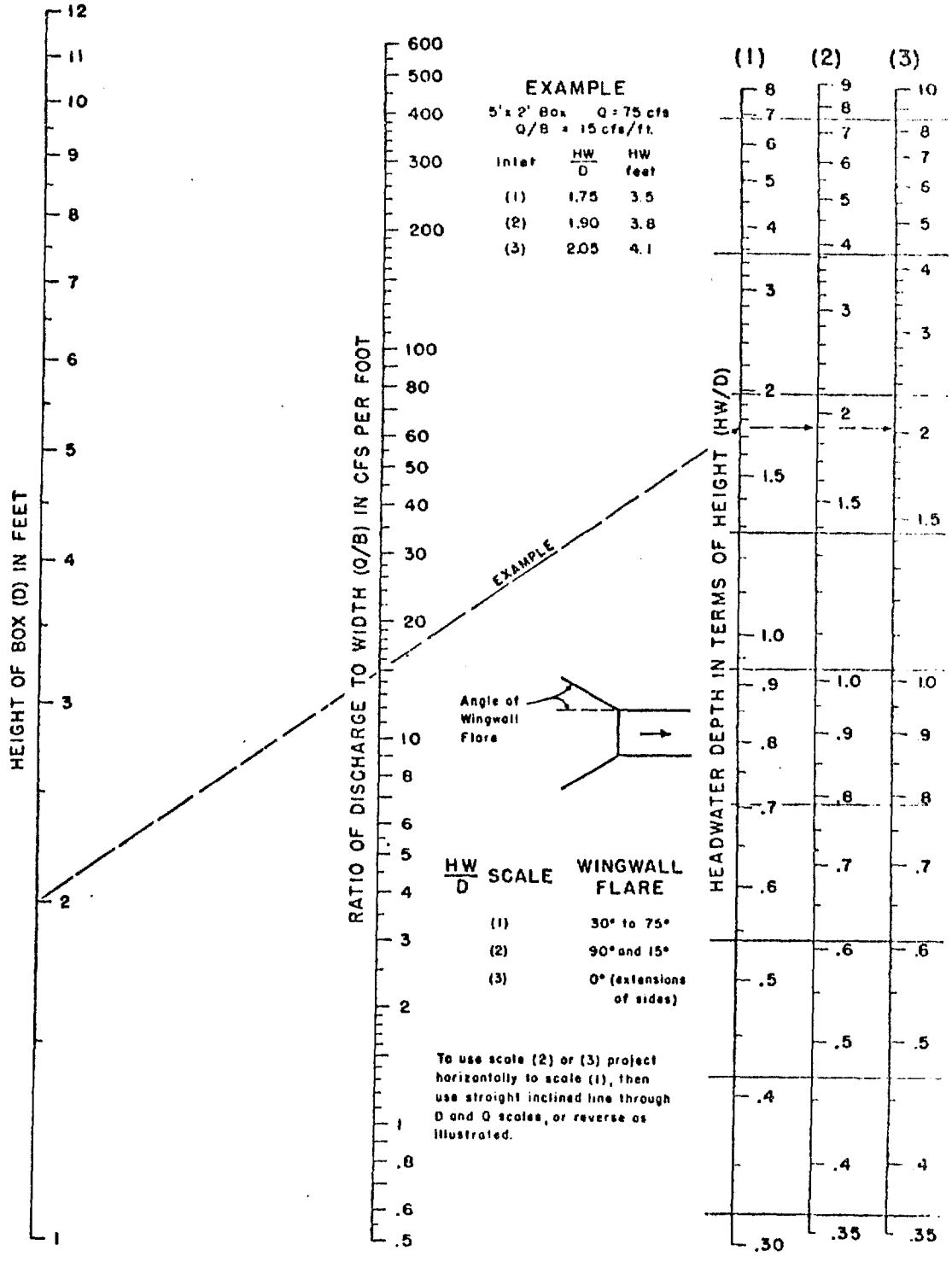


*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG

BUREAU OF PUBLIC ROADS JAN. 1963

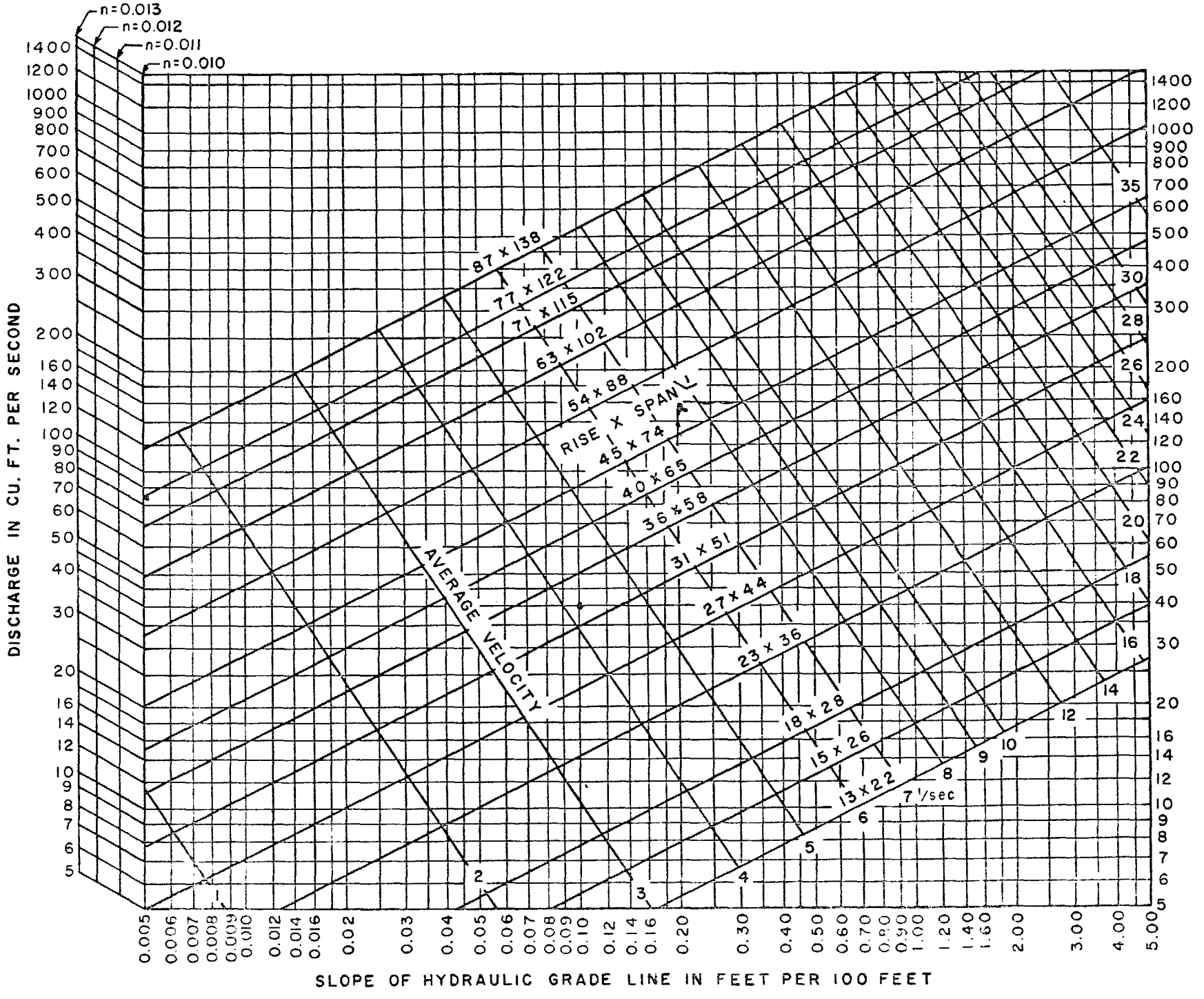
HEADWATER DEPTH FOR C. M. PIPE-ARCH CULVERTS WITH INLET CONTROL

Figure G



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

Figure H



ARCH PIPE DISCHARGE CURVES
(MANNINGS FORMULA)

Figure I

[redacted] Orl[redacted] eme[redacted] duc[redacted] ipan[redacted], 19[redacted]

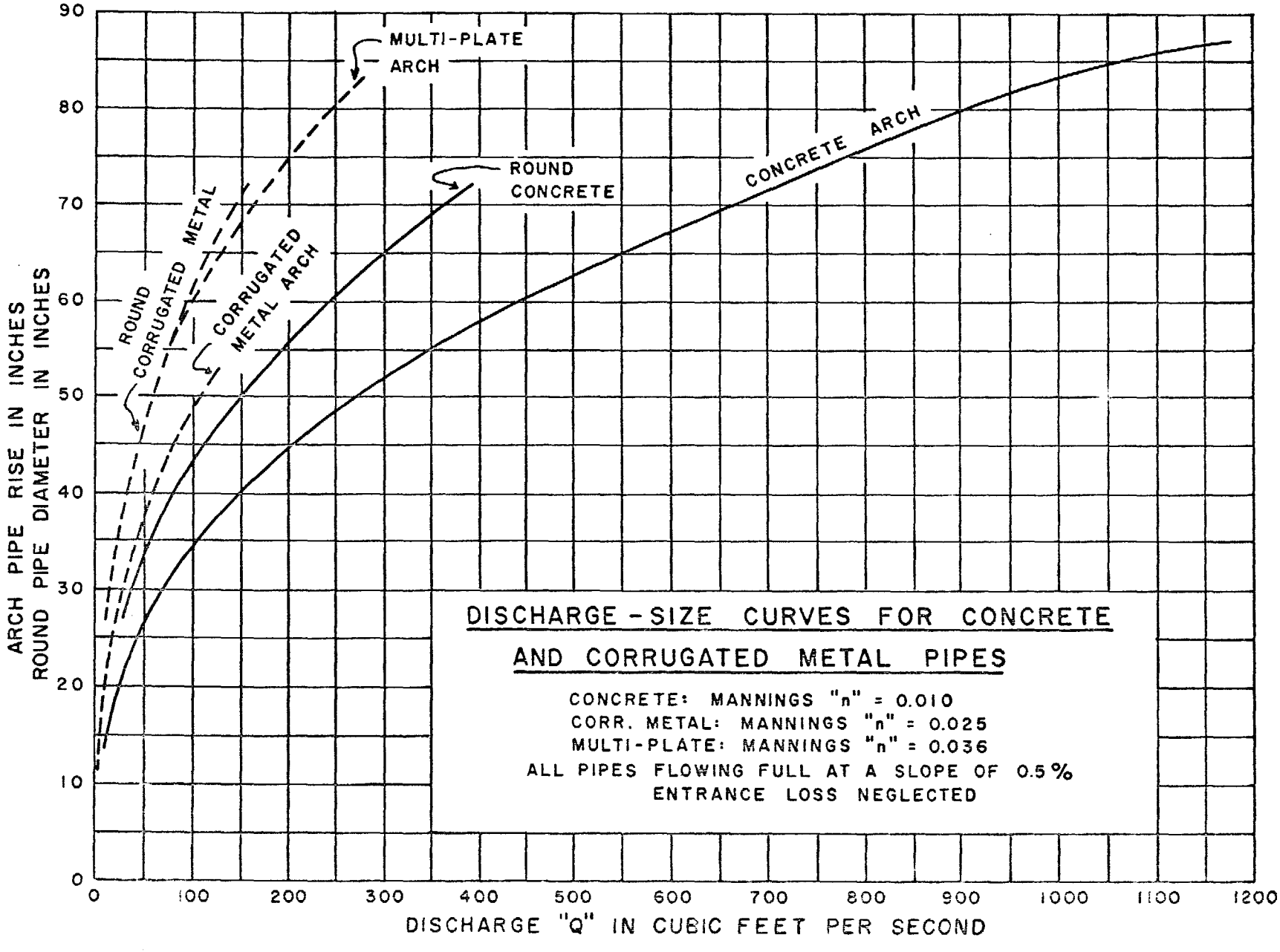


Figure J

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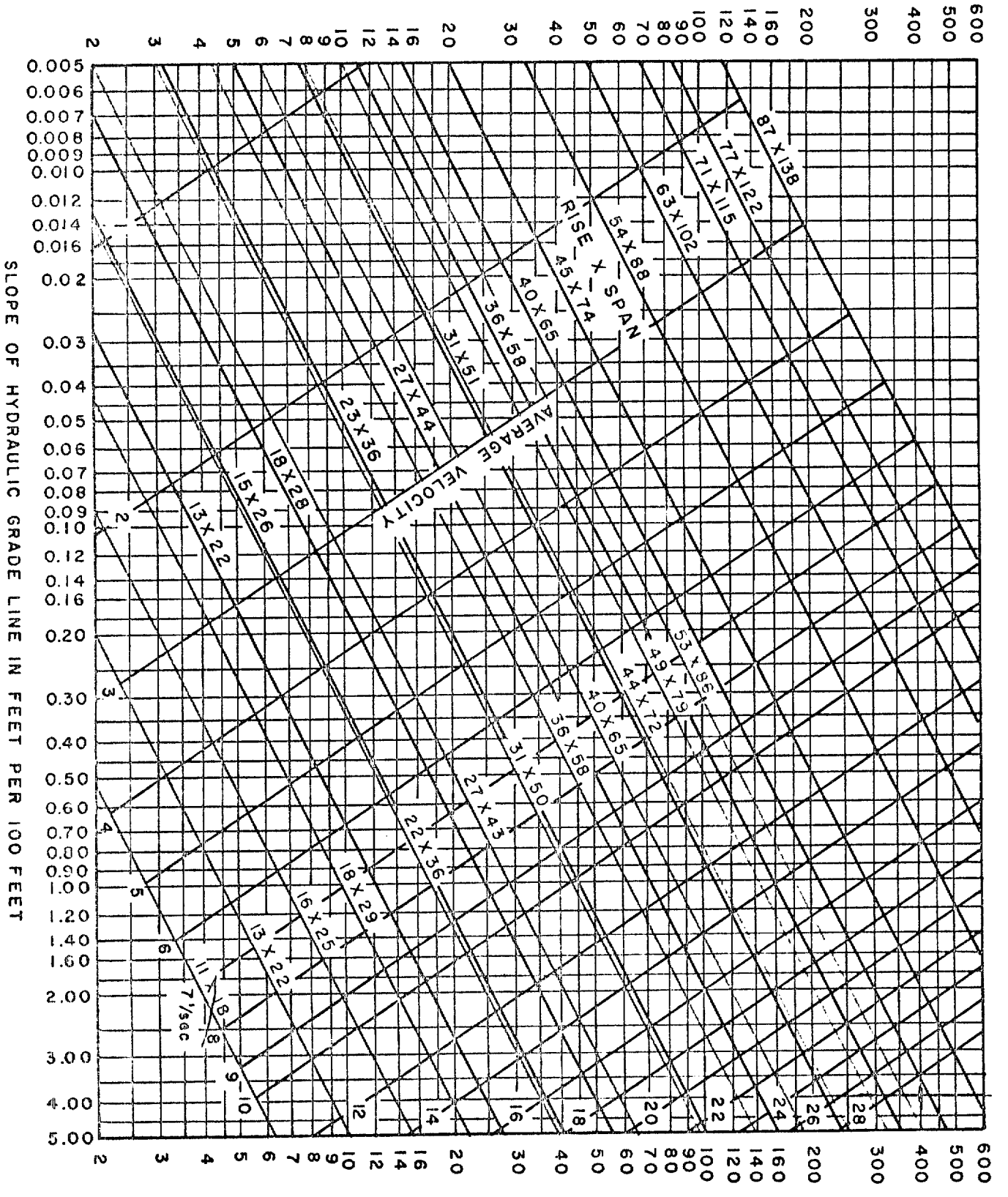
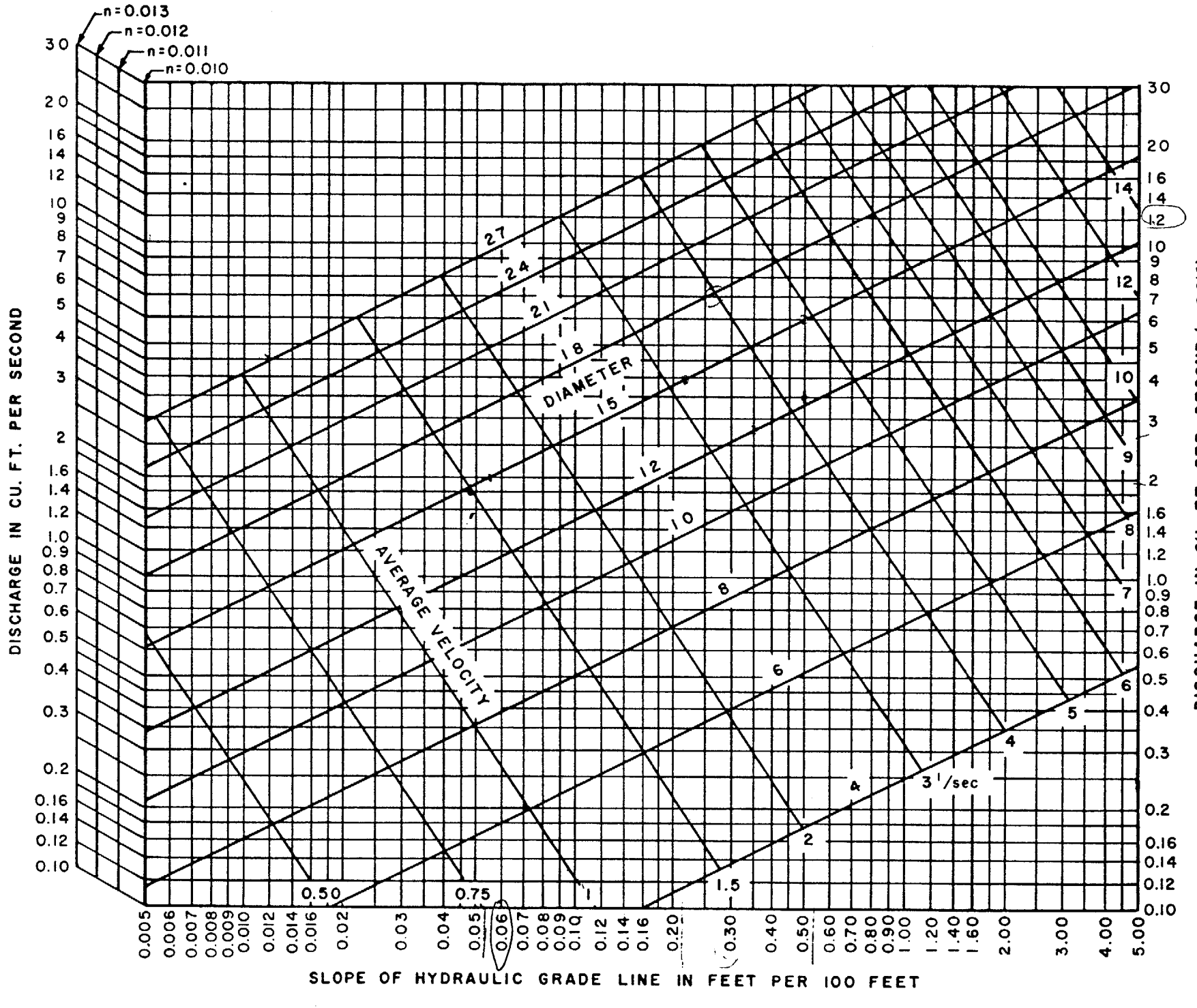
©New Orleans Cement Products Company, Inc., 1966



DISCHARGE CURVES FOR CONCRETE AND CORRUGATED METAL ARCH PIPE

(MANNINGS FORMULA)

Figure K



ROUND PIPE DISCHARGE CURVES

(MANNINGS FORMULA)

Figure L

Orle... Cement Products Company, Inc., 1968

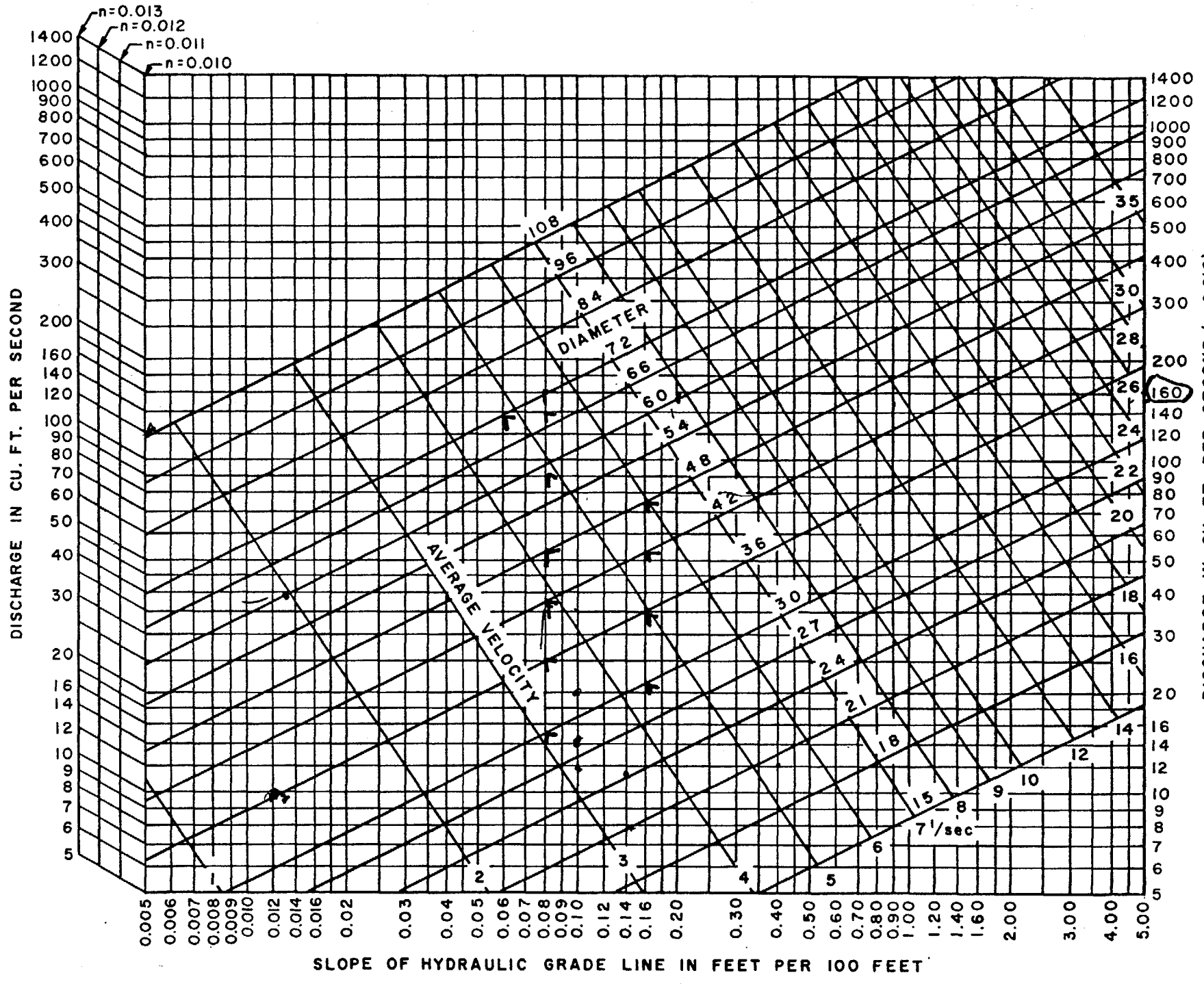


Figure M

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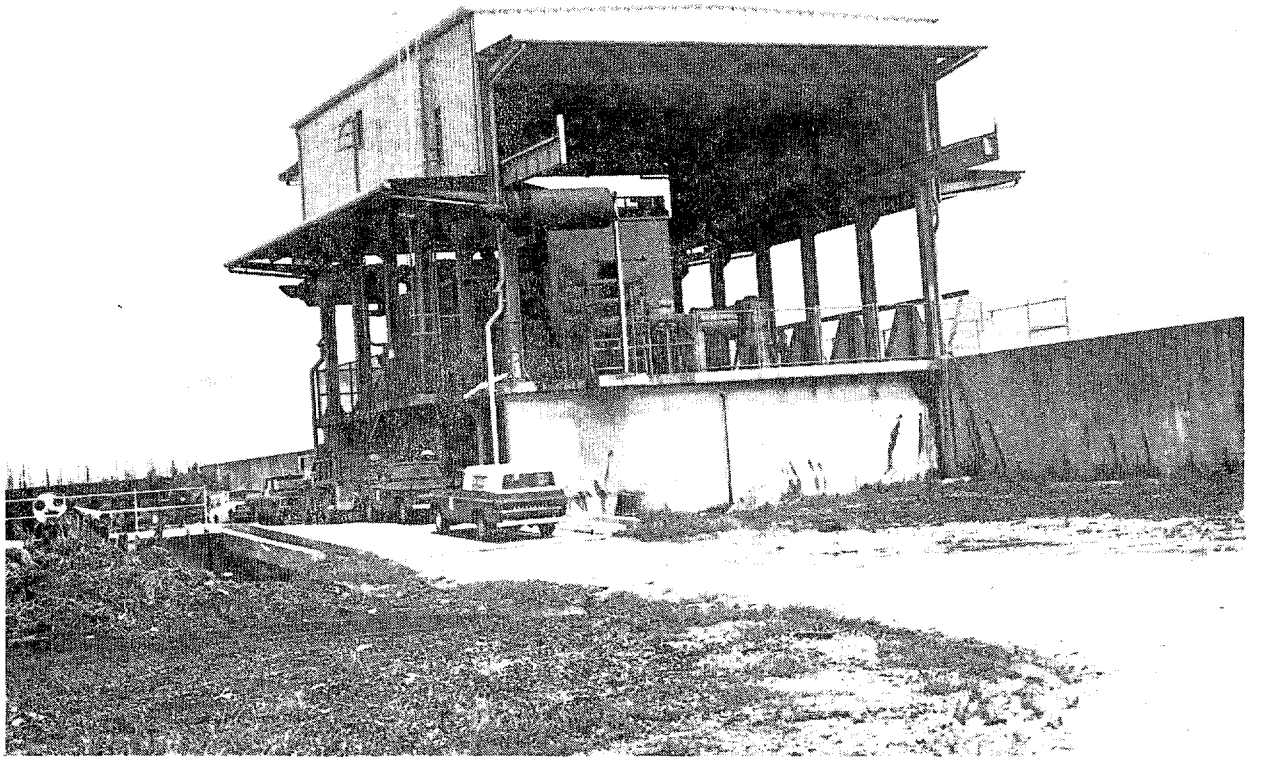
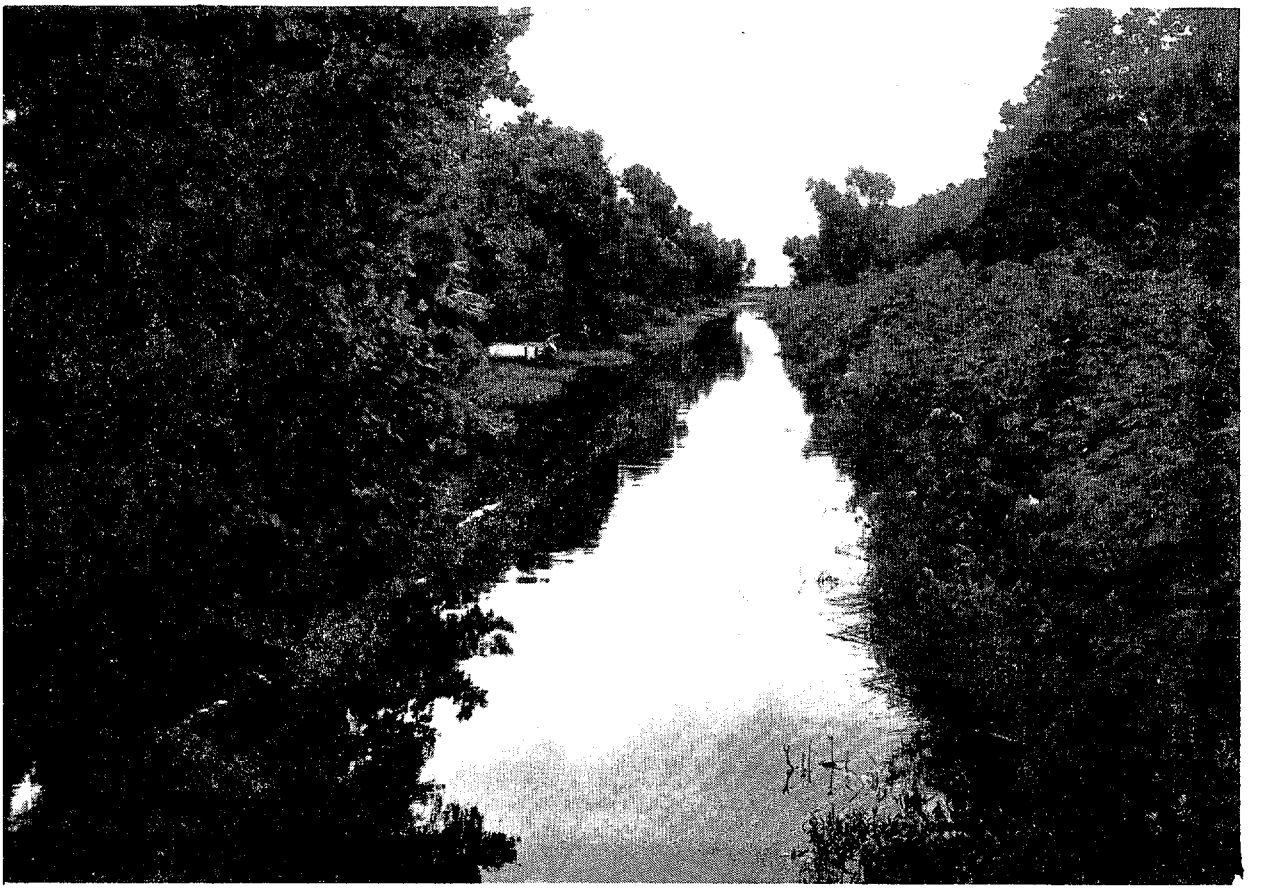
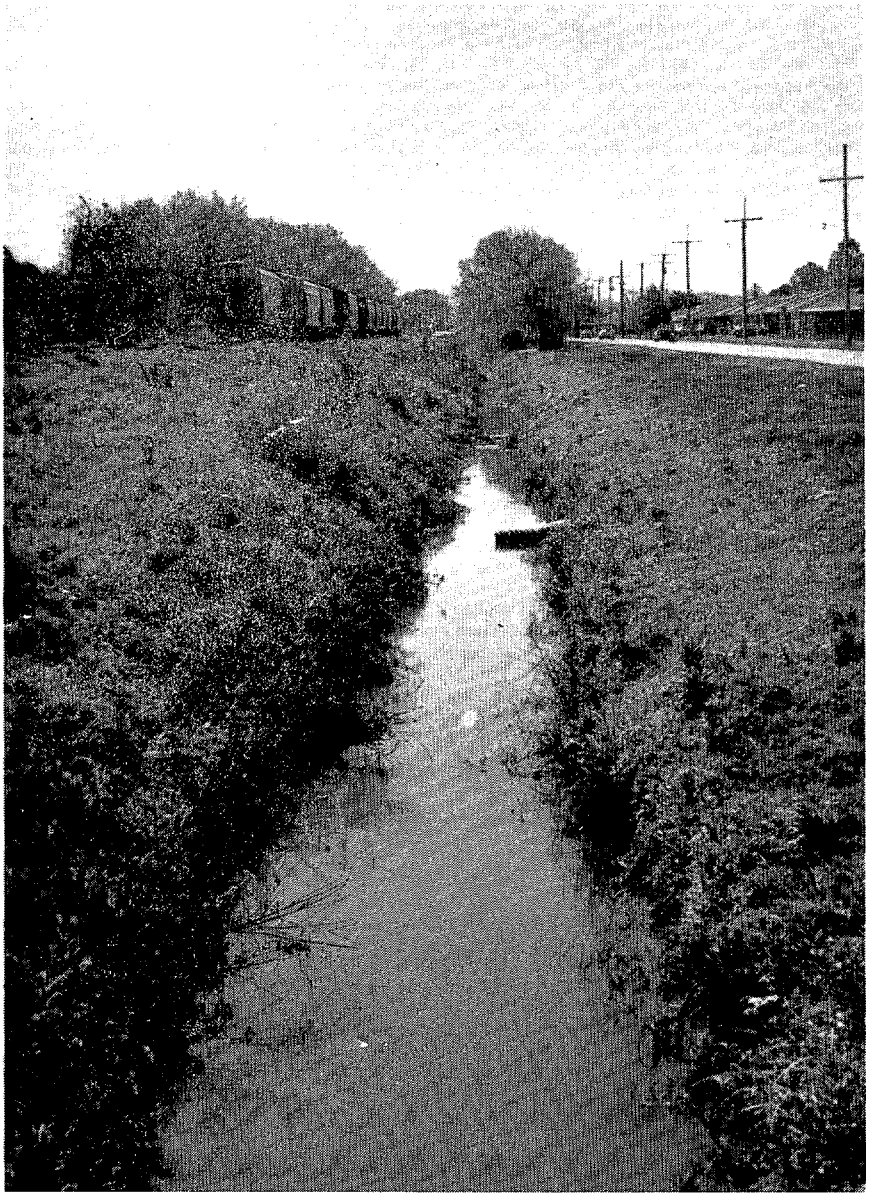


PUMPING STATION NO. 1



GUERENGER CANAL



WEST RAILROAD DITCH