CHAPTER 9 – UTILITIES AND DRAINAGE

This chapter provides a general review of water supply, wastewater collection and treatment, and storm drainage facilities required to serve the City of Stephenville. The utilities planning process includes an inventory and assessment of existing facilities and systems, a projection of future utility demands based on projected land use and associated development, consideration of regulatory requirements for these facilities, and development of master plan layouts for the utility systems with recommendations for implementation.

Key Issues

Reviews of current conditions and trends, previous plans and studies, and community input brought to the forefront a set of key utility and drainage issues in and around Stephenville.

- **Lack of sewer and improvements:** Concern was raised that the eastern side of the City is lacking in sewer connections, and that some of the existing sewer system in the older parts of the city may not be in the condition or be able to handle the capacity of future development.
- **Insufficient wastewater treatment facilities:** There was concern over the existing wastewater treatment facilities and their capacity to handle future growth.
- **Insufficient storm drainage:** There was an overall concern that drainage is inadequate, and that something needs to be done, particularly concerning surface water.

Planning Area Configuration

To establish the proper background and framework for utility planning, the limits of the area of interest should be defined, mapped, and organized into logical planning areas. The Stephenville utility planning area is generally considered to be all land area within the City limits and ETJ ("Planning Area").

Natural and topographical features must also be considered in the utility planning process. The area's topography obviously controls storm drainage routing, and also dictates the configuration of gravity sanitary sewer systems. A review of USGS topographic maps indicate natural ground elevations within the Planning Area ranging from a high of around

1465' (feet above MSL) in the western part of the City to a low of around 1215' in the southern part of the City.

To facilitate projection of future utility demands, the overall Planning Area was broken down into smaller planning areas, defined by jurisdictional boundaries, natural features (i.e., drainage divides), existing and future thoroughfares, and other logical divisors, as presented in **Figure 9.1 – Planning Area Map**. The Land Use Map has been superimposed so that future land use types within each planning area are readily identified. Each planning area has been delineated, then listed in a spreadsheet database along with the associated acreage of each future land use type, as shown in **Table 9.1 – Development Projections**.

Future population and utility connection projections were generated for each planning area by applying factors established in the Land Use section of the Plan. Overall net developable property was assumed to be approximately 75% of the gross acreage. Future residential dwellings or commercial units (equivalent single-family utility connections) for each planning area are calculated by applying density factors for each land use type against the corresponding acreage, as presented in **Table 9.2 – Population and Connection Projections**. The future residential population for each planning area is derived by multiplying the average occupancy factor (2.25 persons per dwelling) by the number of dwelling units.

Water and Wastewater Systems

Design Criteria

The Texas Commission on Environmental Quality (TCEQ) enforces state health regulatory criteria. TCEQ water system criteria are intended to establish minimum standards for public health, but does not address fire protection requirements. Fire protection criteria are administered by the Texas Department of Insurance. The Department of Insurance adopted the ISO Fire Suppression Rating Schedule, which establishes performance-based criteria in lieu of the specific, population-based rules previously used by the State Board of Insurance. The ISO standards for public water supply (i.e., municipal systems) recommends the system be capable of supplying a 3,500 gallons per minute (gpm) fire flow for a three (3) hour

duration coincident with a maximum day demand event. Water system facilities should be sized to conform to the following requirements:

- Supply. TCEQ requires that the system be served by a supply capacity of a minimum 0.6 gpm per connection.
- Total Storage. TCEQ requires that the system must be served by a total storage capacity of a minimum 200 gallons per connection. Total water storage capacity is recommended to satisfy the ISO maximum-day-plus-fire criteria.
- Elevated/Pressure Storage. TCEQ requires that an elevated storage capacity of 100 gallons per connection or a pressure tank capacity of 20 gallons per connection be provided. If pressure tanks are used, a maximum capacity of 30,000 gallons is required. An elevated storage capacity of 100 gallons per connection is required for systems with more than 2,500 connections. Elevated water storage is recommended to maintain consistent system pressure, supplement peak demands, and provide reserve storage for fire protection.
- High Service Pumping. TCEQ requires that each pump station have two or more pumps that have a minimum total capacity of 2.0 gpm per connection, or that have a total capacity of at least 1,000 gpm and the ability to meet peak hourly demands with the largest pump out of service, whichever is less. If the system provides an elevated storage capacity of at least 200 gallons per connection, then two service pumps with a minimum combined capacity of 0.6 gpm per connection are required at each pump station.
- Distribution System. TCEQ requires that the distribution system piping be designed such that minimum pressures of 35 psi are maintained throughout the system during peak hourly demands, and 20 psi during fire flow demands during a maximum day.

Based on TCEQ water system criteria, the existing and future water facilities for the City are shown in Table 9.3 – TCEQ Water Facilities Requirements (Existing System) and Table 9.4 – TCEQ Water Facilities Requirements (Future System).

The existing wastewater system provides service to residential and commercial development that typically produces normal-strength wastewater flows. For the projected industrial development expected to occur within the Planning Area, consideration should be given to requiring industries to pre-treat their wastes through the enforcement of an industrial waste ordinance. Of course, the location, type, and capacity of the required pre-treatment facilities will be according to the specific needs at each industrial site.

Extraneous wastewater, known as infiltration/inflow (I/I), is that part of the wastewater flow that comes from stormwater run-off and groundwater. This water enters the sewage collection system by leakage through faulty pipe joints, manholes, cracked pipe, and any connections that may not be watertight. All wastewater collection systems have some infiltration/inflow because it has not been economically feasible to build and maintain a watertight sewerage system, except in areas where the sewer mains are constructed below the groundwater table.

In the design analysis of the system of wastewater mains, average flows do not represent the flows that the mains must be expected to handle. The wastewater mains should be designed to carry the projected peak flows that can range from 2.5 to 5.0 times the average flow, depending upon the drainage area and population served by the wastewater main. For purposes of this Report, peak flows are based on the Babbitt Formula, $M=5/p^{0.2}$, where M is the ratio of maximum to average for sewage flows and p is the accumulated population in thousands.

Existing Facilities

Based upon a review of the TCEQ utilities database, the City of Stephenville holds two Certificates of Convenience and Necessity (CCN) – CCN #10463 to provide water service and CCN #20169 to provide sanitary sewer service.

The following is a brief summary of the scope and condition of each system, and is based on a review of available background data and discussions with representatives of the City.

Existing Water Facilities

Existing water facilities within the Planning Area consist of twenty-nine (29) ground water supply wells, seven (7) ground and elevated storage tanks, seven (7) pump stations, and transmission and distribution piping. The current water supply and distribution system operates on a dual pressure plane, with the Low Zone serving approximately 40% of the water connections, and the High Zone serving the remaining 60%. Ground water supply is pumped from the Trinity aquifer.

The following tables – Table 9.5 – Existing Water Supply, Table 9.6 – Existing Water Storage Facilities, and Table 9.7 – Existing Pump Station Facilities - summarize the existing Stephenville water system facilities.

TABLE 9.5
EXISTING WATER SUPPLY

Well Field	Number of Wells	Well Field Capacity Avg. Pumpage (gpm)	Well Field Capacity Max. pumpage (gpm)	Pressure Zones
Garfield	4	530	645	High
Alexander Road	8	1,250	1,650	0.67 High/0.33 Low
Airport / Highway 67	9	1,670	2,000	Low
Paddock	2	160	295	Low
Bowman Ridge*	6	1,190	1,315	0.67 High/0.33 Low
Total	**29**	**4,800**	**5,905**	

*Includes the three Greenway wells (online in July 2004) and assumes 200 gpm avg. pumping capacity per well

TABLE 9.6
EXISTING WATER STORAGE FACILITIES

Tank	Tank Type	Pressure Zone	Capacity (MG)
Garfield	Ground	Low*	0.75
Garfield	Elevated	Low	0.50
Airport	Ground	Low	1.00
Paddock	Ground	Low	0.75
Highway 377	Ground	High**	1.00
Highway 377	Elevated	High	0.75
South Lillian	Ground	0.67 High/0.33 Low	1.00
		Total	**5.75**

* Garfield ground storage tank is located in the Low Zone but serves the High Zone as well

**Highway 377 ground storage tank also serves as elevated storage for the Low Pressure Zone

TABLE 9.7
EXISTING PUMP STATION FACILITIES

Pump Station	Total Number Of Pumps	Total Capacity (gpm)	Field Test Capacity (gpm)	Pressure Zone
Garfield	3	2,000	1,378	Low
Airport	2	2,100	575	Low
South Lillian	2	3,000	2,000	Low
Highway 377	2	3,600	2,051	High
Paddock	1	600	600	Low
Garfield	2	3,000	1,500	High
South Lillian	3	4,500	2,314	High
Total	**15**	**18,800**	**10,418**	

Existing Sanitary Sewer Facilities

Existing sewer facilities within the planning area consist of gravity collection lines, one lift station, and a wastewater treatment plant (WWTP) with an additional two (2) lift stations. Operations Management International, Inc. (OMI) is currently operating the City of Stephenville wastewater system. OMI has operated the wastewater facility since 1996 and is under contract until 2006. The Stephenville WWTP currently processes wastewater for approximately 15,000 people, with a treatment capacity of 3.0 million gallons per day (MGD). The City has recently added phosphorus removal equipment and a belt press for sludge removal. Historical wastewater treatment plant data for the year 2003 is shown in **Table 9.8 – 2003 Wastewaster Treatment Plant Data**.

Future Demands

Planning for water and wastewater systems typically begins with a determination of the Planning Area demands at some future milestone, and then developing a system plan that will adequately serve those future demands. For the City of Stephenville, future water and wastewater flows have been calculated for each planning area and are presented in **Table 9.9 – Water & Sewer Flow Projections.** Unit water demand factors are typically based on some combination of system historical demands, regulatory requirements, and future use projections. TCEQ regulations require a minimum supply capacity, which is considered

to be a *maximum* day flow rate, of 0.6 gpm per connection. The Texas Water Development Board (TWDB) 2003 Water Plan for Region G includes the following projected consumption rates for Stephenville:

PROJECTED CONSUMPTION RATES STEPHENVILLE

Year	2000	2010	2020	2030	2040	2050
Avg. Consumption in gallons per capita per day (gpcd)	117	121	127	132	137	155

Considering all of the above factors, a water demand of 130 gpcd is recommended for planning purposes for Stephenville, and will be used in all calculations in this report. Unit wastewater flow rates are also generally based on historical data, or taken as a percentage of water demands. For the purpose of this report, a unit flow rate of 120 gpcd is assumed for sewer flows. This value is intended to include 100 gpcd for dry-weather discharge, and 20 gpcd for I/I. All future utility lines are sized to handle the anticipated population in the year 2030.

Future Water System

The City of Stephenville currently operates it water system on two different pressure planes – the high zone to the west and the low zone to the east. The City currently draws water from 26 different ground wells in the Trinity Aquifer to meet their water supply needs; three additional ground wells are scheduled to be in place by July 2004. Additionally, the City has rights to 1,862 acre-feet of treated surface water from the Brazos River Authority (BRA) and the Upper Leon Municipal Water District at Lake Proctor, southwest of town.

A January 2000 report prepared by HDR Engineering, Inc., *"City of Stephenville – Long-Term Water Resources Plan"*, recommended utilizing the Lake Proctor supply that the City has the rights to. A portion of the transmission line has already been installed and the remainder portion is currently in preliminary design. This will include approximately 14 miles of pipe and a booster pump station and ground storage tank near the City of Dublin, and should be operational within 2 years. An additional well site in the Bowman Ridge well field is also recommended to increase water

supply. The future water supply is shown in **Table 9.10 – Future Water Supply**.

The City will continue to draw ground water from its well facilities. It is anticipated that the Paddock pump station and ground storage facility will be taken offline when the City begins to draw surface water from Lake Proctor. The cost of operation and maintenance for the facility will soon exceed the benefit it provides. No other storage facilities are needed, as the City should exceed storage capacity requirements through 2030. The future water storage facilities are shown in **Table 9.11 – Future Water Storage Facilities.**

TABLE 9.10
FUTURE WATER SUPPLY

Well Field	Number of Wells	Capacity Avg. Pumpage (gpm)	Capacity Max. Pumpage (gpm)	Pressure Zone
Garfield	4	530	645	High
Alexander Road	8	1,250	1,650	0.67 High/0.33 Low
Airport / Highway 67	9	1,670	2,000	Low
Bowman Ridge*	7	1,390	1,515	0.67 High/0.33 Low
Surface Water	-	1,154	1,154	0.67 High/0.33 Low
Total	**28**	**4,800**	**5,905**	

*Includes the three Greenway wells (assuming 200 gpm avg. pumping capacity per well) and includes an additional future well (with 200 gpm avg. pumping capacity)

TABLE 9.11
FUTURE WATER STORAGE FACILITIES

Tank	Tank Type	Pressure Zone	Capacity (MG)
Garfield	Ground	Low*	0.75
Garfield	Elevated	Low	0.50
Airport	Ground	Low	1.00
Highway 377	Ground	High**	1.00
Highway 377	Elevated	High	0.75
South Lillian	Ground	0.67 High/0.33 Low	1.00
Dublin	Ground	0.67 High/0.33 Low	0.50***
		Total	**5.50**

* Garfield ground storage tank is located in the Low Zone but serves the High Zone as well
**Highway 377 ground storage tank also serves as elevated storage for the Low Pressure Zone
***Dublin ground storage capacity is based on allocated surface water rights

Future improvements recommended for the pumping facilities include the installation of a 1,000-gpm pump to the Airport Pump Station. This will help transfer additional water to serve the High Zone. When the Dublin booster pump station comes online, and additional 1,150-gpm pump is recommended for the South Lillian Pump Station. The future pump station facilities are shown in **Table 9.12 – Future Pump Station Facilities.**

TABLE 9.12
FUTURE PUMP STATION FACILITIES

Pump Station	Total Number of Pumps	Total Capacity (gpm)	FIRM Capacity	Pressure Zone
Garfield	3	2,000	1,378	Low
Garfield	2	3,000	1,500	High
Airport	3	3,100	2,000	1,000 High/1,500 Low
Highway 377	2	3,600	2,051	High
South Lillian	2	3,000	2,000	Low
South Lillian	4	5,650	3,465	High
Dublin	2	1,154	1,154	0.67 High/0.33 Low
	Total	**21,504**	**13,548**	

*Dublin pumping capacity is based on allocated surface water rights
FIRM capacity is the capacity of the pump station with the largest pump out of service

Utilizing the Planning Area Map along with existing water line locations, future water lines were selected and are intended to be looped and follow the future thoroughfare plan as closely as possible. The future

water lines are presented in **Figure 9.2 – Future Water System Map** and described as follows:

Segment 1 – a 12-inch waterline along N. State Highway 108. Connects to an existing 16-inch waterline on the south side of Lingleville Road.

Segment 2 – a 12-inch waterline along a future thoroughfare. Connects to an existing 8-inch waterline at the intersection of Prairie Wind Boulevard and River North Boulevard.

Segment 3 – a 16-inch waterline that runs along a future thoroughfare from U.S. Highway 281 to E. South Loop.

Segment 4 – a 12-inch waterline along E. Washington Street. Connects to an existing 12-inch waterline.

Segment 5 – a 12-inch waterline along E. South Loop. Connects to an existing 16-inch waterline.

Segment 6 – a 16-inch waterline along a future thoroughfare. Extends from E. South Loop to Glen Rose Road.

Segment 7 – a 16-inch waterline along Glen Rose Road. Connects to an existing 24-inch waterline.

Segment 8 – a 16-inch waterline along U.S. Highway 281, S. State Highway 108, and Old Hico Road. Connects to an existing 24-inch waterline.

Segment 9 – a 16-inch waterline along a future thoroughfare. Extends from Glen Road Road to U.S. Highway 281.

Segment 10 – a 16-inch waterline along a future thoroughfare. Extends from U.S. Highway 281 to F.M. 914.

Segment 11 – a 12-inch waterline along F.M. 914. Connects to an existing 12-inch waterline.

Segment 12 – a 16-inch waterline along a future thoroughfare.

Segment 13 – a 16-inch waterline along a private road. Connects to an existing 16-inch waterline.

Segment 14 – a 16-inch waterline along a private road. Connects to existing 16-inch waterlines at each end.

Segment 15 – a 12-inch waterline. Connects to an existing 16-inch waterline and extends up to U.S. Highway 377.

Segment 16 – a 12-inch waterline along U.S. Highway 377.

Segment 17 – a 16-inch waterline along U.S. Highway 377. Connects to an existing 16-inch waterline.

Segment 18 – a 12-inch waterline along County Road 386. Connects to an existing 16-inch waterline at Northwest Loop.

Segment 19 – a 12-inch waterline along Forest Lane. Connects to an existing 16-inch waterline at Northwest Loop.

Segment 20 – a 16-inch waterline along Pecan Hill Drive. Connects to an existing 16-inch waterline at Northwest Loop.

Segment 21 – a 16-inch waterline along a future thoroughfare. Extends up to Lingleville Road.

Segment 22 – a 12-inch waterline along Darren Drive and North Dale.

Segment 23 – a 12-inch waterline along W. Lingleville Road. Connects to an existing 12-inch waterline.

Future Wastewater System

The layout of gravity sewer lines is determined primarily by the existing topography, with the majority of sewer lines aligned along creeks, streams and ditches. Lift stations are positioned where topographical conditions prevent gravity flow towards the wastewater treatment plant.

Utilizing the Planning Area Map and existing contours, we were able to divide the City into several different "sewer basins" and determine the direction of sewage flow and the quantity each basin will contribute to the system. From these flows, future sanitary sewer lines were sized and are presented in **Figure 9.3 – Future Sewer System Map** and described as follows:

Segment 1 – Replace the existing 8-inch along E. Washington Street where it crosses the Bosque River with a new 15-inch line. Currently, there is a bottleneck because of the reduced line size and wastewater backs up to the north. A new aerial crossing may have to be installed dependent upon TxDOT regulations of re-connecting to the bridge.

Segment 2, 3, & 4 – As development occurs to the north of town, the exiting 21-inch and 15-inch lines that are adjacent to the Bosque River will either need to be replaced with a larger line, re-lined and paralleled with a new line or "bursted" with a larger diameter pipe. Both existing lines are relatively old and have considerable infiltration.

To limit disturbance to existing development in these areas, we recommend pipe bursting over re-lining and paralleling. There are some areas along the existing 15-inch sewer that could be replaced by open cut. The existing 15-inch sewer should be increased to a 21-inch line, and the existing 21-inch line should be increased to a 24-inch and a 27-inch line.

Segment 5 – To the northwest of town, a 10-inch sewer line will be required to handle development in basins CC, DD, FF and part of BB. This line will follow the Bosque River and connect in to the future 21-inch sewer line (Segment 2).

Segment 6, 7 & 8 – To the southwest, basins O, P, Q, R, S and EE all will flow to the south. Because of the topography, a lift station and force main will be necessary to transfer the sewage to a future gravity line along W. Washington Street. An 8-inch gravity to transfer the flow to the lift station will be needed. Connect to the existing 12-inch line along W. Washington Street with a 6-inch force main and a 10-inch gravity line.

Segment 9 - South of the wastewater treatment plant, a lift station and a 6-inch force main will be necessary to handle flows as basin K and portions of basin I and basin G develop. This could be constructed as development in those areas dictates.

Segment 10 & 11 – To the east of the wastewater treatment plant, a 6-inch and an 8-inch line will serve basins D, F, and portions of G. It will cross U.S. Highway 281 and connect back at the wastewater treatment plant.

Segment 12 – An 8-inch line across State Highway 108 will serve portions of basin L. It will connect to the existing 30-inch sewer line just north of the wastewater treatment plant.

Existing major sewer lines were evaluated for their capability to handle future flows. The 30-inch main that flows south of town to the treatment plant and the 27-inch/24-inch lines that are flowing from the west to the treatment plant are fully capable of handling existing flows and the projected flows through the year 2030.

All wastewater generated within the planning area is expected to be treated at the existing treatment plant site. TCEQ requires that when flows for a treatment plant reaches 75% of its permitted average flow for three consecutive months, the City must initiate engineering and financial planning for expansion and/or upgrading the treatment plant. When the average flow reaches 90% of its permitted average flow for three consecutive months, the City shall obtain necessary authorization to commence construction of the additional treatment facilities.

The City of Stephenville wastewater treatment plant is currently permitted for a capacity of 3.0 MGD (75% of 3.0 MGD is 2.25 MGD; 90% of 3.0 MGD is 2.70 MGD). For the year 2003, the average daily flow into the plant was approximately 1.35 MGD, well below the 75% allowable 2.25 MGD.

Average daily flows in the year 2030 are projected to be 2.19 MGD, just below the 75% allowable 2.25 MGD. The City should begin preliminary preparations for future treatment plant improvements when the average daily flows actually near 2.25 MGD

Drainage System

Introduction

The City of Stephenville is located in Erath County and drains into the North Bosque River. Carter & Burgess completed the current City Drainage Master Plan (DMP) in October 2001. As of the date of this report, none of the recommended improvements contained in the DMP had been implemented. Through review and discussions with City Staff, no revisions are recommended to the current DMP. The plan recommended by Carter & Burgess should remain in effect and the implementation of this plan should proceed.

The current Drainage Master Plan shows seven different drainage basins within the City. The basins were prioritized based on flood hazard risks and the level of development for CIP scheduling purposes. They are shown in **Figure 9.4 – Drainage Master Plan Map** and described in the following paragraphs starting with the area judged most critical and ending with the least critical:

A. Methodist Branch

The Methodist Branch is a highly populated area with a mixture of residential and commercial areas. Tarleton State University is a large portion of this drainage area. Drainage problems in this branch will continue to compound with the growth of Tarleton State University. This area has a history of property damage due to flooding. Specifically, the streets west of the railroad tracks have the greatest impacts including Frey, Cain, Ollie, Sloan, Neblett and Jones. This is an old neighborhood that does not have a storm water drainage system.

A proposed storm water system from the Chamberlin Area south to the Railroad is proposed for this drainage area. A City ordinance

requires storm water systems to convey the 5-year storm event. It has been determined that the existing storm water system downstream of the railroad tracks cannot convey the 5-year storm. To allow the upstream storm water system to work properly, the Washington Street culvert will also need improvement. A culvert designed to convey the 100-year storm is recommended. The Washington Street culvert drains to the "Storm Drain" Tributary. Since the last detailed study for this tributary; was completed in 1977, a new detailed study that reflects existing conditions is recommended.

The Methodist Branch drainage area could be improved in two phases. Phase One would include storm water system improvements downstream of the Railroad through to Washington Street. Phase Two would improve the storm water system from the Chamberlin area to Railroad tracks.

B. Rowland Drainage

The Rowland Drainage area is a priority because of development on the upstream end of the area. The new Junior High School and Frey Street construction have resulted in modifications to this drainage area from the 1990 DMP. The Junior High School includes on-site storm water detention that has been accounted for in our study. Town Creek is the receiving waterway for this drainage area. A detailed Flood Study was conducted for Town Creek in 1977. Development since 1977 has impacted the flood plain and potential flood hazards. A new detailed flood study and subsequent FEMA map revision is recommended for Town Creek.

Proposed improvements include channel improvements from Frey Street to the Railroad. The culverts at Frey Street are sized to convey the 5-year storm. The channel downstream of Frey Street needs minor improvements to convey the 100-year storm, including minor excavation and erosion control. A grass-lined channel is recommended for aesthetic and permitting purposes.

Improvements to the Brenda Street culverts are needed to adequately convey even the 5-year storm. The City has determined it would be more beneficial to close Brenda Street and remove the culverts rather than improve the culverts. The channel that runs from Brenda Street to the Railroad also needs improvement. The proposed channel size and type are dependent on the easements the City can obtain for the channel. Easement restrictions may result in the need for a concrete channel between Brenda and Washington Streets. This may increase Section 404 permitting costs and the time necessary to obtain the permit.

A small drainage channel from Rowland Street to Town Creek is needed to relieve flooding on Rowland Street. The City will need to obtain an easement from two homeowners on Rowland Street for the drainage channel. This would be a small grass-lined channel that would tie into the proposed concrete channel.

The grass-lined channel requires excavation improvements and erosion control between Washington Street and the Railroad. This plan recommends keeping all channels grass-lined where possible due to currently stringent Section 404 permitting requirements.

The existing channel just upstream of the railroad is blocked by fill material that has been dumped into the channel. This channel blockage causes flooding in the mobile home park adjacent to the channel. Maintaining and cleaning the channel can alleviate many complaints that originate from residents of the mobile home park.

C. Oak Tree Drainage

The Oak Tree Drainage area is fairly large and a number of subdivisions are being developed on the upper portion of the area. The priority ranking of this area has been changed from the 1990 DMP because of the new development and large number of residences. Two improvement phases are proposed. Phase One

proposed improvements at Prairie Wind Road and downstream to the Bosque River. Phase Two includes channel improvements upstream of Prairie Wind Road and excavation of the Spicewood Channel.

The existing culverts at Prairie Wind Road do not have the capacity to convey the existing 5-year storm event. Modifications to these culverts are recommended to alleviate flooding of houses immediately upstream of Prairie Wind Road caused by backwater. Downstream of Prairie Wind Road the channel requires maintenance to the Bosque River. A drop structure from this channel into the Bosque River is also recommended. The drop structure is needed to prevent further erosion damage at the confluence.

The grass-lined channel downstream of Highway 8 (Lingleville Hwy.) through Prairie Wind Road needs improvement. This channel splits upstream of Prairie Wind Road. Channel improvements are needed just downstream of Good Tree Road and near the intersection of the North Loop and Lingleville Hwy.

The Spicewood Street sub-drainage area is located within the Oak Tree Drainage area. It is upstream of the area described above. Currently, there is a concrete-lined channel that conveys the flow. The concrete channel is about 30 yards long and it flows into a small grass channel that is blocked with debris. The channel becomes smaller as it flows downstream into a ditch near the Lingleville Hwy. To prevent flooding upstream, the channel needs to be improved and maintained from its origin through to the Lingleville Highway.

D. Lockhart Road Drainage

The Lockhart Drainage area contains a large number of industrial developments. This drainage area was evaluated with existing conditions and future, more developed, conditions. This area is predicted to grow quickly in the future. The requirement of new development storm water detention is recommended. Proposed

improvements are in two phases. Phase One recommends channel improvements in the downstream area at the mobile home park. Phase Two includes culvert and channel improvements at Lockhart Road and upstream. It is recommended that this Phase be accomplished with future development.

Upstream of Washington Street the drainage area includes many new businesses. Wal-Mart has on-site detention. Downstream from Wal-Mart, Nortons also has on-site detention that seems to be adequate to control local runoff.

Phase One recommendations consist of excavation, channel maintenance and erosion prevention measures from the confluence to the Railroad. Channel improvements should keep the water flowing to the Railroad and prevent flooding in the mobile home park.

The small channel downstream of Washington Street near the Coca-Cola plant is the major concern of the Lockhart drainage. The grass-lined channel upstream of Washington is well established and provides adequate drainage. An improved grass-lined channel is proposed from Washington Street south to Lockhart Road. The small bridge at Lockhart Road is inadequate to convey the 5-year storm event. A storm water structure that conveys the 5-year flow is included in the cost estimates. The proposed improvements discussed will greatly decrease flood hazards now and with future development.

E. Tarleton Drainage

The Tarleton Drainage area includes approximately half of Tarleton state University properties. Tarleton State includes urban areas and athletic fields. Washington Street has a large volume of traffic and therefore flooding is a major concern. Modifications are recommended to the 1990 DMP. The proposed improvements can be completed in one phase.

The existing Washington Street culverts will not convey the 5-year storm event. This culvert contains the storm water runoff from the Tarleton State University properties. This culvert should be replaced expeditiously. Tarleton State may be financially responsible for this culvert rather than the City of Stephenville according to City ordinances since all flow originates on University properties.

The existing channel downstream of Washington Street stops a few feet downstream of the street. This causes water to stand next to the road. A small drainage ditch starts a short distance downstream just past a privacy fence. Improvements to this area would help convey storm water and decrease flood hazards. The proposed channel would need to extend from Washington Street to the Railroad. A culvert should also be placed at Swan Street. Improvement costs were not included for the Tarleton Drainage area in the 1990 DMP.

F. Alexander Drainage

There are a large number of residential subdivisions in the Alexander Drainage area. Recommendations for this area have been modified from the 1990 DMP addressing the flooding and road erosion upstream of Alexander Road by recommending an Alexander Road culvert. This culvert would not entirely alleviate the storm water problems. With current development in this area a storm water drainage system would be more appropriate. A 5-year capacity storm drain from Cain and Second Street to Alexander Road would be adequate for this area.

Alexander Road is proposed as a future thoroughfare for the City. This area should become a high priority when the thoroughfare is built. The Alexander Road culvert would extend through Alexander Road into the channel that discharges to the Bosque River. The channel will need minimal improvements to convey the flows from upstream to the Bosque River.

G. Graham Street Drainage

The Graham Street Drainage area was not addressed in the 1990 DMP. No formal complaints have been recorded for this area, but runoff from future development is a concern. Therefore, this drainage area is a low priority. This area is growing primarily through commercial development near Graham Street. Upstream of Graham Street the drainage basin is entirely residential. The roads in the residential area are being damaged by surface water runoff because there is no subsurface drainage system. Implementation in two phases is logical. Section 404 permitting for this area will depend upon a determination of jurisdictional waters.

Phase One consists of the storm water system from Graham Street through the channel to the Bosque River. A house is located at Graham Street that is flooded often. Purchasing this house will be necessary to accomplish the proposed storm water system improvements. The proposed storm water drainage system should extend downstream through a small channel to the Bosque River. Excavation of the channel is required as part of the improvements.

It is recommended that storm drains for each sub-basin area be placed in the residential area for Phase Two. One storm water lien would begin at Park and Paddock Streets, while the other would start at Pecan and Paddock. The storm water drains would tie together at Graham Street with the larger drainage system in Phase One. These storm drains would relieve this developing area of future erosion and flood hazards.

Drainage Criteria/Policies

A cursory review of *Article II – "Design Standards for Storm Drainage"* of the City's Design Standards has been performed. Within the City's Code of Ordinances, Ordinance No. 1994-5 discusses drainage-related issues and covers such topics as runoff and facility design calculations, culverts, storm sewers, street drainage, channels, easements, detention basins, flood damage prevention, erosion control, and other drainage related issues. The documents appeared to adequately address the most

important drainage issues. Proper enforcement of these ordinances is highly recommended so that their usefulness will be maximized.

Stormwater Permitting

The 1987 amendments to the Clean Water Act required the U.S. Environmental Protection Agency to develop regulations for storm water discharges as part of the National Pollutant Discharge Elimination System (NPDES) Program. The Texas Pollutant Discharge Elimination System (TPDES) implements the federal NPDES program in the state of Texas. The TPDES is made up of several different programs aimed at controlling the discharge of pollutants to surface waters. One of these programs is the TPDES Storm Water Program, which regulates storm water discharges from industrial activities, construction activities, and municipal separate storm sewer systems (MS4s). These storm water discharges are regulated through TPDES storm water permits, administered by Texas Commission on Environmental Quality (TCEQ).

TCEQ classifies each MS4 as either large (population greater than 250,000), medium (population between 100,000 and 250,000) or small. The City of Stephenville is considered a small MS4. Large and medium MS4s are required to obtain a permit under Phase I of the NPDES Storm Water Program. Only a select subset of small MS4s, referred to as regulated small MS4s, will have to obtain a storm water discharge permit, per the requirements of Phase II of the NPDES Storm Water Program, published on December 8, 1999. A regulated small MS4 is any small MS4 that is either located in a Bureau of Census-defined "urbanized area" (UA), or determined by TCEQ to have discharges that cause, or have the potential to cause, an adverse effect on water quality. According to TCEQ, this latter, discretionary designation is only done in unusual cases. At the time of this report, the City of Stephenville is not considered a UA according to the 2000 Census of Urban Areas.

For a regulated small MS4, a TPDES MS4 storm water permit would require at a minimum that a City develop, implement, and enforce a storm water management program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable, to protect water

quality, and to satisfy the appropriate water quality requirements of the Clean Water Act. The storm water management program must include the following minimum control measures:

(1) Public education and outreach on storm water impacts. This would involve conducting outreach activities educating about the impacts of storm water discharges on water bodies and the steps that the public can take to reduce pollutants in storm water runoff.

(2) Public involvement/ participation. This would involve complying with State, Tribal, and local public notice requirements when implementing a public involvement/ participation program.

(3) Illicit discharge detection and elimination. This would involve developing, implementing, and enforcing a program to detect and eliminate illicit discharges into the MS4.

a) Developing a storm sewer system map

b) Prohibiting non-storm water discharges into the system

c) Developing a plan to detect and address such discharges

d) Informing the public of hazards associated with illegal discharges.

(4) Construction site storm water runoff control. This would involve developing, implementing, and enforcing a program to reduce pollutants in any storm water runoff to the system from construction activities.

a) A regulatory mechanism requiring erosion and sediment controls, and sanctions to ensure compliance.

b) Requirements for construction site operators to implement appropriate erosion and sediment control best management practices

c) Requirements for construction site operators to control waste at the construction site that may cause adverse impacts to water quality.

d) Procedures for site plan review which incorporate consideration of potential water quality impacts.

e) Procedures for receipt and consideration of information submitted by the public

f) Procedures for site inspection and enforcement of control measures.

(5) Post-construction storm water management in new development and redevelopment. This would involve developing, implementing, and enforcing a program to address storm water runoff from new development and redevelopment projects.

a) Developing and implementing strategies which include best management practices for the community

b) Use of a regulatory mechanism to address post-construction runoff from new development and redevelopment projects

c) Ensure adequate long-term operation and maintenance of best management practices.

(6) Pollution control/good housekeeping for municipal operations. This would involve developing and implementing an operation and maintenance program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations.

Goals and Objectives

Utilities and Drainage Goal: Assure appropriate and adequate water, wastewater and drainage facilities are provided to all the residents of Stephenville in an efficient and cost effective manner.

Objective UD1: *Create and maintain master plans for water, wastewater and drainage to establish the overall framework for the City's utility infrastructure.*

Action UD1.1: Finalize and adopt the utility component of this Comprehensive Plan.

Action UD1.2: Direct City staff and consultants to refer to and apply the master plans in the review of all new development plans.

Action UD1.3: Review and update the utility plans in 3-5 years.

Objective UD2: *Revise and/or update the current City Design Standards to meet the current needs of the City.*

Action UD2.1: Adopt ordinances, or modify the Subdivision Regulations to ensure new development complies with the new stormwater permitting/management practices and requirements.

As Stephenville continues to grow, it will need to regularly assess its utility and infrastructure conditions and capabilities to ensure that it can provide continuous and adequate services to its residents.

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