CITY OF MIDLAND, TEXAS
MASTER DRAINAGE PLAN

SECTION 1
INTRODUCTION

1.1 GENERAL

The City of Midland was incorporated in 1911 and grew rapidly in response to the growth of the petroleum industry in the Permian Basin. The City's founding fathers may not have known it at the time, but the City was situated at, and downstream of, the confluence of two major draws. Development proceeded upstream along these two major draws as the City expanded. As was often the case with other communities, this expansion was at such a pace that water, sewer and transportation infrastructure had to receive priority in funding and construction while surface drainage infrastructure was relegated to a lower priority.

It was noted over the long-term that downstream flooding had correspondingly increased with the upstream urban growth, particularly with urban growth in the draw watersheds. The most recent major flood occurred in 1968; however, citizens and City staff have noticed that road closures during runoff events have become more frequent with each passing decade. This is an indication of the increased volume and rate of runoff which exceeds the original design capacities of the road drainage structures. The City of Midland could foresee increased flooding potential as urban development pressures continued to the north and west of the current April 1996 incorporated city limits.

Initial drainage engineering studies for the City of Midland began in the 1950's and additional studies followed as authorized by the City government. The last such study prior to this master plan was performed in October 1988. Each previous study report was adequate for the scope of work authorized and the problem the report addressed; however, this was a piecemeal approach resulting in stopgap measures to a much larger drainage problem. The Midland City Council recognized in 1991 that this piecemeal approach would no longer adequately serve the citizens and made the commitment to a larger scope of study. That commitment culminated in this Master Drainage Plan.

1.2 SCOPE

In November 1991, the City Council of Midland, Texas authorized the development of a Master Drainage Plan for the City of Midland and for portions of its extra-territorial jurisdiction (ETJ). The City Council recognized the need for a long-range Master Drainage Plan based on the City's historical urban growth rate and recurring drainage problems. The objectives of this Master Drainage Plan are:

A. Provision of a long-range plan for drainage improvements which will allow upstream watersheds to be developed while minimizing increased flood damage potential in other areas;

B. Reduction of existing flood potential where possible within the City; and,

C. Improvement of the City of Midland's community rating in the National Flood Insurance Program.

This Master Drainage Plan is an analysis of the six major watersheds affecting the City of Midland, two of which encompass the major draws mentioned earlier. The watersheds for this plan comprise approximately 412 total square miles, with the vast majority of this watershed area to the north and west of the City. These six major watersheds are listed below and are shown on Figure 1-1.

Watershed	Approximate Total Area (Square Miles)
Jal Draw	208
Midland Draw	155
Scharbauer Channel	7
Mulberry Channel	4
Industrial Channel	1
South Channel	37

1.3 PROCEDURE

The Master Drainage Plan was created with the use of computer modeling. Hydrologic and hydraulic computer models were developed to encompass the six watersheds mentioned in Paragraph 1.2. Two sets of computer models were created, one set for the existing land use conditions as of June 1993, and the other set for the year 2020 projected land use conditions. Extensive use was made of the City of Midland's Geographic Information System (GIS) in creating the computer models. Improvements have been recommended based upon the two sets of computer models in order to meet the goals of the Master Drainage Plan.

1.3.1 COMPUTER MODELING

The original Flood Insurance Study issued by the Corps of Engineers and the Federal Emergency Management Agency in 1991 incorporated the use of the Fort Worth District Corps of Engineer's SWFHYD Hydrologic Model. This software is neither well documented nor readily available through public or private sources. Because of these drawbacks, the SWFHYD Hydrologic Model was determined to be inappropriate for use as the City of Midland's Master Drainage Planning hydrologic software. It was determined that the Corps of Engineers' HEC-1 software would be used as the Master Drainage Planning hydrologic software because of its widespread use and availability. Thus, extensive computer models for hypothetical storm events were created using the Corps of Engineers' HEC-1 hydrologic model.

The U.S. Department of Agriculture Soil Conservation Service (SCS) curve number theory, the SCS unit hydrograph theory and the SCS Type II rainfall distribution were used in the hydrologic models. Hypothetical storm events were derived from rainfall depth-durations contained in NOAA Technical Memorandum NWS Hydro-35 and U.S. Department of Commerce Technical Paper No. 40.

In SCS curve number theory, the soil-cover complex and antecedent moisture condition determine the volume of surface runoff from a watershed or subarea thereof. The soil-cover complex is based on the SCS hydrologic soil group and the ground surface cover. As would be expected, native range land with good vegetative cover has a lower potential runoff volume than an equivalent area of paved parking.

The antecedent moisture condition describes the soil profile moisture content just prior to a storm event. A soil which is very moist and has most of its water-holding capacity filled has a much lower infiltration rate than the same soil in a very dry state. Storm runoff is increased because of the lower infiltration rate associated with a wet antecedent moisture condition. Normally, the soil is in an average antecedent moisture condition in the City of Midland urban and park areas because of extensive sprinkler systems. Rural agricultural and range lands in this area are normally drier than average.

Along with the increase in runoff volume is an increase in peak discharge as land is converted from native range or agricultural use to developed urban use. The triangular mathematical relationships of the SCS unit hydrograph and the underlying unit hydrograph theory, particularly the time to peak discharge and magnitude of that peak, rely on the time of concentration as well as the volume of runoff. When land is converted to urban use, the flow paths that surface runoff follows to a point of concentration are usually paved or otherwise improved. This results in a time of concentration much reduced below that of unimproved property. Coupled with the increased runoff volume, the reduced time of concentration gives not only a high magnitude of peak discharge but a peak value which occurs at an earlier time in the storm event. A more detailed discussion of SCS curve number and unit hydrograph theory is contained in the City's Storm Drainage Design Manual.

Hydraulic analyses of open channels were accomplished with the Corps of Engineers' HEC-2 hydraulic model for water surface profiles. The routing of the flow through the open channels was based upon the Modified Puls Theory. The Texas Department of Transportation's THYSYS hydraulic software was used for closed-conduit storm drain analysis.

1.3.2 LAND USE

Two hydrologic surface conditions were developed for comparative analysis. The first hydrologic condition was for existing land use in the six watersheds. Vacant property within the City limits and ETJ which had an approved plat on file at the City's Planning and Zoning Department, as of June 1993, was considered as already developed for existing land use purposes.

The second hydrologic condition, future land use, was projected to the year 2020 using the City's zoning as of June 1993 and the City's Comprehensive Plan. The Comprehensive Plan provided consistency for the hydrologic analysis of the City's anticipated urban growth in the six watersheds. The extent of the predicted future land use was assumed to be within the incorporated city limits as they existed in June 1993 and within the ETJ for four miles north of Loop 250 and two miles west of Loop 250. It was also predicted that the future land use within this area would include the development of all undeveloped property and that the airport located between Big Spring Street and Garfield Street, just south of Loop 250, would be relocated outside of the area of concern.

1.4 PROPOSED IMPROVEMENTS

The recommended improvements are based on the attenuation of the 100-year, 24-hour rainfall event and have been incorporated into what are designated as the ultimate HEC-1 hydrologic computer model and the ultimate HEC-2 hydraulic computer model. These two ultimate computer models are simulations of the entire Master Drainage Plan with all recommended improvements and predicted land use modelled as completely in place.

The recommended improvements are arranged and presented in order as channels and associated roadway drainage structures, playa lake improvements, detention/retention ponds, and "no action" zones. It is important to understand that many of the recommended improvements affect multiple watershed subareas, so the user cannot glean the entire improvement function from solely viewing one watershed subarea. Another important point is that the improvements are so interdependent in their operation that all of the proposed improvements must be installed to meet the Master Drainage Plan's stormwater runoff mitigation.

Improvements which serve an entire watershed subarea, or region, were given preference over individual on-site runoff controls. Regional facilities are more likely to be operated and maintained by either the City, a homeowner association or a utility district. Operation and maintenance over the long-term is essential for each recommended improvement's continuing function.

Final designs for the construction of the proposed improvements may require some variation from the recommended dimensions, elevations, slopes and lengths shown in the exhibits. Not all existing utilities could be considered nor could all existing rights-of-way be investigated. Any substantial variance from the improvement proposed must be based on physical, engineering, constructibility, or legal obstacles and have the concurrence of the City of Midland Engineering and Development Department.

Most of the playa lakes in the watersheds which lie within the city limits or ETJ have improvements planned. The primary objectives in the Master Drainage Plan for playa lakes were as follows:

A. Use each playa lake to the greatest extent possible to service its contributing drainage area as a regional detention or retention facility.

B. The peak discharge from a playa lake overflow under developed conditions could not exceed that playa lake's overflow peak discharge under June 1993 existing conditions (100-year 24-hour storm event).

C. If the discharge from an upstream playa lake entered another detention, retention or playa lake basin at a downstream location, then the upstream lake's developed discharge volume was limited to the volume of lake discharge under June 1993 existing conditions (100-year 24-hour storm event).

D. Since the area's playa lakes are normally dry, storm drains to dewater each lake's storage volume would be incorporated into the Master Drainage Plan.

E. Each existing playa lake's overflow elevation would be maintained.

F. Overflow routes would be provided, or maintained, so that runoff from storm events exceeding the 100-year 24-hour hypothetical storm event would have an outlet.

1.5 POLICY

The drainage policy for the City of Midland is designed to meet the goals listed previously. The following standards will apply to any property which is platted or replatted within the corporate City limits or within the extra-territorial jurisdiction of the City of Midland after adoption by the City Council of this Master Drainage Plan. This policy makes no guarantees or obligations on the City of Midland to participate financially or otherwise in the design, construction and/or maintenance of stormwater drainage improvements.

A. This Master Drainage Plan shall be used to determine which, if any, regional stormwater facilities are planned to serve the watershed or subwatershed in which the proposed development is located.

B. Required public improvements for the proposed development shall include a proportionate share of all regional stormwater facilities designated to serve the area being developed.

C. Where no regional stormwater facilities are planned to serve the location of the proposed development, on-site detention shall be provided in accordance with the City of Midland Storm Drainage Design Manual.

D. The quantities, amounts and sizes shown in this Master Drainage Plan may be revised by the developer's engineer on the basis of better existing condition information or altered design concept. If changes, revisions and/or alterations to the Master Drainage Plan are proposed, the proposed runoff peak discharge and discharge volume downstream of the proposed development shall not increase over the values provided in the Master Drainage Plan. On streams where multi-peak hydrographs exist, the proposed changes, revisions and/or alterations to the Master Drainage Plan shall not increase any of the peaks over the values provided in the Master Drainage Plan. The detailed engineering analysis used to support the changes must be approved by the City Engineer.

E. Improvements shall be designed in accordance with the City of Midland Storm Drainage Design Manual, this Master Drainage Plan and accepted professional engineering practice.

F. Dedication of Right-of-Way for stormwater improvements shall be in accordance with the City of Midland Storm Drainage Design Manual.

G. Copies of the computer models used to define the Master Drainage Plan are available. New developments which would produce a noticeable effect in these models shall be incorporated in the computed models by the developer's engineer and provided to the City of Midland as revised models.

H. The seal of a Registered Professional Engineer will be required for drainage analyses and for construction plans and specifications for work in which the construction cost exceeds the prevailing civil statute limit. Midland and its ETJ shall comply with the Master Drainage Plan for stormwater mitigation. The quantities, amounts and sizes shown in the Master Drainage Plan are planning quantities only and may change upon final, detailed engineering analyses.

1.6 MASTER DRAINAGE PLAN FORMAT

The Master Drainage Plan is presented by watershed in the following order (See Figure 1-1):

Jal Draw
Midland Draw
Scharbauer Channel
Mulberry Channel
Industrial Channel
South Channel

The primary emphasis of the Master Drainage Plan is on the Jal Draw and Midland Draw watersheds. These two major draws are currently (1995) experiencing the greatest urban development pressures and also present the greatest opportunity for stormwater runoff mitigation. Section 2 and Section 3 are dedicated to the Jal Draw and Midland Draw watersheds, respectively. Section 4 includes the Scharbauer Channel, Section 5 the Mulberry Channel, Section 6 the Industrial Channel, and Section 7 the South Channel watershed.

Section 1 includes a key map to each of the above listed watersheds. A legend sheet has also been included as Figure 1-2 which explains the various symbols and colors on the GIS maps in this Master Plan. For example, the drainage areas for Jal Draw have a "JA" prefix followed by the drainage area number within that watershed. Other symbols and abbreviations are similarly illustrated on Figure 1-2. This legend sheet is applicable for the entire Master Drainage Plan.

Section 2 through Section 7 begin with a brief description of the respective watersheds discussed in each section, followed by a table describing the watershed subarea characteristics. Included next in Section 2

through Section 7 are the proposed improvements to the channels, playa lakes, and detention basins in paragraph and tabular form. Preliminary budget opinions of cost are included for all of the recommended improvements. An index map is also provided in each section followed by hydrographs at selected points along the channel. Each hydrograph drawing includes a hydrograph for the existing condition model, the future condition model with no improvements and the future condition model with Master Drainage plan proposed improvements. Following the hydrograph drawing are the GIS section maps which show the subarea boundaries, the future land use, and all of the channel and playa information. A channel profile drawing, channel cross section drawings and channel crossing drawings complete each section except for Section 7 (South Channel watershed).

The Scharbauer Channel, Mulberry Channel and Industrial Channel in Sections 4, 5 and 6 respectively, offer limited opportunities for improvements because these watersheds are nearly completely developed. Therefore, the information included in these sections is somewhat less than that for Jal Draw and Midland Draw. Few improvements have been recommended for these nearly developed areas at this time.

The South Channel, Section 7, is located south of Interstate Highway 20 and outside the limits of the GIS coverage. Although improvements are recommended in some of the subareas which drain into the South Channel, the majority of the planning in this watershed will be added at a later date as GIS coverage becomes available or urban development pressures intensify. Sections 4, 5, 6 and 7 include the GIS section maps for the Scharbauer, Mulberry, Industrial, and South Channel watersheds and show the subarea boundaries, the future land use, and all of the channel and playa information.

END

Table 1	
Watershed	**Total Opinion of Cost for Improvements**
Jal Draw	$20,294,028
Midland Draw	$40,774,612
Scharbauer Channel	$18,420
Mulberry Channel	$575,085
Industrial Channel	$541,285
South Channel	$686,320
Total for Six Watersheds	**$62,889,750**

JAL DRAW WATERSHED

A combination of channel, roadway culvert bridge crossing, playa lake, and man-made detention basin improvements are planned for the Jal Draw watershed. Approximately 6.2 miles of channel improvements are planned. The opinion of cost for channel earthwork and excavation is approximately $9,034,690. Nine new roadway culvert bridge crossings are planned for the Jal Draw watershed with an opinion of cost of approximately $2,871,541. Also planned are improvements to 12 playa lakes for improved storage capacity at an opinion of cost of $5,973,187. Finally, three man-made detention basins are proposed in the Jal Draw watershed. The opinion of cost for construction of these three man-made basins is approximately $2,414,610.

MIDLAND DRAW WATERSHED

The improvements recommended for the Midland Draw watershed include improvements to the main Midland Draw channel and a tributary channel, improvements to roadway culvert bridge crossings, and playa lake improvements. Approximately 13.8 miles of channel earthwork and excavation improvements are recommended for the Midland Draw watershed for an estimated opinion of cost of $16,341,190. Improvements to existing, or installation of new, roadway culvert bridge crossings is planned at 23 locations for an estimated opinion of cost of $7,155,712. The opinion of cost to improve the storage capacity of 21 playa lakes within the Midland Draw watershed is approximately $17,277,710.

SCHARBAUER CHANNEL WATERSHED

Improvement of a single playa lake is the only runoff mitigation measure recommended for the Scharbauer Channel watershed. Alternatives for runoff mitigation in this watershed were extremely limited since the Scharbauer Channel area is already near fully developed. The opinion of cost to improve the playa lake is approximately $18,420.

MULBERRY CHANNEL WATERSHED

Approximately one mile of channel improvements and two roadway culvert bridge crossing improvements are recommended for the Mulberry Channel watershed. The opinion of cost for the channel improvements is approximately $257,440. The estimated opinion of cost for the two roadway culvert bridge crossings is $317,645.

INDUSTRIAL CHANNEL WATERSHED

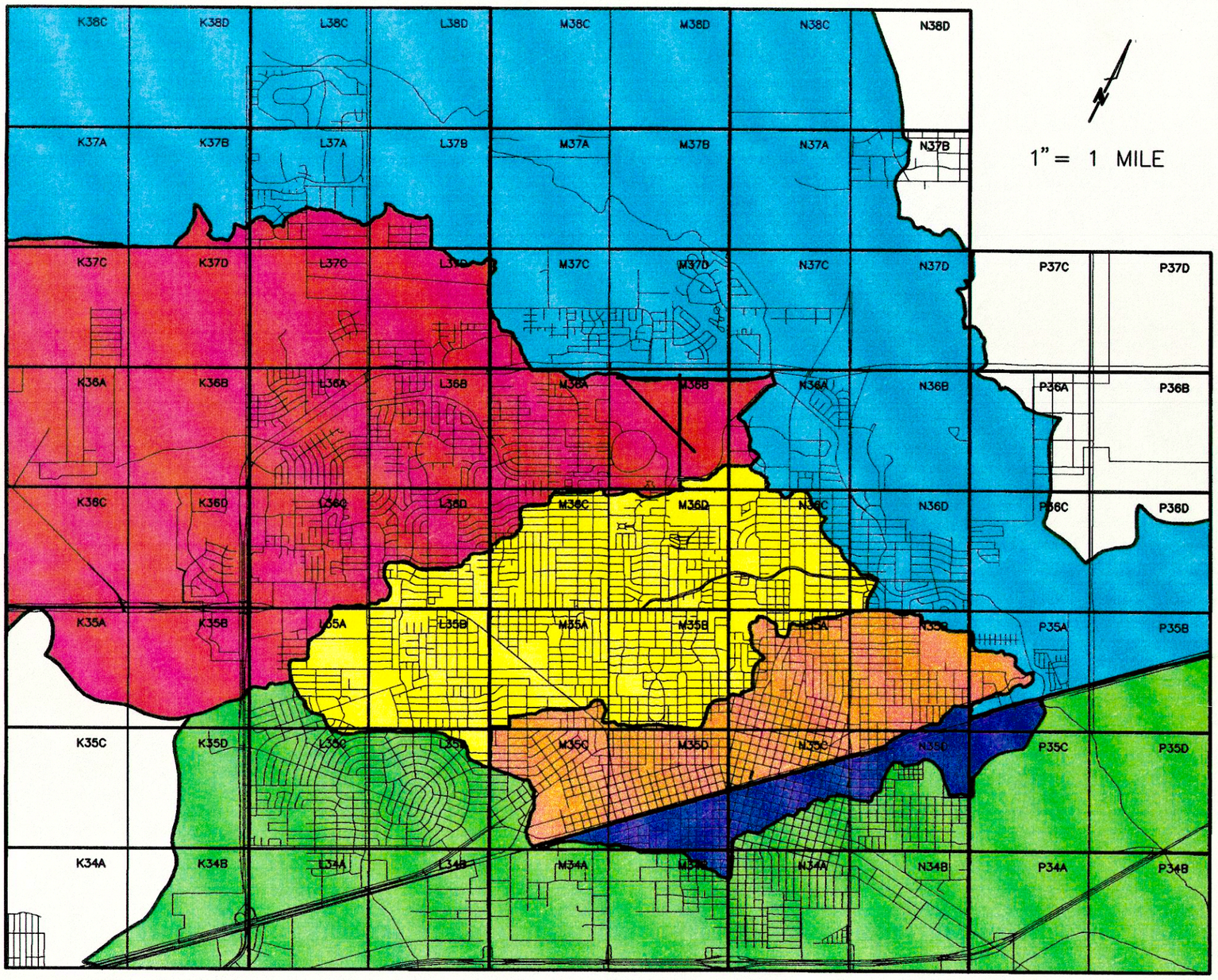
Replacement of one roadway culvert bridge crossing and channel improvements for approximately 1.7 miles are recommended for the Industrial Channel watershed. The opinion of cost for the channel earthwork and excavation improvements is approximately $468,490. The estimated opinion of cost for the single planned roadway culvert bridge crossing is $72,795.

SOUTH CHANNEL WATERSHED

Improvement of a man-made lake is the only recommended runoff mitigation measure for the South Channel watershed at this time. The opinion of cost for the lake improvement is approximately $686,320 and primarily involves earthwork and excavation to improve its storage capacity.

LEGEND

- JAL DRAW WATERSHED . . . . .
- MIDLAND DRAW WATERSHED . . . . .
- SCHARBAUER CHANNEL WATERSHED . . . . .
- MULBERRY CHANNEL WATERSHED . . . . .
- INDUSTRIAL CHANNEL WATERSHED . . . . .
- SOUTH CHANNEL WATERSHED . . . . .
- SECTION MAP INDEX NO. M37B



1" = 1 MILE

CITY OF MIDLAND, TEXAS
MASTER DRAINAGE PLAN
WATERSHED KEY

Parkhill, Smith & Cooper, Inc.
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1-6.

MASTER DRAINAGE PLAN, KEY TO WATERSHEDS

FIGURE 1–1

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TERMINOLOGY

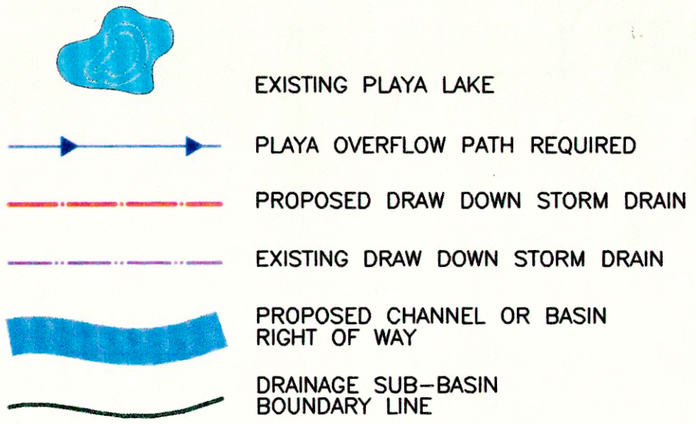
MI#	DRAINAGE SUB-BASIN FOR MIDLAND DRAW
JA#	DRAINAGE SUB-BASIN FOR JAL DRAW
SC#	DRAINAGE SUB-BASIN FOR SCHARBAUER CHANNEL
MU#	DRAINAGE SUB-BASIN FOR MULBERRY CHANNEL
SO#	DRAINAGE SUB-BASIN FOR SOUTH CHANNEL
IN#	DRAINAGE SUB-BASIN FOR INDUSTRIAL CHANNEL

EXISTING RUNOFF/INFLOW (#):	HYDROLOGIC DATA WITH EXISTING LAND USE CONDITIONS
Q ex 100	FLOW RATE FROM 100 YEAR STORM EVENT WITH EXISTING LAND USE CONDITIONS
V ex 100	VOLUME OF RUNOFF FROM 100 YEAR STORM EVENT WITH EXISTING LAND USE CONDITIONS
FUTURE RUNOFF/INFLOW (#):	HYDROLOGIC DATA WITH PREDICTED FUTURE LAND USE CONDITIONS
Q fut 100	FLOW RATE FROM 100 YEAR STORM EVENT WITH PREDICTED FUTURE LAND USE CONDITIONS
V fut 100	VOLUME OF RUNOFF FROM 100 YEAR STORM EVENT WITH PREDICTED FUTURE LAND USE CONDITIONS
LAKE (#):	HYDROLOGIC DATA FOR PLAYA LAKE
BFE	BASE FLOOD ELEVATION FOR PLAYA LAKE (MEAN SEA LEVEL DATUM)
L ex	STORAGE VOLUME AVAILABLE IN EXISTING PLAYA LAKE
L fut	STORAGE VOLUME REQUIRED FOR PREDICTED FUTURE LAND USE CONDITIONS
OVERFLOW (#):	HYDROLOGIC DATA FOR PLAYA OVERFLOW
V ex	VOLUME OF OVERFLOW FROM THE PLAYA LAKE WITH EXISTING LAND USE CONDITIONS
V fut	VOLUME OF OVERFLOW FROM THE PLAYA LAKE WITH PREDICTED FUTURE LAND USE CONDITIONS
Q ex	OVERFLOW RATE FROM THE PLAYA LAKE WITH EXISTING LAND USE CONDITIONS
Q fut	OVERFLOW RATE FROM THE PLAYA LAKE WITH PREDICTED FUTURE LAND USE CONDITIONS
DRAW/CHANNEL STATION (#):	LOCATION OF DRAW/CHANNEL CROSSINGS
CROSSING	STREET LOCATIONS
STRUCTURE	PROPOSED OR EXISTING CULVERTS OR BRIDGES

CURVE NUMBER TABULATION

	LAND USE	CURVE NUMBER USED FOR THE DIFFERENT HYDROLOGIC SOIL GROUPS B	C	D
F	FAMILY DWELLING	85	89	92
R	RETAIL	98	98	98
C	COMMERCIAL	92	94	95
A	AGRICULTURAL ESTATES	73	82	86
W	WATERED GRASS LAND	61	74	80
P	PASTURE LAND	58	69	74

LEGEND



LEGEND SHEET

FIGURE 1-2

CITY OF MIDLAND, TEXAS
MASTER DRAINAGE PLAN
LEGEND SHEET

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