MASTER DRAINAGE PLAN

City of Alton, Texas

1998

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by

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1.0 Introduction

1.1 Basic Philosophy

Upstream areas of urbanizing watersheds contribute to downstream stormwater runoff problems simply because of the cumulative effects. In many cases, land development in upstream areas has occurred with little thought of the consequences to downstream areas.

Many entities of local government are autonomous units primarily concerned with land use and stormwater runoff within their own boundaries. There are exceptions where municipalities receive water or sanitary sewer services from outside areas. Sometimes conflicts have arisen among adjoining communities, particularly over land use issues and its effect on the management of stormwater runoff.

The basic philosophy on the need for watershed management within urban areas has, over the past several decades, changed dramatically. Nationwide experience with the effects of inadequate past practices indicates that stormwater has not always been well managed. This experience has led to a major redirection in the way many communities perceive urban drainage and attempt to deal with it effectively.

The City of Alton recognized the importance of addressing stormwater management and contracted with Perez/Freese and Nichols, L.L.C., in March 1996 to perform a **Master Drainage Study** and prepare a master plan for the management of stormwater for the City of Alton and its

surrounding extraterritorial areas. The study is funded in part through the Texas Water Development Board Flood Protection Planning Study, contract No. 96-483-158.

The basic scope of work is as follows:

Task I. Base Mapping: *Objective:* To develop a digital planimetric and topographic base map from existing mapping available from TNRCC Information Section within the study area at 1" = 400' scale.

Task II. Drainage Policy and Criteria Development: *Objective:* To review current drainage guidelines for the City of Alton and Hidalgo Drainage District No. 1 that will facilitate and establish fundamental drainage policies for the City of Alton. Drainage Criteria, Ordinances, and Drainage Design Procedures will be written and proposed to support the drainage policies.

Task III. Existing Storm Sewer Assessment: *Objective:* To evaluate and determine the capacity of the existing storm sewer systems, detention pounds, open channels, and storm sewers within the Study Area.

Task IV. Master Plan Development: *Objective:* To develop a master drainage plan that will implement adopted drainage policies and criteria. The Master Plan will correctly identify drainage system deficiencies and to provide a document that will lead to an orderly development of the City of Alton and its extraterritorial jurisdiction. The plan will also provide a working document for developers and engineers, including recommended drainage easement widths and methods for determining pipe, channel or detention structure sizes.

Stormwater is a difficult resource to manage primarily because drainage systems are constantly in a state of flux. Even a natural drainage system is not static: streams meander, banks erode, lakes are filled by sediment. Urbanization compounds this problem because it increases the rate and quantity of runoff, and urban runoff is often polluted with chemicals and litter that is carried into the rivers and lakes. It is important to keep in mind that all development increases the stormwater runoff and contirbutes to the problems.

The combination of increased runoff, erosion and excess sediment, and pollution at times threatens public safety and properties and in turn damages the habitat of plants and animals dependent on the streams.

A generally accepted concept is that property within a city should contribute to the remedy of the problem caused by increased stormwater runoff. Two important principles underlie this stormwater management concept:

- First, that all real property within a city will be benefited by the installation of an adequate storm drainage system;
- Second, that the cost of installing an adequate drainage system should therefore be assessed against the real property in a city.

These principles are not easy for property owners to understand at first glance, but they are the keys to an effective stormwater management effort. A property owner may not have a problem immediately on his property, but he contributes a proportionate share to problems downstream. A unified and safe drainage system is the benefit of the basin as a whole. Each property individual

should contribute to the improvements necessary to solve the problem.

The problems that exist today will not go away, and the longer they are put off the more costly they will become to solve. Through advance planning, there will be fewer facilities and they will be larger and more strategically placed to minimize long-term maintenance costs, and they can be multi-purpose in use (for open space and recreation as well as for drainage).

Recognition that stormwater management includes much more than just flood control is important. Keeping streets open to emergency vehicle traffic, maintaining ponds and open channels so they do not become health and safety hazards, and promoting the use of drainage facilities for recreational purposes all contribute to enhancing and maintaining the quality of life for the entire community.

1.2 Statement of the Problem

The City of Alton (like many other cities) has reached a point of "problem convergence" related to management of stormwater runoff from the watershed. A number of factors and conditions have come together to pose a major challenge to the City. The growth and development of the community are manifested in a long-term, often subtle, and pervasive change in the City's drainage systems. Symptoms of the changes are evident in drainage system failures, localized flooding and escalating costs of control. Unfortunately, there is no single cause or simple cure for the problems of stormwater management.

What are the factors which combine to make urban stormwater management a major challenge in Alton? They are a diverse group of problems, circumstances, and conditions. When considered separately, they do not fully indicate the seriousness of the situation. The seriousness

is apparent, however, when they are considered together. The four most prominent factors in the present problems are changes in hydrology, resource conflicts, surrounding jurisdictions, and economics.

Changes in Hydrology: As the City has grown, impervious surfaces such as rooftops and pavement have covered over soils which were relatively pervious. An increasing proportion of the precipitation which previously filtered through the soil to the groundwater has been repelled. Instead, it is diverted by roofs and parking lots to channels and culverts, and carried to receiving streams in the hydraulically most efficient manner, i.e., as quickly as possible in the smallest facility considered being adequate.

Although Alton has some natural and manmade stormwater detention or retention facilities on developed sites, these systems are not coordinated to mitigate major storms. The overall impact of urban development will result in large increases in runoff from smaller, more frequent storms which may not be effectively controlled by on-site detention systems designed for more severe events. The change in hydrology is a basic condition which must be recognized.

Resource Conflicts: Urban levels of development are rarely achieved without conflicts in the use of resources, especially when stormwaters impede potential uses of the land. Unfortunately, land development in the Lower Rio Grande Valley area has not typically been achieved by solving the drainage problems. More often the symptoms (like flooding) have merely been moved to another location.

Urban runoff is a unique product of development. The quantity and quality of stormwater runoff in Alton may pose major problems for the community in general. As new growth occurs in

the area, resolution of short-term resource conflicts related to drainage control should be made with a better vision of long-term needs and impacts. The alternative consequence is that economic and social costs will continue to mount in the form of repetitive stormwater management problems.

Surrounding Jurisdictions: Stormwater runoff does not recognize established jurisdiction lines and close coordination with the surrounding communities (McAllen, Mission, and Palmhurst) is essential for a successful master plan. The concept of a stormwater management in a watershed is not new. A coordinated effort can assist with the management of land within a watershed to enhance the well-being and quality of life of municipalities within the watershed. Once a decision is reached to consider a coordinated watershed program, public meetings can be convened to help promote the need for comprehensive stormwater management planning and subsequent implementation. Ultimately, a regional stormwater management entity may be needed, as it is difficult for individual units of local government to act on a watershed basis outside of their borders. Hence, a regional entity is frequently needed to implement a comprehensive stormwater management plan.

Economics: The problems cited above, which are primarily physical, are compounded by economic factors which make solutions more difficult to achieve. Texas cities are in a period of a serious revenue shortfall in which programs of long-standing are being closely scrutinized, trimmed, and sometimes eliminated. This overriding revenue shortfall problem further exaggerates what has always been a major obstacle to effective stormwater control: the lack of stable and adequate local financing upon which long-range programs can be based.

Lurking behind the immediate economic problems of local governments is an even more

imposing potential problem. Existing physical improvements of all types in the United States, both public and private, are collectively growing old and wearing out. Many will have to be rebuilt or they will fall apart within our lifetimes.

Regardless of what level of government will be responsible for rebuilding public systems, it will meet intense competition for limited capital resources to finance the reconstruction. Private industry faces many similar reinvestment needs, and many other costs of government are also rapidly rising.

The demand for financing to rebuild large public and private systems will likely keep the cost of money, in terms of interest rates, high throughout the next two decades. Even if federal policies change regarding growth of the money supply and interest rates decline somewhat, it is likely that prices will inflate again. Inflation in the construction industry has historically been higher than average price inflation, driving the costs of public capital improvement projects up rapidly. This economic "Catch-22" may be the most serious of all the problems that Alton's drainage program must face.

Summation: The previously discussed factors create potentially serious situations as each drainage problem is compounded by the effect induced by changes in the other factors. This situation indicates the need to consider a comprehensive, balanced, and consolidated stormwater management program.

2.0 Assessment of the Existing Storm Drainage System

2.1 Study Area

The limits of the study area are illustrated on Sheet A-1 through 3-B in Section 8 of this report. The study area extends from FM 107 on the north to Three Mile North on the south and from Sharyland Road on the east to Moore Field Road on the west. The current city limits of Alton and the city limits and the extraterritorial jurisdiction boundaries of the adjacent cities are also shown.

Stormwater runoff does not recognize jurisdiction lines, and close coordination with the surrounding communities is essential for a successful master plan. During the development of the Master Plan efforts have been made to keep the Cities of McAllen, Mission, and Palmhurst, as well as the Hidalgo County Drainage District No. 1, informed about the progress and preliminary results of the study. Continued coordination is recommended as the plan is implemented.

2.2 Contributing Drainage Areas

The City of Alton is located in a relatively flat area of Hidalgo County that falls primarily from west to east. The heavily developed area of Alton is currently along either side of FM 676. Scattered residential and commercial development exists throughout the remainder of the study area. FM 676 follows a slight rise in the ground surface. The terrain north of the road falls generally to the north and east. The portion of the study area south of FM 676 falls generally to the east and south. The extreme western section of the study area is separated from the remainder by the Main Canal and the Hidalgo County Drainage District No. 1 ditch. Runoff from this western area has not been included in the sizing of the proposed drainage control facilities east of these two structures presented in this study since these two facilities should intercept runoff from this western region.

Storm runoff does enter the study area from the area north of FM 107. This outside runoff has been considered in the planning of the proposed drainage control facilities. The drainage control facilities within this northern portion of the study area should be sized to limit the rate of inflow into the Hidalgo County Drainage District No. 1 ditch to the same flow rate as under existing conditions. Making this assumption should eliminate any effects on the City of Alton from this area. To achieve this condition, close coordination will be required with the appropriate governmental entities and irrigation districts as this portion of Hidalgo County is developed.

The remainder, and major portion of the study area, is crossed by many manmade features such as irrigation canals and laterals, drainage ditches and roads. There are also number of natural and manmade depressions in the study area that currently store storm runoff. All of these features were taken into consideration when the existing contributing drainage area boundaries, illustrated on Plate 1, were defined. The identification reference assigned to each contributing drainage area is also included on the plate. The physical characteristics of each contributing drainage area as determined from the available topographic maps are summarized in Table 2.1.

Table 2.1

Summary of Computed Peak Discharges for Existing Conditions
10-year, 24-hour Storm

					Discharge		Hidalgo County Drainage Dist No. 1	
Area No	Area (ac)	∑ Area (ac)	Channel Slope (ft/ft)	Flow Length (ft)	Developed CN=69(cfs)	Undeveloped CN=(cfs)	Urban (cfs)	Rural (cfs)
N1	194.51	194.51	0.001324	4,012	96.93	50.72	74	42
N2	198.28	198.28	0.000721	4,464	71.70	37.40	76	44
N3	396.18	396.18	0.00105	8,114	111.40	61.42	132	76
N4	713.66	713.66	0.00131	9,064	209.42	112.14	210	122
N5	257.43	257.43	0.002367	4,850	142.78	75.47	92	54
N6	164.18	164.18	0.001864	4,549	86.45	45.50	66	38
N7	97.06	97.06	0.00039	3,021	35.14	18.32	44	25.5
N8	976.32	976.32	0.00157	5,938	404.98	214.19	260	157
W1	237.97	237.97	0.00244	4,102	148.93	78.35	90	50
NE1	244.25	244.25	0.00085	4,697	90.79	48.81	92	52
NE2	365.83	365.83	0.00254	4,416	222.04	115.93	124	72
E1	159.68	159.68	0.00165	2,479	116.89	61.42	64	37.2
E2	129.76	129.76	0.00069	2,033	76.44	40.51	52.2	32.8
E3	540.88	540.88	0.00173	6,407	222.91	117.92	170	98
SE1	180.72	180.72	0.00237	3,932	114.42	60.09	72	39
SE2	579.97	579.97	0.00144	6,556	215.18	115.60	180	105
SE3	123.33	123.33	0.001365	4155	60.97	31.95	51	29.6

Continued Table 2.1

					Discharge		Hidalgo County Drainage Dist No. 1	
Area No	Area (ac)	∑E Area (ac)	Channel Slope (ft/ft)	Flow Length (ft)	Developed CN=69 (cfs)	Undeveloped CN=58 (cfs)	Urban (cfs)	Rural (cfs)
S1	661.00	661.00	0.001795	7520	245.26	131.76	202	117
S2	128.15	128.15	0.001978	2887	91.61	48.54	54	31.5
S3	427.07	427.07	0.001404	5577	176.26	93.37	140	80.5
S4	552.17	552.17	0.001586	8828	178.33	92.32	175	100
S5	279.37	279.37	0.002126	4915	147.27	77.53	100	58
S6	288.93	288.93	0.002919	3553	211.25	111.00	104	58.4
S7	362.62	362.62	0.004780	3538	321.73	198.97	122	70

2.3 Storm Runoff Computations

Based on the proposed City of Alton Drainage Design Manual, stormwater discharges produced by watersheds 200 acres or larger shall be computed using a unit hydrograph method. There are two acceptable unit hydrograph methods for drainage system design in the City of Alton: Snyder's Unit Hydrograph Method and the Soil Conservation Service Unit Hydrograph Method. Each contributing watershed was modeled using the SCS Synthetic Unit Hydrograph method as contained in the ***Watershed Modeling*** (1) procedures in the Eagle Point computer software package. Hydrologic elements were used to compute runoff hydrographs at selected design points. The

hydraulic models were used to determine storage-discharge relationships to route flood hydrographs in the hydrologic models. By definition, a unit hydrograph is a plot of discharge versus time for a storm producing one inch of rainfall over the entire drainage basin. The curvilinear shape was used to compute the SCS unit hydrograph, and values were selected for the shape factor and the runoff curve number. The unit hydrographs were computed using a standard shape factor of 484, a constant undeveloped runoff curve number = 58, and a constant developed runoff curve number = 69. These values are included in the Eagle Point ***Watershed Modeling*** Manual. Development of Runoff curve numbers is discussed in the Soil Conservation Service, Section 4 Hydrology, (2).

2.4 Rainfall Intensity

The point rainfall intensities to be used in the design of all stormwater drain facilities within the Alton area are specified in Section 4 of the Drainage Design Manual. The constants to be used in the rainfall intensity equation $I = b/(t_c + d)^e$ (from the TexDOT Drainage Manual (3) are summarized in Table 2.2 below. The t_c is the time of concentration in minutes required for the runoff to flow from the most hydraulically remote point in the watershed to the facility being designed.

Table 2.2

Rainfall Intensity Equation Constants

2 Year			5 Year			10 Year			25 Year			50 Year			100 Year		
e	b	d	e	b	d	e	b	d	e	b	d	e	b	d	e	b	d
.831	74	9.6	.795	80	9.2	.778	87	9.2	.771	98	9.2	.749	99	9.2	.749	103	9.6

2.5 Rainfall Data

Rainfall depths for storms are applied to the unit hydrograph to determine the resulting peak stormwater discharges produced by those storms. Rainfall data for the 5-, 10-, 25-, 50-, and 100-year frequency storms were derived from intensity-duration-frequency curves from the proposed **Drainage Design** Manual. A listing of the rainfall intensities used in the hydrologic models is presented in Table 2.3.

2.6 Precipitation Losses

Interception, depression storage and infiltration within each contributing drainage area are combined and handled as precipitation losses in the hydrologic models. Initial and hourly rainfall loss rates vary with storm frequency and soil type. Typically, storms with a lower return interval (i.e., more frequent storms) will have higher initial and hourly loss rates. Clay soils typically have lower loss rates than sandy soils due to the lower permeability of clay soils. The initial and hourly loss rates used in this project included in the SCS curve number for the soil type.

Table 2.3

Rainfall Intensity-Duration Frequency

	[5 min]	[15min]	[30 min]	[60 min]	[6 hr]	[24hr]
[2 yr]	7.97	5.17	3.48	2.18	0.54	0.17
[5 yr]	9.71	6.35	4.33	2.76	0.73	0.25
[10 yr]	11.04	7.29	5.01	3.22	0.88	0.3
[25 yr]	12.67	8.4	5.79	3.74	1.03	0.36
[50 yr]	13.57	9.1	6.34	4.14	1.18	0.42
[100yr]	14.16	9.63	6.77	4.46	1.3	0.47

2.7 Lag Time

The lag time is the time interval between the center of the rainfall duration and the peak discharge. For the SCS unit hydrographs, the lag time is equal to 0.6 times the time of concentration.

2.8 Hydrograph Routing

The Muskingum routing method, which is described in most standard hydrology and open channel textbooks, was used to route runoff hydrographs between design points. Linsey Kohler and Paulhus in Hydrology for Engineers (4) have expressed the storage in a reach of a stream as:

$$S = b/a\ [xI^{m/n} + (1 - x)O],$$

where *a* and *n* are constants from the mean stage-discharge relation for the reach, $q=ag^n$, and b and m are constant in the mean stage-storage relation for the reach, $S=bg^m$. The constant *x* expresses the relative importance of inflow and outflow in determining storage. For a simple reservoir, $x = 0$ (inflow has no effect). If inflow and outflow have an equal effect on stage, *x* would be 0.5. For most streams, *x* is between 0 and 0.3, with a mean value near 0.2. A value of 0.25 was used in these studies.

In the Muskingum method, m/n is assumed equal to 1 and b/a is assumed to be a constant k.

$$S=K[xI+(1-x)O]$$

The constant *K*, known as the *storage constant,* is the ratio of storage to discharge and has the dimension of time. It is approximately equal to the travel time through the reach and, in the absence of better data, is sometimes estimated in this way. Sufficient historical data does not exist

for the Alton area to compute a K. The K value has been approximated by dividing the travel distance by flow velocity of three feet per second.

2.9 Contributing Drainage Area Computed Peak Flows

The computed peak flows for existing conditions for the 10-year frequency storm for both undeveloped and developed watershed conditions are summarized in Table 2.1. The computed peak flow values using the SCS Synthetic Unit Hydrograph method are compared to those obtained from the Hidalgo County Drainage District No. 1 runoff curve for small tracts of farmland and grass land and the runoff curve for city drainage. The computed values generally agree with those from the Hidalgo County Drainage District No. 1. Where there is a difference, the SCS computed values are larger and, therefore, more conservative for preliminary master drainage planning purposes.

3.0 Methods of Stormwater Management

3.1 Legal Considerations

The Flood Control and Insurance Act (Article 8280-13 of the Revised Civil Statutes of the State of Texas) authorizes Texas cities to develop stormwater management controls. The act provides for the development of a flood plain management program and the adoption and enforcement of permanent land use and control measures to aid in the implementation of the program.

The legal authority of the City to carry out a comprehensive program of stormwater management, and legal procedures for implementation of various funding methods must be carefully examined as the program strategy evolves. It is recommended that the City Attorney be consulted to provide a legal opinion on integrating the stormwater management program into the City process, especially as it relates to control of private drainage systems and the timing of program elements in light of financing implementation steps.

3.2 Structural Alternatives

Structural applications to control floodwater from a watershed may be divided into two fundamentally different approaches. The two approaches are:

- conveyance oriented approach
- storage oriented approach

Conveyance Oriented Approach: The conveyance concept, briefly stated, is the transmission of a given quantity of water within the confined limits of conduit or channel banks to minimize and/or eliminate damage and disruption through the area to be protected. This technique

is the more traditional stormwater management approach, and the system components consist of pipes, culverts, bridges, improved channels, and levees.

Conveyance describes the capacity of a conduit or channel section to transport stormwater runoff. The transmission capability of an improved conduit or channel varies with numerous factors such as the slope of the channel bed, channel width and depth, and smoothness of the channel walls and bottom. It is also necessary to understand that channel improvements must be sized to convey the selected storm frequency. The system that carries flooding for one storm will often be inadequate to carry the runoff from a larger frequency storm within the conduit or channel banks

An improved channel can greatly increase the conveyance capability provided by a typical natural channel. Depending upon conveyance needs, the improvements can include cleaning the clogged natural channel of vegetative growth, channel straightening which eliminates meandering and improves the slope, developing a new channel section to increase the flow area and maximize smoothness, or a combination of one or more of these. Compared to a typical natural channel, an improved straightened earth or grass lined channel having equal cross-sectional area can convey approximately 40 percent more water, and a concrete lined channel can convey more than three times the flow of a natural channel.

Because of the increased conveyance capability of the improved channel, stormwater can be rapidly and efficiently removed from a given area. Since the improved channel is more efficient in conveying water, it provides the benefit of minimizing the required channel area. Increasing channel efficiencies can also affect the overall watershed hydrology (i.e., hydrograph timing to create a peak on peak).

Within existing developments, the improved channel is very adaptable in controlling and removing stormwaters while requiring the minimum loss of right-of-way. In new developing areas, with proper planning, the improved channel can be combined with aesthetic amenities to provide efficient conveyance while minimizing the hard appearance that may be projected, for example, by a stark concrete lined channel.

Without question, the aesthetic quality of a natural tree-lined meandering creek or stream is very attractive and it becomes a desirable location for development. Alton is not unique in regard to development adjacent to many of the swales meandering through the area. However, implementing stormwater control measures in some streams can possibly destroy or certainly diminish the natural aesthetic qualities with channel improvements, depending upon the conveyance requirements.

The advantages gained, from the increased conveyance capability of the improved channel, may be accompanied by loss of aesthetic quality. Another disadvantage sometimes associated with the improved channel is the possible increase in erosion due to higher velocities. There is also a potential for downstream flooding if the improved channel abruptly ends and allows water to stack up in an area of reduced channel conveyance.

Possible channel improvements and their respective advantages and disadvantages are summarized in Table 3.1. These typical improvements are basic and do not reflect the numerous variations to provide floodwater control within defined parameters or the myriad of aesthetic treatments to retain the natural look.

Table 3.1

Typical Channel Improvements

Type	Nature	Advantage	Disadvantage
Channel Clean Out	Selective removal of trees & under-brush to minimize clogging	Maintains maximum natural setting while improving conveyance	Destroys some Vegetation
Channel Straightening	Improved alignment by eliminating excessive mean-dering and increa-sing channel slope	Retains selected natural setting & improves the conveyance capability	Reduces aesthetic quality of natural swales depending upon extent of straigh-tening
Channel Enlargement	Complete modifi-cation of natural channel by straightening & widening	Provides significant increase in conveyance	Reduces aesthetic quality
Channel Lining	Maximum channel modification by providing lining (nor-mally concrete) to reduce right-of-way requirements	Provides maximum conveyance & minimizes land loss	Can project a hard appearance unless supple-mented with amenities

Storage Oriented Approach: This method of stormwater management provides for the control by means of storing water and releasing it at a predetermined rate which can be adequately conveyed by the downstream system. Traditionally, this method has been utilized on large streams and river systems to control major flooding and is an important function of many of the large dams existing on streams and rivers throughout Texas and the United States. In urban areas, detention is being used to limit discharges from developed properties to that of the pre-developed conditions. This is a requirement of Hidalgo County Drainage District No. 1.

The general application of this methodology for watershed management on smaller areas has seen increased use in recent years. Applications of this method are now employed to areas as small as two acres and can even be applied to individual lots. The only requirement to affect this concept, whether large or small, is provision of a storage area for stormwater collection. This storage can be done on roof tops, parking areas, small ponds, or large areas requiring detailed evaluation of the storage area and overflow spillway.

The storage concept may be divided into retention or detention facilities. The retention storage method assumes the continual retainage of a given quantity of water that may be used for aesthetic, recreational or domestic purposes. The retention system, however, has the capacity to retain additional volumes of water for a short duration to reduce the maximum floodwater flow rate. The stored stormwater is released downstream as rapidly as the receiving channels, creeks, or system will allow, consistent with a stormwater management program.

The detention storage method is similar to the retention system except no provision is made for continuous storage of water. Rather, the stored floodwaters are completely released in a time period consistent with a flow rate that will minimize or eliminate downstream flooding. Detention storage has as its major function the control of stormwaters, yet this requirement may be utilized on an infrequent basis. As a result, the detention storage area can very effectively provide multiple uses for such functions as park areas, playgrounds, or athletic fields.

The primary function of the retention/detention concept is elimination or reduction of downstream flooding by storing and controlling the released water. The prime advantage of this concept is the use of smaller conveyance systems downstream. Depending upon the available storage capacity, it may be possible for the natural creek or stream to convey the released waters and not cause flooding. This approach not only can reduce the capital cost for larger downstream facilities, but maximizes preservation of the aesthetic qualities of the natural stream area.

Multiple use of the storage area is also an advantage. New planning concepts generally encourage open space, parks, and other recreation areas within a development. The retention/detention areas are ideal locations for development of water-related aesthetic or recreational facilities, or can be used for maintained green belts, parks, or athletic fields, depending upon the storage area size.

An advantage associated with the retention/detention concept that has recently received considerable attention is the attenuation of stream pollutants. Inherent in the storage concept is rapid reduction of water velocity which allows the precipitation of water-conveyed sediments and other pollutants such as heavy metals, pesticides, and phosphorous, and thereby significantly reduces

downstream pollution. Because urban stormwater has been observed as a major contributor to pollution of surface waters, the storage concept can be a very effective quality control facility. The periodic disposal of collected pollutants is another factor that should be considered in the planning of this type of facility.

Depending upon the upstream drainage area and the desired reduction of peak discharge, the loss of developable land can become significant. For this reason the application of the storage concept is generally restricted to new development that can incorporate the required storage area into desirable open space, park, or recreational areas. In existing developments, the open space requirements are generally prohibitive and the storage concept becomes difficult to apply.

The basic premise of the retention/detention concept is containment and storage of large inflow rates and the gradual release of smaller outflow rates to the downstream area. Due to this differential between inflow and outflow rates, extended period of time is needed to release the stored volume of water. If the downstream conveyance system is inadequate and the peak flow reduction provided by the retention/detention system is limited, it is possible to extend a reduced flood stage problem over a longer period of time as opposed to the natural condition of higher stages of flooding for a shorter period of time. It is important in selection and design of retention/detention facilities to give adequate consideration to the downstream conveyance capabilities.

Construction of retention/detention facilities requires open land areas primarily in the upper regions of a watershed. In the case of Alton, this is also true where a drainage course exits the study area or where a drainage course enters the Hidalgo Drainage District No. 1 facilities. Desirable sites will be those where existing depressions or abandoned caliche pits already exist, and the length of

dam construction will be minimal and sufficient capacity exists. Since the study area is relatively flat, it may be necessary to excavate a storage area with a controlled overflow from the stream. The stored water would later be released downstream through a conduit with a flap gates as the water surface of the stream declines. Lack of property containing sufficient capacity within the watershed management program area may make this concept only viable in select areas without excavation.

A comparison of the two structural methods of watershed management, conveyance systems and retention/detention systems, is provided in Table 3.2. The conveyance and storage concepts are the current state-of-the art structural methods for stormwater management control. Either approach can be employed individually, but the best results will generally be achieved through a combination of the two concepts. The integrated system of improvements should consider each drainage basin as a whole to provide effective stormwater management control.

Federal Programs: Federal support for urban runoff control has been minimal, and limited primarily to program planning and research. The Section 208 program under the 1972 Clean Water Act (Public Law 92-500) invested heavily in evaluations of water quality programs resulting from urban runoff (3). The Soil Conservation Service (SCS) has historically gives technical assistance to local governments to control soil loss and provide water resource management in urban and rural areas. The types of controls the SCS has promoted reduce erosion/sediment, flow, and flooding problems. These controls often have another benefit, stormwater pollution control (8). The federal government has otherwise steered clear of urban runoff.

Table 3.2

Comparison of Conveyance and Storage Features

Conveyance	
Advantages	Disadvantages
1. Removes stormwater runoff rapidly and efficiently.	1. Reduces aesthetic quality, e.g., concrete lined channel.
2. Minimizes land loss by improved conveyance of stormwater.	2. Possible increase in erosion due to increased velocities.
3. Lowers maintenance cost compared to storage concept.	3. Possible increase in downstream flooding.
4. Can be applied to new or existing development.	
5. Generally the more accepted design analysis.	

Storage	
Advantages	Disadvantages
1. Reduces downstream flow therefore, smaller downstream conveyance system required.	1. Increased land loss.
2. Reduces downstream flow, allowing utilization of natural streams with minimum improvements while retaining aesthetic quality	2. Extends runoff period, bu at reduced peak.
3. Can be applied to new development limiting runoff to no more than natural conditions.	3. Generally restricted to new development.
4. Improves water quality by decreasing pollution through precipitation.	4. Collected sediment must be periodically removed which increases maintenance costs.
5. Has potential multipurpose application, e.g., recreation or aesthetic value.	
6. Can make use of existing depressions and abandoned caliche pits.	

Texas Legislation Related to Floodwater Management: Municipal floodwater management controls are authorized by Article 8280-13 of the Revised Civil Statutes of the State of Texas, commonly known as the "Flood Control and Insurance Act." The primary purpose of this Act is the "promotion of public interest by providing appropriate protection against the perils of flood losses and encouraging sound land use by minimizing exposure of property to flood losses." Subsection (5) of Section 5 provides for the development of a flood plain management program and the adoption and enforcement of permanent land use and control measures to aid in the implementation of the program.

Home Rule Authority: Any assessment of the legal considerations and requirements involved in providing an appropriate stormwater management program should include both the program functions and the financing options to properly balance the needs of the community with the authority and resources available to the City. A home rule city has a good deal of flexiblilty in organizing and financing municipal programs to meet the community's needs. The analysis of finance options addresses several innovative financing methods many of which have not previously been widely used. These include establishing drainage as a utility and using impact or capital recovery fees.

The State of Texas has not specifically authorized cities to use the full range of possible drainage financing methods. It is fortunate that a home rule city has some latitude in using a variety of financing concepts. Home rule cities look to state law for limitations upon their powers, not for specific grants of power. Thus, home rule authority enables the City Council to enact funding methods which respond to the City's drainage needs without specific authorization at the state level.

However, restrictive court definitions of local taxing powers in Texas could impose limits on a city's flexibility.

From a practical standpoint, the program and financing strategy proposed for stormwater management must reflect the needs and attitudes in the local community and must be attractive to promote orderly growth. The options identified throughout this report have been developed in a manner that is intended to be consistent with reasonable public policies. The public will better understand drainage issues and the rationale underlying the strategies if the alternatives are clearly in tune with City policies on economic development, neighborhood revitalization, and environmental protection. Existing policies should not, however, foreclose opportunities to introduce new financing concepts or adjust existing policies.

3.3 Nonstructual Alternatives

Governmental Controls: Local governmental or administrative controls are means of providing control to sensitive areas such as the watershed and its flood plain. Such controls significantly broaden the scope of watershed management beyond the normal structural controls. Governmental controls take two forms: regulatory and non-regulatory.

Zoning and subdivision regulations are effective regulatory control tools in stormwater management. New approaches to the control and management of land allow flexibility in the operation of flood plain land use controls.

The detailed specifications commonly found in zoning ordinances are generally inadequate when applied uniformly over an entire flood plain zone. The natural functions of the flood plain vary from site to site (1) due to local conditions, (2) how the site interacts with the surrounding natural

features, (3) which conditions have a direct impact upon the site, and (4) whether the site is relatively pristine or is in the process of adjusting to surrounding disturbances.

An approach, that of controlling the impact of uses, represents a shift from zoning control of uses. Because of the shift in focus, this approach has caused some major changes in the operation of flood plain land use controls. This change can be characterized by a movement away from detailed specifications concerning construction techniques or site requirements and a movement toward performance criteria for land use.

One of the most commonly used methods of establishing performance type controls is the development of a series of policy guidelines that outline the community's expectations on the function of the land. The ensuing regulations are individualized, with each case being judged on its own merits as to how well it satisfies the policy guidelines. An alternate to this method is the use of performance standards. Using this type method, the community sets a specific measurable level at which the key functions of a development will meet these standards.

Subdivision control regulations are effective tools in watershed management. Unlike zoning ordinances which apply only within the city limits, subdivision control in Texas extends to areas within a city's extraterritorial jurisdiction (ETJ).

An effective method used in the establishment of a stormwater management program is the incorporation of runoff, erosion, water quality, and sedimentation controls into the City's subdivision ordinance performance specifications and design standards. This system allows for uniform application of a stormwater management program throughout the watershed, minimizing the possibility of inter-ordinance conflicts.

Non-regulatory controls take several forms. Annexation of areas which could potentially affect the flooding characteristics of the community is a viable method of increasing the effectiveness of stormwater regulatory controls. As discussed in the previous section, the subdivision ordinance and its platting requirements are essentially the only formal control the City has in regulating development in the ETJ. By annexing land, the City can use additional regulatory tools including the zoning ordinance, building code and the site plan review process.

Direct ownership through a fee simple purchase is one of the most effective means of preserving flood plains as open space areas, parks, existing caliche pits, or nature reserves within the City's corporate limits. Because of the direct expenditure of funds, there are fiscal limitations to this approach. However, some grant and loan programs are available to local governments through various public and private agencies for preservation and open space development within the City's corporate limits.

Purchase and/or dedication of flood easements is another option available for the control of flood hazard areas. This technique is usually implemented along drainageways requiring regular maintenance and inspection so as to maximize accessibility.

The development of governmental policies that limit or discourage the extension of public services (i.e., roads, utilities, parks, etc.) into a flood prone areas are effective tools in the promotion of stormwater management. By not authorizing the extension of services to nonconforming developments, the City in conjunction with private utility companies, can encourage flood conscious design.

Municipal Drainage Regulations: The Alton's Zoning Ordinance, Subdivision Regulations, and Building Code are the primary instruments used in the reduction of flood hazards within the city and its extraterritorial jurisdiction.

Drainage regulations to be developed for Alton should be designed to provide a stable foundation for a stormwater management program and provide effective measures for the prevention of flood damage to development. The regulations should outline concise performance standards for development outside of the flood hazard areas. Outlining at least a minimum level of performance for runoff will mitigate the long-term impact of development throughout the watersheds.

4.0 Stormwater Management Costs

Once the scope of stormwater management activities has been defined, it is necessary to estimate the annual cost for programs to achieve the stated program goals. Estimating the total costs (i.e., revenue requirements) of a comprehensive stormwater management program is the first step in preparation of a financing plan. Costs for each specific function performed as part of the program (e.g., capital improvements, operations and maintenance) must be estimated.

For initial studies, such as this one intended to present various management practices, order-of-magnitude estimates are sufficient to obtain a concept of the total cost of such a program. For implementation, more detailed analyses-- preferably in the context of a specific master stormwater development plan--are warranted.

Recently published literature provides a range of estimates of costs for stormwater management. In most cities, basic annual watershed administration, engineering, and reactive maintenance cost $30 to $50 per acre. Comprehensive management, including drainage master plans, preventive maintenance, and major capital improvements will cost several thousand dollars per acre.

This section presents representative data on the cost of each aspect of stormwater management: administration; planning, design, and engineering; regulation and enforcement; operations and maintenance; and capital improvements.

4.1 Administration

Administrative costs for watershed management are difficult to estimate. In situations where

no separate drainage division exists, estimating administrative costs from historical records will involve, for example, determining the percentage of time devoted to stormwater management by various personnel in Public Work, Planning, Code Enforcement, and other departments.

In most cases, the assumption that administrative expenses will be a certain percentage of total capital costs is a reasonable approach. The formation of a stormwater management utility will significantly increase administrative costs, however, because of the costs of developing and administering a billing system. Therefore, the percentage of total costs for administration most likely will be higher under a utility approach.

4.2 Planning, Design, and Engineering

Costs for planning, design, and engineering may be determined separately or may be included with other functions such as capital improvements, maintenance, and plan review (regulation). In cities where separate engineering divisions exist, estimates of the costs can be prepared by totaling the historical cost of personnel and adding an overhead percentage.

4.3 Regulation and Enforcement

Many jurisdictions charge fees based on actual cost of service for plan review, inspections, and other regulatory services. Therefore, compared to other costs, the costs for regulation and enforcement can be determined relatively easily and fairly accurately. However, to the extent these costs are financed by fees, they should not be added to the estimate of cost for function that will be financed by some other method.

4.4 Operation and Maintenance

The difficulties in estimating operations and maintenance (O&M) costs are similar to those in estimating costs for administration. To determine stormwater management costs, most public work's maintenance supervisors have to estimate the percentage of time that various people spend on stormwater maintenance as opposed to maintenance of other infrastructure. This division is difficult to do accurately.

Another approach is to estimate O&M costs as a percentage of total capital investment. This is relatively straightforward for recently built or proposed facilities; it is not as helpful for older facilities that need substantial maintenance. For recently built or proposed facilities, 3% to 5% of the base construction cost should be allocated for maintenance

A third approach, which presumes knowledge of the location and condition of all facilities, is to assign unit costs for maintenance to each facility that will be maintained. This approach is likely to be possible only in situations where inventories of facilities recently have been completed or where master plans recently have been prepared. Table 4.1 shows representative costs for mowing, debris removal, and other routine activities.

Table 4.1

Typical Maintenance Costs for Drainage Facilities

Activity	1997 Cost (dollars)
Grass-lined channel	
Mowing	130/acre/year/cycle
Cleaning	1.00/linear foot
Rock-lined channel	
Rock replacement	3.55/linear foot
Debris removal	1.00/linear foot
Concrete-lined channel	
Minor repair	2.25/linear foot
Debris removal	1.00/linear foot
Detention pond	
Mowing	38.75/acre/year/cycle
Cleaning	500 lump sum
Weed control	105/acre

4.5 Capital Improvements

Capital costs can be estimated for master drainage plans, capital improvement budgets, or other similar sources. One method for estimating is the use of tabulations for previous projects. These tabulations can be used as a guide, but no assurances can be drawn involving similar applications, especially if the severity of the conditions varies between the applications.

A second method is the use of old master drainage plans, capital improvement budgets, and engineering publications to supplement bid tabulations. However, these figures are only as accurate as the quantity of materials estimated.

A third method is the use of published equations for estimating construction costs. These equations may be useful in situations where a capital cost estimate of facilities is needed to estimate maintenance costs, and no other method is available. For example, if an estimate of maintenance costs is needed for an old facility for which no construction costs are available, these equations could be used to estimate current construction costs, and then calculate maintenance costs from that estimate. Also, these equations can be used for rough replacements costs of new facilities that have failed. This method should be utilized only when the first and second estimating methods cannot be used.

4.6 Summation

Establishing a concept for the stormwater management program is a critical first step in the preparation of a financing plan. Costs for each specific function performed as part of the program must be analyzed with respect to the program concept to determine total costs for comprehensive

stormwater management. Adequate funds for maintenance as well as capital improvements must be available for an effective watershed management program.

The Watershed Management Program must generate sufficient funds to provide for maintenance of existing and future stormwater structures, personnel costs, annual capital improvement projects and administrative expenses.

5.0 Financing Options

The lack of stable and adequate local financing is a major obstacle to implementation of comprehensive, long-range stormwater management programs. Traditional municipal financing methods have proven to be ill-suited to funding major improvements to drainage systems, their maintenance and operation, and regulation of private sector activities which impact the systems. This section addresses major recent changes in watershed management financing, and describes some of the alternative and innovative approaches which can be considered. It briefly summarizes a range of financing concepts and suggests criteria for evaluating various financing alternatives.

The range of financing option concepts available to the City of Alton includes those which are explicitly authorized by state legislation, those available under home rule authority, and methods which might require legislative authorization at the state level. Each of the options identified in this section has been used in one or more cities in the United States, though some have not been implemented in Texas. Their use in Alton could be subjected to legal challenge and judicial interpretation. Financing concepts used in other states cannot be assumed to be legal under Texas law, and methods held to be invalid in other applications should not necessarily be considered invalid for stormwater management.

Since both legislative and judicial actions may limit the application of the various methods of drainage financing, this list of options will require legal review by the City Attorney's Office. No legal evaluation was made during this analysis.

5.1 Summary of Financing Options

Traditionally, stormwater management has been financed using general fund revenues for annual operating expenses and a mix of revenue sources for capital improvements. The level of operational funding in most jurisdictions has only been sufficient to respond to the highest priority needs, and has not allowed comprehensive programs to be developed.

The range of financing option concepts presented herein is a contrast to the limited number of funding sources that have been used for stormwater management in the past. The options should be viewed as opportunities to broaden the base of support and balance financial participation in a stormwater management program, while also localizing costs when it is more appropriate than distributing them citywide

.

5.2 General Fund

The general fund of the City is the "base" of financing for municipal programs, with revenues from a number of sources including property taxes, excise and sales taxes, business licenses and taxes, utility taxes, and fees of several types. It supports wholly or partially those city functions which do not have other sources of funding such as service charges.

The City administration and Board of Alderman have discretionary control of the general fund through the budget process. Identified municipal responsibilities and political realities tend to define how most of these revenues are spent, however. It has historically been difficult for programs which focus on long-term, capital intensive, public facilities construction and maintenance to complete effectively in an annual municipal budget process.

There are few explicit limitations on the use of general fund revenues. They can be spent on both operational and capital expenses, although most often they are used for annual operating costs. Capital outlays which are sometimes paid from the general fund include equipment and land acquisition, but only rarely major construction.

General fund revenues are often relatively susceptible to economic conditions in the community. Sales tax and excise tax receipts drop during a bad economic slump. Property values may decline leading to reduced tax assessments. Property tax delinquencies tend to increase during periods of recession and high interest rates. At the same time demand for many municipal services (especially police and social services) increases.

Insofar as drainage is concerned, financing through the general fund tends to create an imbalance of costs in comparison to contribution to drainage problems, benefit or services received. The complexity of drainage problems makes it difficult to accurately define who pays a disproportionate amount or receives more in benefit than they may be paying. It is clear, however, that there is no measurable basis of equity inherent in general fund financing of stormwater management.

5.3 Drainage Utility Service Charges

This financing method has been instituted in a number of cities and counties (particularly in the western U.S.) as an alternative to general fund financing for annual operating expenses. These "user" charges are analogous to water and sanitary sewer service charges, but dedicated for stormwater management. This approach requires that an enterprise fund utility be established for

stormwater management.

The drainage utility is an innovative concept, but one which fits uniquely well with the program needs in most local stormwater management operations. The functions and costs for effectively managing drainage are similar to those needed to provide water supply and sanitary sewer programs. Since water and sewer have been financed through service charges for some time, it is not surprising that drainage utilities and service charges have been implemented in the same basic format.

The philosophy behind user charges for watershed management differs from those for water and sewer service in several ways. Unlike water supply, a measurable commodity is not delivered to the customer. The service provided is similar to sanitary sewers or solid waste disposal in that something is carried away and disposed of (i.e., stormwater) but quantified measurement is difficult and costly. The demand for the "service" is not comparable to the demand for water supply, since most properties drain onto downhill neighbors fairly effectively without any public system. A broader definition of benefit resulting from service is needed in the case of drainage than for other utilities. Finally, drainage programs are more oriented to solving or mitigating problems than are the other utility functions, which have focused on providing service to clients.

Unlike some of the other financing options, user charges can provide a true alternative to general fund financing for drainage, rather than just a supplement to it. The other options have a limited clientele group and will not generate sufficient revenue to fund all the necessary functions. User charges, on the other hand, spread the expense of the drainage program as broadly as possible throughout a community, resulting in a relatively low cost for each property owner.

Revenues derived from service charges can be used to pay for administration, planning, design, operations and maintenance, revenue bonds for new construction and replacement of old systems, support services, regulatory functions, and virtually anything else required in a drainage program. Rate structures are flexible mechanisms which enable a city to tailor the cost distribution to fit the local program and be consistent with other local policies. Finally, drainage utility revenues remain in the utility fund if not spent, rather than reverting for redistribution in the next year's budget, an important factor in long-term program stability.

5.4 Interfund Loans to Drainage Utility

The legislative action establishing an enterprise utility necessarily precedes the imposition of service charges and collection of revenues. An interfund loan from another municipal fund(s) may be desirable for interim financing of stormwater management functions until revenues are generated by the drainage utility. An interfund loan of this type is normally repaid from the utility service charge revenues.

5.5 General Obligation Bonding Repaid by Property Taxes

Capital improvements are often too expensive to finance from operating revenues, especially when an activity is funded from the general fund. General obligation bonding is a form of municipal borrowing in which the full credit of the city is pledged to service the bond debt. These bonds require voter approval, and usually involve an excess property tax levy. They have been used for many purposes in the past, though use of them for utility projects has diminished with greater

acceptance of revenue bonds.

Because they are backed by the full credit of the local government, general obligation bonds normally receive the most attractive (lowest) interest rates of any municipal borrowing instrument. They can be issued with varying maturities and other provisions which may affect their marketability and the interest rate they must pay.

5.6 Revenue Bonding Repaid by Service Charge Revenues

Enterprise funds, such as utilities, which have a source of financing separate from the general fund can borrow money for capital improvements through bonds to be paid off with service charge revenues. These bonds do not require a voted approval, but are usually subject to slightly higher interest rates than general obligation bonds because the full credit of the city is not pledged.

Revenue bonds do not authorize an increase in taxes, nor do they usually authorize a specific increase in utility service charges. If necessary to support the bonds, a rate increase is normally enacted separately. It is possible to use service charge revenues from throughout a service area to repay revenue bonds or to specify that only revenues from one area or even certain properties be used for the bond payments. In most cases, it is best to place few limitations within the bond ordinance which relate to revenue sources, while still being consistent with financing philosophies and local policies. This provides the bondholders with some assurance of payment, and may result in a lower interest rate.

Although typically the bonds are repaid from the regular service charge revenues, municipalities may also establish system development charges, hook up fees, and other financing

methods and earmark those funds for repayment of the revenue bonds. This reduces the revenue required from the standard service charge by the amount generated by the special fees and charges, and ensures that developing properties help pay for the project.

5.7 Utility Tax Revenues

Utility taxes and franchise taxes are levied on utilities operating with a municipality, including one or more of the following in most jurisdictions: telephone, electricity, natural gas, water, sewer, solid waste, fuel oil, cable television, and drainage. In recent years, cities have used utility tax revenues to construct various kinds of capital improvements, including drainage system improvements. In general, communities have a high level of discretionary control of utility taxes and their uses.

5.8 Tax Increment Financing

Tax increment financing can be used to provide funds for an infrastructure in areas where development is desired but funding for public facilities are not otherwise available when needed. In this approach, increases in tax revenues that are realized as a result of new development in a specified area are earmarked for financing public improvements or services in that area.

Usually administered by a public agency, a district is defined with a specified "base line" tax base of existing development. Improvements within the area are financed from the general fund or from bonds, then repaid from increasing tax revenues generated by the new development. The new development in effect pays its own way, using the community's normal tax program as the

mechanism for deriving revenues. The method does have the drawback of siphoning off all increases in revenues, even revenues attributable to increased value of existing development in the area, until the bonds are paid off.

5.9 State Funding

Community Development Block Grant Funds: These revenue sharing funds are intended for use in neighborhoods which have been targeted for improvement based on social-economic and physical condition criteria. The City has discretion in the use of the funds within broad guidelines. In Texas, CDBG funds are administered by the Texas Department of Commerce.

With pressures to balance the federal budget, the future of federal development funding is uncertain and the City should not depend on CDBG funds. In addition to the uncertainty surrounding revenue sharing funds, the program itself has substantially more applicants that funds available. Therefore, grants are generally awarded to those communities with highest priority needs, such as substandard housing, inadequate water and sewer systems, and a significant percentage of low/moderate income residents.

Texas Water Development Board Funding: The Texas Water Development Board (TWDB) administers state funds for financing flood control projects. TWDB funds are disbursed to eligible political entities, generally as loans. Using the state's excellent bond rating, TWDB sells Texas Water Development Bonds which are general obligations of the state and purchases the bonds of local political subdivisions.

Historically, use of the Texas Water Development Fund was reserved for "hardship" political

entities (political subdivisions unable to sell bonds in the open market or political subdivisions unable to sell bonds at a reasonable interest rate). However, passage of House Bill 2 by the 69th Legislature and approval by voters in November 1985 expanded the program to allow TWDB to make loans without a finding of hardship for the construction of a regional water treatment facility, flood control project, and facilities designed for conversion from the use of ground water to surface water.

TWDB may provide loans from flood control funds for the following flood-control related projects: (1) construction of stormwater retention basins, (2) enlargement of stream channels, (3) modification or reconstruction of bridges, (4) the acquisition of floodplain land for use as a public open space, (5) acquisition and removal of buildings located in a floodplain, (6) relocation of residents of buildings removed from a floodplain, and (7) development of flood plain management plans. To determine if a project is eligible for loan funds, several points are considered including the needs and benefits of the project to the area to be served, the availability of revenue for repayment of the loan, and whether the political subdivision can reasonably finance the project without State assistance (hardship).

5.10 Fees and Charges

Cities have developed a variety of special administrative fees and charges to cover expenses which are associated with permits and other services for individuals. In most cases an identifiable "client" is assessed the fee or special charge, which is often earmarked to support a specific function.

Plan Review and Inspection Fees: The City has specific design and construction standards which private drainage systems must meet. Development permits are issued only when the plans meet these standards, requiring that the staff check that plans. Field inspections are necessary to verify that the systems are installed as designed, since private drainage systems may have a direct impact on the function of public systems. Some cities attempt to make plan review and inspection financially self-sufficient through the fees, while others subsidized these functions partially out of general fund revenues to encourage development. The net effect of this type of fee is to have individuals with changes in land use bear some or all of the cost for improvement of public services impacted by their projects.

On-site Detention/Retention System Inspection Fees: The private drainage systems which are installed on private property are important components of the total drainage system. Public systems are often designed and operated on the assumption that the private systems will function properly. Experience has shown, however, that voluntary maintenance of private drainage systems is very lax. Annual inspections of private on-site facilities can identify needed maintenance before problems occur, but they are relatively expensive to carry out on a regular basis. These inspections can be billed to the property owner as a service charge if a drainage utility is established. It may be possible for the City to also levy such a charge without a utility, though an annual permit of some type may be needed.

Impact Fees: Impact fees are charges or assessments against new development to fund the cost of capital improvements or facility expansions necessitated by and attributable to the new development. As of June 1987, Texas cities are expressly authorized to assess impact fees for

drainage facilities provided that the fees are directly associated with actual impacts and earmarked to ensure they are used to mitigate those effects. Further, the costs of over sizing facilities constructed prior to adoption of an impact fee ordinance may be recouped through the fees.

Impact fees began as a response to the realization that construction and land development may have significant impacts on a neighborhood or even an entire community. Rapid growth fostered a concern not only for the environmental effects of growth, but the economic implications as well. Increased urban runoff and pollution, congested highways, and larger water and sewer facilities often translate into higher property taxes to upgrade municipal systems in response to problems. Impact fees are perceived as a mechanism to make growth pay it's own way by participating in the cost of new facilities at the front end of a project rather than indirectly through long-term enhancement of the tax base and increased local employment.

While the recently enacted state legislation limits the use of the impact fee concept, the statute validates a funding process that has already passed judicial scrutiny. The new law requires that, prior to adoption of an ordinance establishing impact fees, a City must conduct several studies to determine the real impact of new development on the infrastructure. These studies include land use assumptions, establishment of service areas, a capital improvements plan, and analyses relating the costs of improvements to individual "service units." The statute also prescribes a definitive adoption procedure and requirements for earmarking and accounting, refunds, and assessment and collection of the fees. Prohibitions on the use of fees include "repair, operation or maintenance of existing or new capital improvements" and "administrative and operating costs" of the City.

Impact fees are sometimes confused with the other types of special fees and charges cited in

this report. Care should be taken to differentiate between impact fees, which are associated specifically with the impact of a project, and the general needs for new facilities to serve the community.

Development Assessment Charges: As an alternative to requiring each new development to provide conveyance systems, on-site detention or retention to mitigate increases in peak runoff, the City could institute this type of charge as an option available to developers in some drainage basins. Detention capacity and conveyance systems would be satisfied by regional public facilities, which the developers would be "buying into" through the development assessment charge instead of building the on-site detention system. Such fees are then earmarked to pay for regional detention facilities.

This approach will probably be enthusiastically welcomed in communities where developers have experience with building their own on-site detention systems. Not only are the developers relieved of the cost of design and responsibility of building the on-site facility, but they gain more flexibility in the use of their property since an area need not be set aside for detention of stormwater.

Assessment fees are particularly useful when more than one type of drainage system would solve or mitigate a problem, but one approach would be privately financed while the other would be paid for from public funds. In some cases, the cities would prefer to have the type of system that would require public financing, yet do not want to forego the private investment which is justified. Assessment charges can offer the best of both options by allowing the most desirable system to be built while still ensuring private financial involvement.

System Development Charges (SDCs): These charges have been used by municipal utilities

for a number of years as a method of financing improvements. They have been known by several titles other than system development charges, e.g., utility expansion charges and extension and improvement charges. System development charges differ from other similar charges, such as general facility charges, in that they are associated with specific improvements are constructed as a means of balancing financial participation.

Communities must frequently install suitable water, sewer, and drainage systems in anticipation of growth. System development charges enable communities to meet the increasing demands on systems which accompany growth pressures. The SDC resembles the latecomer fee for developer extensions, which is explained below, in that the intent is to enable a community to achieve excess capacity improvements in advance of growth. At the same time, place an equitable portion of the cost on those properties which later develop and makes use of the extra capacity that was built into the system.

When revenue bonds (supported by drainage utility service charges) are used to finance drainage improvements, SDC's can ensure that all properties, adjacent to or within the watershed, equitably participate in the financing of the capital improvements. Major drainage improvements are normally sized with future development in mind and have a useful life at least two or three times as long as the bond maturity. One purpose of the SDC's concept is to ensure that the properties which develop after the bonds are sold also help to pay for the improvements. SDC's should be consistent with that amount paid by developed properties when the improvements were constructed.

The SDC provides a rational financing method which responds to the sensitive issue of who pays for over-sizing to accommodate future growth. Care must be taken, however not to place too

much confidence on future growth as a revenue source. If the growth slows or does not occur, the existing developed properties might have to pay a larger service charge in the future to cover the shortfall of SDC revenue. Unanticipated increases in service charges due to SDC shortfalls can erode a utility's credibility with the public, and should be avoided through conservative projections.

General Facilities Charges: General facilities charges are similar to the SDC concept, although they are more often used for overall improvement to a system, or for maintenance or replacement than for specific capital improvements. This method of financing is most often used when improvements which will benefit an entire service area are involved.

If a community has sufficient drainage utility service charge revenues that improvements made to the drainage system can be paid for directly out of revenues rather than through bonding, general facilities charges can be used to balance the financial participation. For example, if all improvements to the drainage systems are oversized for future conditions but the developed properties are not billed a service charge, the general facilities charge can be used to ensure that developing properties "buy into" the prior capital investment in the system. This type of financing works best when the newly developing properties must obtain a permit to hook up to the drainage system, similar to the case of water and sewer.

The general facilities charge is probably most appropriate when a simplified rate structure is used which lumps operating and capital expense into a uniform system of charges or an "equivalent residential unit" approach. In such cases, the costs of all elements of the drainage program are spread area-wide without a highly refined cost distribution formula.

The underlying philosophy of this approach is that the improvement serves everyone, or the

system is viewed as a fairly uniform whole rather than as a number of discrete parts. There is usually no need to break down a general facilities charge into component parts, whereas a system development charge is often associated specifically with revenue bonds for individual improvements, which suggests that much closer accounting practices are justified.

Other terminology is used in different areas of the country for financing concepts quite similar to general facilities charges. Water and sanitary sewer "hook up" fees are often intended to help finance general improvements to the systems rather than simply cover the expenses related directly to the hook up itself. Some cities include general facility charges in building permit fees, or other municipal approvals associated with development. Regardless of what they are called, general facilities charges for drainage provide an additional revenue source which may fill in gaps in a utility rate structure. The gaps are often intentional and reflect the City's financing policies (e.g., undeveloped properties do not help finance utility systems), or occur because of billing system limitations.

Latecomer's Fees: These charges are especially useful in developing areas or where major reconstruction or upgrading of a drainage system is needed, public funds are limited or not available, and a private development is contingent on the improvement. Through a developer extension agreement, the City can allow the developer to construct the improved and oversized drainage facility in conjunction with the project.

Developer extensions are common for water and sewer systems in new developments, but have not been widely used for drainage systems. The latecomer's fee is usually only used for over sizing costs, for example in the case of sanitary sewer interceptors or to ensure fire flow capacity to

other properties. This charge method may be applied to drainage systems as well.

Regardless of what these various fees and charges may be called, they typically have specified purposes, and are accounted for in a manner which allows the revenues to accumulate. Fees and charges dedicated for specific purposes can be carried forward, and reserves can accumulate if an enterprise utility fund is established for drainage which separates the revenues from the general fund.

Revenue which is not spent for several years may also require special accounting treatment in municipalities in some state. Usually, the money must be accounted for in the budget, even if it is not intended to be spent during that year. For water, sewer, and solid waste, a utility expansion fund is often the reserve account for these revenues in a municipal budget. Drainage utilities can use the same accounting technique to make dedicated reserves less susceptible to application to other needs, a protection which may be important in differentiating fees from taxes.

Utilities are allowed to retain surplus funds, both as a reserve to respond to emergencies and as a natural function of long-term rate structures which are predicated on differing rates of change in expenditures and revenues over time. This reduces the frequency at which the rate structure must be changed, contributing to stability. Similar accounting practices allow revenue accounts for fees and charges in a utility to accumulate. It is important to clearly identify reserved funds in the annual budget and to maintain a proper audit trail to ensure that an accurate picture is given of the enterprise's balance sheet, including fee accounts.

5.11 Special Assessments

Several methods of levying special assessments on benefited properties to pay for drainage improvements have been used around the country. In most cases, the projects have a demonstrable benefit to the properties included in the assessment area and the charges for each parcel are consistent with the relative benefit to each property. In Texas, special assessment options include drainage districts, which are special-purpose taxing districts with specific authority to deal with stormwater management (10), and special improvement districts, which are areas of the city where the majority of property owners have requested City Council to establish a district and collect assessments to fund levels of service and programs in excess of the existing levels (11).

5.12 Criteria for Evaluating Financing Options

Whenever an effort is made to develop a new drainage program and/or a new financing concept for a municipal function as complex as stormwater management, some basis must be established for judging the appropriateness of the various options. A financing strategy must provide a stable, adequate, and publicly acceptable source of funds which will support the entire program as efficiently and equitably as possible. Transition, growth, and future program requirements must be considered as well as immediate needs. Further, the financing strategy must be consistent with the community's perceptions and resources.

Based on experiences in cities which have implemented stormwater management programs, the following criteria were selected as qualitative measures of the financing options. It is unlikely that any single financing method will be judged best under this wide range of considerations, but the criteria should help identify the best mix of funding methods, and reconcile differences between

program and financing strategies. Some of the criteria may be viewed as more important than others. The order does not imply a priority, although public acceptance based on perceived equity is essential for political success of any new stormwater financing proposal. No single criteria should outweigh the others to the extent that an option is selected or rejected solely on one consideration.

Perceived Equity and Public Acceptance: Public acceptance of a financing strategy and the mix of financing methods it incorporates is essential for a drainage program to be successful. It must be recognized that some members of the community will not wish to pay anything, through any financing method, to fund drainage control. In most cases, a larger segment of the population will understand the need for an adequate stormwater management program, and the necessity of paying for it. To these citizens the critical issue is usually equity. It is important to note that perfect equity is probably not achievable either technically or economically, and that public opinion will be based on "perceived equity" and an appearance of basic fairness in financing.

The key is to finance stormwater management in an understandable manner. This is the strength of classifying financing techniques according to purposes for which the technique typically is used. It presents a logical association between what is done (functions) and how to pay for it (financing). To achieve perceived equity and public acceptance this logic must be communicated to the general public through various public information concepts.

Flexibility: A great deal of change could occur in stormwater management programs during the next decade. More effective regulation and maintenance of systems could be required. Water quality may become as important a concern in the overall management of the drainage systems as flow control. A financing strategy should be responsive to the growth needs of the program and to

the physical complexities of the drainage basins. It must provide a flexible approach which can grow incrementally with the program.

To gain this flexibility, a mix of financing methods is likely to be needed. Some methods may require authorizing legislative action at the state level, and the local government may have to substitute a second choice for funding some functions until such legislation is adopted. Care should be taken during the interim not to foreclose options which require legislative authorization. It is also possible that a financing strategy selected through this process will not fit the needs 10 or 20 years in the future, in which case the most flexible system might be the easiest to adjust to meet changing priorities.

Capacity: The financing methods should be carefully evaluated to determine if they can generate sufficient revenue now and in the future to meet program needs. The public's willingness to pay may have thresholds beyond which they will not support even the most equitable financing system for watershed management.

Perceived equity is a factor in the public's willingness to pay. Their willingness may increase with the strength of their perception of equity. However, emphasis on equity also carries with it a potential problem if the financing capacity of the most logical and equitable funding method is insufficient to accomplish the program.

Analysis of long-term financing capacity is important, and the equity criteria must be tempered with a degree of reasonableness. Inflation and other factors can render even the best estimates unreliable, which would suggest that the greatest emphasis be placed on short-term financing capacity (for not more than five to seven years).

Cost of Implementation: The bottom line to many of the criteria identified in this section is cost. A perfectly equitable financing method might be desirable and achievable except for the cost of development and maintenance. Compatibility with other programs and policies may be limited in a financing strategy to avoid the expense of an excessively complicated mix of financing methods, or to limit the complexity of needed rate structures.

The initial cost of implementation must be weighed against the financing capacity of the options and the program needs. A financing method which costs more to implement may be worth the added expense if the alternatives cannot generate sufficient revenue to fund the program. Another consideration is the source of revenue against which the implementation costs would be charged. One element of a financing strategy could be to delay the implementation of some financing methods until a drainage utility is formally established, making the subsequent implementation costs a utility expense rather than a general fund expense. The work might initially have to be funded from an interfund loan from another fund, but could be repaid later from utility revenues.

Finally, the cost of implementation must be weighed against the price of delay. Many segments of a drainage system may be in need of remedial repair or even replacement to prevent costly and dangerous failures. At least one year lead time is usually needed to prepare plans, designs, and bid documents to correct major drainage problems. Timely implementation may prove less costly in the long-run than the method with the lowest initial cost of implementation. Also, each month that a utility service charge concept is not in place, it means that the revenue is foregone.

Compatibility: Whenever possible, the financing methods for stormwater management

should be compatible with existing policies, practices, and systems. This simplifies implementation and acceptance among City staff, and minimizes costs. Special emphasis should be given to ensuring compatibility between policies pertaining to the water and sewer utilities and those of a drainage utility, if one is established.

In some cases, financing methods may necessitate substantial changes in existing practices or systems. For example, use of drainage utility service charges might require that the utility billing system be altered to incorporate the additional billing. An effort should also be made to anticipate opportunities to improve existing systems during a changeover in the drainage program. Development of a master billing file for a utility service charge could provide the mechanism for assembling a parcel-based data system which would have spinoff benefits for land use planning, economic development, and other municipal programs. The incremental cost of generating additional data for management information systems is minimized if it can be piggybacked with the base file work being done for drainage or other related purposes. The City should also consider compatibility with programs in neighboring jurisdictions and special-purpose agencies.

Upkeep Requirements: The financing methods may have differing needs in terms of upkeep. Some require virtually no file or record maintenance, whereas others demand constant updates. Fee systems can be set up in a variety of ways which imply different upkeep procedures. Systems which minimize upkeep costs are desirable, but this must be weighed against both the equity and flexibility considerations.

This criterion is especially important with regard to drainage utility service charges. The upkeep requirements can be controlled through proper design of the data systems and processes that

are used in the rate structure and for billing. The best reference, for evaluating the upkeep costs of drainage utility service charge financing options during the finance strategy phase, is the experience of the other cities which have implemented similar systems.

Balance: A financing strategy must be balanced in the terms of dependency placed on any single method of funding, the fit with the drainage program, and the resources of various sectors of the general public. A single source is likely to provide most of the money for annual operating expenses, i.e., either the general fund or a utility service charge. An effort should be made, however, to balance the dominant revenue source with complementary funds for special elements of the program. A municipality can control (to some degree) the balance the dominant revenue source with complementary funds for special elements of the program. A municipality can control (to some degree) the balance of revenue sources to ensure that the financing capacity is hedged against economic downturns and is responsive to economic improvements.

Drainage utility rate structures are relatively inelastic, and more stable than other utility rates that are based on consumption (e.g., water and electricity). Most drainage rates are based on how the use of property effects hydrology and/or water quality (with no charges assessed to unimproved property). These rates do not change in response to the economy. Delinquencies tend to increase during recessions, however, and a drainage utility is not totally immune from a revenue shortfall.

With so much emphasis placed on reconciling the financing strategy with the program strategy, that aspect of balance is usually well-assured initially. Care must be taken that the balance of the financing strategy remains consistent with the various stages in the development of the program, especially in light of the capacity of various financing methods. If the cumulative

willingness to pay of the citizens in a neighborhood is fully tapped during the first two years by application of a variety of fees and charges, another element of the financing strategy might later be rejected. Also, no segment of the community should feel that the entire drainage program is being carried solely on their backs.

Timing: This consideration is most important in terms of the time required for implementation, and whether it fits with the desired timing of the program development process. If possible, charges should be initiated during the rainy season, when residents' recognition of drainage problems is highest. Some financing methods are highly dependent on timing for success. For example, special assessment districts should be proposed when the problems are fresh in the residents' minds and not during drought times.

Geographical and Jurisdictional Considerations: Unique geographical conditions should be incorporated into the evaluation, especially when there are numerous drainage basins, as the case in Alton. Over the long-term, demand for drainage services may be similar, but some areas might require replacement of inadequate or failing systems years before others.

Possibly the most important jurisdictional consideration is the difference in service level and design standards between neighboring local governments which share responsibility for drainage basins. The financing options should be evaluated on their suitability for bridging technical differences to support mutually desirable solutions to problems. The priorities which each local jurisdiction place on achieving its standards should also be reconciled with the opportunities afforded by financing options.

5.13 Summation

Experience has shown that implementation of numerous service charges, fees, and taxes cause confusion and misunderstanding in payment and funding allocations. In addition to an administrative fee charge for drainage plans review, a general drainage facilities charge, a base charge for the entire City similar to a utility charge but based upon land use, should be considered to supplement the existing fee structure. This charge would be designed to generate the additional revenue needed for program operations and allow the burden for generating revenue to be distributed equitably among all the citizens of Alton.

The City of Alton needs to review the financing options and adopt a combination that should provide adequate funding for a stormwater management program.

6.0 Administrative and Managerial Considerations

Effective stormwater management involves establishing goals, specifying the scope and defining the functions of the stormwater management program to achieve the goals, and delineating. Responsibility for the functions or activities (i.e., organization) must be delineated. These aspects of management are important for both legal and administrative reasons.

A comprehensive program of stormwater management could be subjected to legal challenges. To counter a challenge, officials must be able to show that the program was created as the result of a careful master planning process and is based on rational, objective principles. City officials with a good understanding of the scope of their program are in a better position to document costs (revenue requirements), relate revenue sources to costs, and justify financing techniques.

6.1 Scope of the Stormwater Management Program

In Texas, state law authorizes municipal floodwater management. Within the constraints of the state requirements, local governments may establish their own goals. Local jurisdictions are allowed to determine who will have responsibility for administration of the programs.

The goals of the program can be quite broad. For example, the principal goal of the stormwater program could be to identify the existing and future flooding, sedimentation, and water quality problems within Alton and its extarterritorial jurisdiction and evaluate and implement appropriate measures to eliminate, reduce, or prevent these problems. Other program goals could include:

- Integration of the planning, design, and construction of public and private (on-site) stormwater management systems into a single watershed management plan.

- Mitigation of the adverse impact of stormwater flows within the studied watersheds.
- Coordination of City efforts through the stormwater management program to reduce duplication of effort.
- Periodic review and revision to the watershed management program to assure continuity with City policies, laws, regulations, and ordinances.

6.2 Stormwater Management Functions

Stormwater management typically involves these functions: administration; planning; design, and engineering; operations and maintenance; regulation and enforcement; and capital improvements. Water quality improvement and finance sometimes are included as separate activities.

The types of functions which will make up the stormwater program are a major consideration in molding the financing strategy. Defining the functions or activities of the stormwater management program allows the financing option to be evaluated in relation to various aspects of the long-range program. For example, a mix of different financing methods is often found to best for comprehensive programs that include planning, maintenance, construction and various other activities.

6.3 Options for Program Administration

The decision on how to organize these functions within the City of Alton should be made

after careful consideration of the strength and weaknesses of alternative approaches. No two communities resolve the organizational issues in exactly the same way. Stormwater management may be performed by:

- the Planning Department;
- the Public Works Department;
- a Department of Environmental Regulation;
- a separate Drainage Utility controlled by the municipal government;
- an independent Drainage District.

In some situations, responsibility for stormwater management is shared among departments. For example, Public Works may have responsibility for design and engineering, capital improvements, and operations and maintenance, with City Administrator or Finance responsible for billing, and Planning or Community Development responsible for regulation and enforcement. Decisions about the assignment of stormwater functions to specific departments should be made only after evaluation of the possible alternatives.

6.4 Evaluating Administrative Options

Evaluating the strengths and weaknesses of different administrative approaches to stormwater management is a difficult task for which there are no precise guidelines. Evaluation criteria necessarily will be qualitative; professional judgement will be the basis for most decisions.

Factors to be considered are presented in Table 6.1. The list is not inclusive. The most important aspect of the evaluation is that the options should be evaluated systematically.

Table 6.1

Criteria for Evaluating Administrative Approaches

1. Department currently exists.
2. Department has sufficient, competent staff to administer and manage a program.
3. Department has ability to integrate water quantity and water quality concerns.
4. Department has experience dealing with public and development community.
5. Department has engineering capabilities.
6. Department has regulatory experience.
7. Department has experience in contracting with other entities.
8. Department has experience with implementation of fee schedules for services.
9. Department has experience in managing capital improvements and maintenance programs.
10. Department has testing, sampling, and laboratory capabilities.
11. Department has experience in managing complex database such as a utility master accounts file.

Note: This list of criteria is not complete; others should be added and, if necessary, some removed, depending on the needs of the City of Alton.

In situations involving reorganization of ongoing responsibilities, bureaucratic infighting may occur. The possibility for this should be recognized, and all agency heads potentially affected should have opportunities to collaborate and present recommendations before final decisions are made.

6.5 Public or Private Maintenance of Drainage Facilities

There are strong arguments in favor of private maintenance, especially from the perspective of public works managers who have inadequate funding for existing maintenance activities. The main one is that private maintenance limits the direct public costs of stormwater management.

The American Public Works Association (APWA) suggests that maintenance activities are best carried out by the entities with the "greatest interest in the specific benefits associated with each maintenance operation" (2). With this approach, maintenance for aesthetic purposes would best be done by residents or users of the area near the particular facility. Maintenance for reasons of safety (e.g., to maintain the structural integrity of drainage facilities) is a public concern and should be carried out by a public agency. Maintenance responsibility often would differ with the type of facility.

APWA has identified factors to be considered in deciding whether drainage facilities are to be privately or publicly owned (Table 6.2). Nevertheless, APWA concludes that:

> "there appears to be a preference for and a trend towards public ownership. Generally, unless basins are maintained by public agencies, long-term

Table 6.2

Factors Affecting Decisions About Ownership of Stormwater Facilities

1. Type of development.
2. Size, location, and proposed use of development.
3. Potential impact of failure or malfunction of the drainage system
4. Possible multipurpose use of the facility.
5. Design life of the facility.
6. Runoff contributions from offsite areas.
7. Resources in funds, equipment, and personnel of the City.
8. Existing local ordinances and regulations.
9. Control of the facility as to safety and theft or vandalism.
10. Public ability and willingness to provide maintenance

adequate maintenance cannot be assured."

Cost is the biggest obstacle to providing public maintenance. It is clear that decisions by the City of Alton to maintain facilities in the private sector would greatly increase public expenditures for stormwater management.

6.6 Drainage District vs. Drainage Utility

Local government's ability to respond to drainage problems and needs has historically been limited by two major factors. First, the traditional structure of municipal government does not

provide an organizational focus for drainage activities. The second obstacle has been the lack of stable, adequate, and publicly acceptable financing methods.

Public work's strategies tried and proven in dealing with other municipal problems have not always adapted well to drainage applications. Cities have had to seek or develop creative new alternatives for meeting the stormwater challenge. Two such alternatives are described herein: drainage districts and drainage utilities are as follows:

1. Drainage districts are special-purpose local government agencies authorized to deal with watershed management. In Texas, they may levy valorem taxes and issue bonds; as of June 1987, they are also authorized to impose capital recovery fees. These special-purpose governments lack many of the essential general-purpose responsibilities of cities and counties which enable a comprehensive approach to urban runoff management, such as land-use control and police powers. Many special districts have been used successfully for drainage control in rural agricultural areas, but their track record in urban communities, especially those undergoing rapid growth, has been poor.

The creation of drainage districts as political subdivisions assures local control over water resources. However, the state does exercise substantial control over most districts through approval of plans for development projects and continuing supervision, primarily regarding financial matters, by the Texas Natural Resources Conservation Commission.

2. A Storm Drainage Utility is a special-purpose organization within the City government given the responsibility to provide for public needs in the area of stormwater management. In the same way that the Water and Wastewater and Electric Utilities are self-supporting, the Drainage

Utility charges fees for the operations and maintenance of facilities and for capital improvements.

Storm drainage utilities provide a variety of services including maintenance of detention ponds, repair and cleaning of catch basins and storm sewers, as well as monitoring storm water quality. The utility staff reviews new developments and subdivisions to ensure that they provide adequate drainage facilities and share in the cost of basin improvements. These functions, along with administration, budgeting, and answering questions from the public, are part of the operations of a storm drainage utility.

6.7 Summation

There are many options available to the City of Alton on how it can manage a stormwater management program. The City of Alton needs to review the administrative and managerial options and establish an organizational system which by definition could oversee the stormwater management program.

7.0 Suggested Drainage and Stormwater Management Policy

7.1 Purpose

A drainage and stormwater management policy to establish the general framework of the desired management program needs to be formally adopted by the City of Alton. The general purpose of the proposed City of Alton's drainage and stormwater management policy would be to protect and provide for the safety and welfare of the general public and to minimize and mitigate flood damage to private and public property within the community, and to establish methods of fiscal responsibility by developers. A suggested policy is summarized in the sections below. The objective of this suggested policy is to identify an outline of the key elements that can be used to establish a stormwater management policy for the City of Alton. The City of Alton should thoroughly review this suggested policy and then adopt one that meets its specific needs.

7.2 Suggestions for a Drainage and Stormwater Management Policies

It shall be the City of Alton's policy to:

- Incorporate natural floodways in areas of new development
- Establish management practices to be used for the drainage and control of stormwater runoff and flood waters, where it can be shown the use of natural floodways will not adequately protect life and property.

  The order of preference for structural techniques is as follows:

  a. Conveyance-oriented approaches

(1) Channel alterations

(a) Vegetative lined channels

(b) Stone or riprap lined channels

© Concrete lined channels

b. Storage-oriented approaches

(1) Regional storage facilities

(a) Detention

(b) Retention

(2) On-site storage facilities

(a) Detention

(b) Retention

- Initiate and continue coordination with the Cities of McAllen, Mission, and Palmhurst and the Hidalgo County Drainage District No. 1 to utilize non-structural approaches to maintain the natural floodways and the integration of the drainage and stormwater management program. Non-structural approaches include, but are not limited to, the following:

  a. Annexation

  b. Fee simple purchase of land for open space uses.

  c. Acquisition of floodway easements and right-of-way in flood hazard areas.

- Initiate and continue coordination with the Cities of McAllen, Mission, and

Palmhurst and the Hidalgo County Drainage District No. 1 on the use of structural approaches to manage the drainage and stormwater management improvements

7.3 Application of Drainage and Stormwater Management Policy

A City's policies for drainage and stormwater management govern the planning, design, construction and operation of storm drainage facilities within the City's jurisdiction. A drainage and stormwater management policy should based on the City of Alton's Code of Ordinances, the **Drainage Design Manual**, and this Report. Each should be considered effective on the date of acceptance by the Alton City Board of Alderman. The overall drainage and stormwater management policy should apply to any drainage and stormwater management system improvement not having plans released for construction as of the date of the City's approval of this manual.

7.4 Regional Stormwater Management

To limit the impact of development and corresponding storm runoff within the Hidalgo County Drainage District No. 1's (HCDD No.1) Main Ditch(s) watershed(s) and to provide flood control in that area, regional stormwater management must be implemented by the City of Alton in a coordinated effort with the Hidalgo County Drainage District No.1 and the surrounding communities. All inflows into the Hidalgo County System are limited in accordance with the rules and regulations of the HCDD No.1 and all latest permit requirements for discharge into such

county ditches must be adhered to.

7.5 Drainage System Classifications

Major Drainage Systems: Major drainage facilities should include natural or improved manmade channels, detention reservoirs (Natural or manmade), bridges or roadway culverts, overflow swales and street rights-of-way. In certain instances, an enclosed storm drain pipe system may be considered part of a major drainage facility if it drains a sump area. The design storm, as defined by the 100-year frequency flood, must be contained within the right-of-way or dedicated easement of all major drainage systems to provide for public safety and welfare.

Minor Drainage Systems: Minor drainage systems are intended to provide conveyance for more frequent occurring flooding and usually consist of streets, storm drain inlets, pipes, roadside ditches and driveway culverts. To enhance the quality of life and provide for public safety, minor drainage systems are required to provide conveyance for the 10-year frequency flood under fully developed watershed conditions.

7.6 Drainage and Stormwater Management Plans Submittals

A review process should be established by the City of Alton to provide control of all development activities related to drainage and stormwater runoff through natural or manmade facilities. As part of the review process, a preliminary drainage plan containing a conceptual layout of the proposed storm drainage system must be submitted as part of the preliminary platting process.

When land development is proposed contrary to those assumptions used in the development of the **Master Plan**, detailed analysis of the drainage and stormwater facilities for the development will be provided by the developer's engineer to determine the need to compensate for the additional runoff created above that for current conditions.

The developer requesting a change in land use should be required to compensate for the additional runoff in excess of that calculated for the existing conditions. Measures to be taken by the developer should be approved by the City Administrator or designated representative. Measures used to compensate for the additional runoff should be one or a combination of the following methods and procedures, in order of preference:

- Acquisition and dedication to the City of additional downstream flooding easements to include areas not previously flooded.
- Storm runoff conveyance by use if streets, improved channels, culverts, and storm sewers to convey the runoff to the main drainage systems or existing stormwater conveyance systems whose discharge points are in the location of the major drainage systems.
- On-site flow attenuation by the use of time of concentration extensions, ditch attenuation with culvert under sizing, balancing of runoff coefficients (C), or methods based upon sound engineering principals and approved by the City Administrator or designated representative.
- Stormwater detention structures.

A final drainage plan must be submitted at the time of the final plat application. The final drainage plan shall include the appropriate computation sheets as required in Section 2.8, "Drainage Design Computations" of the City of Alton **Drainage Design Manual.**

7.7 Floodplain Development

Development within and improvements to the 100-year floodplain should be consistent with the improvements shown in this Manual and shall abide with all requirements of the Federal Emergency Management Agency (FEMA) and the National Flood Insurance Program.

7.8 Drainage Structure Aesthetics

Hydraulic design in the urban environment requires an approach not encountered elsewhere because appearance must be an integral part of the design. In an effort to maintain the natural aesthetics of its existing floodplains, the City of Alton encourages preservation of the natural floodplains and detention areas as greenbelt areas, and in some areas, the City may require the floodplain be designated as a greenbelt area in addition to the developer providing drainage or flowage easements. When utilized, the design of drop structures and other hydraulic structures should blend with the natural surroundings as much as possible to maintain the aesthetics of the natural occurring area.

7.9 Drainage Design Computations

Computations to support all drainage designs should be submitted to the City Administrator or designated representative for review and approval as part of the final drainage plan and should be in the form of standard computation sheets as contained in the City of Alton **Drainage Design Manual**. Computer programs (other than spreadsheets) used to perform computations shall be limited to those referenced in that manual. All computations submitted should be certified by an engineer experienced in municipal stormwater drainage design and registered in the State of Texas in accordance with the requirements set forth by the Texas State Board of Registration for Professional Engineers and in accordance with the City of Alton Code of Ordinances. Stormwater runoff computations should be based upon conditions representing ultimate watershed development in accordance with the Code of Ordinances and the Alton Master Drainage Plan.

7.10 Construction of Drainage and Stormwater Management Facilities

Development activities associated with the construction of drainage facilities must minimize erosion caused during construction. The protection of trees and vegetation should be maximized during construction of development activities. Whenever possible, the replacement of trees destroyed by storm water management procedures is encouraged.

7.11 Maintenance of Drainage and Stormwater Management Facilities

The hydraulic integrity of major and minor drainage systems dedicated to and accepted by the City of Alton will be maintained by the City of Alton. The hydraulic integrity of drainage systems retained by the owner with approval of the City and not dedicated to the City of Alton should be maintained by the owner. That is, all vegetative growth and foreign debris should be removed from the private drainage facility periodically to insure proper conveyance of storm waters. The appearance of drainage ways and floodplains, excluding the area between the top of each channel bank, and overflow swales should be maintained by the adjacent property owners.

All drainage and stormwater management facilities constructed, installed or provided by the owner should, upon acceptance by the City, become the property of the City. The City should be responsible for the operation and maintenance of the accepted facilities.

The City should maintain all accepted public drainage facilities located within City-owned land, city right-of-ways, and City easements. The City may maintain other accepted public drainage facilities located within or adjacent to the City. Such public facilities include, but are not limited to, open drainage ways and piped drainage ways constructed expressly for use by the general public and as part of the City drainage facilities; bridges; roadside drainage ditches and gutters; flood control facilities, including detention and retention storage, dikes, overflow channels, pump stations, etc., that have been designed and constructed expressly for use by the general public.

Duly authorized inspectors of the City should have the right of entry on the land or premises where property owners are required to maintain drainage and stormwater management

facilities, for the purpose of inspection of the maintenance required. The City Administrator's office should inspect the premises of each such facility approved at least once per year. Where a noncompliance is found, the City should request in writing that the property owner comply. This notice should describe the measures required to be taken. If, within one month of the notice, the maintenance required is not accomplished, the City shall either:

- Cause the necessary restoration to be accomplished and assess the property owner for the City's actual cost, or
- Bring an action for a mandatory injunction to require the property owner to accomplish the necessary maintenance.

8.0 Discussion of Improvement Alternatives

The improvements described in this master plan represent, for the most part, only those major construction projects that will be required to manage the drainage and stormwater runoff for the assumed conditions in the future. The assumption is made that the more localized drainage improvements will be incorporated in the development of subdivisions following the criteria set forth in the proposed **Drainage Design Manual** and will discharge into these major construction projects. Within the developed area of the community, preliminary plans are included to relieve known, existing drainage problems. Interim solutions to correct these problems that are consistent with the long range master plan are suggested.

The described improvements are well planned based on the available data, but they should be considered as conceptional or preliminary. Although there is always interest in more detailed information in specific locations, the scope of the study does not permit detailed planning. The terrain in the study area is relatively flat and the only limited topographic information (five-foot contours) represents the principal constraint on detailed planning. The opinions of probable construction cost are realistic, but sufficiently conservative, and they are adequate for financial planning and the development of a concept for an improvement program that can be reasonably managed by the community.

8.1 Planning Criteria

The applicable design criteria for an open channel in the proposed **Drainage Design Manual** states that all improved channels shall be designed to carry the 10-year, based on the ultimate

watershed development, and shall have one foot of freeboard. The proposed **Drainage Design Manual** also states that the design shall assure that no flooding of buildings or other improvements will occur for the 100-year frequency peak flow. Drainage easements are required on all channels of sufficient width to contain the 100-year frequency peak flow. Improvements to channels and creeks, to include culverts and bridges, are to be designed for the 25-year frequency storm.

Since the terrain in the study area is relatively flat and there are no clearly defined creeks, the preliminary plans for major improvements have been sized to handle the 100-year frequency storm within the constructed channel with one-foot of freeboard. Although this approach is conservative, it is selected to meet the intent of the requirement that the design shall assure that no flooding of buildings or other improvements will occur for the 100-year frequency flow peak.

The improved grassed lined channels have been shaped with a minimum bottom width of 10 feet, three to one side slopes, and a minimum depth of four feet (three feet of flow depth and one foot of freeboard). The relatively flat side slopes of the shape are intended to provide a drainage path that is easily maintained with mowers. With additional planning for connecting routes and landscaping of the overbank easement, these major drainage improvements have the potential of being connected into a beneficial linear park system within the community.

Coordinating with and satisfying the criteria of the Hidalgo County Drainage District No. 1 is another key in the planning of the major improvements. The Hidalgo County Drainage District No. 1 facilities are sized to handle slightly less than a ten-year frequency storm (approximately a 9.5-year storm) under existing conditions. As urbanization of the drainage areas continue with its associated increase in the rate and quality of runoff, the rate of discharge for the

ten-year frequency storm to the Hidalgo County Drainage District No. 1 ditches must be kept at the same rate as existing conditions. To achieve this requirement, stormwater has to be stored in the study area and to be released at a slower rate. This detention of drainage and stormwater runoff can be achieved by a number of smaller detention ponds in the watershed or by a larger detention pond at the lower end of the watershed. In the **Master Plan** development, larger detention ponds at the lower end of the watershed have been assumed. These detention storage facilities would likely be planned, designed, constructed, and maintained by the City of Alton in conjunction with the major drainage channels improvements.

The Texas Natural Resource Conservation Commission regulations governing detention facilities have been reviewed for their applicability to the proposed detention facilities. The TNRCC typically requires any dam designed to impound floodwater that is six feet or greater in height to be permitted. Although some of the detention facilities proposed in this **Master Plan** will be higher than six feet, no permitting will be required as long as there is no permanent storage of water within the detention facilities. Therefore, since the proposed detention facilities are not planned to permanently store water, no TNRCC permits should be required. However, should the final design of a detention pond incorporate permanently ponded water to enhance the aesthetic quality of the detention facility (i.e., such as in a park), an application must be made to the TNRCC for a permit.

Channel improvement projects often fall under the jurisdiction of the Corps of Engineers 404 permit program. In most cases, the work will most likely fall under one of two nationwide permits: (1) Nationwide 26, and (2) Nationwide 3.

The Nationwide 26 permit is required for fill (improvements) within channel areas below the

headwaters of the waters of the United States. The point, at which a stream is below the headwaters, approaches a contributing drainage area on the order of 25 square miles. The permit allows up to ten acres below the normal high water mark upstream of the headwaters to be filled (modified). The normal high water mark is usually observed as the distinct point at which vegetation along the stream ends. If the improvements below the high water mark are less than one acre, no formal notification to the Corps is necessary.

The other permit that may cover a portion of the channel is the Nationwide 3 Permit. Under this permit, repairs are authorized for maintenance of existing channels. This permit could cover the connections to the existing Hidalgo County Drainage District No.1 ditches. Under this permit, repairs are authorized for the maintenance of existing channels.

8.2 Coordination with Surrounding Jurisdictions

The limit of the area over which the City of Alton has direct control is only a portion of the study area. The future limits of the City of Alton extend to Four Mile Road on the south, to Sharyland Road on the east, to Five Mile Road on the north, and to Moore Field Road on the west. The City of Palmhurst lies to the south, McAllen borders the city on the east and north, and Mission lies to the west. Fairly specific conceptual or preliminary improvements are defined within the limits of the City of Alton jurisdiction. Since improvements outside the limits of the City of Alton will be the responsibility of other jurisdictions, they have been developed in a more general manner to illustrate how the drainage and stormwater runoff can be managed in the entire

study area.

Four Mile Road acts as an effective drainage boundary between the Cities of Alton and Palmhurst. The **Master Plan** assumes that the detail planning drainage and stormwater management facilities for the area south of Four Mile Road will be the responsibility of the City of Palmhurst. A general concept of how this area can be served is illustrated.

The City of McAllen currently has planning underway for the area to the east of Alton. Facilities within the City of Alton of have been planned to limit the discharge from the ultimate 10-year frequency storm to the same level as from the existing 10-year frequency storm. The improved channels within the City of Alton are sized to handle the 100-year frequency storm within the channel. This approach needs to be coordinated with the City of McAllen to avoid a lack of congruency at the boundary between the two cities.

A narrow strip of McAllen exists between Six Mile Road and the Hidalgo County Drainage District No. 1 ditch to the north of the City of Alton. Since the discharge into this ditch of the 10-year frequency storm is to be limited to that from existing conditions, detention storage will be required in the northern portion of the City of Alton. To avoid the need for multiple smaller detention facilities, this area would appear to be an excellent candidate regional detention facilities that could be shared by the two communities. This approach has been utilized in the planning the drainage and stormwater improvements for this area base on the assumption that an agreement can be reached.

On the west side of Alton, the Main Canal and the Hidalgo County Drainage District No. 1

ditch stretches across the city between Inspiration Road and Los Ebanos Road. Drainage and stormwater runoff in the area to the west of this boundary can be collected in an improved channel and detained in ponds to meet the criteria of the Hidalgo County Drainage District No. 1 criteria. This concept has been incorporated in the specific master planning for the City of Alton; however, this area is also a potential candidate for coordination with the City of Mission.

8.3 Drainage and Stormwater Management Plans

Appendix A contains the drainage maps showing proposed drainage and stormwater management facilities. The existing facilities are shown on a separate map that has been furnished to the city. Generally, the maps of the proposed facilities provide the following information:

- Drainage areas contributing to the stormwater collection points and channels are identified by area designation
- Drainage channels are improved earth (grass-lined) channels and "Concrete Lined" for concrete lined channels. The bottom width, depth of the channel, channel slope and the 100-year frequency discharge are also provided.
- It is assumed that the proposed improved grass-lined channels have a roughness coefficient 0.027.
- Proposed culverts and inverted siphons are identified by size and number of barrels, and the 100-year frequency discharge is provided. It is assumed that all of the proposed culvert improvements are either reinforced concrete pipe or reinforced concrete box sections.

Hydrologic Design Considerations: The hydrologic considerations used in the determination of the design discharges are based on the criteria and methodologies as defined in the City of Alton proposed **Drainage Design Manual**, which is assumed to be adopted as part of the Subdivision and Land Development Regulations. Additional constraints are utilized in the evaluation of drainage areas due to the uncertainty of future drainage boundary locations.

Drainage area boundaries generally follow natural drainage divides. In cases where existing or future major roadways and existing and future irrigation canals interrupt the natural flow path, the drainage area boundary follows the roadway or irrigation canal: that is, flow is assumed to cross a major roadway or irrigation canal only at a location where closed pipe systems or drainage channels would likely cross the roadway or canal.

Hydraulic Design Considerations: The procedures for determining the required storm drain pipe and channel designs are outlined in the City of Alton proposed **Drainage Design Manual.** Additional constraints were imposed due to the unpredictability of future development (particularly street layouts) which allow flexibility for future storm drain designs in these areas. More specifically, hydraulic design considerations used to determine the required storm drain systems were based on the items listed below:

Open Channel Systems

- Proposed drainage channels generally follow the natural flow paths.
- Open channels were based on the 100-year frequency flow capacity. The depths for improved (grass-lined) channels were based on the 100-year frequency depth plus one foot.

- Culverts and inverted siphons in channels that cross major roadways and irrigation canals were designed to convey the 100-year frequency discharge from the upstream drainage area.
- Grass-lined drainage channels are unlined, earthen trapezoidal channels with a minimum bottom width of ten feet, sideslopes of 3:1 and a corresponding roughness coefficient equal to 0.027.
- The maximum allowable design flow velocity was 6 feet per second for grass-lined channels.

8.4 Preliminary Estimate of Probable Construction Cost

Summarized in Table 8.1 are the preliminary estimates of probable construction cost for the major elements in the **Master Drainage Plan** for the ultimate conditions within the detailed study area. The total preliminary estimate of the probable construction cost for these major elements is $ 40,177,300. Preliminary estimate of the probable construction cost for the improvements shown on Shart 3A and 3B have not been developed because they are within the City of Palmhurst and are not the responsibility of the City of Alton. The details on the development of these preliminary estimates of probable construction costs are included in Appendix B.

In addition to these major elements, local storm drainage projects will be required to convey the storm runoff to these major elements. In developing areas, these local conveyance systems are assumed to be incorporated in the planning and design of developments. The construction cost for these local conveyance systems will be included in the cost of the development.

Local stormwater conveyance systems will also be required in some currently developed areas of the City of Alton. The specific detailed planning of these improvement projects is beyond the scope of this study. Specific detailed planning requires field surveying and/or more detailed topographic maps which were not included as a part of this study. To account for the cost of these local stormwater conveyance systems which will likely be borne either totally, or in part, by the citizens of Alton, an allowance of $ 6,800 per currently developed acre has been included in the preliminary estimates of probable construction cost. For the estimated currently developed acreage, this adds $ 4,500,000 to the construction cost. Including this estimate for the local stormwater conveyance systems in the currently developed area, increases the total preliminary estimated probable construction cost to $ 44,677,300. A portion of this cost could be shared with adjacent cities if regional facilities were developed.

8.5 Preliminary Estimate of Probable Annual Operation and Maintenance Cost

Initially, the City of Alton can use existing city personnel to man and operate the watershed and storm drainage management program. However, once the program has been fully established, funding should be available to provide for personnel, administrative, and maintenance needs. Depending on the rate at which development takes place, minimum staffing requirements would be clerk/typist at $ 34,300 and a staff engineer at $ 88,000, or a total of $122,300. This amount includes allowances for salary burden and office space and supplies.

It is assumed that the maintenance of the drainage facilities would be handled through out-sourced contracts. Using the information presented in Section 4.4, on page 4.3, for recently

Table 8.1

Summary of Preliminary Estimate of Probable Construction Costs

Project	Preliminary Estimate of Probable Construction Costs
South Central Area	
South Central Drainage Ditch	$ 4,406,200
Improvements to Five Mile and Bryan Road Detention	$ 6,641,700
Subtotal	$ 11,047,900
Southeast Area	
Southeast Drainage Ditch	$ 2,735,700
Sharyland and Four Mile Detention	$ 3,190,000
Subtotal	$ 5,925,700
Northeast Area	
East Drainage Ditch	$ 1,683,900
Northeast Drainage Ditch	$ 756,300
Glasscock and Six Mile Detention	$ 5,340,100
Subtotal	$ 7,780,300
North Central Area	
North Central Drainage Ditch	$ 1,184,200
Bryan and Six Mile Detention	$ 1,111,500
Mayberry and Six Mile Detention	$ 1,438,500
Subtotal	$ 3,734,200

Table 8.1 (continued)

Project	Preliminary Estimate of Probable Construction Cost
Northwest Area	
Northwest Drainage Ditch No. 1	$ 1,113,200
Northwest Drainage Ditch No. 2	$ 255,000
Trosper and Six Mile Detention	$ 2,813,200
Los Ebanos and Six Mile Detention	$ 1,346,100
Subtotal	$ 5,527,500
West Central Area	
West Central Drainage Ditch	$ 723,900
Louisiana Street Detention	$ 1,387,600
Subtotal	$ 2,111,500
West Area	
West No. 2 Detention	$ 1,103,900
West No. 3 Detention	$ 755,900
West No. 4 Detention	$ 1,004,300
West No. 5 Detention	$ 1,186,100
Subtotal	$ 4,050,200
Local Stormwater Conveyance in Developed Areas	$ 4,500,000
Total Preliminary Estimate of Probable Construction Costs	$ 44,677,300

constructed or proposed facilities, the maintenance cost can be estimated as 3 to 5 % of the base construction cost. If average conditions are assumed and full development has occurred, the estimated annual maintenance cost would be $ 1,787,100 in 1997 dollars. This amount will increase with inflation and as facilities age. Experience in the operation and maintenance of the initial facilities should provide excellent guidance in the establishment of annual operating budgets.

9.0 Recommended Master Plan Improvements

The drainage and stormwater management facilities as illustrated on Sheets A-1 through B-3 are recommended as the **Master Plan** improvements for the City of Alton. These improvements are planned to meet the ultimate development conditions within the extraterritorial jurisdiction of the City of Alton. They have received initial coordination with the surrounding communities and Hidalgo County, but this effort should be pursued on a continuous basis as the detailed plans are developed for these improvements.

9.1 Discussion of the Economic Feasibility

The preliminary estimate of the probable total construction cost, in the amount of $ 44,677,300, is certainly a significant sum of money. For the City of Alton to consider the expenditure of such an amount at this time is challenging. What has to be kept in mind is that the development of the drainage and stormwater management system will occur over several years as the community develops.

The test for the reasonableness of the plan at this point in time is whether the total estimated construction cost per person, when the community is totally developed, is realistic. Within the boundaries of the extraterritorial jurisdiction of the City of Alton, there are approximately 5,640 acres. If there is an average of four housing units per acre and an average of four persons per housing unit, then unit costs can be developed. For the approximately 5,640 acres, the unit cost in 1997 dollars would be approximately $ 2,000 per dwelling unit, or $ 500 per person.

Although these are significant amounts, they are certainly within the range of reasonableness.

Planning now to make these investments in the implementation of the drainage and stormwater master plan over the next two to three decades will result in a higher quality of life for all the citizens of the City of Alton.

9.2 Discussion of Safety Considerations

Safety always has to be considered in the planning and design of public works projects. This fact is particularly true with water related projects. Most people find water in a tranquil state, such as a lake or pond, to be pleasant and relaxing. Water in a turbulent state, can be very stimulating and exciting. This can be particularly true for young children who have not developed an appreciation for the danger.

To partially address safety issues the preliminary plans have been developed to the maximum extent possible with wide shallow drainage ditches. The side slopes of the ditches are planned with three feet of width for one foot of rise. This relatively flat side slope approach should allow someone who is caught in the stormwater to exit more easily. Also, regular maintenance of the grass lined drainage ditches will be critically important to maintain their functionality. Mowing of the side slopes, as well as the ditch bottom, will be more comfortably and safely accomplished with the flatter side slopes.

The box culverts at road crossings and the inverted siphons at the irrigation canal crossing may require some special considerations in their planning and design. These can be particularly dangerous locations during higher stormflow rates. Warning signs and protective fencing may be required in some locations. If the drainage ditch is particularly deep, safely devises can be installed

upstream to aid an individual caught in the stormwater to pull themselves out.

9.3 Discussion of Environmental Concerns

Environmental concerns are part of the City of Alton. The Board of Aldermen recently took the necessary steps to enhance habitat for birds within the city. The actual construction of the proposed drainage and stormwater management facilities may have some negative impact on the environment. Some of the proposed facilities are located along natural drainage paths where native vegetation exist. This locations are also likely the homes of the native habitat and potential wetlands may also occur.

Detail evaluation of the environmental impact of the proposed improvements is beyond the scope of this study. Based on available mapping and aerial photographs, alignments were selected that avoided developed areas to the maximum extent possible and to take advantage of the natural terrain. Consideration of the environmental impacts would logically be included in the detail planning and design of each improvement.

Although the construction of the proposed improvements will have a negative impact on the environment during the construction, following the completion an opportunity exists to restore and perhaps enhance the environment. The planned right-of-ways for the proposed drainage ditches are adequate for the construction and maintenance of the facilities. In most locations along the right-of-way, it should be possible to include landscaping on the overbank that would not interfere with the functionality of the ditch and the maintenance of the facility.

9.4 Discussion of Aesthetics

A frequent initial negative reaction to planning and construction of drainage and stormwater management projects occurs in almost every project. This condition is particularly true where concrete lined channels are required in developed areas due to limited space. The proposed grassed lined drainage ditches can, with proper planning, become a positive benefit to the community and improve the overall aesthetics of the City of Alton.

SH 107 is and will continue to be major North-south transportation artery through the heart of Alton. Many of the proposed drainage ditches cross or are planned near SH 107. With carefull planning, the overbank space along the drainage ditches can be used for walking, hike and bike trails that would connect residential neighborhoods with this transportation link. Even those drainage facilities not directly adjacent to SH 107 could be utilized as walkways, and hike-bike trails. With some fairly short connecting segments, all the potential walkways and hike-bike trails along the drainage ditches could be joined to create an extensive network through all segments of the city. Coupling this effort with the proposed environmental landscaping concepts discussed above could result in an exceptional amenity for all sections of the city.

An additional opportunity to increase the aesthetics of the community is the use of the detention basins' bottom areas as athletic fields. The right-of-way area around the detention basins could be landscaped and used as neighborhood park space along with the grassed play area in the bottom of the basin. Funding to plan and construct these types of projects could be available though the TexDOT ISTEA Program and the Texas Parks and Wildlife.

10.0 Implementation Schedule

The following proposed implementation schedule is based on an understanding of the stormwater drainage pattern developed during the preparation of the report. The current growth pattern of the City of Alton was also considered during the development of this implementation schedule. The proposed schedule should be reviewed at regular intervals, but certainly at least every five years.

10.1 Immediately, or during the First Year

Using the general framework outlined in Section 7 and the information contained in this **Master Drainage Plan** and the **Drainage Design Manual**, the City of Alton needs to establish and formally adopt a drainage and stormwater management policy.

Stormwater runoff does not recognize established jurisdiction lines and close coordination with the surrounding communities (McAllen, Mission, and Palmhurst) is essential for a successful stormwater management program. The role that the City of Alton should play in proactively seeking to establish a regional stormwater management program should be thoroughly considered. Such a stormwater management plan can be implemented through a consortium of local governments and Hidalgo County. A steering committee can be established to make recommendations to the respective political bodies within the watershed. However, not being a legislative body, the watershed management group's recommendations may be ignored or given a low priority for action by the individual units of government.

A procedure is needed for pulling watershed communities together through a common theme.

Some sequential steps might included:

1. Organize a series of public meetings to explore the problems and opportunities that need to be addressed.
2. Identify the resources that can be used to assist with watershed planning and implementation.
3. Formulate watershed management alternatives.
4. Select a publicly acceptable watershed management alternative.
5. Implement the watershed management alternative.

There are many options available to the City of Alton on how it can manage a stormwater management program. The City of Alton needs to review the administrative and managerial options outlined in Section 6 and establish a plan for an organizational system to oversee the stormwater management program.

Historically, stormwater management has been financed using general fund revenues for annual operating expenses and a mix of revenue sources for capital improvements. The City of Alton needs to review the financing options outlined in Section 5 and adopt a combination that should provide adequate funding for a stormwater management program.

Two sections of the City of Alton's exterritorial jurisdictional area were identified that should receive immediate attention during the first year. The recommended activities for the first year for these first two areas are to perform a detail study, field surveying, the preparation of preliminary construction plans, and a detailed estimate of the probable construction cost.

The first area is located northwest of the intersection of Five Mile Road North and Glasscock

Road. The general limits of this area are illustrated on Figure 10.1. The streets in this area are Alexandria Street, Bonnie Street, and two unnamed streets in the eastern portion. In the western portion of the area, the existing streets are Jo Beth Lane, Linda Lane, and K & K. Localized flooding is known to exist in all or part of this area.

The second area is located west of Stewart Road and south of Six Mile Road. The general limits of this area are illustrated on Figure 10.2. The streets in this area include Palm Drive, Mission Drive, Lomita Drive, and two unnamed streets. Much of this area is located in a natural low area, or basin, and is potentially subject to severe drainage problems.

Both of these areas need to be studied in greater detail to include field surveying and the preparation of preliminary plans. This effort should include the preparation of a detailed opinion of the probable construction cost. Based on this preliminary design effort, the City of Alton can make specific plans on funding and on how and when to proceed with the preparation of final plans, bidding, and the construction phase of the project.

Both of these areas will require the installation of local stormwater conveyance facilities. To be consistent with the **Master Plan**, these local stormwater conveyance facilities for the first area should take the flow north to the proposed East Drainage Ditch. It is not economically feasible to consider constructing the entire East Drainage Ditch at this time. An approach would be to construct the portion of the East Drainage Ditch north of this area to create a stormwater storage sump. The size and shape should be consistent with proposed East Drainage Ditch and its length would be dependent on the frequency of the storm to be stored. This approach would require the use of a permanent or protable pump station to empty the sump. The use of portable sump pumps would likely be the most economical approach since they could be used at other locations.

IMMEDIATE, OR DURING THE FIRST YEAR PROJECT No. 1

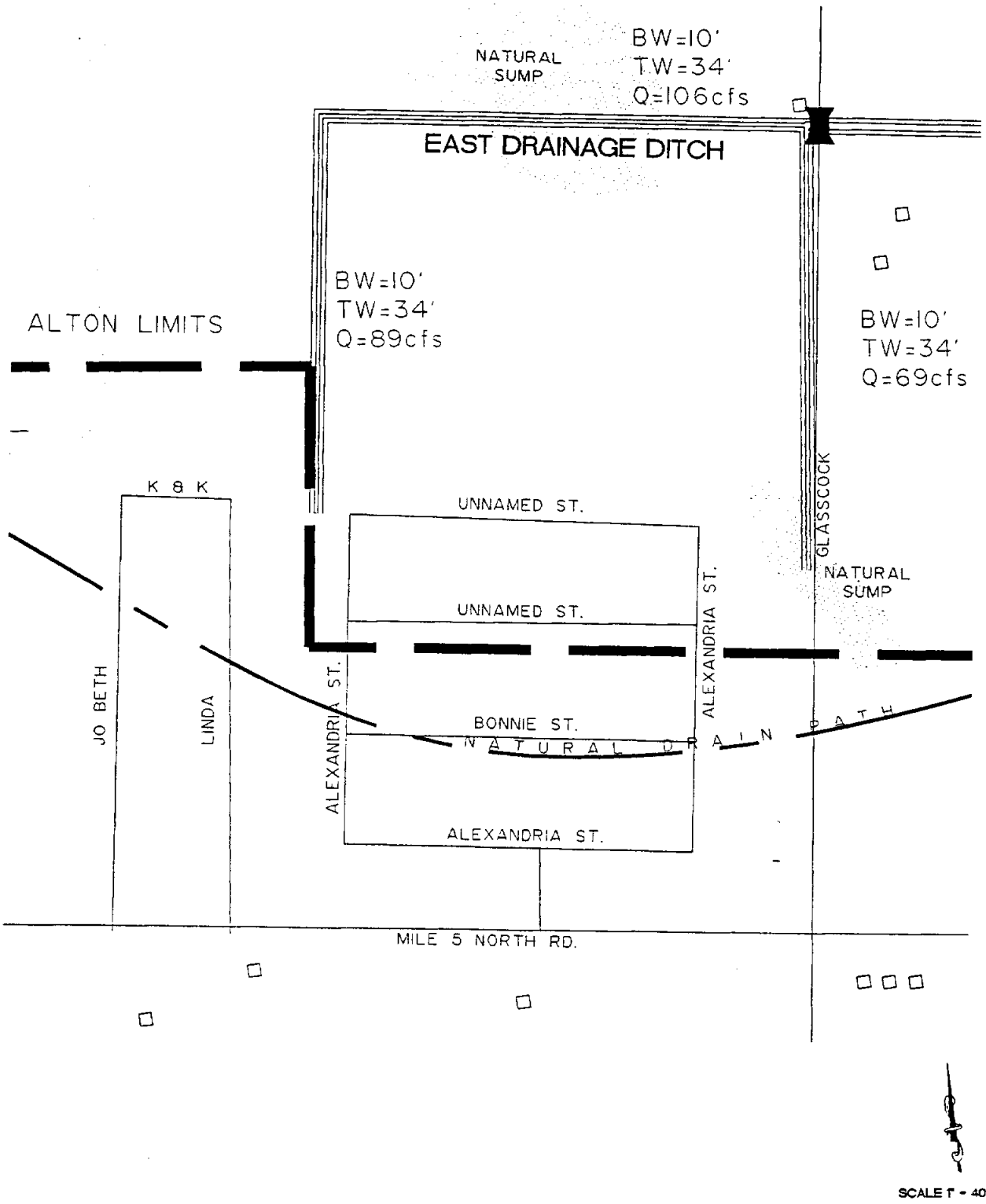


FIGURE 10.1

IMMEDIATE, OR DURING THE FIRST YEAR PROJECT No. 2

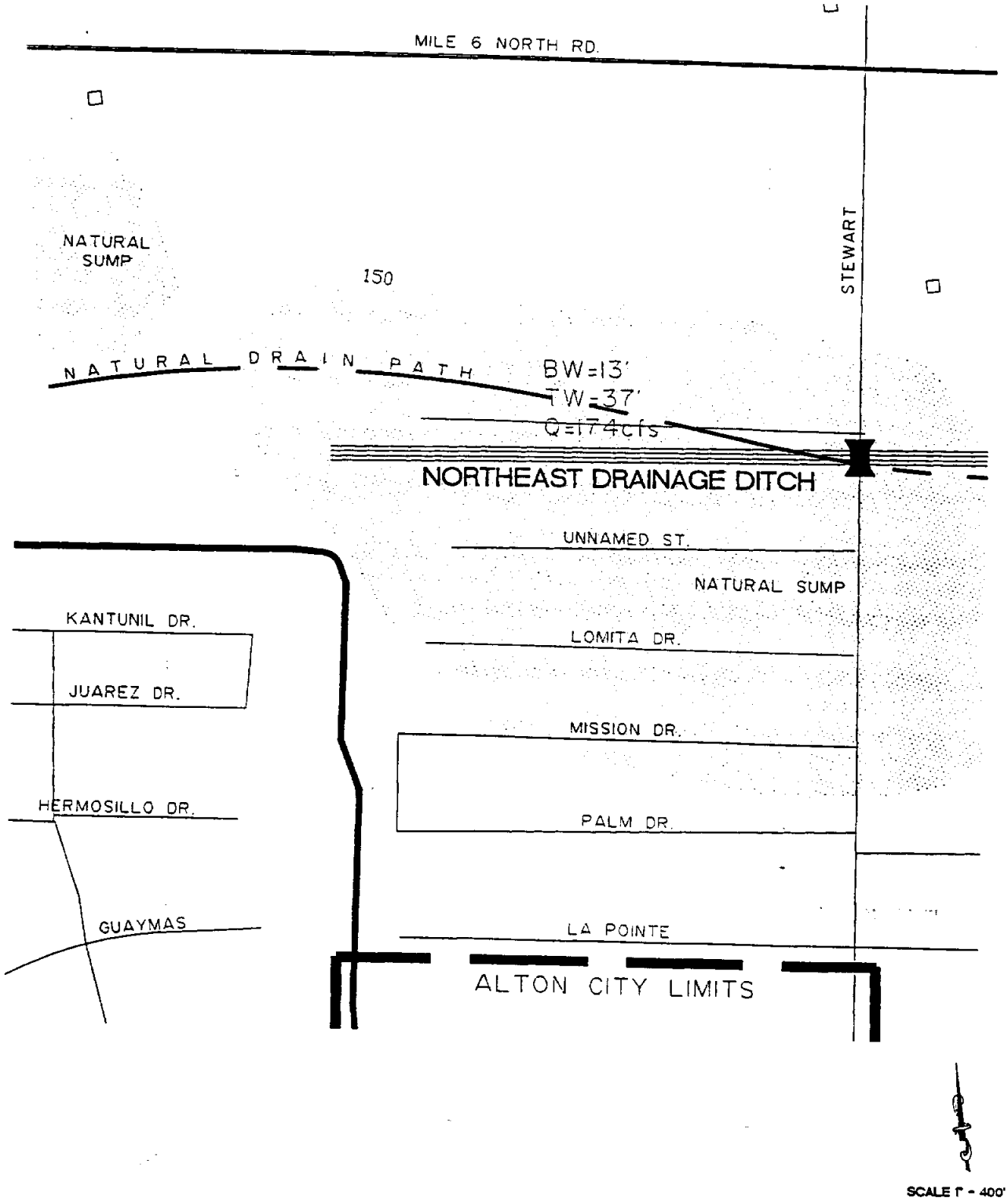


FIGURE 10.2

In the second area to be consistent with the **Master Plan**, the local stormwater conveyance facilities should be designed to deliver the stormwater to the Northeast Drainage Ditch which, as proposed, would pass through this second area. The size and shape should be consistent with the proposed Northeast Drainage Ditch and its length would be dependent on the frequency of the storm to be stored. The use of portable sump pumps would likely be the most economical approach since they could be used at other locations.

10.2 The 1- to 5-year Period

The two projects evaluated during the first year should be funded and constructed during this period. The exact schedule will be a function of the length of time required for the design process and the process adopted to identify and arrange for the construction funding.

A third project that should be undertaken during this period is the detail study, planning, right-of way acquisition, and preliminary design of the West Central Drainage Ditch and the Louisiana Street Detention Basin. The general location and extent of this project are illustrated on Figure 10.3. Due to the general slope of the terrain, much of the stormwater runoff from this area west of the developed area of Alton would naturally pass through the city. As this western area develops and the runoff increases, drainage through the developed area of the City will increase. The second concern with this improvement is the need to identify a specific routing for the West Central Drainage Ditch through the partially developed section of Alton between Louisiana Street and Delaware Street.

10.3 The 6- to 10-year Period

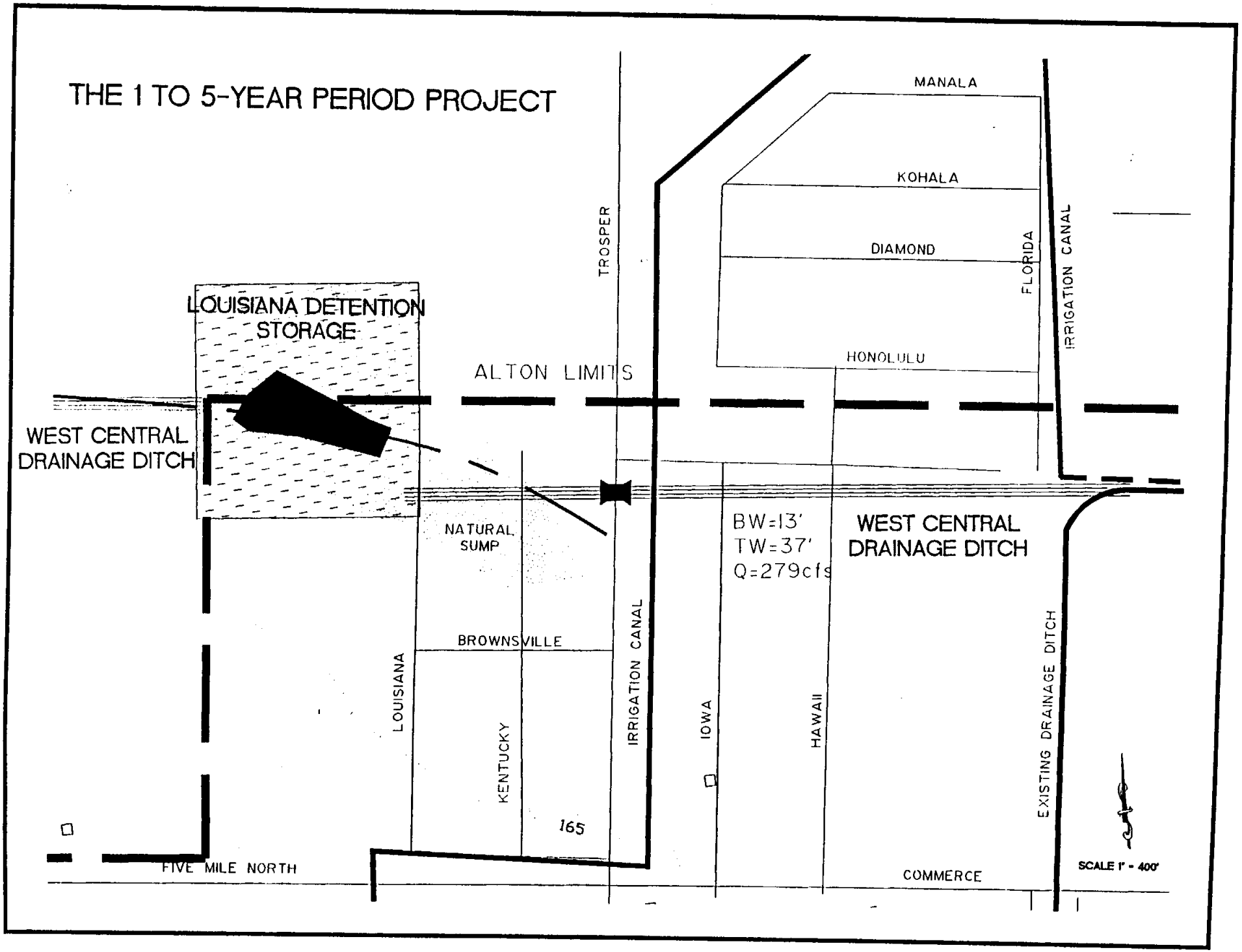

THE 1 TO 5-YEAR PERIOD PROJECT
MANALA
KOHALA
DIAMOND
HONOLULU
TROSPER
FLORIDA
IRRIGATION CANAL
LOUISIANA DETENTION STORAGE
ALTON LIMITS
WEST CENTRAL DRAINAGE DITCH
NATURAL SUMP
BW=13'
TW=37'
Q=279cfs
WEST CENTRAL DRAINAGE DITCH
BROWNSVILLE
LOUISIANA
KENTUCKY
IRRIGATION CANAL
IOWA
HAWAII
EXISTING DRAINAGE DITCH
165
FIVE MILE NORTH
COMMERCE
SCALE 1" = 400'

FIGURE 10.3

The principal project during this period should be the funding and construction of the West Central Drainage Ditch and the Louisiana Detention Basin. The exact schedule will be a function of the length of time require for the design process and the process adopted to identify and arrange for the construction funding.

A second major project scheduled for this period should be the detailed study, planning, right-of-way acquisition and preliminary design of the Five Mile and Bryan Road Detention Basin as illustrated on Figure 10.4. The location of this drainage improvement in the heart of the City of Alton offers an opportunity for the consideration of a multi-use facility. A municipal park could serve the citizens well in this location. If the concept of a number of walk, hike and bike trails throughout the city is pursued, a park in this location of the city could easily serve as junction point for many of the trails. When Alton reaches full development, it will likely have a population of between 75,000 and 90,000. As this level of population is reached, other concepts that could be incorporated in this detention basin would be an amphitheater with seats on one of the sloping sides, or a challenging nine-hole, and perhaps an eighteen-hole, golf course.

Related projects that should be included in this detail study, planning, right-of-way acquisition, and a preliminary design phase are:

- The need for an overflow ditch from the existing Mayberry Road Detention Basin
- The need for an additional overflow pipe or ditch from the existing detention basin between Ave de Mexico and Linares and north of Campeche
- The culverts for the South Central Drainage Ditch under Five Mile Road.
- The stormwater pump station and discharge pipeline to the Hidalgo Drainage District No. 1 drainage ditch north of Six Mile Road.

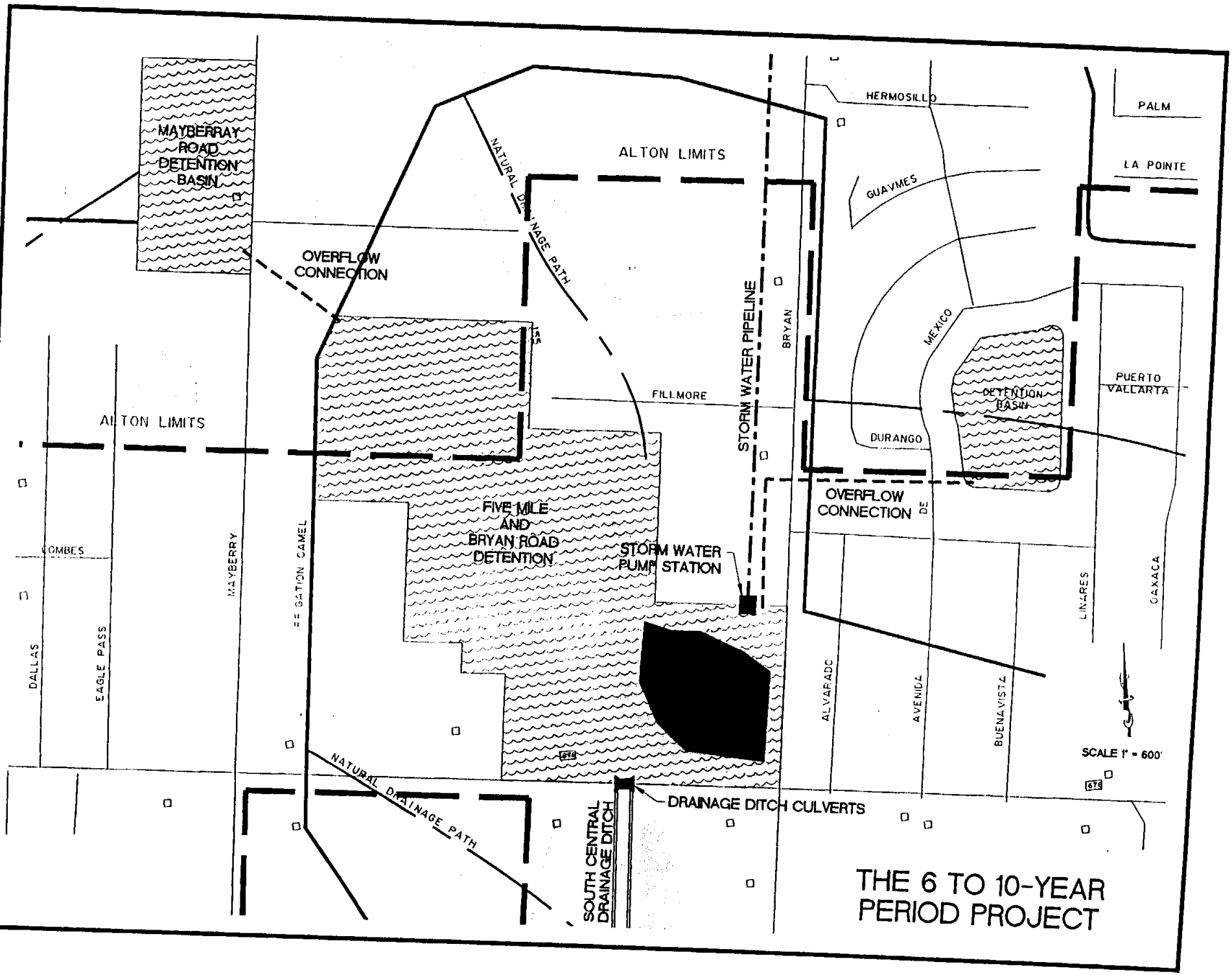

MAYBERRAY ROAD DETENTION BASIN
OVERFLOW CONNECTION
NATURAL DRAINAGE PATH
ALTON LIMITS
HERMOSILLO
PALM
LA POINTE
GUAYMES
MEXICO
PUERTO VALLARTA
DETENTION BASIN
STORM WATER PIPELINE
BRYAN
FILLMORE
DURANGO
ALTON LIMITS
FIVE MILE AND BRYAN ROAD DETENTION
STORM WATER PUMP STATION
OVERFLOW CONNECTION
COMBES
DALLAS
EAGLE PASS
MAYBERRY
IRRIGATION CANAL
ALVARADO
AVENIDA
BUENAVISTA
LINARES
OAXACA
SCALE 1" = 600'
NATURAL DRAINAGE PATH
SOUTH CENTRAL DRAINAGE DITCH
DRAINAGE DITCH CULVERTS
THE 6 TO 10-YEAR PERIOD PROJECT

FIGURE 10.4

10.4 The 11- to 15-year Period

The project elements associated with the Five Mile Road and Bryan Road Detention Basin evaluated during the previous period should be funded and constructed during this period. The exact schedule will be a function of the length of time required for the design process and the process adopted to identify and arrange for the funding.

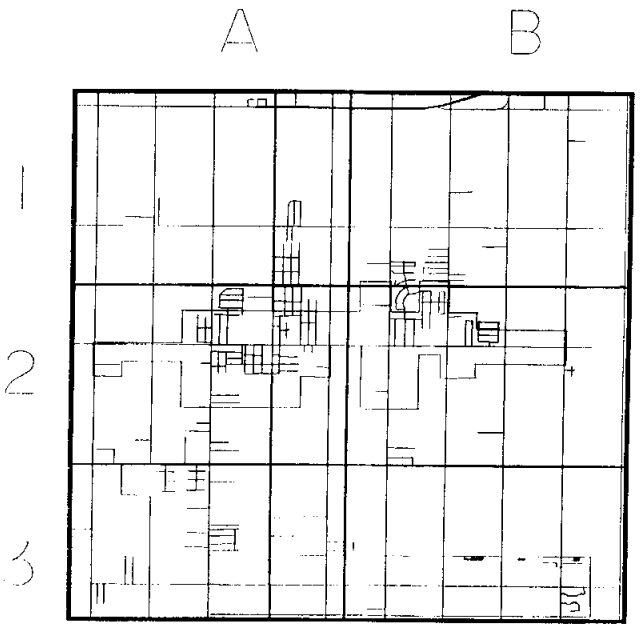
10.5 Improvements that can be Accommodated as Development Proceeds

The remainder of the drainage and stormwater improvements identified on Sheets 1-A through 3-B should be studied and planned as development proceeds. The City of Alton needs to consider and adopt a policy on methods that development will be required to follow to fund, or assist in the funding of, these improvements. These policies need to be reasonably consistent with those of the surrounding communities.

City of Alton
Master Drainage Plan

1997

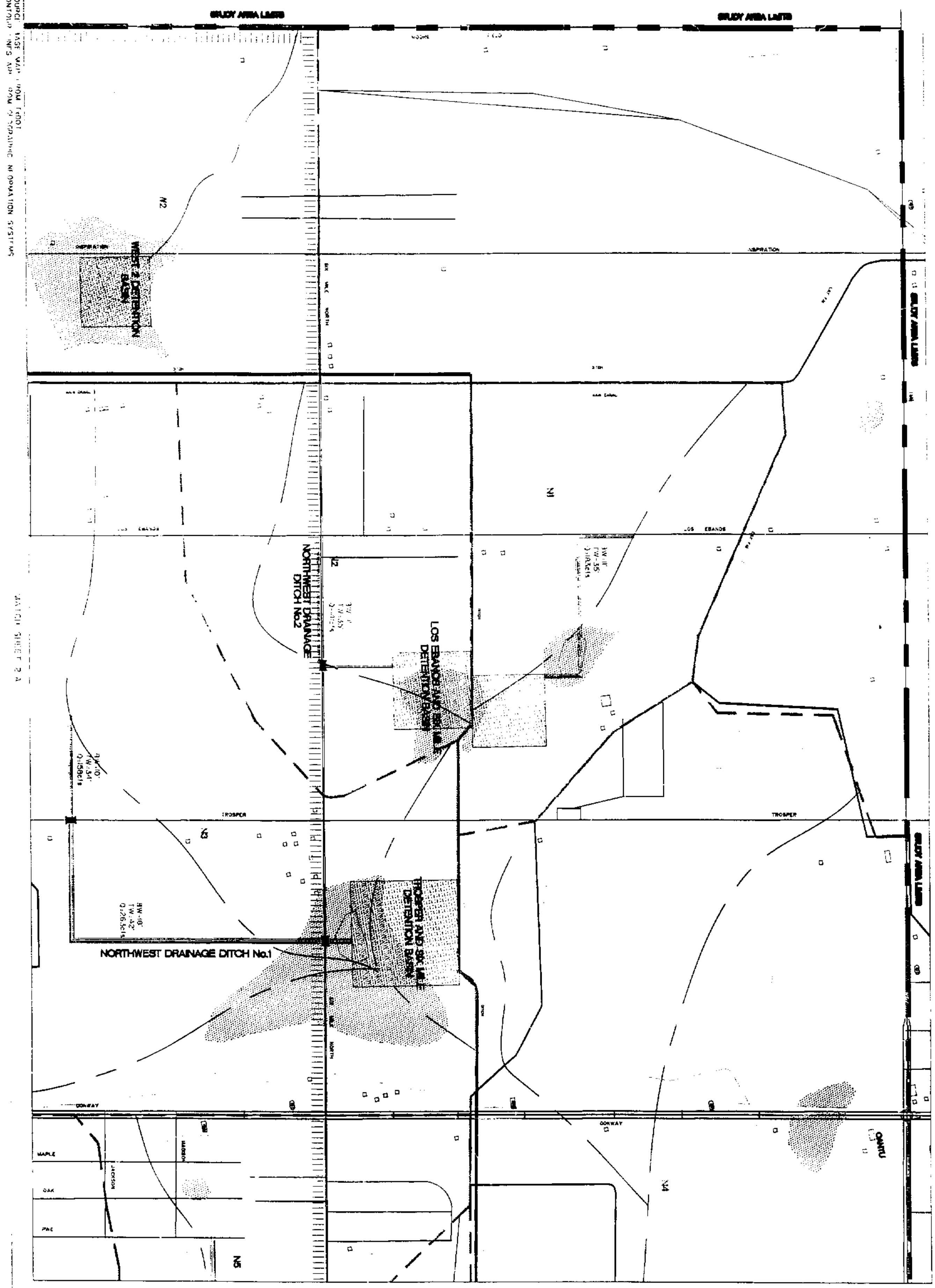
ALTONS ETJ BOUNDARY
CITY LIMITS
STUDY LIMITS
CANALS
UNDERGROUND IRR. PIPE
EXISTING DITCHES
WATER SHED C.L.
WATER SHED
PROPOSED DRAINAGE DITCH
BOX CULVERTS
INVERTED SIPHONS
PROPOSED BASIN
EXISTING BASIN
USGS FLOOD ZONE



CITY OF ALTON, TEXAS
Master Drainage Plan

NOT FOR CONSTRUCTION

PEREZ/FREESE AND NICHOLS, L.L.C.



SHEET 1-A	KEY MAP	SEQ. 1 OF 6

F&N JOB NO. ALT69101
DATE 04/15/97
DESIGNED TAR,JDP
DRAWN JAG

NOT FOR CONSTRUCTION

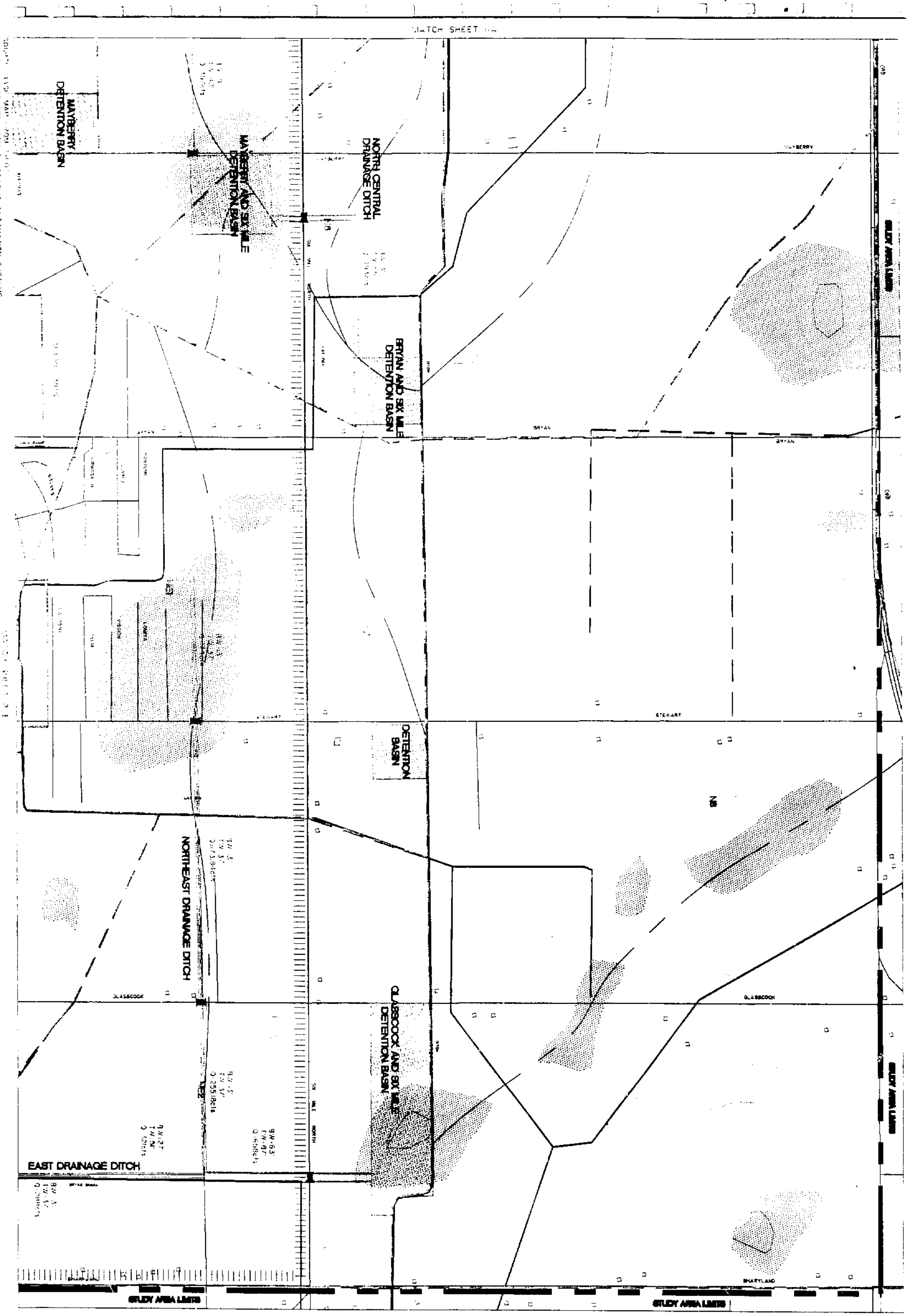
PEREZ/FREESE AND NICHOLS, L.L.C.

CITY OF ALTON, TEXAS

Master Drainage Plan

1—A

PEREZ/FREESE AND NICHOLS L.L.C.
717 S. 12th St.
210/631-4482 Fax210/682-1646



FPN JOB NO. ALT68101

NOT FOR CONSTRUCTION

DATE 04/15/97
DESIGNED TAR,JDP
DRAWN JAG

PEREZ/FREESE AND NICHOLS, L.L.C.

CITY OF ALTON, TEXAS

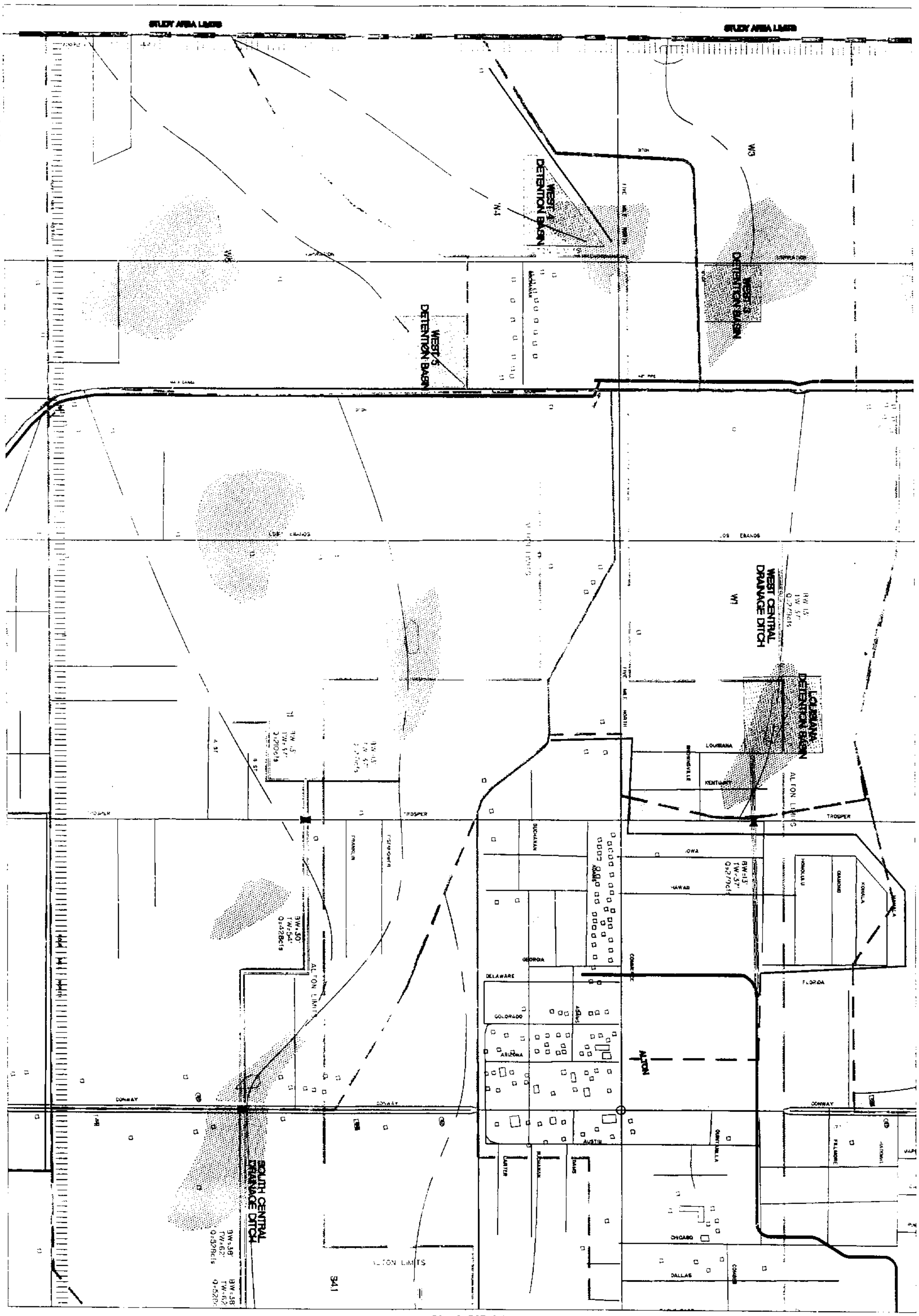
Master Drainage Plan

1–B

PEREZ/FREESE AND NICHOLS, L.L.C.
Engineers • Environmental Scientists • Architects
717 S. 12th St. McAllen, Texas 78501
210/631-4482 Fax210/682-1545

MAP 1-B

SHEET 2 OF 6



CITY OF ALTON, TEXAS

Master Drainage Plan

2–A

NOT FOR CONSTRUCTION

PEREZ/FREESE AND NICHOLS, L.L.C.

FN JOB NO. ALT69101

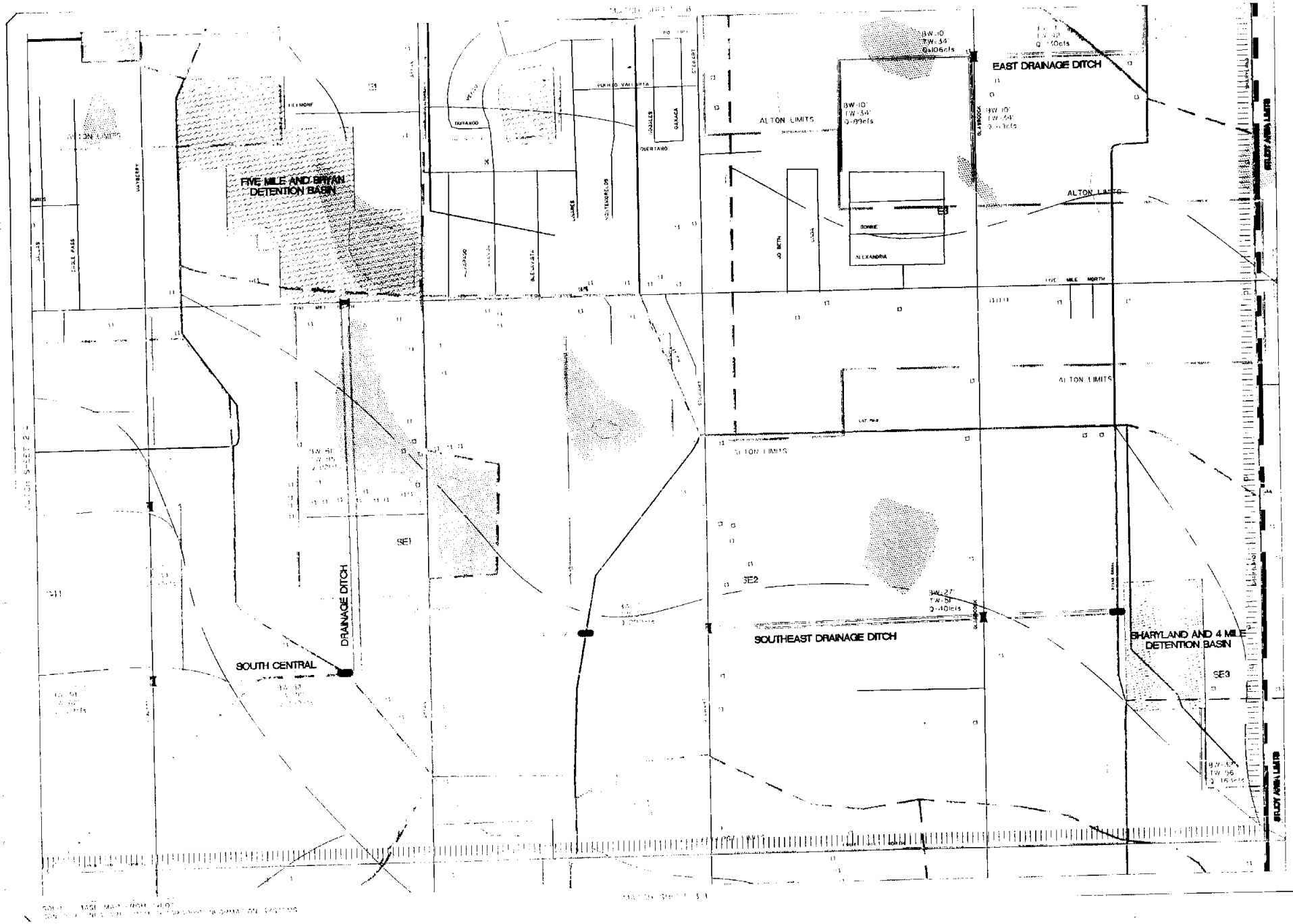
DATE 04/15/97

DESIGNED TAR/JDP

DRAWN JAG

SHEET 3 OF 6

2-A



CITY OF ALTON, TEXAS

Master Drainage Plan

2-B

2-B

4 6

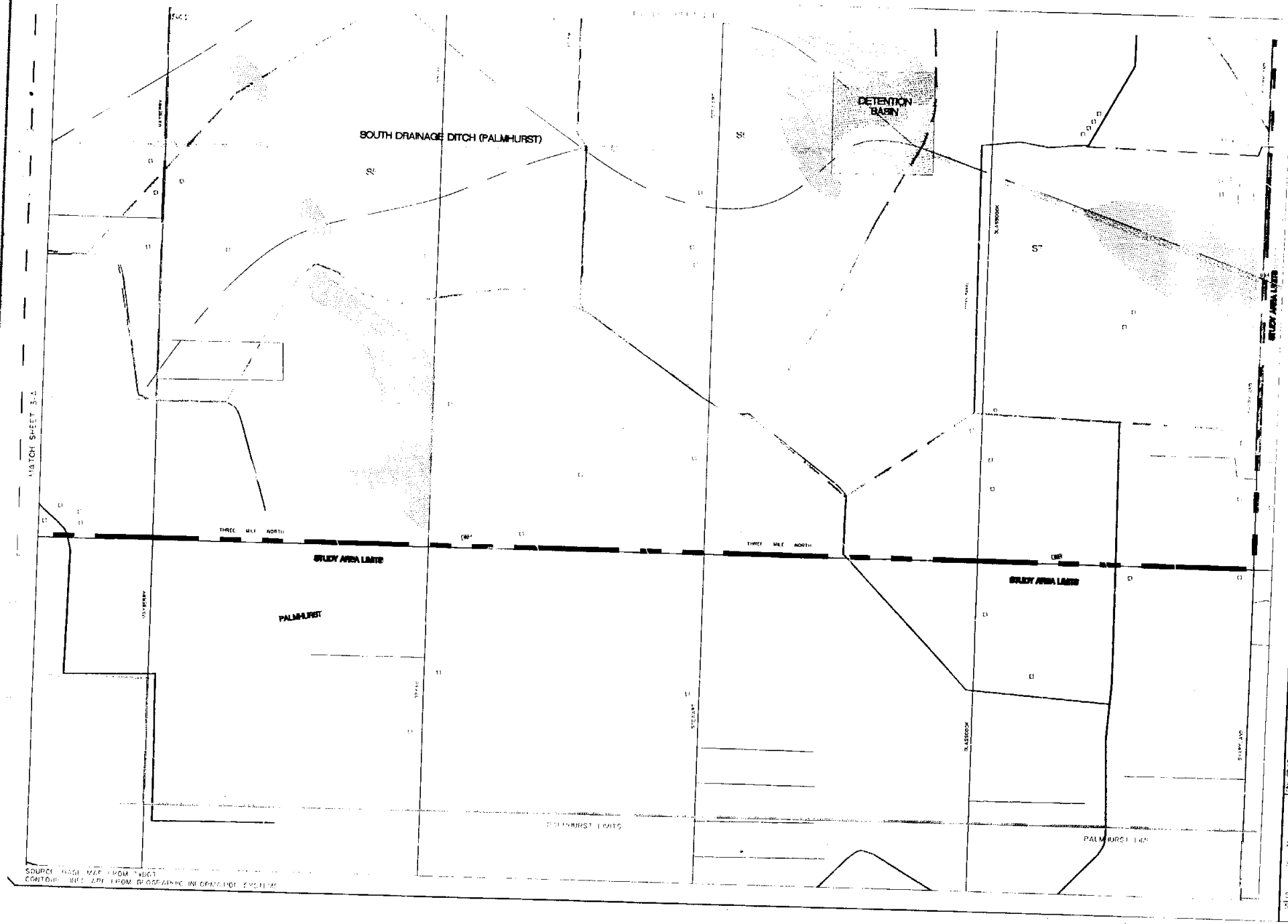
SHEET NO. 5 OF 6	3-A	FAN JOB NO. ALT59101	NOT FOR CONSTRUCTION
		DATE 04/15/97	
		CERTIFIED FAR_JOB	PEREZ/FREESE AND NICHOLS, L.L.C.
		DRAWN JAG	
		CHECKED	

CITY OF ALTON, TEXAS

Master Drainage Plan

3--A

PEREZ/FREESE AND NICHOLS, L.L.C.


SOUTH DRAINAGE DITCH (PALMHURST)
DETENTION BASIN
MATCH SHEET 3-A
THREE MILE NORTH
STUDY AREA LIMITS
PALMHURST
PALMHURST LANE
SOURCE: BASE MAP FROM INDOT
CONTOUR LINES ARE FROM GEOGRAPHIC INFORMATION SYSTEM
CITY OF ALTON, TEXAS
Master Drainage Plan
3-B
NOT FOR CONSTRUCTION
JOB NO. ALTB0101
KEY MAP
SHEET NO. 6 OF 6

APPENDIX A

List of References

REFERENCES

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(5) Cyre, Hector J., "Stormwater Management Financing," paper presented to the International Public Works Congress, American Public Works Association, 1982.

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(7) Maryland Department of the Environment, Sediment and Stormwater Division: A Planning Guide to Stormwater Management Utilities, draft, Annapolis, 1987.

(8) Texas Department of Community Affairs, City and County Assistance: Texas Community Development Program, Austin, 1987.

(9) Texas Advisory Commission on Intergovernmental Relations: Handbook of Governments in Texas, Austin, 1984.

(10) Harman, Douglas and Diveley, Ann Long, "Fort Worth Improvement District: A First in Texas," Texas Town and City, September 1987.

APPENDIX B

Estimates of Probable Construction Cost

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Project: South Central Drainage Ditch

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	40.6	acre	$12,000.00	$487,200.00
Site preparation	40.6	acre	$2,000.00	$81,200.00
Unclassified channel excavation	100,700	cu. yd.	$8.00	$805,600.00
Furnish box culvert under Trosper Rd (6 - 5'x3')	120	foot	$670.00	$80,400.00
Headwalls for box culvert	2	each	$13,500.00	$27,000.00
Furnish box culvert under Conway (SH 107) (7 - 5'x3')	200	foot	$775.00	$155,000.00
Headwalls for box culvert	2	each	$15,200.00	$30,400.00
Furnish box culvert under Mayberry (South) (2 - 5'x3')	120	foot	$775.00	$93,000.00
Headwalls for box culvert	2	each	$15,200.00	$30,400.00
Furnish box culvert under Mayberry (North)	120	foot	$245.00	$29,400.00
Headwalls for box culvert	2	each	$6,800.00	$13,600.00
Furnish inverted siphon under irrigation canal	150	foot	$1,750.00	$262,500.00
Headworks for siphon	2	each	$23,500.00	$47,000.00
Furnish box culvert under Five Mile Road (12 - 5'x3')	200	foot	$2,570.00	$514,000.00
Headworks for box culvert	2	each	$23,500.00	$47,000.00
Hydromulch seeding	40.6	acre	$6,000.00	$243,600.00

Subtotal	$2,947,300.00
Mobilization at 5%	$147,365.00
Overhead and Profit at 10%	$294,730.00
Subtotal	$3,389,395.00
Contingencies at 30%	$1,016,818.50
Total Project Construction Cost	$4,406,213.50

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Project: Southeast Drainage Ditches

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	20	acre	$12,000.00	$240,000.00
Site preparation	20	acre	$2,000.00	$40,000.00
Unclassified channel excavation	107,400	cu. yd.	$8.00	$859,200.00
Furnish inverted siphon under irrigation canal	150	foot	$580.00	$87,000.00
Headwalls for siphon	2	each	$10,200.00	$20,400.00
Furnish box culvert under Stewart Rd. (3 - 5'x3')	120	foot	$350.00	$42,000.00
Headwalls for box culvert	2	each	$8,500.00	$17,000.00
Furnish box culvert under Glasscock (5 - 5'x3')	120	foot	$560.00	$67,200.00
Headwalls for box culvert	2	each	$11,800.00	$23,600.00
Furnish box culvert under Sharyland (6 - 5'x3')	120	foot	$670.00	$80,400.00
Headwalls for box culvert	2	each	$13,500.00	$27,000.00
Furnish inverted siphon under Main Canal	150	each	$1,150.00	$172,500.00
Headwalls for inverted siphon	2	each	$16,800.00	$33,600.00
Hydromulch seeding	20	acre	$6,000.00	$120,000.00

Project: Southeast Drainage Ditches - (continued)

Subtotal	$1,829,900.00
Mobilization at 5%	$91,495.00
Overhead and Profit at 10%	$182,990.00
Subtotal	$2,104,385.00
Contingencies at 30%	$631,315.50
Total Project Construction Cost	$2,735,700.50

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Project: Northeast Drainage Ditch

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	10	acre	$12,000.00	$120,000.00
Site preparation	10	acre	$2,000.00	$20,000.00
Unclassified channel excavation	25488	cu. yd.	$8.00	$203,904.00
Furnish box culvert under Stewart Rd (2 - 5'x3')	120	foot	$245.00	$29,400.00
Headwalls for box culvert	2	each	$6,800.00	$13,600.00
Furnish box culvert under Glasscock Rd. (3 - 5'x3')	120	foot	$350.00	$42,000.00
Headwalls for box culvert	2	each	$8,500.00	$17,000.00
Hydromulch seeding	10	acre	$6,000.00	$60,000.00
Subtotal				$505,904.00
Mobilization at 5%				$25,295.20
Overhead and Profit at 10%				$50,590.40
Subtotal				$581,789.60
Contingencies at 30%				$174,536.88
Total Project Construction Cost				$756,326.48

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Project: East Drainage Ditches

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	21.4	acre	$12,000.00	$256,800.00
Site preparation	21.4	acre	$2,000.00	$42,800.00
Unclassified channel excavation	58,447	cu. yd.	$8.00	$467,576.00
Furnish box culvert under Glasscock Rd (3 - 5'x3')	120	foot	$350.00	$42,000.00
Headwalls for box culvert	2	each	$8,500.00	$17,000.00
Furnish box culvert under Six Mile Rd. (10 - 5'x3')	120	foot	$1,095.00	$131,400.00
Headwalls for box culvert	2	each	$20,200.00	$40,400.00
Hydromulch seeding	21.4	acre	$6,000.00	$128,400.00
Subtotal				$1,126,376.00
Mobilization at 5%				$56,318.80
Overhead and Profit at 10%				$112,637.60
Subtotal				$1,295,332.40
Contingencies at 30%				$388,599.72
Total Project Construction Cost				$1,683,932.12

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Project: North Central Drainage Ditches

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	11	acres	$12,000.00	$132,000.00
Site preparation	11	acres	$2,000.00	$22,000.00
Unclassified channel excavation	48,640	cu. yd.	$8.00	$389,120.00
Furnish box culvert under Mayberry Rd (4 - 5'x3')	120	foot	$460.00	$55,200.00
Headwalls for box culvert	2	each	$10,200.00	$20,400.00
Furnish box culvert under Six Mile North Rd. (6 - 5'x3')	120	foot	$670.00	$80,400.00
Headwalls for box culvert	2	each	$13,500.00	$27,000.00
Hydromulch seeding	11	acre	$6,000.00	$66,000.00
Subtotal				$792,120.00
Mobilization at 5%				$39,606.00
Overhead and Profit at 10%				$79,212.00
Subtotal				$910,938.00
Contingencies at 30%				$273,281.40
Total Project Construction Cost				$1,184,219.40

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Project: Northwest Drainage Ditch No 1

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	11	acres	$12,000.00	$132,000.00
Site preparation	11	acres	$2,000.00	$22,000.00
Unclassified channel excavation	52,830	cu. yd.	$8.00	$422,640.00
Furnish box culvert under Trosper Rd (2 - 5'x3')	120	foot	$245.00	$29,400.00
Headwalls for box culvert	2	each	$6,800.00	$13,600.00
Furnish box culvert under Six Mile North Rd. (3 - 5'x3')	120	foot	$350.00	$42,000.00
Headwalls for box culvert	2	each	$8,500.00	$17,000.00
Hydromulch seeding	11	acre	$6,000.00	$66,000.00
Subtotal				$744,640.00
Mobilization at 5%				$37,232.00
Overhead and Profit at 10%				$74,464.00
Subtotal				$856,336.00
Contingencies at 30%				$256,900.80
Total Project Construction Cost				$1,113,266.80

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Project: Northwest Drainage Ditch No. 2

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	4.3	acre	$12,000.00	$51,600.00
Site preparation	4.3	acre	$2,000.00	$8,600.00
Unclassified channel excavation	5,200	cu. yd.	$8.00	$41,600.00
Furnish box culvert under Six Mile North Rd. (2 - 5'x3')	120	foot	$245.00	$29,400.00
Headwalls for box culvert	2	each	$6,800.00	$13,600.00
Hydromulch seeding	4.3	acre	$6,000.00	$25,800.00
Subtotal				$170,600.00
Mobilization at 5%				$8,530.00
Overhead and Profit at 10%				$17,060.00
Subtotal				$196,190.00
Contingencies at 30%				$58,857.00
Total Project Construction Cost				$255,047.00

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Project: West Central Drainage Ditch

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	8.4	acre	$12,000.00	$100,800.00
Site preparation	8.4	acre	$2,000.00	$16,800.00
Unclassified channel excavation	24,780	cu. yd.	$8.00	$198,240.00
Furnish box culvert under Los Ebanos Rd	120	foot	$350.00	$42,000.00
Headwalls for box culvert	2	each	$8,500.00	$17,000.00
Furnish box culvert under Trosper Rd.	120	foot	$350.00	$42,000.00
Headwalls for box culvert	2	each	$8,500.00	$17,000.00
Hydromulch seeding	8.4	acre	$6,000.00	$50,400.00
Subtotal				$484,240.00
Mobilization at 5%				$24,212.00
Overhead and Profit at 10%				$48,424.00
Subtotal				$556,876.00
Contingencies at 30%				$167,062.80
Total Project Construction Cost				$723,938.80

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin: Louisiana Street

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	16	acre	$12,000.00	$192,000.00
Site preparation	16	acre	$2,000.00	$32,000.00
Unclassified channel excavation	75,124	cu. yd.	$8.00	$600,992.00
Furnish inlet structure	1	each	$3,600.00	$3,600.00
Furnish overflow discharge weir structure	1	each	$3,600.00	$3,600.00
Hydromulch seeding	16	acre	$6,000.00	$96,000.00
Subtotal				$928,192.00
Mobilization at 5%				$46,409.60
Overhead and Profit at 10%				$92,819.20
Subtotal				$1,067,420.80
Contingencies at 30%				$320,226.24
Total Project Construction Cost				

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin: Trosper and Six Mile

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	30.2	acre	$12,000.00	$362,400.00
Site preparation	30.2	acre	$2,000.00	$60,400.00
Unclassified channel excavation	159,600	cu. yd.	$8.00	$1,276,800.00
Furnish box inlet structure	1	each	$500.00	$500.00
Furnish overflow discharge weir structure	1	each	$500.00	$500.00
Hydromulch seeding	30.2	acre	$6,000.00	$181,200.00
Subtotal				$1,881,800.00
Mobilization at 5%				$94,090.00
Overhead and Profit at 10%				$188,180.00
Subtotal				$2,164,070.00
Contingencies at 30%				$649,221.00
Total Project Construction Cost				

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin: Mayberry and Six Mile

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	16	acre	$12,000.00	$192,000.00
Site preparation	16	acre	$2,000.00	$32,000.00
Unclassified channel excavation	79,300	cu. yd.	$8.00	$634,400.00
Furnish inlet structure	1	each	$3,900.00	$3,900.00
Furnish overflow discharge weir structure	1	each	$3,900.00	$3,900.00
Hydromulch seeding	16	acre	$6,000.00	$96,000.00
Subtotal				$962,200.00
Mobilization at 5%				$48,110.00
Overhead and Profit at 10%				$96,220.00
Subtotal				$1,106,530.00
Contingencies at 30%				$331,959.00
Total Project Construction Cost				

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin: Bryan and Six Mile

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	7	acre	$12,000.00	$84,000.00
Site preparation	7	acre	$2,000.00	$14,000.00
Unclassified channel excavation	70,300	cu. yd.	$8.00	$562,400.00
Furnish inlet structure	1	each	$21,200.00	$21,200.00
Furnish overflow discharge weir structure	1	each	$19,900.00	$19,900.00
Hydromulch seeding	7	acre	$6,000.00	$42,000.00
Subtotal				$743,500.00
Mobilization at 5%				$37,175.00
Overhead and Profit at 10%				$74,350.00
Subtotal				$855,025.00
Contingencies at 30%				$256,507.50
Total Project Construction Cost				$ [illegible]2

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin: Glasscock and Six Mile

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	30	acre	$12,000.00	$360,000.00
Site preparation	30	acre	$2,000.00	$60,000.00
Unclassified channel excavation	364,000	cu. yd.	$8.00	$2,912,000.00
Furnish inlet structure	1	each	$39,700.00	$39,700.00
Furnish overflow discharge weir structure	1	each	$20,300.00	$20,300.00
Hydromulch seeding	30	acre	$6,000.00	$180,000.00
Subtotal				$3,572,000.00
Mobilization at 5%				$178,600.00
Overhead and Profit at 10%				$357,200.00
Subtotal				$4,107,800.00
Contingencies at 30%				$1,232,340.00
Total Project Construction Cost				

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin: Sharyland and Four Mile

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	21	acre	$12,000.00	$252,000.00
Site preparation	21	acre	$2,000.00	$42,000.00
Unclassified channel excavation	214,100	cu. yd.	$8.00	$1,712,800.00
Furnish inlet structure	1	foot	$500.00	$500.00
Furnish overflow discharged weir structure	1	foot	$500.00	$500.00
Hydromulch seeding	21	acre	$6,000.00	$126,000.00
Subtotal				$2,133,800.00
Mobilization at 5%				$106,690.00
Overhead and Profit at 10%				$213,380.00
Subtotal				$2,453,870.00
Contingencies at 30%				$736,161.00
Total Project Construction Cost				[illegible]

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin: Los Ebanos and Six Mile

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	15	acre	$12,000.00	$180,000.00
Site preparation	15	acre	$2,000.00	$30,000.00
Unclassified channel excavation	74,300	cu. yd.	$8.00	$594,400.00
Furnish box inlet structure	1	each	$3,000.00	$3,000.00
Furnish overflow discharge weir structure	1	each	$3,000.00	$3,000.00
Hydromulch seeding	15	acre	$6,000.00	$90,000.00
Subtotal				$900,400.00
Mobilization at 5%				$45,020.00
Overhead and Profit at 10%				$90,040.00
Subtotal				$1,035,460.00
Contingencies at 30%				$310,638.00
Total Project Construction Cost				[illegible]

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin:West 2

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	13	acre	$12,000.00	$156,000.00
Site preparation	13	acre	$2,000.00	$26,000.00
Unclassified channel excavation	58,400	cu. yd.	$8.00	$467,200.00
Furnish box inlet structure	1	each	$5,600.00	$5,600.00
Furnish overflow discharge weir structure	1	each	$5,600.00	$5,600.00
Hydromulch seeding	13	acre	$6,000.00	$78,000.00
Subtotal				$738,400.00
Mobilization at 5%				$36,920.00
Overhead and Profit at 10%				$73,840.00
Subtotal				$849,160.00
Contingencies at 30%				$254,748.00
Total Project Construction Cost				[illegible]

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin: West 3

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	9	acre	$12,000.00	$108,000.00
Site preparation	9	acre	$2,000.00	$18,000.00
Unclassified channel excavation	39,800	cu. yd.	$8.00	$318,400.00
Furnish box inlet structure	1	each	$3,600.00	$3,600.00
Furnish overflow discharge weir structure	1	each	$3,600.00	$3,600.00
Hydromulch seeding	9	acre	$6,000.00	$54,000.00
Subtotal				$505,600.00
Mobilization at 5%				$25,280.00
Overhead and Profit at 10%				$50,560.00
Subtotal				$581,440.00
Contingencies at 30%				$174,432.00
Total Project Construction Cost				

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin:West 4

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	12	acre	$12,000.00	$144,000.00
Site preparation	12	acre	$2,000.00	$24,000.00
Unclassified channel excavation	53,000	cu. yd.	$8.00	$424,000.00
Furnish box inlet structure	1	each	$3,900.00	$3,900.00
Furnish overflow discharge weir structure	1	each	$3,900.00	$3,900.00
Hydromulch seeding	12	acre	$6,000.00	$72,000.00
Subtotal				$671,800.00
Mobilization at 5%				$33,590.00
Overhead and Profit at 10%				$67,180.00
Subtotal				$772,570.00
Contingencies at 30%				$231,771.00
Total Project Construction Cost				[illegible]

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin: West 5

Description	Quantity	Unit	Unit Price	Total
Purchase property for construction	14	acre	$12,000.00	$168,000.00
Site preparation	14	acre	$2,000.00	$28,000.00
Unclassified channel excavation	63,200	cu. yd.	$8.00	$505,600.00
Furnish box inlet structure	1	each	$3,900.00	$3,900.00
Furnish overflow discharge weir structure	1	each	$3,900.00	$3,900.00
Hydromulch seeding	14	acre	$6,000.00	$84,000.00
Subtotal				$793,400.00
Mobilization at 5%				$39,670.00
Overhead and Profit at 10%				$79,340.00
Subtotal				$912,410.00
Contingencies at 30%				$273,723.00
Total Project Construction Cost				

City of Alton Master Drainage Plan

Opinion of Probable Construction Cost

Detention Basin: Five Mile and Bryan

Description	Quantity	Unit	Unit Price	Total
Unclassified channel excavation	808,296	cu. yd.	$4.00	$3,233,184.00
Subtotal				$3,233,184.00
Mobilization at 5%				$161,659.20
Overhead and Profit at 10%				$323,318.40
Subtotal				$3,718,161.60
Contingencies at 30%				$1,115,448.48
Total Project Construction Cost				[illegible]

Stormwater Pump Station	1	L.S.		$1,100,000.00
Contingencies at 30%				$330,000.00
Total Project Construction Cost				[illegible]

24-inch Stormwater Pipeline	5,400	Ft	$54.00	$291,600.00
Contingencies at 30%				$87,480.00
Total Project Construction Cost				[illegible]

Total Cost of Project		$6,642,690.08

APPENDIX C

Texas Water Development Board Review Comments for the City of Alton Flood Protection Planning Contract- Contract No. 96-483-158 on the Final Draft Report

TEXAS WATER DEVELOPMENT BOARD

JUN 16 1997

June 9, 1997

Mr. Salvador Vela
Mayor, City of Alton
P. O. Drawer 9004
Alton, Texas 78572

Re: Review Comments for Draft Report Submitted by the City of Alton, TWDB Contract No. 96-483-158

Dear Mr. Vela:

Staff members of the Texas Water Development Board have completed a review of the draft report under TWDB Contract No. 96-483-158. As stated in the above referenced contract, the City will consider incorporating comments from the EXECUTIVE ADMINISTRATOR shown in Attachment 1 and other commentors on the draft final report into a final report. The City must include a copy of the EXECUTIVE ADMINISTRATOR's comments in the final report.

The Board looks forward to receiving one (1) unbound camera-ready original and nine (9) bound double-sided copies of the Final Report on this planning project. Please contact Mr. Alfredo Rodriguez, the Board's Contract Manager, at (512) 463-7987, if you have any questions about the Board's comments.

Sincerely,

Carolyn L. Brittain

for Tommy Knowles
Deputy Executive Administrator
for Planning

cc: Alfredo Rodriguez, TWDB

ATTACHMENT 1
TEXAS WATER DEVELOPMENT BOARD
REVIEW COMMENTS FOR THE CITY OF ALTON
FLOOD PROTECTION PLANNING CONTRACT
CONTRACT NO. 96-483-158

Comments on the Master Drainage Plan:

1. Table 2.1 is on section 2, page 3. On section 2 Page 4, there is a "continued Table 2.5". There is no reference on the text on Table 2.5. It appears that the table on page 4 of section 2 is the continuation of Table 2.1, and if so, the headings on both tables should be the same (i.e. on Table 2.1 the heading Discharge/Develop and Undeveloped do not have CN values as in the table on Page 4).

2. In section 2.3 (section 2, page 5) the source and the methodology by which the Runoff Curve Numbers are calculated need to be included.

3. In section 2.8 (section 2, page 7) the source of the Muskingum Equation needs to be referenced.

4. For clarification purposes the statement on Section 10.5 (section 10, page 6) that refers to the improvements identified should read "Sheets 1-A through 3-B" to match the title of the sheets.

5. The table of contents should include Appendix A - References and Appendix B - Estimates of Probable Construction Costs.

6. Task III - Existing Storm Sewer Assessment in the Scope of Work calls for the delivery of a map(s) showing existing storm sewer systems. Looking through the report, the existing maps do not show the storm sewer system. Please provide such maps.

7. The reports call for a population of 75,000 to 90,000 when the City of Alton will reach full development (section 10.3) but it does not state when this full development might be reached. TWDB population projections calls for a maximum of 22,510 people by the year 2050. There is a need for clarification on how the 75,000 to 90,000 population numbers were calculated.

8. Cost analysis need to be made available for improvements in the 3A and 3B quadrants of the regional map. (South drainage ditch)

9. Flow capacity of receiving drainage courses toward the southeast flowing out of the study area need to be included and the probable impact the improved system would have on these existing unimproved drainageways need to be addressed.

10. Any probably impact fees caused from increased flows on existing systems need

to be addressed, especially to the southeast and out of the study area.

11. In the Scope of Work, flow and holding capacity evaluations need to be included in the report, particularly when in Table 2.1 Developed Discharges exceed Hidalgo County DD #1 flow capacities.

12. In the Scope of Work, the evaluation of the system's outlet points into the Hidalgo county Drainage District's system need to be included in the report, particularly when in Table 2.1 Developed Discharges exceed the DD's flow capacities.

13. An analysis of the 100-year storm event comparisons need to be included in the report.

14. Identifiable non-structural alternatives need to be included in the report.

15. In the Scope of Work, evaluation of alternatives on economic feasibility, safety considerations, environmental concerns and aesthetics need to be included in the report.

16. Onsite detention should have been one non-structural alternative evaluated.

Comments on the Drainage Design Manual:

1. The definition of Swales on Appendix B needs to be included.

2. Computation Sheet 5-1 needs to be included.

3. On Table 5-5 the meaning of R-20, R-12.5, CBD, PO, HCO, etc, need to be included.

4. Computation Sheet 7-2 has 23 columns, there is an explanation for columns 1 through 14, but the explanations for columns 15 through 22 are missing and need to be included. All other Computation sheets within the manual are fully explained.

5. Appendices D, E, and F, missing from the manual need to be included.

ATTACHMENT 2
TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
REVIEW COMMENTS FOR CITY OF ALTON
FLOOD PROTECTION PLANNING CONTRACT
CONTRACT NO. 96-483-158

1. An Application for Approval of Reclamation Project need not be filed with the Texas Natural Resource Conservation Commission for the referenced proposal. It was determined from our review that the proposed project, since it is in the City of Alton, needs to be permitted by the City. The City of Alton by virtue of its participation in the National Flood Insurance Program, and in accordance with Section 16.236 (d) (3&4) of the Texas Water Code, has approval authority for the project. If the City has not already done so, they should insure that the proposed construction is documented and permitted in accordance with their Flood Hazard Prevention Ordinance. This documentation should also be submitted by the City to the Federal Emergency Management Agency to obtain a Letter of Map Revision (LOMR) of Alton's Flood Insurance Rate Map.

2. The technical content of the referenced report is based on acceptable hydrological and hydraulic methods and is complete. Therefore, the merits of the proposed project can be evaluated from the report.

Responses to Texas Water Development Board Comments on Final Draft Report

Comments on the Master Drainage Plan:

1. Concur

2. Concur

3. Concur

4. Concur

5. Concur

6. The map of the existing storm sewer systems as required in Task III- Existing Storm Sewer Assessment in the Scope of Work has been developed and furnished as a separate document. A large scale map of the developed area of the city is required to show the existing storm sewer system.

7. The full development population range was developed by assuming five to six dwelling units per acre and four persons dwelling unit.

8. The improvements in the 3A and 3B quadrants are within the City of Palmhurst. Their cost will not be the responsibility of the City of Alton.

9. The evaluation of the flow capacity of the receiving drainage courses toward the southeast is not included in the Scope of Work. Coordination meetings were held with the City of McAllen so that they would be informed about the proposed plans.

10. Not included in the Scope of Work.

11. Numerous attempts were made to coordinate with Hidalgo County Drainage District No.1. The capacity of their existing system is approximately a 10-year frequency storm. Hidalgo County Drainage District No. 1 currently has consultants evaluating improvements to its system. A meeting was held with the District's consultant to make them aware of the City

of Alton Master Drainage Plan.

12. See response to number 11.

13. The drainage system was evaluated in the study and presented in the report.

14. Non-structural alternatives are discussed in Section 3.

15. Discussions on economic feasability, safety considerations, environmental concerns and aesthetics are included in Section 9.

16. A future detailed land use plan does not exist for the City of Alton. The level of detail possible in establishing the runoff characteristics of the contributing watersheds can only be on an average basis. The proposed approach to watershed management is to permit the land developer to evaluate and proposed alternatives, including on-site detention, that achieve the prescribed level in the most economical matter.

Comments on the Drainage Design Manual

1. Concur

2. Concur

3. Concur

4. Explanations for columns 15 through 22 are included on Section 7, Page 6.

5. Appendices D, E, and F have been included in the manual.

TEXAS WATER DEVELOPMENT BOARD

November 3, 1997

Mr. Salvador Vela
Mayor, City of Alton
P. O. Drawer 9004
Alton, Texas 78572

Re: Response to Comments Regarding Flood Protection Planning Contract Between the Texas Water Development Board (Board) and the City of Alton (City), TWDB Contract No. 97-483-158

Dear Mayor Vela:

Staff members of the Texas Water Development Board have completed a review of the consultant's response to our comments and have determined that our comments have not been completely addressed. The attached comments should be considered before the report is finalized.

The Board looks forward to receiving your response to the comments in Attachment 1. Please contact Mr. Gilbert Ward, the Board's Contract Manager, at (512) 463-6418, if you have any questions about the Board's comments.

Sincerely,

Tommy Knowles
Deputy Executive Administrator
for Planning

cc: Gilbert Ward, TWDB

ATTACHMENT 1
TEXAS WATER DEVELOPMENT BOARD

RESPONSE COMMENTS FOR THE CITY OF ALTON
FLOOD PROTECTION PLANNING CONTRACT
CONTRACT NO. 97-483-158

1. Your response to TWDB comment #1 is not complete. Table 2.1 is continued from page 3 to page 4, but the headings on the columns are not the same. Also, it should be clear by looking at the table (by column headings) that the table compares calculated discharges from SCS methodology to calculated discharges by HCDD#1 (which methods were used by HCDD#1?).

2. On page 4, portion of Table 2.1, what does the Q2 after Drainage District No. 1 in column heading mean?

3. Response to TWDB comment #2 - the source and methodology for Runoff Curve No. discussion was added, but the reference was not added to the List of References in Appendix A.

4. Your response to TWDB comment #3 was not what we desired. It appears that nearly all of Section 2.8 is taken from "Hydrology for Engineers" by Linsley, Kohler and Paulus (2nd ed, copyright date 1975, Section 9-8, page 300). The text should be denoted as a quotation and properly cited, otherwise it could be construed as plagiarism.

5. Please include the formula which introduces the constant K in the storage equation.

6. Eagle Point software, Watershed Modeling Manual needs to be included in the List of References.

7. TxDOT Drainage Manual needs to be included in the List of References.

8. It is assumed that the last sentence of Section 2.3 is citing that the Curve Number Values used by Eagle Point came originally from a SCS document, Section 4-Hydrology. This is not clear and not properly cited (and not in the List of References).

9. Response to TWDB comment #6 - the map provided of Existing Drainage Facilities has no legend.

10. Response to TWDB comment #13- as defined in the Scope of Work for Task III, Subtask 6, develop analysis of the 100-year storm event and compare to FEMA Insurance Rate Maps. Your response states that the 100-year storm event was evaluated, but the evaluation or a comparison to FEMA maps cannot be located in the report. Please note where in the report this is performed.

Responses to Texas Water Development Board on Final Report

Comments on the Master Drainage Plan:

1. Concur.

2. Concur.

3. Modified as requested.

4. Modified as requested.

5. Modified as requested.

6. Modified as requested.

7. Modified as requested.

8. Modified as requested.

9. The map will be modified as requested.

10. The drainage system concept proposed in the study was sized to accommodate the 100-year frequency storm. The FEMA FIRM Flood Insurance Rate Map for the unincorporated area of Hidalgo County around the City of Alton only contains Zone A designated areas in the form of depressed areas in the ground surface. The FEMA explanation of Zone A is "Areas of 100-year flood; base flood elevation and flood hazard factors not determined." In the consultants opinion, a detailed comparison in the report of the proposed drainage-ditch system to the FEMA approximate 100-year flooded areas would not add to the understanding and value of the Master Plan. Many of these depressed areas were incorporated into the drainage ditch routes and the detention storage areas.

11. New comment from TWDB. Section 3 has been reorganized as requested by the TWDB.

12. New comment from TWDB. Section 3 has been reorganized as requested by the TWDB.