
TERREBONNE PARISH

DESIGN MANUAL

STORM WATER DRAINAGE AND DETENTION



Terrebonne Parish Consolidated Government
P. O. Box 2768
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DESIGN MANUAL

STORM WATER DRAINAGE AND DETENTION TERREBONNE PARISH, LOUISIANA

I. EXECUTIVE SUMMARY

A. Purpose: The purpose of this manual is to provide a consistent policy direction for physical improvements necessary for storm water management. Proper provisions for drainage are required to minimize the risk of flooding to homes and businesses. The health, welfare and safety of the entire parish is affected by drainage. Therefore, it is in the interest of the public, sub-dividers/developers and the parish that development be conceived, designed and constructed in accordance with sound drainage management practices. It is therefore, the philosophy of the Terrebonne Parish Consolidated Government that:

1. All property to be developed shall be designed to accommodate a 25-year 24-hour rainfall event as defined by TP-40 of The National Oceanic and Atmospheric Administration.
2. The rate and volume of discharge from any proposed development shall be limited to a 10-year 24-hour event pre-development rate or a 25-year 24-hour rate if downstream improvements are made so as to not cause adverse impact.
3. Major drainage arteries shall at all times feasible be designed for a 25-year 24-hour rainfall event.

4. The development or improvement of existing lots of record less than one acre in size will not be subject to system volume storage requirements.
5. Developments within a gravity drainage area adjoining the Intracoastal Waterway (ICWW) and other selected waterways south of the ICWW will not be subject to system volume storage or limited rate of runoff requirements.
6. Terrebonne Parish Consolidated Government shall consider impact fees to fund drainage improvements, mitigate adverse impacts and assist in creating regional detention areas.
7. The concept of large regional detention areas and reservoir banking is encouraged and should be pursued by developers and Terrebonne Parish Consolidated Government whenever possible.
8. Drainage facilities shall consider long-term maintenance, potential expansion and future pollutant discharge elimination requirements.

II. GENERAL PROVISIONS

- A. General Design Requirements: The regulations contained in these standards will apply to all projects which are to be submitted for consideration to the Houma-Terrebonne Regional Planning Commission for the development of land in Terrebonne Parish such as residential subdivisions, commercial centers, industrial subdivisions, institutional and recreational areas. These standards cannot be expected to provide for all possible situations. They are intended to provide minimum design criteria, but not be substituted for the competent work of a registered civil design professional. These standards are also not intended to place unreasonable limitations on any innovative or creative effort, which could result

in better quality facilities, cost savings, or both. Any proposed departure from the standards will be considered if it is demonstrated that the approach will produce a compensating or comparable result, to the benefit of both the Parish and the system user.

The objective is a Parishwide storm water management system that will:

1. Be consistent with all other parish codes and land use plans and policies,
2. Be of adequate design to manage all volumes of water generated upstream and on site to an approved point of discharge,
3. Prevent the capacity of downstream channels and storm drainage facilities from being exceeded,
4. Prevent the uncontrolled discharge of storm water onto adjoining public or private property,
5. Maintain or reduce the maximum stage elevations of the original undeveloped drainage basin,
6. Be constructed of materials that will have sufficient strength to support external loads that may be imposed and to minimize corrosion.
7. Maximize efficient use of the natural drainage system including bayous, canals and wetlands,
8. Be designed in a manner that allows economical ongoing maintenance and ease of access,

9. Be designed using materials that ensure a specified design life; and
10. Maintain the highest feasible level of water quality.

B. INTERPRETATION AND COMPATIBILITY WITH OTHER REGULATIONS

In the interpretation and application of this chapter, all provisions shall be:

- 1) Considered as minimum requirements for the promotion of the public health, safety and general welfare.
- 2) Liberally construed in favor of the Terrebonne Parish Consolidated Government.
- 3) Not intended to repeal, abrogate or impair any existing federal, local or state law.

Further, where these provisions and any other law, ordinance or regulation conflicts or overlaps, whichever imposes the more stringent restrictions or imposes higher protection standards for human health or the environment shall control.

C. Definitions:

1. *Act of God* - A combination of events such as rainfall, flooding and general runoff which may cause damages of natural origin without the interference of man and for which the human prudence cannot anticipate or prevent over the design requirements established by these standards.
2. *Adverse Impacts* - Any increase in maximum stages, which cause uncontrolled or irresponsible discharge of storm water onto adjoining public or private property.
3. *Allowable Discharge* - The restricted discharge from a site after development or redevelopment as calculated in accordance with this manual.
4. *Base Flood, 100 Year* - A flood having a one-percent chance of being equaled or exceeded in any given storm event.

5. *Best Management Practice (BMP)* - A measure used to control the adverse storm water related effects of development. BMP includes structural devices designed to remove pollutants, reduce runoff rates and volumes, and protect aquatic habitats. BMP also includes nonstructural approaches, such as public education efforts to prevent the dumping of household chemicals into storm drains.
6. *Catch Basin* - Structure of a gravity storm drainage system with openings to allow the entrance of the superficial runoff to the subsurface drainage system.
7. *Channel* - Any river, bayou, stream, ponded area, slough, ditch, conduit, culvert or natural or man-made drainage way in or into which surface or ground water flows, either perennially or intermittently.
8. *Compensatory Storage* - An artificially excavated, hydraulically equivalent volume of storage within the watershed used to balance the loss of natural flood storage capacity when fill or structures are placed within the watershed.
9. *Conduit* - Any channel, pipe, storm sewer, culvert or appurtenance used for the conveyance or movement of water, whether open or closed.
10. *Design Engineer* - Registered and licensed Professional Engineer in the State of Louisiana retained by Owner/Developer responsible for the design of a drainage plan.
11. *Design Storm, 10-Year Event* - A runoff, rainfall or flood event, having a ten percent (10%) chance of occurring in any given storm event.

12. *Design Storm, 25-Year Event* - A runoff, rainfall or flood event, having a four percent (4%) chance of occurring in any given storm event.
13. *Detention Basin/Pond* - A facility designed and constructed or modified to provide for the temporary storage of storm water runoff and the controlled release by gravity of this runoff at a prescribed rate during and after a flood or storm.
14. *Development* - Any man-made change to real estate, including:
 - a. Construction or placement of a building or any addition to a building,
 - b. Construction of roads, bridges, or similar projects,
 - c. Redevelopment of a site,
 - d. Filling, dredging, grading, clearing, excavating, paving, or other nonagricultural alterations of the ground surface,
 - e. Storage of materials or deposit of solid or liquid waste, and
 - f. Any other activity that might alter the magnitude, frequency, deviation, direction, or velocity of storm water flows from a property.
15. *Discharge* - Total runoff produced by a tributary area including surface and subsurface runoff expressed in volume or volume per unit of time.
16. *Drainage Facilities* - Pipes, ditches, detention basins, canals, culvert bridges, weirs, or any other appurtenances, used singularly or in combination with each other for the purpose of conveying or storing runoff.

17. *Drainage Plan* - A plan, including engineering drawings and supporting calculations, which describes the existing storm water drainage system and environmental features as well as the drainage system and environmental features which are proposed after development of a property.
18. *Dry Basin/Pond* - A detention basin designed to drain completely after temporary storage of storm water flows and to normally be dry over the majority of its bottom area.
19. *Energy Dissipator* - A structure designed for the purpose of minimizing kinetic energy of the flow.
20. *Energy Gradient* - Total energy in any point along the flow through a channel or conduit and is represented by the sum of velocity head, pressure head and static head.
21. *Erosion* - The general process whereby earth is removed by flowing water or wave action.
22. *Excess Storm Water Run-Off* - The volume and rate of flow of storm water discharged from an urbanized drainage area, which is or will be in excess of that volume and rate, which existed before urbanization.
23. *Extraordinary Rainfall* – Rainfall which exceeds design parameters and is considered an act of God.
24. *Flood or Flooding* - A general and temporary condition of partial or complete inundation of normally dry land areas resulting from the overflow of water bodies or the unusual and rapid accumulation of surface water runoff from any source.

25. *Flow Line (FL)* - The elevation of the bottom of the inside of a culvert or conduit.
26. *Flow Time* – The time it takes water to travel from the most remote point in the drainage area to the point under consideration.
27. *Forced Drainage Pumping Station Main Feeder Channel* - A natural or manmade channel capable of conveying the runoff from a developed site without over topping its banks or cause adverse impacts. These channels shall have a minimum end area of 50 square feet for its entire length, shall be the main feeder channel to the pump station and shall be free of any hydraulic obstructions.
28. *Freeboard* - The vertical distance from the maximum water elevation of a conduit, channel or pond to the top of the structure that provides vertical containment.
29. *Grade* - Grade or slope is the vertical change in elevation divided by the horizontal distance between the same two points. Slope is usually expressed in foot per foot (rise over run). Grade is often expressed as a percentage (rise divided by run times 100).
30. *Hydraulic Grade Line (HGL)* - Water surface profile represented by the difference in hydraulic head at two points.
31. *Hydrograph* - A graph showing, for a given location in any drainage system, the discharge, stage, velocity with respect to time.

32. *Impervious Surface* - Surface that does not allow storm water runoff to slowly percolate into the ground.
33. *Invert* - The bottom or flow line of a channel, pipe, or manhole.
34. *LDOTD* - Louisiana Department of Transportation and Development.
35. *Major Drainage Arteries* - A collector discharge channel, which is capable of transporting large volumes of water. These major arteries are identified in Exhibit 1.
36. *Maximum Flood Stage* - The maximum water surface elevation for a design storm event at a given location.
37. *Mitigation* - Mitigation includes those measures necessary to minimize the negative effects, which storm water drainage and development activities might have on the public health, safety and welfare.
38. *NAVD 88* - North American Vertical Datum of 1988 (this datum may require adjustments to conform to the latest revised).
39. *On-Site Detention* - Storage of excess runoff on a development site prior to its entry into the public storm drain system and gradual release of the stored runoff after the peak of the runoff event has passed.
40. *Peak Discharge* - The maximum water runoff rate (CFS) determined for the design storm.

41. *Property* - A parcel of real estate.
42. *Retention Basin* - A facility designed to completely retain a specified amount of storm water runoff without release except by means of evaporation, infiltration, emergency bypass or pumping.
43. *Servitude* - Any land that is dedicated for use by the parish by deed, conveyance, donation, agreement, easement, dedication, usage or process of law, and within which the Parish shall have the right to install and maintain storm drains or other drainage facilities.
44. *Runoff Coefficient* - A decimal value, which defines the characteristics of the runoff of a specific tributary area.
45. *Storm Drain* - A system of open or enclosed conduits and appurtenant structures intended to convey or manage storm water runoff, ground water and drainage.
46. *Storm Water Runoff* - The water from a rainstorm or other natural event, which flows over the surface of the ground or is collected in a drainage system.
47. *Time of Concentration* - The elapsed time for storm water to flow from the most distant point in a drainage basin to a particular point of interest in that watershed.
48. *Tributary Watershed* - A drainage area that contributes runoff to a given point.

- 49. *Uninhabited Areas* - Areas of allowed inundation for design storm. These are areas where structures do not exist.
- 50. *Variance* - Is a grant of relief to a person from the requirements of this ordinance when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise prohibited by this manual.
- 51. *Watershed* - A region draining into a water body.
- 52. *Wet Basin/Pond* - A detention basin designed to maintain a permanent pool of water after the temporary storage of storm water runoff.

D. **Enactment Authority:** By authority of Ordinance No. 7449 of the Terrebonne Parish Council, these standards will apply to all projects which are to be submitted for consideration to the Houma-Terrebonne Regional Planning Commission for development.

E. **Enforcement:** It shall be the duty of the Planning Commission to enforce this manual in accordance with procedures developed and adopted in a separate written document.

No approval shall be issued for any parcel or plat of land created by subdivision, development or otherwise after the effective date of the ordinance from which this manual is adopted, and not in conformance with the provisions of this manual; and no excavation of land pursuant to activities covered by this manual or construction of any improvements covered by this manual shall take place or be commenced except in conformity with this manual.

- F. Impact Fee: Until legislation is passed and a parish wide fee schedule is adopted, the Terrebonne Parish Consolidated Government may elect to accept a fee from developers in lieu of providing on-site improvements provided the following criteria is met:
1. The fee amount shall cover the expenses to provide mitigation so as to offset any impacts.
 2. The development cannot cause any adverse impacts.
 3. The mitigation has to be implemented immediately if impacts are expected or the Parish may elect to accumulate funds to construct larger projects for the benefit of the parish.

III. REVIEW AND APPROVAL PROCEDURES

- A. Review Process (Drainage Impact Studies, Construction Plans and Mitigation): The design and construction of the drainage system for development projects shall be included as part of the engineering plans required for development. The Engineer and/or Developer shall submit and follow the procedures of the Houma-Terrebonne Regional Planning Commission and/or the Terrebonne Parish Consolidated Government in order to obtain the approval of the engineering plans.
- B. Building Permit Process: For approval of a Building Permit Application, all proposed commercial or industrial developments shall have submitted adequate plats, plans, calculations and approvals necessary to demonstrate compliance with Code Section 22-168. A Building Permit Drainage Design Flow Chart is included within Section X, Exhibit 2.

- C. Subdivision Review Process: For approval of a division of property, all proposed development shall have submitted approved engineering plans in compliance with Chapter 24 of the Terrebonne Parish Subdivision Regulations.
- D. Special Requirements: Subsurface drainage shall be provided on all streets in the City that are to be accepted by the Terrebonne Parish Government for maintenance, in accordance with the minimum standards and requirements of this manual.

IV. HYDROLOGY

Hydrology is generally defined as a science dealing with the interrelationship between water on and under the earth and in the atmosphere. For the purpose of this manual, hydrology will deal with estimating flood magnitudes as the result of precipitation.

- A. Rainfall: All new property to be developed shall be designed to accommodate a 25-year, 24-hour duration as defined by TP40 of the National Oceanic and Atmospheric Administration (NOAA). A NOAA Chart showing rainfall magnitudes for this event is included within Exhibit 3.

The rate and volume of discharge from any proposed development shall be limited to a 10-year, 24-hour duration pre-development rate or a 25-year, 24-hour duration rate if downstream improvements are made so as to not cause adverse impact. A NOAA Chart showing rainfall magnitudes for this event is included within Exhibit 4.

- B. Hydrologic Data: To prepare the preliminary plan of development, the Engineer must be familiar by means of a personal inspection of the existing conditions and surrounding areas. The plan shall include information with regards to previous flooding and existing flood plains in order to determine the maximum water level,

water body conditions and structures, which may regulate the flow. Typical data to be included in the plan are vicinity map, topographic maps, aerial photographs, stream flow records, historical high water elevations, FEMA 100 year flood elevation, soil types, land use, slope, surface infiltration and storage.

- C. Coordination: The location of all possible discharge points shall be identified along major drainage arteries. Maximum stage elevations at these discharge points for the design storm will be furnished by the Terrebonne Parish Engineering Department. If within a forced drainage area, the maximum pump drawdown will also be furnished and/or approved.

- D. Runoff Computation, Hydrograph Development and Modeling: There are numerous methods available for rainfall runoff computations on which the design of storm water drainage and flood control plans may be based. For Terrebonne Parish, the following three methods will be considered acceptable for determining the rate of runoff, volume of runoff and the distribution of flow of water being discharged from a specific area.
 - 1. Rational method,

 - 2. Soil Conservation Service (SCS) Method, now the Natural Resources Conservation District (NRCS) (TR-55),

 - 3. Unit Hydrograph Method (HEC-1, SWMM, TR-20).

The Rational Method is acceptable for drainage areas no greater than 150 acres, where only the peak discharge is of concern. For larger drainage systems or where runoff volumes are needed, the Hydrograph Methods (TR-55, HEC-1 or TR-20) and the SCS runoff curve number should be used. The Rational Method of Louisiana Department of Transportation and Development's Hydraulic Program

HYDR6020 and HYDR6000 shall be used in calculating storm drain and inlet spacing for urban roadways with curb and gutter and subsurface drainage systems. Rational method analysis, runoff coefficients, time of concentration and rainfall intensities shall conform to Chapter II of the Louisiana Department of Transportation and Development Hydraulics Manual. Acceptable runoff coefficients to be used in the Rational Method are contained in Exhibit 5.

The Soil Conservation Service (SCS) method was originally based on the observed runoff from agricultural watersheds. The SCS method uses a curve number to define some of the characteristics of the watershed. This curve number reflects a combination of the soil hydrologic group, the land use and the treatment class. The SCS analysis, hydrologic soil group, runoff curve number and adjustment factors shall conform to Chapter I of the Louisiana Department of Transportation and Development Hydraulics Manual. Hydrographs for SCS method shall be based upon Type III, 24-hour rainfall distribution shown in Technical Publications of the National Weather Service of the National Oceanic and Atmospheric Administration (NOAA). Hydrograph shape factor of 256 will be used unless supporting data is provided for review and accepted by Terrebonne Parish reviewer.

The unit hydrograph of a drainage basin or watershed is defined as a graph of direct runoff resulting from one inch of effective rainfall generated uniformly over a basin area at a uniform rate during a specified time or duration. A unit hydrograph can be used to derive the hydrograph of runoff or peak discharge due to any amount of rainfall. Hydrographs give the designer an accurate tool to use for analysis since actual rainfall-runoff events can be simulated. With calibration to actual historical events, then a calibrated model can be used to simulate other events of different magnitudes for that same watershed. Synthetic hydrographs for un-gaged drainage basins, or watersheds, still provide the designer a more accurate tool for simulation and analysis than non-hydrograph methods. A simple

visual observation of a stream segment or a curb and gutter during a storm event shows that runoff and discharge will build to a peak over time and then gradually recede. While a synthetic unit hydrograph may not exactly simulate the occurrence, the variation of runoff with time in the synthetic unit hydrograph more closely portrays the actual occurrence than a non-hydrograph method.

- E. Flood Routing: Designers shall be required to either provide on-site storage volume to restrict runoff to 10-year pre-condition or route post condition runoff to major drainage artery without adverse impact. If an adequate receiving channel or pipe does not exist on or off the development site, one shall be constructed to the nearest existing adequate channel. There are two types of routing that are important; stream flow routing and reservoir routing:
1. *Stream Flow Routing* - Stream Flow Routing is conceptually similar in that a hydrograph is moved from a point upstream to a point downstream, and the channel storage characteristics determine the degree of attenuation of the hydrograph.
 2. *Reservoir Routing* - Reservoir Routing is the process of moving an upstream hydrograph through a structure to a point on the downstream side of the structure; the routing process takes into account the storage characteristics of the structure.
- F. Land Use: Accepted runoff curve number (CN) for selected agricultural, suburban and urban land uses are contained in Exhibit 5.
- G. Datum: All elevations shall be referenced to the latest Parish adopted Vertical Datum.

- H. Gage Reading (Historic Data): Maximum stage elevations at major drainage arteries for design storm within forced drainage areas shall be based upon recent hydraulic models contracted by Terrebonne Parish. In gravity areas and forced drainage areas without recent model data, maximum stages shall be obtained from the Resio Report, which is contained in Appendix "A". The Terrebonne Parish Engineering Department will interpret and furnish these elevations to the designer.

V. HYDRAULIC DESIGN

- A. Storm Design Requirements: Storm Sewer Systems shall be designed for a minimum of a 25-year storm. Discharge points shall be restricted to a 10-year pre-condition rate or provide downstream improvements to the major artery so as to not cause adverse impact.

The following minimum information shall be included in the drainage and/or construction plans:

1. Existing Site Plan (Minimum Scale 1" = 100') showing drainage features, one foot contours, utilities, roads, structures, impervious areas and flood encroachment areas.
2. Proposed Site Plan (Minimum 1" = 100') showing streets, utilities, drainage features, lot lines, lot grading, discharge canals and location of major drainage artery.
3. Plan/Profile Drainage Sheets (Minimum Scale 1" = 50' Horizontal and 1" = 5' Vertical), Plan/Profile Roadway Sheets (Minimum Scale 1" = 40' Horizontal and 1" = 4' Vertical) showing size, type, and invert elevation of all drain pipes and structures, geometric layout of all streets including centerline, geometry centerline roadway stations, finished centerline

roadway slopes (minimum 0.35% for curb and gutter streets) including points of vertical intersection, finished grade at right-of-way, hydraulic gradient, tail water elevation, ditch flow lines, top and invert elevations of all drainage structures and utility lines, dimension of all servitudes, all utilities within road right-of-way, north arrow and legend.

4. Drainage Map/Hydraulic Computations showing all drainage features, right-of-ways and servitudes, tributary areas, watershed boundaries, structure reference numbers, discharge points, design criteria, hydraulic computations (rounded to the nearest 0.10 foot), maximum stages at all nodes, graphic representation of surface and subsurface flow, tail water elevation, statement of no adverse impact, maximum flows (pre vs. post), volume runoff (pre vs. post), hydrographs at discharge points (pre vs. post), runoff factors, time of concentration, land slope, north arrow and legend. An example of pre and post hydrographs showing required volume storage is shown in Exhibit 6. On-site stage elevations shall be determined by routing flows from the downstream tailwater elevation furnished by the Parish to the development's downstream discharge point.
5. Typical roadway section showing roadway width and thickness, shoulder width (if applicable), ditch dimensions and side slopes (if applicable), location of all utilities, subsurface drainage, right-of-way width, and transverse road slope.
6. Lot drainage: Storm drainage pipe shall be located within the street right-of-way. Special servitudes may be required for interconnection or outfall purposes with the subdivision.

All lots in subdivisions inside the Urban Services District and Urban Planning Area are to be graded to drain to the street or to MAJOR DRAINAGE ARTERIES as defined by Exhibit 1.

All lots in subdivisions inside Rural Subdivisions are to be graded to drain to the street or to MAJOR DRAINAGE ARTERIES as defined by Exhibit 1.

Outside the Urban Services District and Urban Planning Area, the Houma-Terrebonne Regional Planning Commission is authorized to allow that portion of a lot that it deems appropriate to drain to the rear if the drainage is to be perpetually privately maintained or in the following non-exclusive circumstances:

- i) In areas where parish maintained drainage to the rear of the lots being developed already exists or is to be dedicated; however, the percentage drained to the rear may not exceed 60% of the total depth on lots up to 225' deep, or that portion greater than 135' on lots greater than 225' deep, unless a greater percentage is required to comply with items (ii) or (iii) below.
- ii) Where the size limitation of the road side ditches will otherwise be exceeded.
- iii) Where the size of the curb and gutter drainage pipe exceeds 36" in diameter.

The culverting or fencing of rear lot drainage servitudes is strictly prohibited except as provided by the Terrebonne Parish Consolidated Government Code.

7. Reference standard plan details of all drainage structures. A list of LDOTD drainage structures is shown in Exhibit 7.

8. Existing cross sections at maximum hundred foot intervals showing proposed roadway, ditch and lot grades.

9. The following equations may be used to determine the time of concentration for overland flow:

a. Rational Method: $t_c = 0.7039 * (\ell^{0.3917}) * (c^{-1.1309}) * (s^{-0.1985})$

t_c is the overland time of concentration (minutes)

ℓ is the length of flow (feet)

c is the rational equivalent runoff coefficient (unitless)

s is the frictional gradient (unitless)

b. SCS LAG Method: $L = \frac{\ell^{0.8} (S + 1)^{0.7}}{1900 Y^{0.5}}$

L is the time in hours from center of mass of rainfall to peak discharge.

ℓ is the hydraulic length.

S is the maximum retention

Y is the slope in percent

$t_c = 5/3 L$

10. Projects south of the South Terrebonne Development Zone shall be designed for a minimum roadway elevation of +3.5' and a minimum lot elevation of +2.0'. The Development Zone is defined as all land southerly and 1,500' northerly of a line drawn connecting the following points: Falgout Canal Marina, Buquet Bridge, Montegut Bridge, Humble Canal Bridge, and the southern tip of the Wildlife and Fisheries Management Area in Point-aux-Chenes. All existing land below the 25-year stage elevation shall be designed to drain under ordinary conditions, but will not

be required to restrict post development runoff rates. A map showing these boundaries can be obtained from the parish engineering department.

B. Closed Storm Drainage System: Design of closed drainage systems and preparation of construction plans shall adhere to the following:

1. All drain pipes shall have a minimum inside diameter of 15” diameter or equivalent except restrictor pipes on downstream end may be 8” diameter.
2. All storm drain pipe (closed storm drain systems) to be dedicated to the Parish shall have a minimum design service life of 70 years. All cross drain pipes (under roadways and turnouts) to be dedicated to the Parish shall have a minimum 50 year design service life. All side drains (under drives, rear lots and similar installations) to be dedicated to the Parish shall have a minimum 30 year design service life. Corrugated metal pipe used for non-highway drainage purposes shall conform to minimum gage requirements of the LDOTD Standard Plan SAM-1.
3. Pipes or pipe arches should be sized to operate full with a minimum self-cleansing velocity with the exception of initial pipes in the system.
4. Maximum slope of pipes should be that which permits a maximum velocity of ten feet per second for the design flow. Outlet protection will be required for velocities above 10 feet per second.
5. Manholes or catch basins shall be located at all changes in vertical and horizontal direction. Maximum spacing between manholes and/or catch basins shall conform to Louisiana Department of Transportation and Development Hydraulic Manual, but shall not exceed 250 feet.

6. Values of Manning's roughness coefficient used in design shall conform to Exhibit 8 of this manual.
7. A minimum vertical distance of 6" shall be maintained from bottom of the pavement to the top of drainpipe. A greater distance may be required depending on the structural strength of the drain pipe.
8. All drain pipes under roadway shall be joined in conformance with Louisiana Department of Transportation and Development Type 3 joints.
9. Catch basins, manholes and grate inlets shall conform to Louisiana Department of Transportation and Development standard plans.
10. The minimum width of servitude for drain pipes outside road right-of-way and less than 42" diameter shall be 15 feet. Pipe diameters 42" and greater shall be 20' wide.
11. To determine inlet spacing and type, designers shall be required to run Louisiana Department of Transportation and Development HYDR6000 computer program or provide basic inlet calculations as described below. Results of run shall provide a gutter flow of less than 10 CFS, and width of flooding of less than 8 feet and catch basin spacing of less than 250' between catch basins or between catch basin and high point in roadway.
 - a) Inlet capacity of drop openings (CB-01)

$$Q = 3 * fl * P * d$$

Q is the mass flow rate (cfs, cubic feet per second).

fl is the clogging reduction factor (0.8 unitless).

P is the perimeter of the grate opening neglecting the side against the curb (feet).

d is the depth of water over the grate (feet).

- b) Inlet capacity of curb openings (CB-06)

$$Q = 3 * f_2 * L * d$$

Q is the mass flow rate (cfs, cubic feet per second).

f₂ is the clogging reduction factor (0.9 unitless).

L is the length of the clear opening (feet).

d is the depth of water over the grate (feet).

- c) Inlet capacity of combination openings (CB-07)

$$Q = 3 * d ((f_1 * P) + (f_2 * L))$$

Q is the mass flow rate (cfs, cubic feet per second).

f₁ is the clogging reduction factor (0.8 unitless).

f₂ is the clogging reduction factor (0.9 unitless).

P is the perimeter of the grate opening neglecting the side against the curb (feet).

L is the length of the clear opening (feet).

d is the depth of water over the grate (feet).

12. To determine pipe size and hydraulic grade line, designers shall be required to run Louisiana Department of Transportation and Development HYDR 6020 Computer Program. Results of run shall provide a maximum hydraulic clearance at gutter line of 0.20' above gutter grade. Design sketches of numbered structures and drainage areas shall be included.
13. Other computer models for analysis may be used at the discretion of the Parish Engineer and with prior approval.

- C. Open Storm Drainage System: Design of open storm drainage systems and preparation of construction plans shall adhere to the following:
1. All drain pipes shall have a minimum inside diameter of 15" or equivalent except restrictor pipes on downstream end may be 8" diameter.
 2. All storm drain pipe (open storm drain systems) to be dedicated to the Parish shall have a minimum design service life of 70 years. All cross drain pipes (under roadways and turnouts) to be dedicated to the Parish shall have a minimum 50 year design service life. All side drains (under drives, rear lots and similar installations) to be dedicated to the Parish shall have a minimum 30 year design service life. Corrugated metal pipe used for non-highway drainage purposes shall conform to minimum gage requirements of the LDOTD Standard Plan SAM-1.
 3. Pipes or pipe arches installed in major drainage arteries shall be sized for a maximum allowable headwater of 0.5' or 1.0' below the edge of roadway, whichever provides less differential head.
 4. Outlet protection will be required for velocities above 10 feet per second.
 5. Values of Manning's roughness coefficient used in design shall conform to Exhibit 8 of this manual.
 6. Entrance loss coefficients used in design shall conform to Louisiana Department of Transportation and Development Hydraulics Manual.
 7. A minimum vertical distance of 6" shall be maintained from the bottom of the pavement to the top of drain pipe. A greater distance may be required depending on the structural strength of the drainpipe.

8. All storm and cross drain pipes shall be joined in conformance with Louisiana Department of Transportation and Development Type 3 joints.
9. The minimum width of servitude for drain pipes outside of road right-of-way and less than 42" diameter shall be 15 feet. Pipe diameters 42" and greater shall be 20' wide.
10. Roadside ditches shall have a minimum 3:1 side slope (both sides) and a maximum depth of 3' – 6" measured from top bank.
11. Ditch centerline shall not be less than 12' from edge of roadway.
12. Minimum longitudinal ditch invert slope shall be 0.001 ft./ft. Ditch invert elevation shall be established to accommodate future placement of culverts in ditch.
13. Minimum road right-of-way with open ditch shall be 60'.
14. To determine normal depth of flow in channel, designers shall be required to run Louisiana Department of Transportation and Development HYDR1140 Computer Program. Results of the run shall provide a depth of flow within the banks of the channel.
15. Minimum width of ditch bottom shall be 2'.
16. Manning roughness factors for channels shall conform to Exhibit 8.
17. A water surface profile must be computed for all ditches and channels and shown on final drawings.

18. Sizes of future driveway culverts shall be depicted on final subdivision plat. Culverts shall be sized as though the entire subdivision was subsurface drainage.
19. Other computer models for analysis may be used at the discretion of the Parish Engineer and with prior approval.

VI. SYSTEM STORAGE

Detention facilities are required on developments greater than one acre or whenever proposed development will create conditions that will increase storm flows and/or stages that cause adverse impacts on adjacent properties. Detention facilities hold runoff for a short period of time and then release it at a controlled rate into the area storm drain system. Proposed storm sewer detention facilities shall be designed to have capacity to detain at minimum the 25-year recurrence interval design storm runoff volume in excess of the allowable 10-year pre-developed rate.

- A. Detention Facilities: Design of storm water detention facilities and preparation of construction plans shall adhere to the following:
 1. Detention requirements shall not be required on developments of less than one acre.
 2. Where existing conditions make storm water detention impossible for part of a site, compensatory storage volume may be provided on another part of the site provided the compensatory storage offsets any adverse impacts of the developed site.

3. Detention facilities may be open basins or ponds, roof top storage, parking lot ponding, underground storage, uninhabited areas or a combination. Uninhabited areas shall be designated as “Raw Land”.
4. Drainage plans shall include plan, profile and cross sections of the detention facilities together with size, length and inverts of pipes and structures, design volume of detention ponds, grades and bottom elevation of ditches, channels, swales, ponds and parking lots, and maximum stage elevations.
5. System design should be based upon a careful conceptualization of how water will move into, through and out of the system, anticipating possible problems such as flow impediments, construction difficulties, future maintenance and erosion problems. The on-site drainage system, including conveyance, flow restriction, detention, and emergency elements, must be properly designed to handle both on-site runoff and conveyance through the site of off-site runoff.
6. Systems should be designed to anticipate, enable and minimize future maintenance needs.
7. Multiple uses of on-site facilities are encouraged, for example: using parks, play areas, soccer fields, baseball fields, and parking lots for detention facilities. The Parish Engineer will work with designers to facilitate multiple uses of facilities. The onsite storage facilities will only apply to the initial development.
8. Visual impacts and other aesthetic concerns should be considered in the design of the system.

9. Developer shall provide adequate access for maintenance personnel to move appropriate equipment to all control structures and maintenance of facilities.
10. Maximum depth of any parking lot detention shall be eight (8) inches.
11. Slopes for parking lot detention shall be no less than one (1) percent and no more than three (3) percent.
12. Parking lot detention shall be designed and constructed with a design flood surface elevation at least one (1) foot below the lowest habitable floor elevation of buildings within 50' of the detention area. Systems shall be designed so that no flooding can occur in habitable building areas even in the event of system failure.
13. Detention ponds, other than parking lot detention, shall be constructed with interior slopes that do not exceed 2:1. Exterior side slopes shall not exceed 3:1.
14. Detention ponds that only provide private benefit shall remain under private ownership. The developer shall provide methods, procedures and guarantees, including appropriate documentation, that the facilities will be perpetually maintained so as to function as designed and not result in nuisances or health hazards.
15. The minimum width for the bottom of a detention pond less than three (3) feet deep shall be six (feet) unless approved by Parish Engineer. The minimum width for detention ponds three (3) feet deep or deeper shall be fifteen (15) feet.

16. Detention ponds shall be landscaped for aesthetic purposes and to stabilize banks. Sodding and seeding should be used in combination. In no case will the use of easily floatable or erodible materials such as bark mulch be allowed in pond interiors.
17. Failure of property owner to maintain detention pond shall be cause for the Parish to perform the work and bill the Owner.
18. Parish maintained detention pond control structures that do not abut a public right-of-way should be accessible by a fifteen (15) foot wide or wider access easement as needed to allow vehicle access.
19. Detention pond control structures shall be designed and constructed to operate passively or automatically.
20. Detention ponds other than parking lot ponds shall be designed and constructed with one (1) foot of freeboard above the elevation of the design flood.
21. The bottom of any constructed and graded dry detention basin shall be sloped no flatter than 0.30% toward drainage outlets. In detention facilities with wet bottoms, a “low flow” channel shall be installed across the facilities’ bottom to allow water to collect in one area and drain out rather than stand in the entire bottom. Low flow channels shall have concrete, asphalt or other appropriate lining in order to allow water to drain at a minimum 0.30% slope.
22. Wet detention basins may be constructed flat provided the bottom elevation is one and a half (1.5) foot below normal low water elevation.

23. Design of “flow through” detention ponds shall have a well-defined low flow channel to contain the runoff of lesser storms.
24. Ponds deeper than four (4) feet shall require protective fencing and a locked gate.
25. The design volume of the detention pond shall be shown on the plans. Volume storage shall be measured from the on-site 25 year stage elevation to a maximum depth of the pump drawdown elevation. Wet and dry basins shall be designed so that the portion of their bottom area, which is intended to be dry, shall have standing water no longer than 48 hours for all runoff events equal to or less than the 25-year event.
26. Design of closed systems on private property such as underground pipes and vaults shall consider hydraulic losses and structural integrity. Maintenance shall be the responsibility of the property owner.
27. A written restriction shall be added to the final plat hard copy to the effect that no structure, fill or obstructions shall be located within any drainage easement or delineated flood plain area.
28. All publicly maintained facilities that are not located in a public right-of-way shall be located in a recorded drainage servitude, including any necessary servitude for access.

VII. EROSION AND SEDIMENT CONTROL

- A. Design: This section applies to all development sites before, during and after construction. Design of erosion and sediment control and preparation of construction plans shall adhere to the following:
1. Erosion control measures shall be required on all proposed developed sites of one acre or greater (see Terrebonne Parish web site for design criteria).
 2. Erosion control measures shall be incorporated into excavation, construction and post-construction site management practices to control runoff, erosion and sedimentation until vegetation and other measures effectively stabilize the site.
 3. Before initial clearing and grading of any land for development, provisions shall be made for interception of all potential silt-laden runoff from discharging from the site to any downstream property or watercourse. Said intersection shall convey such silt-laden runoff to an open ditch or other temporary facility as needed to settle out silt and other eroded materials prior to downstream discharge.
 4. An erosion control and storm water pollution prevention plan shall be provided. A sample plan is shown in Exhibit 9.
 5. Erosion protection is required for all disturbed areas, including temporary cover and permanent vegetation. Geotextiles and non-vegetative cover shall be approved by the Parish Engineer.
- B. Maintenance: Maintenance of storm water facilities located on private property shall be the responsibility of the Owner of the property. Before a building permit is obtained from the Parish, the applicant shall execute a maintenance agreement guaranteeing that the applicant and all future Owners of the property will maintain

its storm water drainage system. The maintenance agreement shall also specifically authorize representatives of the Parish to enter onto the property for the purpose of inspections and maintenance of the drainage system. Such agreement shall be recorded with the Clerk of Court's office. The maintenance agreement shall include a schedule for regular maintenance for each aspect of the system. The maintenance agreement shall also stipulate that if the public works director notifies the property Owner in writing of maintenance problems, which require correction, the property Owner shall make such corrections within 30 calendar days of such notification. If the corrections are not made within this time period, the Parish may have the necessary work completed and assess the cost to the property Owner.

C. Best Management Practices: Terrebonne Parish Consolidated Government promotes the preservation of storm water quality, and utility enhancement, where implementation of certain controls and practices can avoid or reduce the sediment, fertilizer, oil, grease and other pollutant contents in storm water runoff. Often, the amount of pollutants in storm water runoff from development construction sites can be reduced significantly through the use of best management practices. Those practices may include, but are not limited to, the following measures:

1. Ensure that existing vegetation is preserved where feasible and that disturbed portions of the site are stabilized as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased. Stabilization measures may include: temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, preservation of mature vegetation, and other appropriate measures.
2. Use of structural practices to divert flows from exposed soils, store flows, or otherwise limit runoff and the discharge of pollutants from the site to the extent feasible.

3. Prevention of the discharge of building materials, including cement, concrete, and mortar, to the Parish storm sewers or waters of the United States.
4. Provide general good housekeeping measures to prevent and contain spills of paints, solvents, fuels, septic waste, and other hazardous chemicals and pollutants associated with construction.
5. Implementation of proper waste disposal and waste management techniques, including covering waste materials and minimizing ground contact with hazardous chemicals and trash.
6. Timely maintenance of vegetation, erosion and sediment control measures and other best management practices in good and effective operating condition.

VIII. SERVITUDE REQUIREMENTS AND DEDICATION

Whenever a ditch, canal, drain pipe, detention basin or other drainage facility is located in an area that is being subdivided, the sub-divider shall dedicate an adequate servitude sufficient to provide for the drainage course and access for the purpose of cleaning, widening, deepening, sloping, improving or protecting the stream and for drainage maintenance.

- A. Servitude Criteria and Guidelines: Servitudes for ditches not adjacent to a roadway shall adhere to the following:

1. Fifteen (15') feet on both sides of a ditch, that is less than or equal to four (4') feet in depth and less than or equal to eighteen (18') feet in width, plus the width between top banks of the ditch.
 2. Fifteen (15') feet on one side of the ditch and twenty (20') feet on the other side of the ditch, for ditches greater than four (4') feet in depth and/or greater than eighteen (18') feet in width, plus the width between top banks of the ditch.
 3. Whenever an existing ditch along a property line is to be widened because of a new development, all widening will be on the side to be developed. The widening shall include providing the necessary land and servitudes for the final ditch to meet the requirements of this section. Parallel ditches shall have a minimum 20' crown access between ditches. It is desirable to incorporate parallel ditches into one when possible and practical.
 4. No ditch adjacent to roadway which is to be dedicated to the Terrebonne Parish Consolidated Government shall be greater than three and a half feet (3.5') deep and twenty three feet (23') wide.
 5. The minimum width of servitude for drain pipes outside of road right-of-way and less than 42" diameter shall be 15 feet. Pipe diameters 42" and greater shall be 20' wide.
- B. Letter of No Objection: Whenever drainage improvements are proposed on Parish dedicated or owned property, a Letter of No Objection will be required from the Parish Public Works Director or Parish Engineer.
- C. Responsibility: It is the developer's responsibility to obtain and cause to be recorded any necessary servitude or right-of-ways that are needed to connect a

development site with an approved point of discharge. Dimensions and other characteristics of the servitude/right-of-way area shall be approved by the Parish Engineer.

IX. LIST LDOTD STANDARD DRAINAGE DETAILS

CB-01	Brick or Reinforced Concrete Catch Basin (24" x 36" Max. Pipe)
CB-02	Reinforced Concrete Catch Basin (42" x 72" Max. Pipe)
CB-05	Catch Basin Yard Drain, Open Top (8" Max. Pipe)
CB-06	Catch Basin Curb Opening (42" x 72" Max. Pipe)
CB-07	R.C. Catch Basin, Curb and Gutter Opening (42" x 72" Max. Pipe)
CB-08	Double Comb. Type Catch Basin (84" RCP or 96" CMP Max. Pipe)
CB-09	Comb. Type Catch Basin (84" RCP or 96" CMP Max. Pipe)
CP-01	Portland Cement Concrete Pavement Details
MC-01	Grates, Frames and Covers for Catch Basins and Manholes
MH-06	R.C. Manhole (Max. Pipe 120" x 60")
PC-01	Pre-cast Catch Basins and Manholes
R-CB-11	R.C. Manhole (36" x 36" Max. Pipe)
R-CB-11Mod	R.C. Manhole (36" x Open Max.)
R-CB-12	R.C. Manhole (36" x 36" Max. Pipe)
SAM-1	Corrugated Metal Pipe Gage

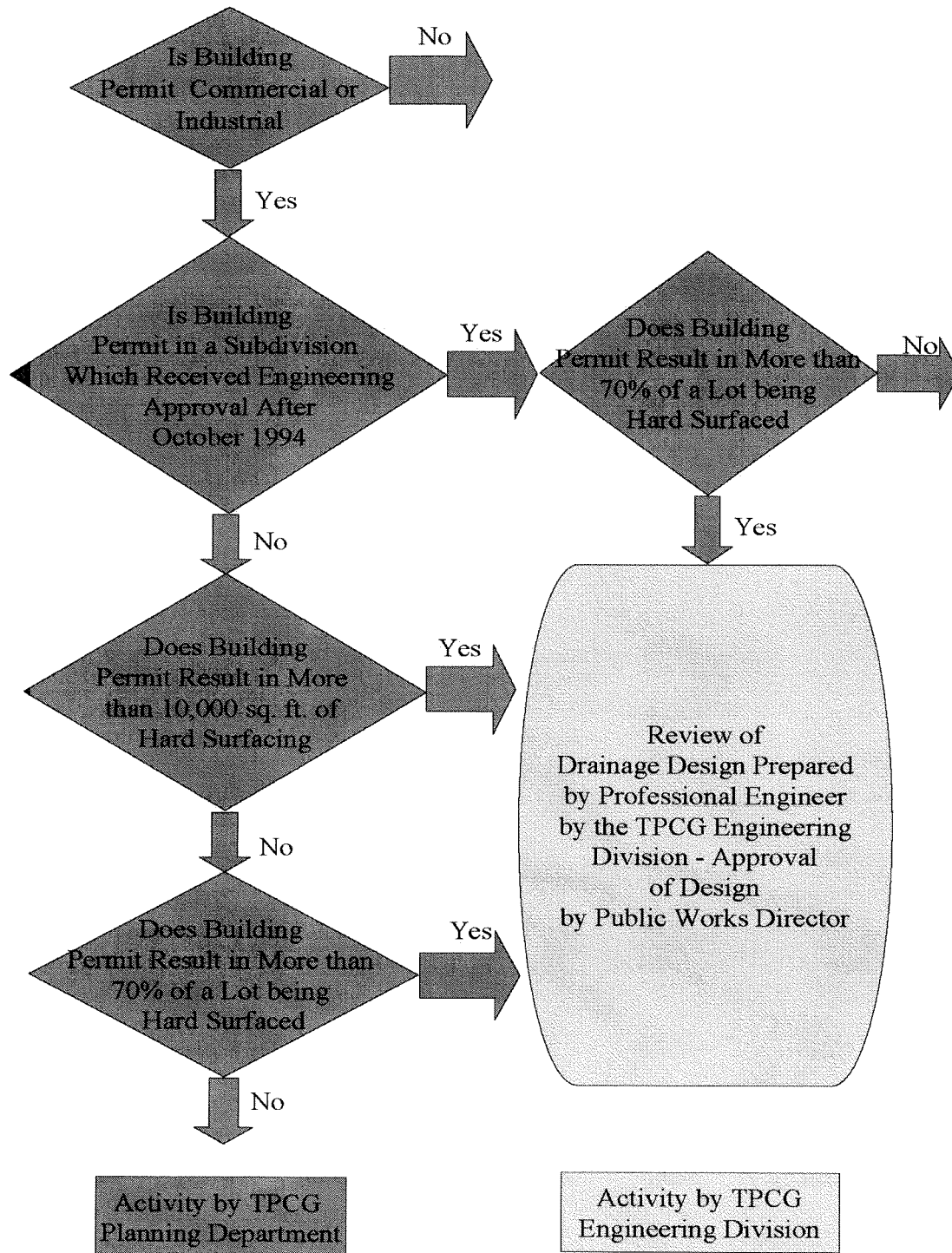
X. EXHIBITS (See Exhibit Sheets to Follow)

- A. EXHIBIT 1 - Major Drainage Arteries, Terrebonne Parish, Louisiana
- B. EXHIBIT 2 - Building Permit Drainage Design Flow Chart
- C. EXHIBIT 3 - NOAA 24-Year, 24-Hour Rainfall
- D. EXHIBIT 4 - NOAA 10-Year, 24-Hour Rainfall
- E. EXHIBIT 5 - CN and C Values
- F. EXHIBIT 6 - Pre- vs. Post-Hydrographs with Volume
- G. EXHIBIT 7 - LDOTD Drainage Structures
- H. EXHIBIT 8 - Manning Roughness Factors
- I. EXHIBIT 9 - Sample of Best Management Practices (BMP)
- J. EXHIBIT 10 - Engineering Approval Check List

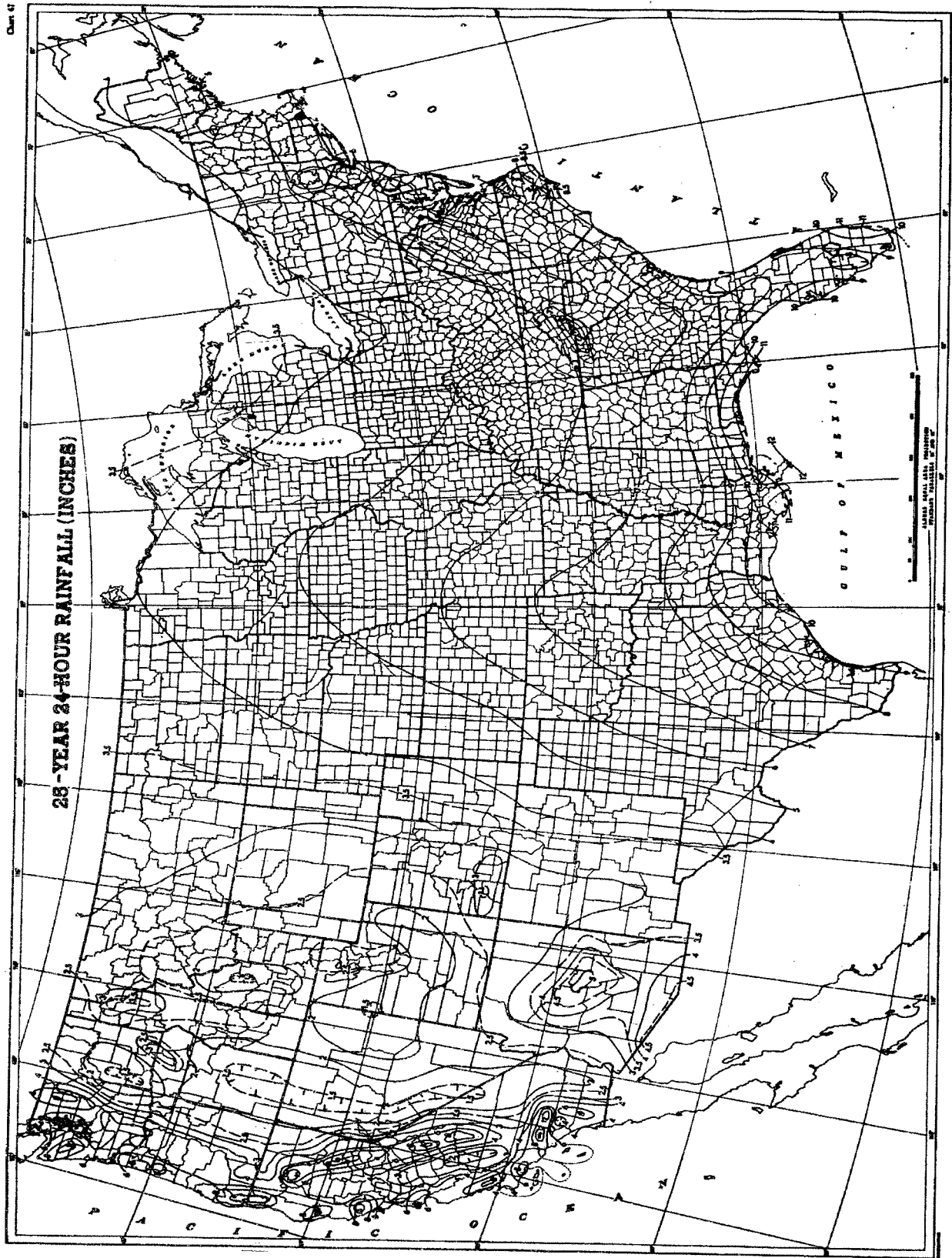
A. EXHIBIT 1 - Major Drainage Arteries, Terrebonne Parish, Louisiana

Bayou Black
Bayou Blue
Bayou Cane
Bayou Chauvin
Bayou Dularge
Bayou Grand Caillou
Bayou LaCache
Bayou Petit Caillou
Bayou Point Au Chien
Bayou Terrebonne
CCC Ditch
Chacahoula Bayou
Company Canal
Donner Canal
Falgout Canal
Gulf Intracoastal Waterway
Hanson Canal
Little Bayou Black
Marmande Canal
Minors Canal
Ouisiki Bayou
Ringo-Cocke Canal
Six Foot Ditch
St. Louis Bayou
St. Louis Canal
Terrebonne-Lafourche Drainage Canal
Forced Drainage Pumping Station Main Feeder Channels

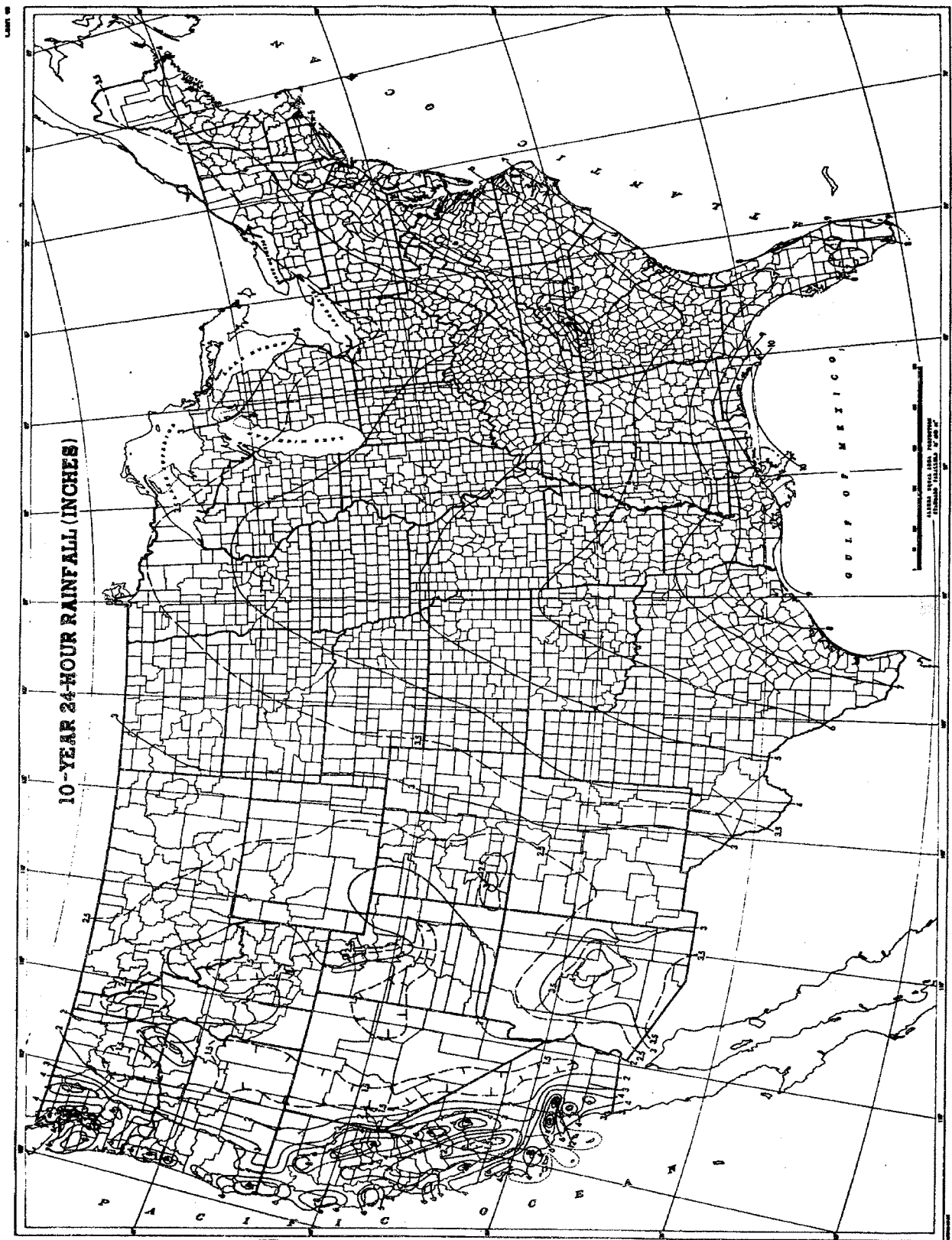
B. EXHIBIT 2 - Building Permit Drainage Design Flow Chart



C. EXHIBIT 3 - NOAA 25-Year, 24-Hour Rainfall



D. EXHIBIT 4 - NOAA 10-Year, 24-Hour Rainfall



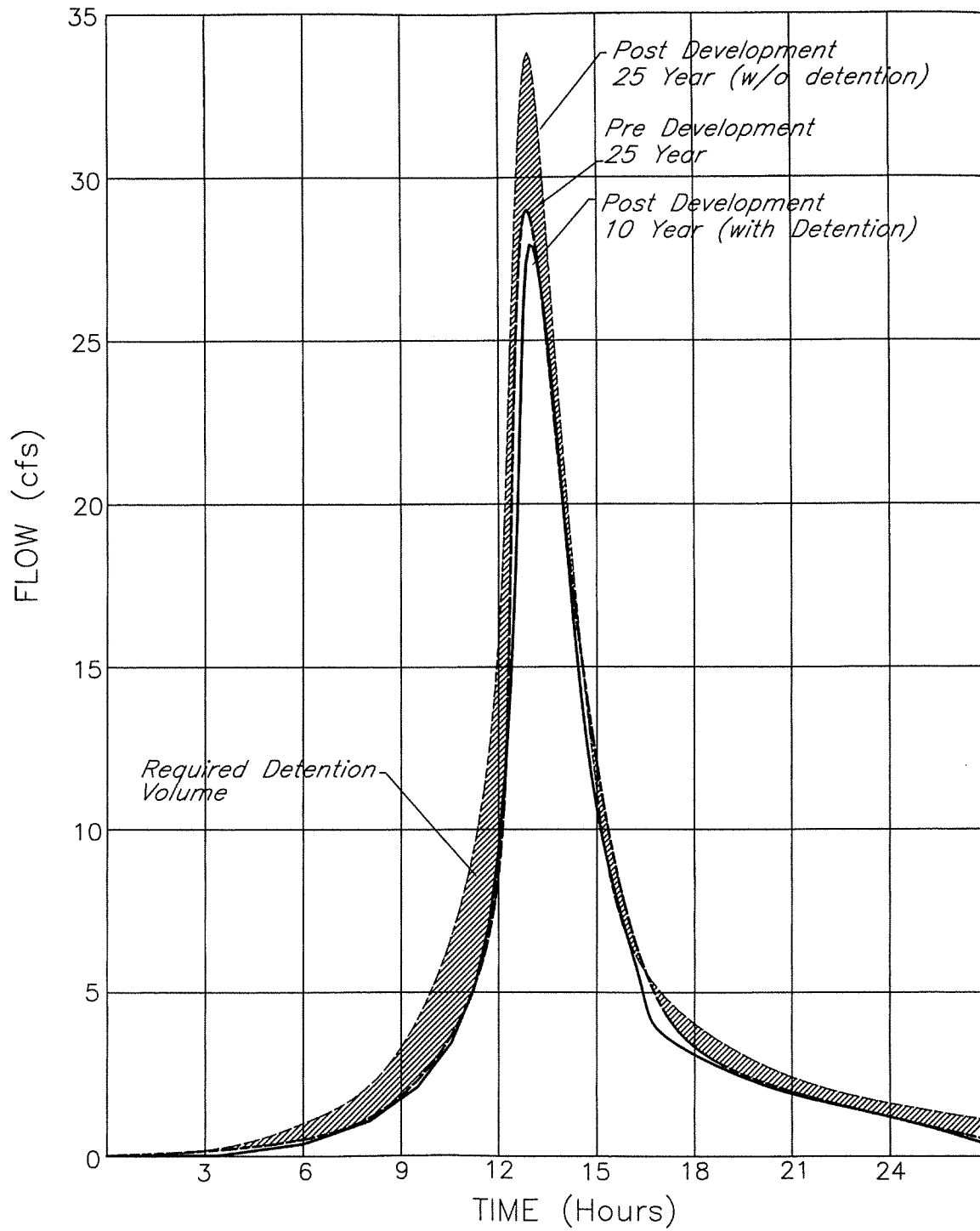
E. EXHIBIT 5 - TABLE OF LAND USE COEFFICIENTS

CN Values (SCS Method)

C Values (Rational Method)

Table of Land Use Coefficients			
Land Use Description	Additional Information	CN	C
Cultivated Land		86	0.45
Pasture or Range Land	Poor Condition	89	0.53
	Good Condition	80	0.30
Woods or Forest Land	Poor Condition	83	0.38
	Good Condition	77	0.25
Open Spaces, Lawns, Parks, Golf Courses, etc.	Poor Condition Grass <50%	84	0.40
	Good Condition Grass <50%	80	0.30
Commercial and Business Areas	85% Impervious	95	0.88
Industrial Districts	72% Impervious	93	0.78
Residential Areas			
1/8 acres lot or less	65% Impervious	92	0.71
1/4 acre lot	38% Impervious	87	0.47
1/3 acre lot	30% Impervious	86	0.45
1/2 acre lot	25% Impervious	85	0.43
Greater than 1 acre	9,000-ft ² imp. Max	Var.	Var.
Paves Areas		95	0.99
Limestone		91	0.66

F. EXHIBIT 6 - Pre- vs. Post Hydrograph with Volume
(Sample Site Discharge Hydrograph)



G. EXHIBIT 7 - LDOTD Drainage Structures

Standard plans for the construction of the following structures may be obtained through the LDOTD Website @ <http://www.dotd.state.la.us/>

BH-01	Bedding and Backfill Material
CB-01	Concrete Open Top Catch Basin
CB-02	Concrete Open Top Catch Basin
CB-05	Catch Basin Yard Drain
CB-06	Catch Basin Curb Opening
CB-07	Catch Basin Curb and Gutter Opening
CB-08	Double Combination Type Catch Basin
CB-09	Combination Type Catch Basin
CP-01	Portland Cement Concrete Pavement Details
EC-01	Temporary Erosion Control Details
MC-01	Grates, Frames and Covers for Catch Basins and Manholes
MH-06	Concrete Manhole
PC-01	Pre-cast Catch Basin and Manholes
R-CB-11	Concrete Manhole
R-CB-11 MOD	Concrete Manhole
R-CB-12	Concrete Manhole
SAM-1	Metal Pipe Wall Thickness and Connecting Bands

H. EXHIBIT 8 - Manning Roughness Coefficient
n, for Closed Conduits:

Type of Structure	n
<hr/>	
Concrete Pipe	
Good Alignment, Smooth Joints	0.011 - 0.013
Fair Alignment, Ordinary Joints	0.013 - 0.015
Poor Alignment, Poor Joints	0.015 - 0.017
Concrete Box	0.012
Corrugated Metal Pipe (unpaved)	
2 2/3" x 1/2" corrugations	0.024
3" x 1" corrugations	0.027
6" x 2" corrugations	0.031
Plastic Pipe	
Smooth Flow	0.009
Corrugated	0.020
<hr/>	
n, for Open Channels:	
<hr/>	
Open Channels, Lines	
Concrete	0.015
Asphalt	0.015
Open Channel, Excavated	
Earth, fairly uniform section, with	
no vegetation	0.020
grass, some weeds	0.025
dense weeds	0.030
Channels not maintained	
dense weeds, high as flow depth	0.100

dense brush	0.120
Natural Stream Channels and Flood Plains	
Major streams (surface width at flood stages more than 100 feet)	0.030
Minor Streams	
some grass and weeds, little or no brush	0.035
dense growth of weeds	0.050
some weeds, heavy brush on banks	0.060
Flood plains (adjacent to natural streams)	
pasture, no brush	
short grass	0.035
high grass	0.050
cultivated areas	
no crops	0.035
crops	0.050
heavy weeds, scattered brush	0.060
light brush and trees	0.080
medium to dense brush	0.160

I. EXHIBIT 9 - Sample of Best Management Practices (BMP's)










Sample of Best Management Practices (BMP's) and Louisiana Pollutant Discharge Elimination Systems (LPDES) can be found on the Terrebonne Parish Website @ <http://www.tpcg.org/engineering/index.asp> #LPDES. The following information can be found on this website:

Storm Water:

Louisiana Pollutant Discharge Elimination System (LPDES)












Storm Water General Permit for Small Construction Activities

(equal to or greater than 1 acre and less than 5 acres)

-  Permit No LAR 200000
-  Storm Water Pollution Prevention Plan (SWPPP)
-  Inventory of BMP's
-  Inspection Report
-  Record Keeping Report
-  Updated Parish-Species List
-  Endangered Species Letters (example letter)
-  Historic Properties Letter (example letter)
-  Completion Report

Storm Water General Permit for Small Construction Activities

(equal to 5 acres or more)

-  Permit no LAR 100000
-  Storm Water Pollution Prevention Plan (SWPPP)
-  Inventory of BMP's
-  Inspection Report
-  Record Keeping Report
-  Updated Parish - Species List
-  Endangered Species Letters (example letter)
-  Historic Properties Letter (example letter)
-  1701 Addendum
-  Notice of Intent
-  Notice of Termination

STORM WATER DRAINAGE AND DETENTION CHECKLIST

Y N N/A

IV. HYDROLOGY

A. Rainfall

- Desgined for 25-year, 24-hour duration as defined by TP40 (Exhibit 3)
- Discharge limited to 10-year, 24-hour pre-development unless downstream improvements are made as to not cause adverse impacts (Exhibit 4)

B. Hydrologic Data: Preliminary Plan

- Vicinity Map
- Topographic Map
- Aerial photographs
- Stream flow records
- Historical high water elevations
- FEMA 100 year flood elevation
- Soil types
- Land use
- Slope
- Surface infiltration
- Storage

C. Coordination: Maximum stage elevation furnished or approved by Terrebonne Parish Engineering Division

D. Runoff Computation, Hydrograph Development and Modeling:

- 1. Rational Method
 - Drainage area no greater than 150 acres
 - c value taken from Exhibit 5
 - DOTD HYDR6020 and HYDR6000 used for storm drain and inlet spacing
- 2. Soil Conservation Service (SCS) Method (NRCS) (TR-55)
 - Curve Number (CN) taken from Exhibit 5
 - Type III, 24-hour rainfall distribution
 - Shape factor 256
- 3. Unit Hydrograph Method (HEC-1, SWMM, TR-20)

E. Flood Routing:

- 1. Stream Flow Routing
- 2. Reservoir Routing

F. Land Use

-

Y N N/A

G. Datum: Elevation referenced to the latest Parish adopted Vertical Datum

H. Gage Reading (Historic Data) at major drainage artery

V. HYDRAULIC DESIGN

A. Storm Design Requirements:

1. Existing site plan:

Minimum scale 1"=100'

Drainage features

1 foot contours

Utilities

Roads

Structures

Impervious areas

Flood encroachment areas

2. Proposed site plan:

Minimum scale 1"=100'

Streets

Utilities

Drainage features

Lot lines

Lot grading

Discharge canals

Location of major drainage artery

3. Plan/Profile Sheets

Drainage

Horizontal Scale 1"=50' minimum

Vertical Scale 1"=5' minimum

Roads

Horizontal Scale 1"=40' minimum

Vertical Scale 1"=4' minimum

Geometric layout

Centerline

Roadway stations

Finished centerline slopes (0.35% minimum curb and gutter)

Points of vertical intersection

Y N N/A

Drainpipes

Size

Type

Invert elevation

Structures & Utility lines

Size

Type

Invert elevation

Top elevation

Finished grade at right-of-way

Hydraulic gradient

Tailwater elevation

Ditch flow lines

Utility lines

Dimension of all servitudes

North arrow

Legend

4. Drainage Map/Hydraulic Computations

Drainage Map

All drainage features

Right-of-ways and servitudes

Tributary areas

Watershed boundaries

Structure reference numbers

Discharge points

North arrow

Legend

Hydraulic Computations

Design criteria

Rounded to nearest 0.10 foot

Maximum stages at all nodes

Tailwater elevation

Graphic representation of surface and subsurface flow

Statement of no adverse impact

Maximum flows (pre vs. post)

Volume runoff (pre vs. post)

Y N N/A

- Hydrographs at discharge points (pre vs. post) (Exhibit 6)
- Runoff factors
- Time of concentration
- Land slope
- Onsite elevation determined by routing flows from downstream tailwater elevation

5. Typical roadway section

- Roadway width
- Roadway thickness
- Shoulder width
- Ditch dimensions
- Ditch side slopes
- Location of all utilities
- Subsurface drainage location
- Right-of-way width
- Transverse road slopes

6. Lot drainage

- Storm drain pipe located within street right-of-way
- Special servitude for interconnection or outfall purposes within subdivision
- All lots inside the Urban Services District and Urban Planning Area graded to drain to the street or to a Major Drainage Artery (Exhibit 1)
- All lots inside Rural Subdivisions graded to drain to the street or to a Major Drainage Artery (Exhibit 1)
Outside the Urban Services District and Urban Planning Area the HTRPC can allow a portion to drain to the rear if:
 - Drainage is to be perpetually privately maintained, or
 - i. Drainage to the rear already exists or is to be dedicated; however, the percentage may not exceed 60% of the total depth of lots up to 225' deep, or that portion greater than 135' on lots greater than 225' deep unless a greater percentage is required to comply with items ii or iii below.
 - ii. Where the size limitation of the roadside ditches will be exceeded
 - iii. Where the size of the curb and gutter drainage pipe exceeds 36" in diameter

7. Reference standard plan details of all drainage structures

-

Y N N/A

8. Existing cross sections at maximum 100' intervals showing:

Roadway

Ditch

Lot grades

9. Time of concentration

a. Rational method

b. SCS LAG method

10. South of the South Terrebonne Development Zone

Minimum roadway elevation +3.5'

Minimum lot elevation +2.0'

B. Closed Storm Drainage System

1. Minimum sizes

15" minimum diameter

8" minimum diameter for restrictor pipe

2. Minimum Service Life

Diameter less than 48" 50 year service life

Diameter greater than or equal to 48" 70 years

Side drain 30 years

3. Sized to operate full with a minimum self cleansing velocity

4. Slopes

Maximum slope 10 ft/sec

Outlet protection for velocity above 10 ft/sec

5. Manholes or catch basins

Located at all changes in vertical and horizontal direction

Maximum Spacing (LaDOTD Hydraulics Manual), but shall not exceed 250'

Pipe Diameter	3-7 ft/sec	8-12 ft/sec	13-20 ft/sec
15"	150'	250'	300'
18"	300'	350'	400'
24" – 36"	400'	450'	500'
42" and larger	600'	650'	700'

6. n value taken from Exhibit 8

7. Minimum vertical distance of 6" from bottom of pavement to top of drain pipe

8. All drainpipes under roadway joined in conformance with LaDOTD Type 3 joints

9. Catch basins, manholes and grate inlets in conformance with LaDOTD standard plans

Y N N/A

- 10. Minimum servitude for drain pipe
 - Diameter less than 42" = 15'
 - Diameter 42" and greater = 20'
- 11. Inlet spacing
 - LaDOTD HYDR6000 used
 - Gutter flow less than 10 cfs
 - Width of flooding less than 8'
 - Spacing less than 250'
- 12. Pipe size and hydraulic grade line
 - LaDOTD HYDR6020 used
 - Maximum hydraulic clearance at gutter line of 0.2' above gutter grade
 - Design sketches of numbered structures & drainage areas provided
- 13. Other model with prior approval
- C. Open Storm Drainage System
 - 1. Minimum sizes
 - 15" minimum diameter
 - 8" minimum diameter for restrictor pipe
 - 2. Minimum Service Life
 - Cross drains 50 year service life
 - All Storm drain pipe 70 years
 - Side drain 30 years
 - 3. Pipes installed in major drainage arteries shall be sized for a maximum allowable headwater of 0.5' or 1.0' below the edge of roadway whichever is less
 - 4. Outlet protection for velocity above 10 ft/sec
 - 5. n value taken from Exhibit 8
 - 6. Entrance loss coefficients in conformance with LaDOTD Hydraulics Manual
 - 7. Minimum vertical distance of 6" from bottom of pavement to top of drain pipe
 - 8. All drainpipes under roadway joined in conformance with LaDOTD Type 3 joints
 - 9. Minimum servitude for drain pipe
 - Diameter less than 42" = 15'
 - Diameter 42" and greater = 20'

Y N N/A

- 10. Roadside ditches
 - 3:1 side slope
 - Maximum depth of 3'-6"
- 11. Ditch centerline not less than 12' from edge of roadway
- 12. Minimum longitudinal ditch invert slope = 0.001 ft/ft
- 13. Minimum road right-of-way with open ditch = 60'
- 14. LaDOTD HYDR1140 used to determine normal depth of flow in channel
- 15. Minimum width of ditch bottom 2'
- 16. n for channels taken from Exhibit 8
- 17. Water surface profile computed and shown on final drawings
- 18. Culvert sizes
 - Future driveway sizes shown on plat
 - Culverts sized as though entire subdivision was subsurface
- 19. Other model with prior approval

VI. SYSTEM STORAGE

A. Detention Facilities:

- 1. Greater than 1 acre
- 2. Compensatory storage
- 3. Type
 - Open basin or pond
 - Roof top storage
 - Parking lot ponding
 - Underground storage
 - Uninhabited areas
 - Designated as raw land
- 4. Drainage Plan
 - Plan
 - Profile
 - Cross Section
 - Pipes & Structures
 - Size
 - Length
 - Invert
 - Design volume
 - Grades
 - Bottom Elevation

Y N N/A

- Maximum stage elevation
- 5. Onsite system designed to handle both on-site runoff and conveyance through the site of off-site runoff
- 6. Designed to anticipate, enable and minimize future maintenance needs
- 7. Multiple uses encouraged
- 8. Visual impacts considered
- 9. Adequate access for maintenance personnel
- 10. Maximum depth of parking lot detention 8"
- 11. Slopes for parking lot detention no less than 1% no more than 3%
- 12. Flood surface elevation of parking lot detention at least 1' below the lowest habitable floor elevation of building within 50' of the detention area
- 13. Detention pond slopes
 - Interior slope does not exceed 2:1
 - Exterior slope does not exceed 3:1
- 14. Private benefit = private ownership
 - Methods, procedures and guarantees, including appropriate documentation, that the facilities will be perpetually maintained so as to function as designed and not result in nuisances or health hazards
- 15. Pond dimensions
 - If depth is less than 3' deep minimum width = 6'
 - If depth is 3' or deeper minimum width = 15'
- 16. Landscaped for aesthetic purposes and to stabilize banks
 - Seeding and sodding
 - No floatable or erodible material (bark mulch) in interior
- 17. Failure of owner to maintain will be cause for Parish to perform work and bill owner
- 18. Parish maintained pond control structures that do not abut a public right-of-way should be accessible by a 15' minimum right-of-way to allow vehicle access
- 19. Control structures designed and constructed to operate automatically as much as possible
- 20. Designed with 1' of freeboard above the elevation of the design flood (except parking lot ponds)

Y N/A

21. Pond design

- Dry - Sloped no flatter than 0.3% toward drainage outlet
- Wet – “low flow” channel installed with lining at minimum 0.3% slope

- 22. Wet pond bottom elevation 1.5 ft below normal low water elevation if constructed flat

- 23. “Flow through” pond has well defined low flow channel

- 24. Ponds greater than 4’ in depth have fence and locked gate

25. Design Volume

- Shown on plans

- Storage measured from the on-site 25 year stage elevation to a maximum depth of the pump drawdown elevation

- Wet and dry basins designed so that the portion of their bottom area, which is intended to be dry, shall have standing water no longer than 48 hours for all runoff events equal to or less than the 25-year event

- 26. Hydraulic losses and structural integrity considered in closed systems on private property

- 27. Written restriction on final plat stating that no structure, fill or obstructions shall be located within any drainage easement or delineated flood plain

- 28. All publicly maintained facilities located in a recorded drainage servitude including any necessary for access

VII. EROSION AND SEDIMENT CONTROL

A. Design:

- 1. Required on all proposed developed sites of one acre or greater
- 2. Incorporated into excavation, construction and post-construction
- 3. Provisions for interception of all potential silt-laden runoff made before initial clearing and grading
- 4. Erosion control and storm water pollution plan provided
- 5. Erosion protection provided for all disturbed areas

- B. Maintenance agreement provided before building permit is obtained

C. Best Management Practices:

- 1. Existing vegetation preserved where feasible and disturbed portions stabilized as soon as practicable
- 2. Structural practices to divert flows from exposed soil, store flows, or otherwise limit runoff and the discharge of pollutants from the site to the extent feasible
- 3. Prevention of the discharge of building materials into the Parish storm sewers or waters of the United States

Y N N/A

- 4. Provide general good housekeeping measures to prevent and contain spills
- 5. Implementation of proper waste disposal and waste management techniques
- 6. Timely maintenance of vegetation, erosion and sediment control measures

VIII. SERVITUDE REQUIREMENTS AND DEDICATION

A. Ditches not adjacent to a roadway

- 1. Ditch less than or equal to 4' deep or 18' wide 15' on both sides
- 2. Ditch greater than 4' deep and/or 18' wide 15' on one side and 20' on the other
- 3. Parallel ditches minimum 20' crown between
- 4. Ditch adjacent to roadway not greater than 3.5' and 23' wide
- 5. Minimum servitude for drain pipe
 - Diameter less than 42" = 15'
 - Diameter 42" and greater = 20'

B. Letter Of No Objection required for work in parish right-of-way or parish property

C. Developer's responsibility to record any necessary servitude that are needed to connect a development site with an approved point of discharge

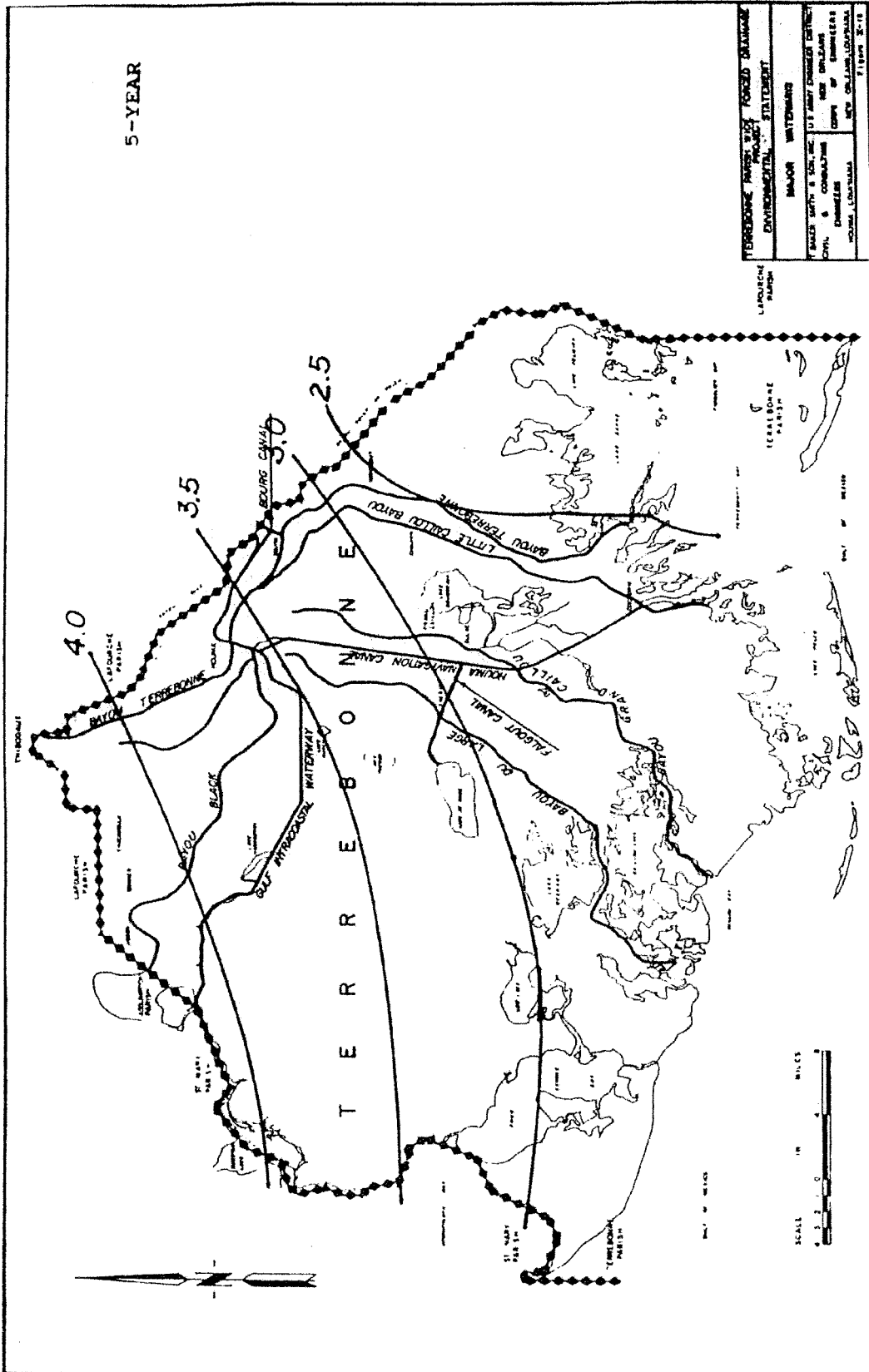
XI. APPENDIX “A”: Resio Stage Elevations

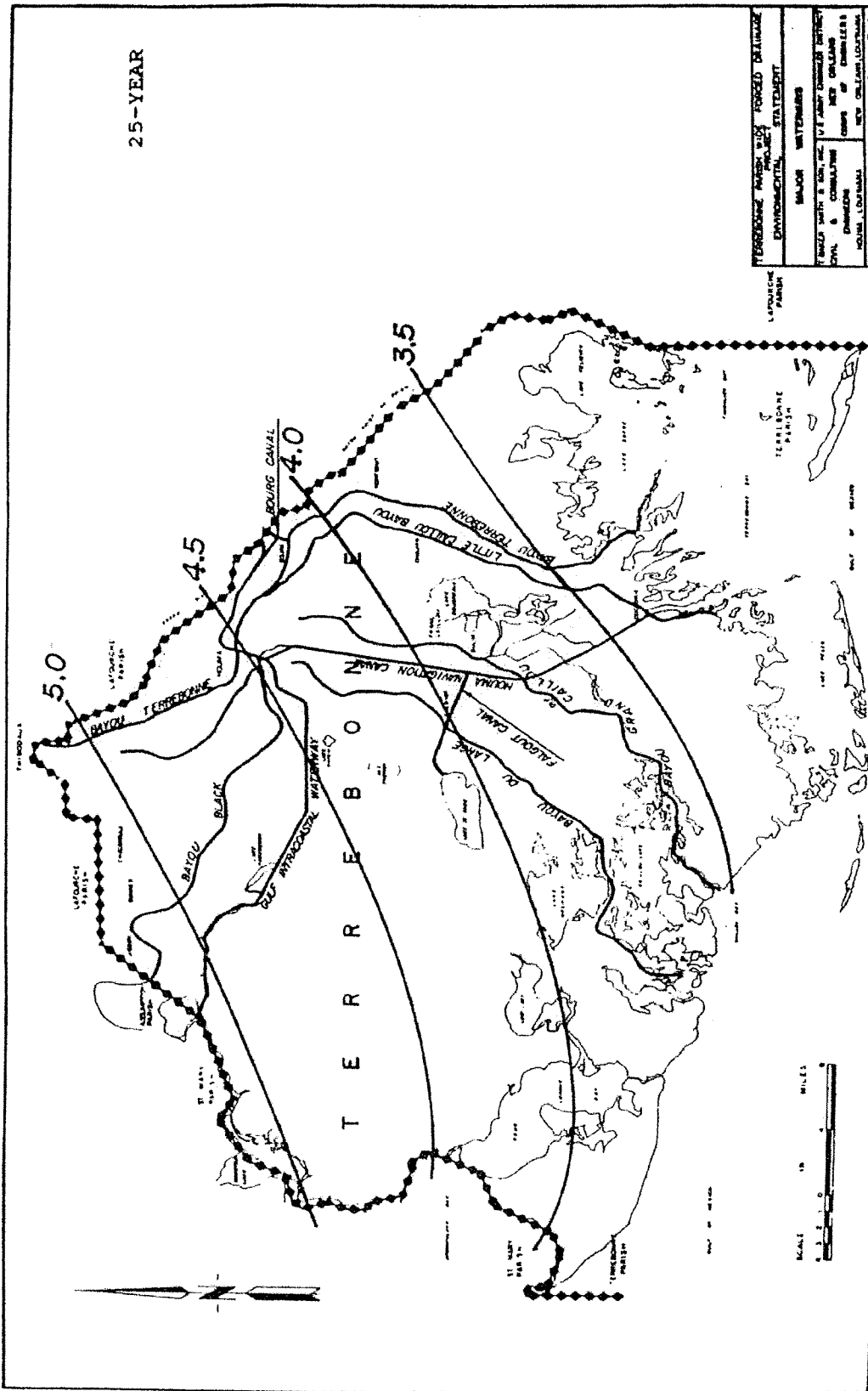
FLOOD ELEVATIONS RESULTING FROM EXTRA-TROPICAL DESIGN STORM

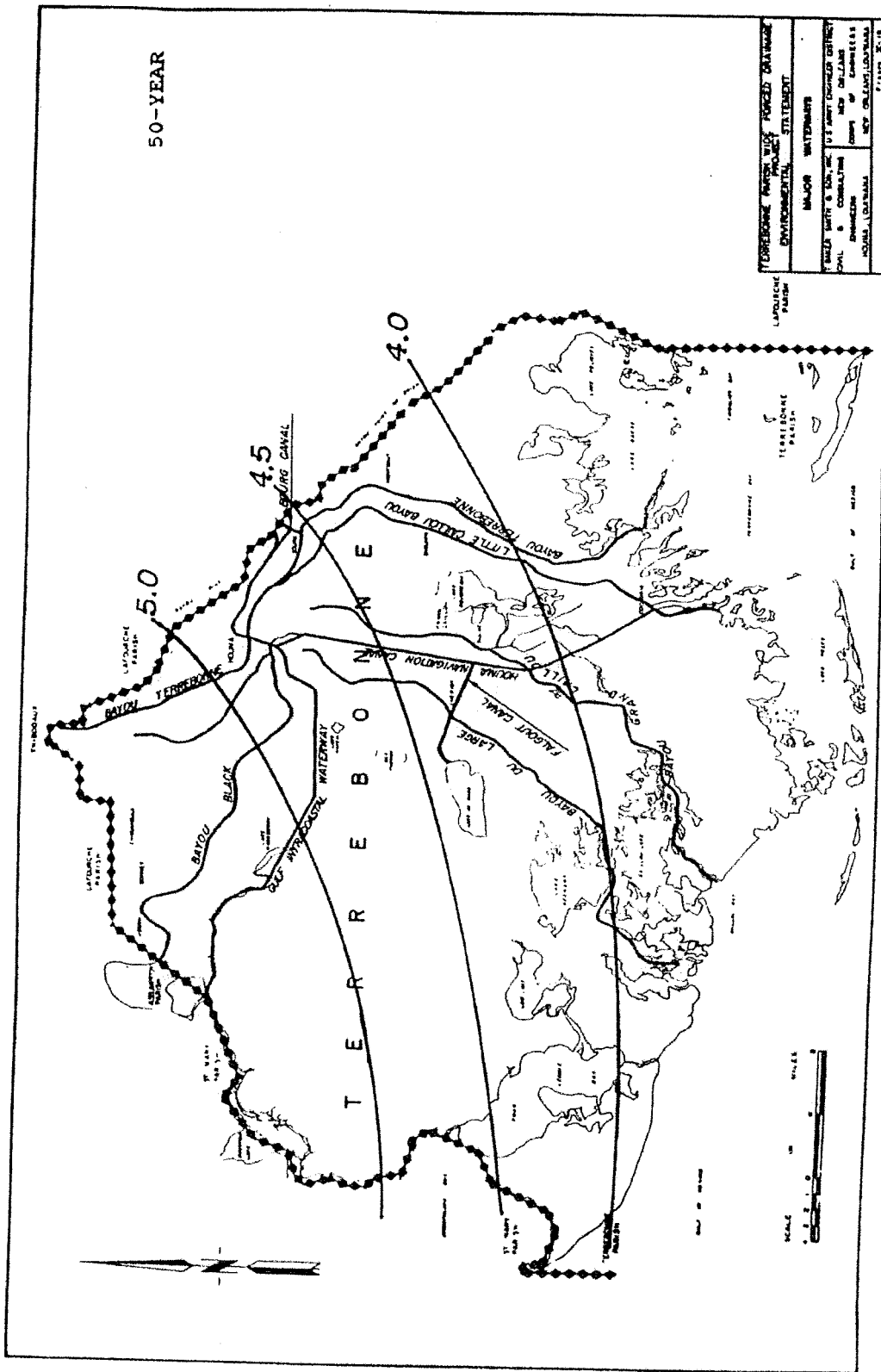
PROJECT NAME	LEVEE MIN EL	100YR MAX EL	25 YR MAX EL	10 YR MAX EL	5 YR MAX EL	2 YR MAX EL
1-1A (Bonanza)	4.30	4.21	3.31	2.47	1.76	0.15
1-2 (Ashland)	6.00	3.84	3.59	3.29	3.14	2.74
1-3 (Industrial Blvd)	4.92	3.47	2.50	1.33	0.33	-4.00
1-5 (Bayou Chauvin)	5.00	4.48	3.62	3.02	2.10	0.00
1-7 (Baroid)	6.00	6.45	6.20	5.97	5.64	5.13
1-8 (M&L)	5.10	6.80	6.00	5.22	4.69	3.26
2-1A (Schriever)	1.24	2.92	2.05	1.34	1.22	1.15
2-1B (Summerfield)	10.00	2.59	2.19	1.66	1.33	0.65
3-1B (Boudreaux)	3.00	1.19	1.00	1.00	0.85	0.67
3-1C (Boudreaux)	3.70	2.12	1.67	1.31	1.15	1.02
4-1 (Point Aux Chien)	4.00	1.58	1.24	1.02	0.95	0.00
4-2A (Smithridge)	5.00	4.47	4.09	3.80	3.50	3.02
4-7 (Bourg)	4.20	4.73	3.95	3.34	2.85	1.60
4-MONTE (Montegut)	5.00	2.23	1.71	1.26	1.08	1.01
5-1A (Chauvin)	2.50	1.68	1.33	1.08	1.00	0.92
5-1B (Chauvin)	1.10	1.19	1.00	0.91	0.75	0.50
6-1 (Gibson)	4.30	1.16	1.01	0.88	0.74	0.51
6-2A (Donner)	4.20	4.20	4.20	4.20	3.53	0.00
8-2 (Bayou Dularge)	2.80	2.52	1.65	1.16	1.01	1.00
D-38 (Concord Rd)	3.67	3.33	2.40	1.00	0.42	-0.80
D-39 (Barataria)	10.00	6.83	6.26	5.73	5.36	1.87
D-40 (Cenac St)	3.00	1.74	1.47	1.27	1.18	1.04
D-41 (Williams St)	5.00	4.98	4.21	3.49	-1.20	-3.00
HOUMA LAKE S.A.	-	2.03	1.60	1.20	1.04	0.73
OUISKI BAYOU S.A.	-	0.94	0.74	0.60	0.51	0.38
TIGER BAYOU S.A.	-	1.40	0.81	0.65	0.60	0.41
COTEAU-ST LOUIS S.A.	-	2.34	1.82	1.42	1.20	0.82
BULL RUN S.A.	-	1.44	1.12	0.90	0.70	0.50

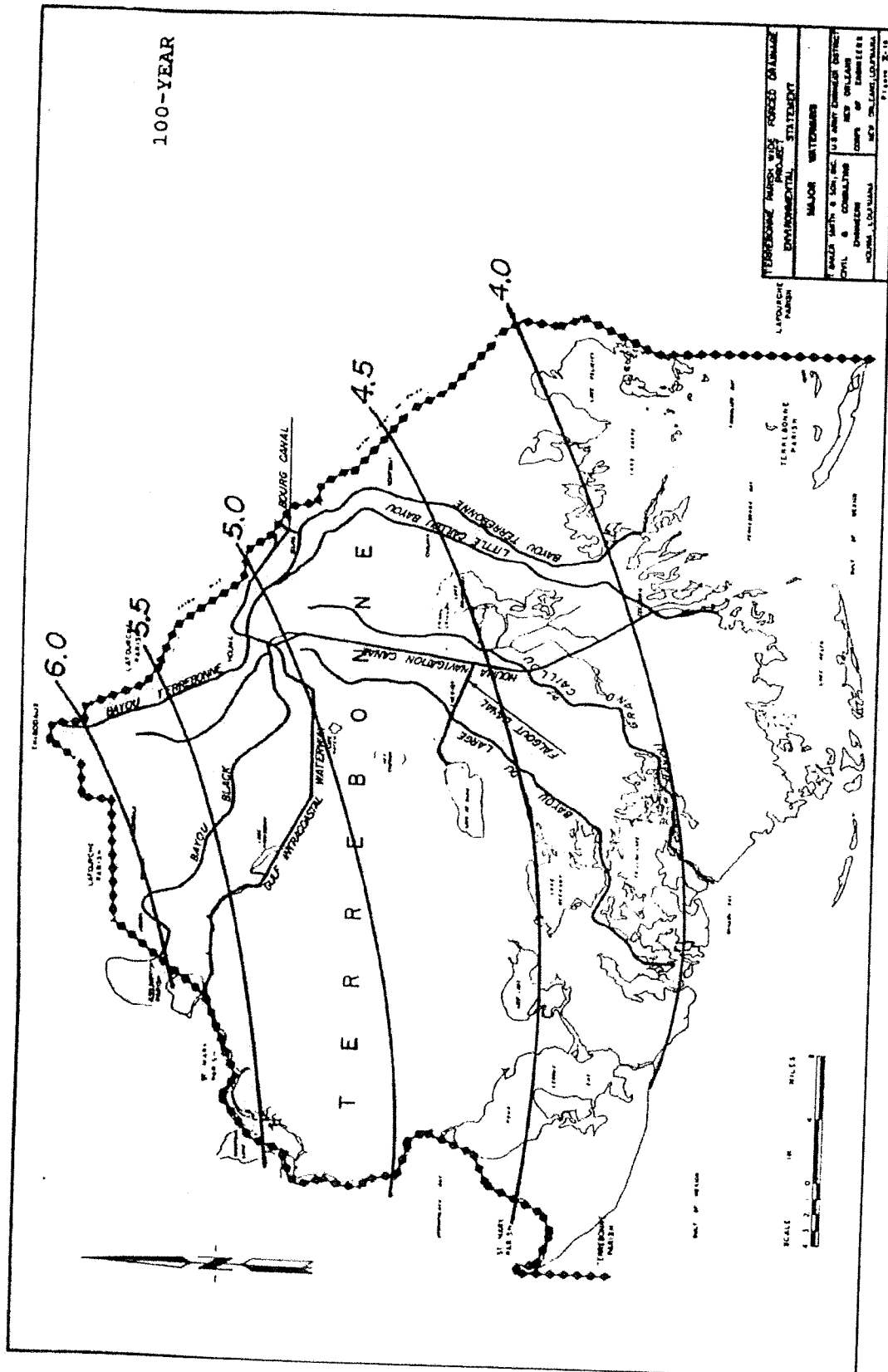
TABLE 4-3. Extra-tropical storm peak pump station reservoir flood elevations.

Check with Engineering Division to see if these elevations have changed.









XII. REFERENCES

- A. Georgia Storm Water Management Manual, Volume 2 (Technical Handbook).
- B. August County, Virginia, Regulation of Storm Water, Chapter 18.
- C. Ionia County, Michigan, Guidelines For Storm Water Management, March 2002.
- D. City of Talent, Storm Water Management Design Standards, December 1988.
- E. Los Angeles County Flood Control District, Design Manual, March 1982.
- F. Village of Sleepy Hollow, Section 7 - Chapter 6: Storm Water Drainage and Detention, October 1995.
- G. City of Lubbock Texas, Drainage Criteria Manual, November 1994.
- H. Louisiana Department of Transportation & Development, Hydraulics Manual, March 1987.
- I. Louisiana Department of Transportation & Development, User's Manual for Hydraulics Programs, July 1997.
- J. Terrebonne Parish, Storm Drainage Design Manual, 1985.
- K. A Guide to Hydrologic Analysis Using SCS Methods by Richard H. McCuen, 1982.

- L. Terrebonne Parish Storm Drainage Design Manual Committee formulated in 2005, (Members: Arthur A. De Fraités, Jr., Al Levron, Jeanne Bray, Joan Schexnayder, Perry Blanchard, Jimmy Ledet, David A. Waitz, Jr., Gene Milford, Hillary Thibodeaux, Dennis Kelley, Brandon Arceneaux, Jimmy Theriot, Naveen Chillara and Clay Breaud).