WATER DISTRIBUTION SYSTEM MASTER PLAN

Submitted To

McKINNEY™
TEXAS
Unique by nature.℠

Submitted By

BIRKHOFF, HENDRICKS & CARTER, L.L.P.
PROFESSIONAL ENGINEERS

August 2013

8/13/13

STATE OF TEXAS
MATTHEW HICKEY
85480
LICENSED PROFESSIONAL ENGINEER

Texas Firm F526

CITY OF MCKINNEY
WATER DISTRIBUTION SYSTEM MASTER PLAN

TABLE OF CONTENTS

Page No.

SECTION II - 10-YEAR CAPITAL IMPROVEMENT PLAN (2007-2017)

SECTION III - FIRE FLOW ANALYSIS

APPENDIX "A" - 2012 RESIDENTIAL WATER DEMAND STUDY

MASTER PLAN MAP

CITY OF MCKINNEY, TEXAS

Section I - Water Distribution Master Plan

A. GENERAL

This analysis and report presents a comprehensive plan for the development of the Water Distribution System to serve the City of McKinney at buildout conditions. This plan is based on the best available information on existing and future land uses. Although the proposed system is designed to accommodate the ultimate development of the City's planning boundary, it should be examined at intervals and revised to conform to changing conditions that may arise as the City continues to grow. Likewise, prior to undertaking a major expenditure an examination should be made to sufficiently verify the design criteria used in developing the overall plan is still valid.

Included in this report is the methodology used to establish water demand rates for residential and non-residential land uses, review of the service area pressure planes, the sizing of water lines, the sizing of pump stations, sizing of elevated storage tanks, and the sizing of ground storage facilities to meet anticipated system demands. At the end of this report we have enclosed a Master Plan Map that shows the planning boundary, the location and size of proposed pump stations, ground storage reservoirs, elevated tanks, and the proposed network of distribution and transmission lines.

The hydraulic analysis was performed utilizing H_2ONET Computer Software to aid in developing an overall system of water mains, storage facilities and pump stations required to efficiently serve the area within the planning boundary. Extended Period Simulation (EPS) hydraulic models were created for the buildout condition, 2022 condition and 2012 (Existing) condition with maximum daily, maximum hourly and minimum hourly demands simulated with a 72-hour diurnal curve. The 72-hour diurnal curves utilized in the hydraulic model are shown in Appendix "A" of this report.

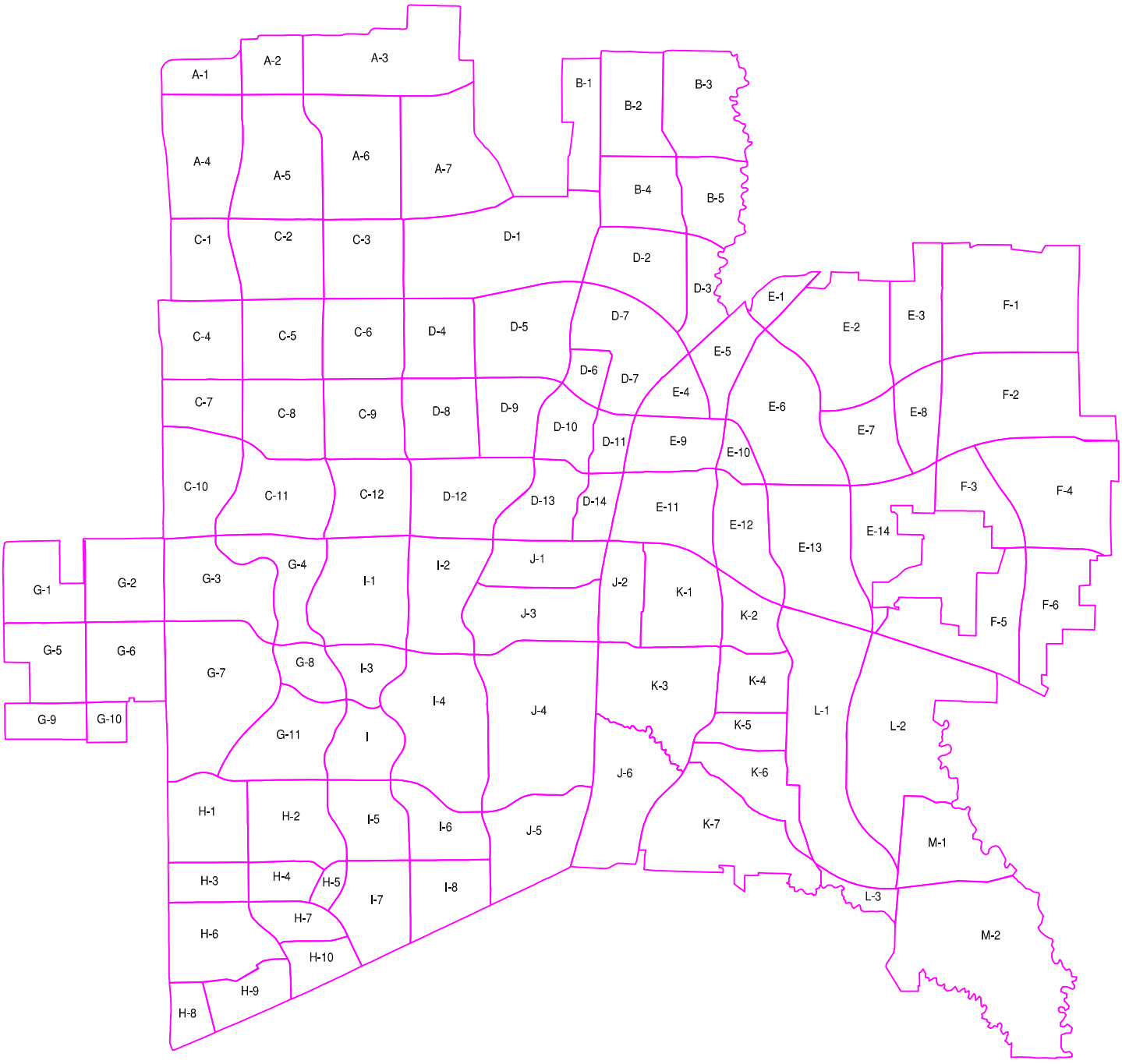
B. PLANNING BOUNDARY

The planning area for the 2012 Water Distribution Master Plan is consistent with McKinney's anticipated ultimate city limits and ETJ. The Planning Boundary is identified by the dashed purple line on the Master Plan Map, included at the end of this report. The land within the City's proposed ultimate water distribution service area consists of approximately 75,016-acres or 117-square miles. The City's existing Certificate of Convenience and Necessity (CCN) service area does not extend to the projected ultimate planning boundaries. Recently the City purchased the remainder of the Danville Water Supply Corporation system and CCN. Water service within the City's planning area, but outside the City's CCN service area, is currently provided by North Collin Water Supply Corporation in future north/northeast McKinney and Milligan Water Supply Corporation in future southeast McKinney. Typically, water supply corporations do not provide fire protection to its customers. As the City expands its water system beyond the current CCN boundaries, negotiations will be required with the Water Supply Corporations to adjust their CCN boundaries. The 2012 Master Plan Study assumes the City's existing CCN boundary will be expanded to include all areas within the planning area. The City's ultimate planning boundary surrounds the corporate limits of the City of New Hope. Population and water demand were estimated and included in the buildout hydraulic model for the possibility of future water service to the City of New Hope.

C. LAND USE ASSUMPTIONS (LUAs)

The Land Use Assumptions (LUAs) utilized in this update were prepared by the City of McKinney's Planning Department and are presented in a separate document titled, Land Use Assumptions Report – 2012 Impact Fee Update. Within the Planning Boundary, one hundred six (106) sub-service areas were developed for demands to be distributed. Figure No. 1 illustrates the sub-service area locations. Water demand for the hydraulic models were calculated and distributed to model nodes based on these sub-service areas. The LUA's projected an ultimate residential population of approximately 357,967 in the City of McKinney's ultimate planning boundary. This is a lower ultimate population than projected in the City's previous 2007 Water Master Plan Update, which estimated a residential population of 387,964, a decrease of 29,997 people. The residential and non-residential LUAs provided by the City for the years 2012, 2022 and Buildout are summarized in Table No. 1.

N.T.S.



POPULATION & NON-RESIDENTIAL SERVICE AREA DISTRIBUTION MAP

FIGURE 1

TABLE NO. 1
RESIDENTIAL AND NON-RESIDENTIAL LAND USE ASSUMPTIONS

Year	Residential Population*	Non-Residential Uses**	
		Type	Developed Area (SF)
2012	136,813	Basic	11,453,254
		Service	9,804,571
		Retail	9,900,940
		Total:	**31,158,274**
2022	199,003	Basic	12,780,084
		Service	14,260,185
		Retail	14,401,196
		Total:	**41,441,465**
Buildout	357,967	Basic	59,212,145
		Service	42,347,198
		Retail	57,933,959
		Total	**159,493,302**

** Residential Population – Represent Estate, Low Density, Medium Density & High Density Residential Categories*
*** Basic – Industrial Land Uses*
*** Service – Office & Institutional Land Uses*
*** Retail – Commercial Land Uses*

As shown in Table No. 1, increases in the residential population and non-residential uses will occur between 2012 and 2022. The water demand from the residential and non-residential uses dictate the ultimate size of facilities, while the rate of growth is important to determine the timing of system capital improvements to meet the City's growing needs.

The developed area for non-residential land uses summarized in Table No. 1 include developed square footage of structures within gross areas of land. Water demands in the models for non-residential uses are based on total gross acreage of land in Gallons per Acre per Day (gpad). The developed square footage of non-residential uses was converted to gross acreage by land use to calculate the projected non-residential water demands.

Steady residential growth is expected. Commercial and industrial development is expected to be more sporadic and is predicted to lag behind the residential buildout.

Table No. 2 provides a summary of the historical and projected residential population from 1900 to 2012, 2022 and Buildout.

TABLE NO. 2
RESIDENTIAL POPULATION PROJECTIONS

Year	Status	Population
1900	Reported	4,342
1910	Reported	4,714
1920	Reported	6,677
1930	Reported	7,307
1940	Reported	8,555
1950	Reported	10,560
1960	Reported	13,763
1970	Reported	15,193
1980	Reported	16,256
1990	Reported	21,283
2000	Census	54,369
2010	Census	131,117
2012	Reported	136,813
2022	Projected	199,003
Buildout	Projected	357,967

D. PRESSURE SERVICE AREAS

The City currently maintains three pressure planes, the 794 Service Area, the 850 Service Area and the 920 Service Area. Modeled ground elevation in the buildout 794 Service Area varies between 514-ft and 667-ft mean sea level (MSL). The ground elevation in the buildout 850 Service Area varies between 553-ft and 718-ft MSL. The ground elevation in the buildout 920 Service Area varies between 590-ft and 797-ft MSL. The ground elevation of the proposed 840 Service Area, discussed later in this section, varies between 628-ft and 682-ft MSL. The lower ground elevations in each service area are in locations in close proximity to Wilson Creek or the East Fork of the Trinity River and their tributaries.

The service area elevation designation is related to the High Water Level (HWL) of elevated storage tanks. Evaluation of pressure service areas is based on the ground elevation in relation to the HWL and Low Water Level (LWL) of Elevated Storage Tanks. The highest pressures in a service area generally occur at the lowest elevation in the service area when pumps are on and elevated tanks are nearing their HWL's. Conversely, the lowest pressures in a service area generally occur at the highest ground elevation during peak demand conditions when elevated storage tanks are nearing their LWL. Pressure Service Areas are evaluated on this range between ground elevation and the HWL and LWL of elevated storage tanks. Generally, the design of pressure service areas is based on providing a pressure range of 40-psi to 95-psi. The Texas

Commission on Environmental Quality (TCEQ) requires minimum system pressures to be no less than 35-psi. The existing Service Area pressure divides are shown on Figure No. 2. The pressure range of modeled junction nodes was evaluated to determine where existing pressures were less than 40-psi or greater than 95-psi.

1) 794 / 850 Service Area Pressure Divide

Since the previous 2007 Water Distribution System Master Plan, several planned changes to the 794 and 850 Service Area divide have occurred. The new 794 and 850 pressure divide was implemented generally along U.S. 75, with two areas west of U.S. 75 located in 794 Service Area. The first is an area bounded by Northbrook Drive, Virginia Parkway and U.S. 75. The second is in the area of the Collin County Justice Center located on the west side of U.S. 75, north of Bloomdale Road.

2) 850 / 920 Service Area Pressure Divide

The existing 850/920 Service Area divide is shown on Figure No. 2. Along this pressure divide there is a wide variation in ground elevation and topology. These variations cause high pressures in the vicinity of Wilson Creek. In the area, generally bounded by U.S. 380, Lake Forest Drive, Virginia Parkway and Stonebridge Drive, the existing 850 and 920 Service Area Divide generally follows Wilson Creek. Areas to the north of Wilson Creek are located in the 850 Service Area and areas south of Wilson Creek are located in the 920 Service Area. The hydraulic models showed the areas along Wilson Creek in the 920 Service Area will experience pressure greater than 100-psi with isolated periods where system pressure approaches 140-psi. The peaks in pressure occur during periods where pumps are on and elevated tanks are nearing full.

Based on the hydraulic analysis, it was recommend the City move this area from the 920 Service Area into the 850 Service Area. In previous discussions with City staff, it was reported the pressures in this area were controlled with pressure-reducing valves at the service meters. Additionally, if the recommended service area divide change were to occur, additional distribution lines through developed areas would be required to loop the distribution system into the 850 Service Area. A second option of installing main line pressure reducing valves was also discussed with City staff. It was the City's opinion to minimize main line pressure reducing valves and to keep the pressure reducing valves

located at individual water services. Based on these discussions, the service area divide in this location was not changed.

3) Proposed 840 Service Area Pressure Divide

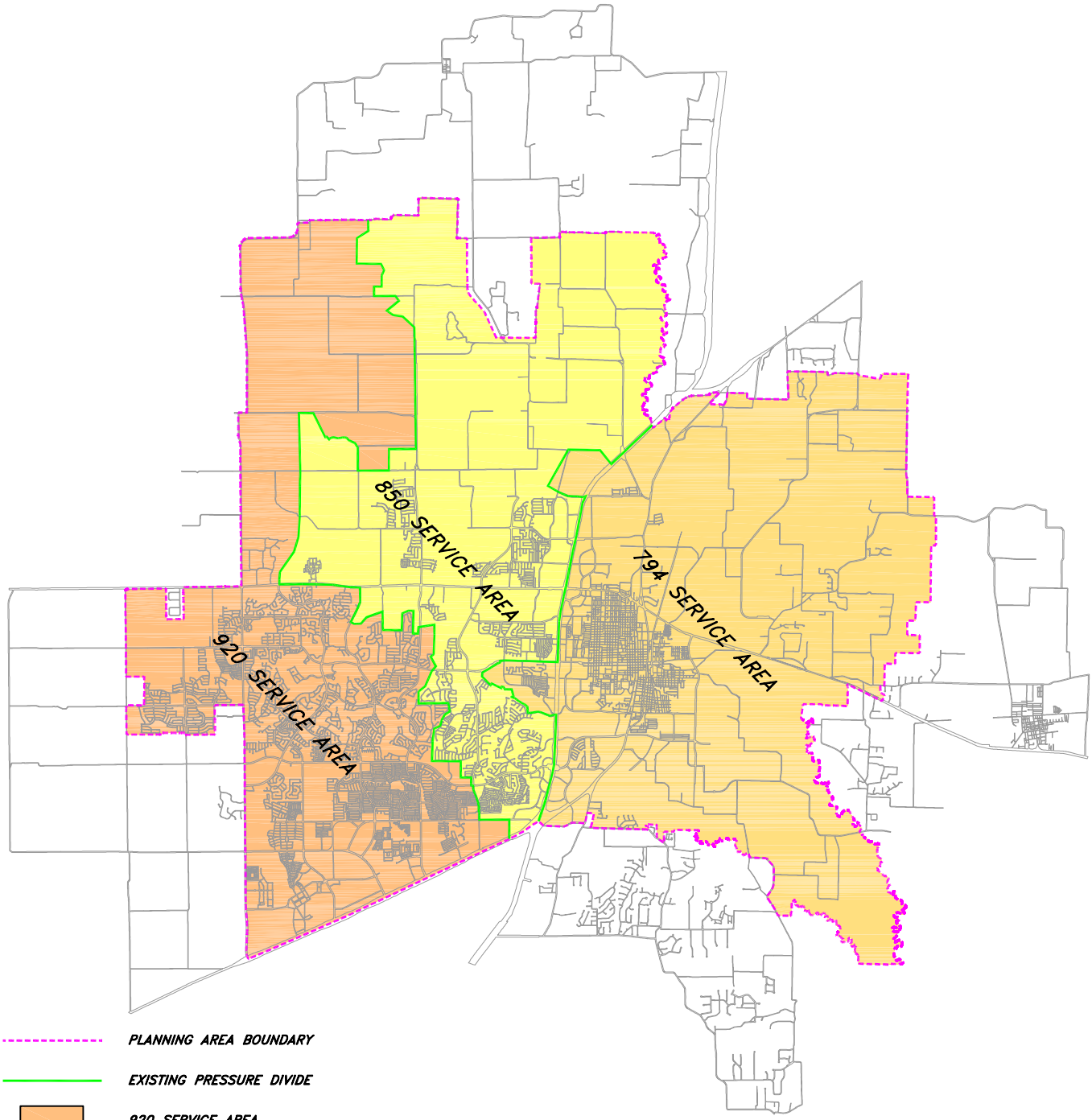
The City has a boundary agreement in the northeastern portion of the planning boundary, north of U.S. 380, with the City of Princeton. The previous agreement added land to the City's planning boundary in the far northeast portion of the planning boundary. In order to serve these areas, a fourth pressure plane was established to provide pressure between 40-psi and 95-psi. It is envisioned the proposed 840 Service Area will be supplied by the 794 Service Area and pressurized with a booster pump station and pneumatic tank. The limits of the proposed 840 Service Area is shown on Figure No. 3 and is delineated on the Master Plan Map at the end of this report.

4) Proposed Trinity Falls Municipal Utility District (MUD)

The proposed Trinity Falls MUD is to be located in the 850 Service Area north of Bloomdale Road between Hardin Road, the east Fork of the Trinity River and the City's northern planning boundary. Portions of the proposed development will experience pressures ranging between 100-psi and 125-psi. We recommend pressure be reduced in this area by installing pressure reducing valves at each water service.

The proposed service area pressure divides at buildout are shown on Figure No. 3 and the Master Plan Map at the end of this report. Areas of the distribution system that have been identified with high pressure and that will require pressure reducing valves at water services is identified with a cross hatch superimposed over the service area coloring on the Master Plan Map.

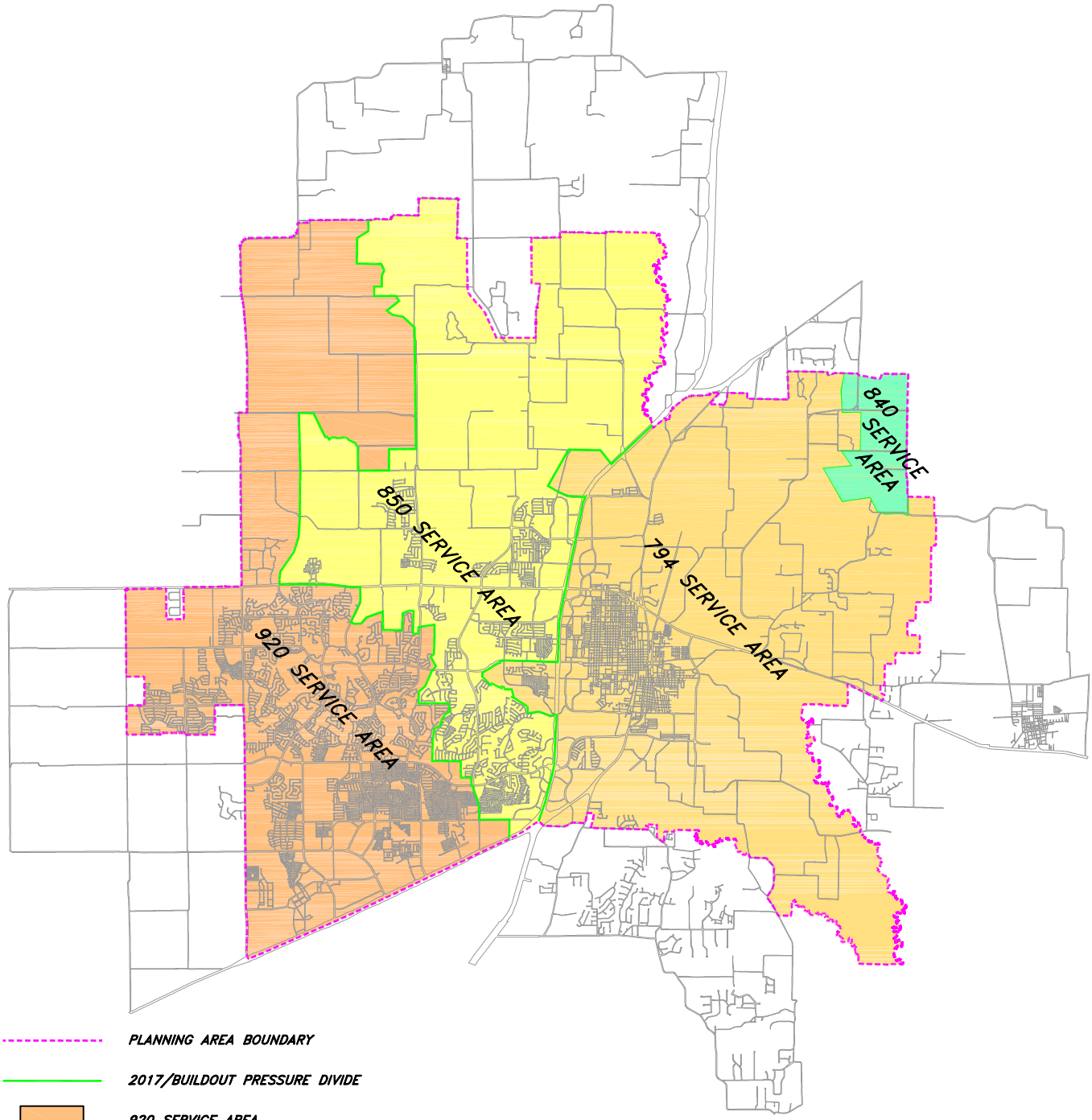
N.T.S.



PRESSURE SERVICE AREAS (2012)

FIGURE 2

N.T.S.



PRESSURE SERVICE AREAS (BUILDOUT)

FIGURE 3

E. PROJECTED WATER USE

The design of the water distribution system involves various rates of water use, which are generally referred to as water demand. For the purpose of this study, water demand rates are generally expressed in million gallons per day (MGD). The three most significant water demand rates are defined as follows:

1) Maximum Daily Demand: This is the total amount of water used during the day of heaviest consumption in any given year and the minimum rate, which the high service pumps must be capable of pumping. Water must be supplied to the pumps at this rate.

2) Maximum Hourly Demand: This is the rate at which water is drawn from the entire system during the hour of maximum consumption on the day of maximum demand. This rate is generally of a short duration and is most economically provided for by the use of elevated storage in addition to water supplied to the system by pumps. The distribution system, including storage and pumping capacity, must be able to satisfy this demand.

3) Minimum Hourly Demand: This is the rate at which water is drawn from the distribution system during the hour of minimum demand on the day of maximum demand. This demand rate is used in the water distribution analysis to determine the adequacies of the system to replenish elevated storage.

Analysis and design of the proposed water distribution system is based on the maximum water demand anticipated and the distribution of that demand according to the projected future land use in McKinney. A water demand study was completed from pumping and elevated storage records provided by the City during the summer of 2012 to establish a design residential per capita water rate in gallons per capita per day (gpcd.) Appendix A provides a report of the residential per capita demand derived for the City of McKinney's Water Distribution System Master Plan. The summer of 2012 consisted of several periods with temperatures exceeding 100 degrees with scattered days containing measurable rainfall. Actual per capita demand rates from the summer of 2012 data were applied to the 2012 hydraulic model. For the design per capita rates utilized in the 2022 and buildout hydraulic models, the results from the 2012 Water Demand Study (Appendix A) were utilized.

Table No. 3 summarizes the residential per capita demand rates applied to the 2012 hydraulic model. Table No. 4 summarizes the design per capita demand rates applied to the 2022 and buildout hydraulic models.

TABLE NO. 3
2012 MODEL - RESIDENTIAL PER CAPITA RATES

Service Area	Residential Per Capita Maximum Daily Demand	Residential Per Capita Maximum Hourly Demand	Max. Day to Max. Hour Peaking Factor
794 Service Area (Existing Development)	253 gpcd	374 gpcd	1.5
850 Service Area	428 gpcd	980 gpcd	2.3
920 Service Area	523 gpcd	941 gpcd	1.8

gpcd – gallons per capita per day

TABLE NO. 4
2022 & BUILDOUT MODEL - RESIDENTIAL PER CAPITA DESIGN RATES

Service Area	Residential Per Capita Maximum Daily Demand	Residential Per Capita Maximum Hourly Demand	Max. Day to Max. Hour Peaking Factor
794 Service Area (Existing Development)	300 gpcd	540 gpcd	1.8
794 Service Area (Future Development)	495 gpcd	990 gpcd	2.0
850 Service Area	495 gpcd	990 gpcd	2.0
920 Service Area	495 gpcd	990 gpcd	2.0

gpcd – gallons per capita per day

Non-residential demand rates were established by comparing the anticipated land and water use in McKinney to that of other communities in North Central Texas. Compilation of water use records with similar land uses completed along the Central Expressway, Dallas North Tollway, S.H. 121 and S.H. 190 (George Bush Turnpike) corridors in the Cities of Plano, Farmers Branch and Addison were used to establish the non-residential demands applied in this analysis on a gallon per acre per day (gpad) basis. The non-residential demand rates from these studies were calculated by obtaining the water billing records from large commercial water users and applying the daily use to a known acreage or a floor-to-area-ratio for multi-story offices. Table No. 5 summarizes the non-residential land uses expected in McKinney and the demand rate applied to the water distribution system for each non-residential land use.

TABLE NO. 5
NON-RESIDENTIAL WATER DEMANDS BY LAND USE

Land Use	Max. Daily Demand	Max. Hourly Demand
Local Commercial / Office	1,500 gpad	3,000 gpad
Public / Semi-Public	1,500 gpad	2,000 gpad
Light Industrial	2,000 gpad	3,000 gpad
Heavy Industrial	2,500 gpad	3,000 gpad
Regional Commercial	3,000 gpad	3,900 gpad
Regional Employment	3,000 gpad	4,500 gpad
Office Park	6,000 gpad	6,000 gpad
Parks	1,500 gpad	1,500 gpad
Golf	1,000 gpad	1,000 gpad

gpad –gallons per acre per day

In addition to its own residential non-residential uses, the City of McKinney also provides wholesale water to the City of Melissa and to the Greater Texoma Utility Authority (GTUA) between the years 2008 to 2018. The City recently purchased the Danville Water Supply Corporation and has incorporated that water system into the City's water distribution system. As the City of McKinney continues to grow and development dictates, most of the "Danville" system will be replaced with new transmission and distribution lines in accordance with proposed pipe diameters shown on the Master Plan map at the end of this report.

The City of Melissa is currently supplied a contractual rate of 0.50-MGD from the City of McKinney through a 12-inch water line constructed by the North Texas Municipal Water District (NTMWD) from McIntyre Road, north along the Union Pacific Railroad (Now DART ROW), to a location north of S.H. 121 in the City of Melissa. The City has reported supply rates as high as 1.0-MGD provided to Melissa in the past. The 12-inch supply line's design capacity is approximately 1.0-MGD. It is anticipated the NTMWD 12-inch supply line to the City of Melissa will become part of the City of McKinney's water distribution system once the GTUA supply to Melissa is fully operational. For the purposes of the Master Plan, the 0.50-MGD Melissa supply was included in the McKinney water demand calculations. If at some point in the future, the City of Melissa no longer requires this supply from the City of McKinney, the water demand can be removed from the Master Plan models.

The GTUA pump station is located in the 794 Service Area on S.H. 5 at F.M. 543 (Weston Road), in the vicinity of Node J1006. From this location, the GTUA pumps water to its customer cities. The GTUA will require supply from the City of McKinney until the year 2018 when it is

envisioned the NTMWD can provide supply directly to the GTUA. The contracted supply to the GTUA from the City of McKinney began at a possible maximum rate of 4.000-MGD in the year 2008 and terminates at a possible maximum rate of 9.939-MGD in the year 2016. Based on these contractual rates, the GTUA is required to construct a supply line from Node J4011 in the 850 Service Area to the GTUA owned and operated pump station facility in the 794 Service Area. The maximum contractual rates have not been achieved to date. In the summer of 2013 it is anticipated a maximum rate of 1.0-MGD will be required by the GTUA. With the addition of the proposed 794/850 Pressure Reducing valve on Bloomdale Road at Community Ave. in 2014 and the projected 2015 improvements to the Gerrish Pump Station, the 794 Service Area can support the reduced GTUA demands up to 3-MGD until the year 2018 without the need for the GTUA to construct a supply line from their S.H. 5 Pump Station to the City of McKinney's 850 Service Area (J4011).

The demand rates in Table Numbers 3, 4, and 5 were applied to the LUA's to determine McKinney's total maximum daily and maximum hourly demands. Table No. 6 summarizes the resulting 2012, 2022 and buildout demands in million gallons per day (MGD) for the combined 794, 850, 920 and proposed 840 Service Areas

TABLE NO. 6
SYSTEM WIDE (CALCULATED MAX. DAY AND MAX. HOUR DEMAND)

Design Year	Max. Day Demand (MGD)	Max. Hour Demand (MGD)
2012 McKinney Residential	60.59	113.48
2012 McKinney Non-Residential	8.54	12.48
2012 City of Melissa	0.50	0.50
2012 Total:	**69.63**	**126.46**
2022 McKinney Residential	96.00	191.22
2022 McKinney Non-Residential	12.63	19.56
2022 City of Melissa	0.50	0.50
2022 Total:	**109.13**	**211.28**
Buildout McKinney	174.79	348.66
Buildout McKinney Non-Res.	44.34	66.30
Buildout City of New Hope	1.42	2.85
Buildout City of Melissa	0.50	0.50
Buildout Total:	**221.05**	**418.31**

Table Numbers 7, 8 and 9 provide a breakdown of the total demand for 2012, 2022 and buildout conditions for the 794/840, 850 and 920 Service Areas, respectively.

TABLE NO. 7
794 & 840 SERVICE AREA (CALCULATED MAX. DAY & MAX. HOUR DEMAND)

Design Year	Max. Day Demand (MGD)	Max. Hour Demand (MGD)
2012 McKinney Residential	7.69	11.37
2012 McKinney Non-Residential	4.18	6.38
2012 City of Melissa	0.50	0.50
2012 Total:	**12.37**	**18.25**
2022 McKinney Residential	14.86	28.95
2022 McKinney Non-Residential	5.64	8.40
2022 City of Melissa	0.50	0.50
2022 Total:	**21.00**	**37.85**
Buildout McKinney Residential	31.41	62.04
Buildout McKinney Non-Residential	21.00	30.68
Buildout City of New Hope	1.42	2.85
Buildout City of Melissa	0.50	0.50
Buildout Total:	**54.33**	**96.07**

TABLE NO. 8
850 SERVICE AREA (CALCULATED MAX. DAY AND MAX. HOUR DEMAND)

Design Year	Max. Day Demand (MGD)	Max. Hour Demand (MGD)
2012 McKinney Residential	14.35	32.75
2012 McKinney Non-Residential	1.43	2.20
2012 Total:	**15.78**	**34.95**
2022 McKinney Residential	28.58	57.15
2022 McKinney Non-Residential	2.25	3.82
2022 Total:	**30.83**	**60.97**
Buildout McKinney Residential	68.62	137.10
Buildout McKinney Non-Residential	11.27	16.83
Buildout Total:	**79.89**	**153.93**

TABLE NO. 9
920 SERVICE AREA (CALCULATED MAX. DAY AND MAX. HOUR DEMAND)

Design Year	Max. Day Demand (MGD)	Max. Hour Demand (MGD)
2012 McKinney Residential	38.55	69.36
2012 McKinney Non-Residential	2.93	3.90
2012 Total:	**41.48**	**73.26**
2022 McKinney Residential	52.56	105.12
2022 McKinney Non-Residential	4.74	7.33
2022 Total:	**57.30**	**112.45**
Buildout McKinney Residential	74.76	149.52
Buildout McKinney Non-Residential	12.06	18.78
Buildout Total:	**86.82**	**168.30**

Required water supply, pump station capacities, volume of ground storage reservoirs and the volume of elevated tanks were calculated and based on the projected demands in Table Nos. 7, 8 and 9.

F. WATER SUPPLY

The North Texas Municipal Water District (NTMWD) currently supplies treated water at three delivery points in the City of McKinney. The Gerrish Street Pump Station (McKinney No. 1) is supplied through a 24-inch supply line. The McKinney Ranch Pump Station (McKinney No. 2), formerly F.M. 720 Pump Station, is supplied through a 42-inch supply line. The University Pump Station (McKinney No. 3) is supplied through a 48-inch supply line. NTMWD plans to supply a rate of 40-MGD at buildout to the McKinney Ranch Pump Station. The Gerrish Street Pump Station was previously capped at a 10-MGD rate by the NTMWD. With upgrades currently underway in the NTMWD supply system, Gerrish Street Pump Station will increase to an ultimate rate of 18-MGD. At buildout, the University Pump Station will require a supply rate of 87-MGD. Supply to the proposed Bloomdale Pump Station (McKinney No. 4) is anticipated to be available from the NTMWD in 2018 at an initial rate of 10-MGD. Ultimately, the Bloomdale Pump Station will require a supply of 76-MGD. The locations of the existing and proposed pump stations are shown on the Master Plan Map at the end of this report.

Table No. 10 summarizes the projected supply requirements for each pump station from 2012 through 2022 and at buildout.

TABLE NO. 10
SUPPLY REQUIREMENTS BY PUMP STATION

Year	Gerrish Pump Station (MGD)	McKinney Ranch Pump Station (MGD)	University Pump Station (MGD)	Bloomdale Pump Station (MGD)	Total Supply (MGD)
2012	10.0	25.5	31.4	0.0	66.9
2013	10.0	27.0	33.0	0.0	70.0
2014	10.0	28.5	34.6	0.0	73.1
2015	13.4	30.0	36.3	0.0	85.1
2016	13.4	31.0	38.4	0.0	88.2
2017	13.4	32.0	40.5	0.0	91.3
2018	18.1	33.0	32.6	10.0	94.4
2019	18.1	34.0	34.8	10.0	97.6
2020	18.1	35.0	37.4	10.0	101.2
2021	18.1	36.0	38.8	11.5	105.1
2022	18.1	37.0	40.3	13.0	109.1
Buildout	18.1	40.0	86.7	75.5	221.0

G. PUMP STATIONS

Pump stations, ground storage reservoirs and elevated storage tanks were sized to meet the maximum hourly demands projected for the overall water distribution system at buildout with approximately 65% of that demand met by pumping and the remaining 35% met by elevated storage.

The City of McKinney currently operates three high service pump stations, the McKinney Ranch Pump Station (Formerly F.M. 720 Pump Station), Gerrish Pump Station and the University Pump Station. The McKinney Ranch Pump Station currently pumps to the 850 and 920 Service Areas. The Gerrish Pump Station pumps to the 794 Service Area and the University Pump Station pumps to the 850 and 920 Service Areas.

1) McKinney Ranch Pump Station (Formerly F.M. 720 Pump Station)

The McKinney Ranch Pump Station is located on the north side of McKinney Ranch Parkway, west of U.S. 75 and east of Hardin Road. The pump station consists of three banks of pumps, Pump Station 1 (850 and 920 Zone), Pump Station 2 (920 Zone) and Pump Station 3 (850

Zone). The pump station is supplied by a 42-inch NTMWD supply line with a maximum rate of 40-MGD into an existing 6-Million Gallon (MG) and an existing 10-MG ground storage reservoir.

Pump Station 1 (850 and 920 Zone) pumps are the original set of pumps at this location. Pump Station 1 (three 850 Zone pumps) originally served the 794 Service Area but are no longer utilized in the 850 Service Area and are shown for reference only. Pump Station 1 (three 920 Zone pumps) are currently being utilized in the 920 Service Area. Pump Station 2 (920 Zone), consists of five pumps that serve the 920 Service Area. Pump Station 3 (three 850 Zone pumps), which were placed into service in 2007, serve the 850 Service Area. An overview of the rated capacity of existing pumps at the McKinney Ranch Pump Station is summarized in Table No. 11.

TABLE NO. 11
MCKINNEY RANCH PUMP STATION OVERVIEW

850 SERVICE AREA	
Pump Station 1 – 850 Zone (Rated Capacity) (Previous 794 Pumps)	
Pump 1 (Not Used)	2,800 gpm (4.03 MGD) @ 125' TDH
Pump 2 (Not Used)	2,800 gpm (4.03 MGD) @125' TDH
Pump 3 (Not Used)	2,800 gpm (4.03 MGD) @ 125' TDH
Pump Station 3 – 850 Zone (Rated Capacity)	
Pump 1	3,472 gpm (5.00 MGD) @ 186' TDH
Pump 2	6,950 gpm (10.00 MGD) @ 189' TDH
Pump 3	6,950 gpm (10.00 MGD) @ 189' TDH
920 SERVICE AREA	
Pump Station 1 – 920 Zone (Rated Capacity)	
Pump 6	3,300 gpm (4.75 MGD) @ 265' TDH
Pump 7	3,472 gpm (5.00 MGD) @ 330' TDH
Pump 8	3,300 gpm (4.75 MGD) @ 273' TDH
Pump Station 2 – 920 Zone (Rated Capacity)	
Pump 1	3,500 gpm (5.04 MGD) @ 330' TDH
Pump 2	3,500 gpm (5.04 MGD) @ 330' TDH
Pump 3	3,500 gpm (5.04 MGD) @ 330' TDH
Pump 4	3,500 gpm (5.04 MGD) @ 330' TDH
Pump 5	3,500 gpm (5.04 MGD) @ 330' TDH

The City has reported the Pump Station 1 850 Zone pumps are not utilized frequently. These pumps were designed for use in the 794 Service Area. When the 850 Service Area was created, these pumps became isolated from the 794 Service Area. These pumps now serve as standby

pumps and are only used for emergency purposes. Therefore, the Pump Station 1 850 Zone pumps were not included in capacity computations.

Pump Station 3 850 Zone consists of three pumps with a rated capacity of 25-MGD at 189-ft of head and a firm pumping capacity of 15-MGD with one large pump on standby. No further 850 Service Area pumps are planned for the McKinney Ranch Pump Station. All future pumping capacity expansions for the 850 Service Area will be at the University and Bloomdale Pump Stations.

Pump Station 1 and Pump Station 2 920 Zone consists of eight pumps with a rated capacity of 39.7-MGD at approximately 330-ft of head. The 920 Zone pumps have a firm pumping capacity of 34.7-MGD with one large pump on standby. No further 920 Service Area pumps are planned for the McKinney Ranch Pump Station.

The volume and number of ground storage reservoirs at the McKinney Ranch Pump Station were sized to meet buildout pumping capacities and the City's target criteria of providing at least 90% of 400 gallons of combined ground storage and elevated storage per person in any given year. With an existing ground storage capacity of 16-MG, these target criterions are met.

The existing 16-MG of ground storage will provide approximately 6-hours of storage for maximum hourly pumping or approximately 19-hours of average day pumping, if the ground storage reservoirs were near full when a supply interruption occurs.

The pumps station has two diesel driven standby emergency generator sets to provide continuous power to the pump station in the event of power outage. One 1,000-kw generator set and one 2,000-kw generator set are in service.

A schematic of the existing McKinney Ranch Pump Station is shown on Figure 4 at the end of Section I of this report.

2) <u>Gerrish Street Pump Station</u>

The Gerrish Street Pump Station facilities are located north of Gerrish Street and east of Healy Avenue. This pump station currently serves the 794 Service Area with four high service pumps with a rated pumping capacity of 15.6-MGD at approximately 230-ft of head and a firm pumping capacity of 10.8-MGD with the largest pump out of service and if Pump 4 is operable. The pump station is supplied from a 24-inch NTMWD supply line at a rate of 10-MGD into an existing 2-MG ground storage reservoir. An overview of the rated capacity of existing pumps at the Gerrish Pump Station are summarized in Table No. 12.

TABLE NO. 12
GERRISH STREET PUMP STATION OVERVIEW

794 SERVICE AREA	
794 Zone (Rated Capacity)	
Pump 1	3,000 gpm (4.32 MGD) @ 217' TDH
Pump 2	3,000 gpm (4.32 MGD) @ 217' TDH
Pump 3	3,300 gpm (4.75 MGD) @ 240' TDH
Pump 4	1,500 gpm (2.16 MGD) @ 234' TDH (Reported Inoperable)

The Gerrish Street Pump Station is currently the only pump station serving the 794 Service Area. It is anticipated the capacity of this pump station is at or near capacity. The NTMWD is currently upgrading their system for supplying the future Bloomdale Pump Station delivery point and other NTMWD customers. These upgrades will allow the City to increase supply at the Gerrish Street Pump Station. In turn, we recommended the capacity of the Gerrish Street Pump Station be increased at buildout by 8-MGD to a capacity of 18.1-MGD. In the interim, we recommend the Gerrish Street Pump Station Pump 4 be replaced in 2015 with a 3,300-gpm pump. This will increase the firm pumping capacity to 13.4-MGD with one large pump reserved for standby. This will allow the City to grow in the 794 Service Area until the proposed Bloomdale Pump Station supply is available in the year 2018. In 2018, one of the two proposed 10-MGD 794 Service Area pumps will be reserved for standby in the 794 Service Area and allow all Gerrish pumps to be operated at a firm pumping capacity of 18.1-MGD. The increased capacity at the Gerrish Street Pump Station will increase reliability of pressure and fire flow to the proposed redevelopment of the McKinney Town Center.

The proposed 794 Service Area Bloomdale Pump Station is scheduled to begin pumping into the 794 Service Area in the year 2018. Until then, the 794 Service Area will be supported by the recommended Gerrish Street Pump Station Improvements and supplemental flow of approximately 2 to 3-MGD from the 850 Service Area between the years 2014 and 2018 with the construction of a temporary pressure-reducing valve capable of delivering the needed rate of flow. The recommended location of the 850/794 Pressure Reducing Valve is on Community Ave. at Bloomdale Road. This location is identified on the Master Plan Map.

With the proposed expansion of Gerrish Street Pump Station capacity, ground storage will need to be increased from 2-MG to 4-MG with the addition of a second 2-MG ground storage reservoir. A schematic of the existing and proposed improvements at the Gerrish Street Pump Station is shown on Figure 5 at the end of Section I of this report.

3) University Pump Station

The University Pump Station is located on the north side of U.S. 380 between Stonebridge Drive and future Ridge Road. The pump station was placed into service in 2001 and was expanded in 2006. This pump station serves the 850 and 920 Service Areas. The pump station is currently supplied by a 48-inch NTMWD supply line at a rate of 32-MGD into an existing 6-Million Gallon (MG) and an existing 10-MG ground storage reservoir. As demand in the 850 and 920 Service Areas continues to increase in the future, the supply rate from NTMWD will need to increase up to a maximum rate of 87-MGD at this pump station. It is our understanding the NTMWD future plans includes looping the existing 48-inch supply line at University Pump Station to the future Bloomdale Pump Station to provide the required supply.

University Pump Station 1 (920 Zone) consists of the first two 10-MGD pumps constructed in 2001. University Pump Station 2 consists of four pump slots for the 850 Service Area and four pump slots for the 920 Service Area. Two of the 850 Service Area pump slots were filled with 15-MGD pumps and two of the 920 Service Area pump slots were filled with 15-MGD pumps. An overview of the rated capacity of existing pumps at the University Pump Station is summarized in Table No. 13.

TABLE NO. 13
UNIVERSITY PUMP STATION OVERVIEW

920 SERVICE AREA	
Pump Station 1 – 920 Zone (Rated Capacity)	
Pump 1	6,944 gpm (10.00 MGD) @ 259’ TDH
Pump 2	6,944 gpm (10.00 MGD) @ 259’ TDH
920 SERVICE AREA	
Pump Station 2 850 Zone (Rated Capacity)	
Pump 1	10,416 gpm (15.00 MGD) @ 141’ TDH
Pump 2	10,416 gpm (15.00 MGD) @ 141’ TDH
Pump 3	Empty Slot
Pump 4	Empty Slot
Pump Station 2 920 Zone (Rated Capacity)	
Pump 5	10,416 gpm (15.00 MGD) @ 242’ TDH
Pump 6	10,416 gpm (15.00 MGD) @ 242’ TDH
Pump 7	Empty Slot
Pump 8	Empty Slot

The existing rated capacity of the University Pump Station 850 Service Area pumps is 30-MGD at 141-ft of head. The firm pumping capacity is 15-MGD with one large pump on standby. The University 850 Service Area pumping capacity will need to be expanded in the year 2034 (Pump 3) to a rated capacity of 45-MGD (three 15-MGD Pumps) and a firm pumping capacity of 30-MGD with one large pump on standby. Ultimately, the University Pump Station 850 Service Area pumps will need to provide a rated pump capacity 60-MGD (four 15-MGD Pumps) and firm pumping capacity of 45-MGD. The addition of Proposed Pump 4 will in the year 2050. Once this ultimate firm pumping capacity is reached, all further pumping expansions to the 850 Service Area will be provided by the proposed Bloomdale Pump Station.

The existing rated capacity of the University Pump Station 920 Service Area pumps is 50-MGD (two 15-MGD + two 10-MGD Pumps) at approximately 250-ft of head. The firm pumping capacity is 35-MGD with one large pump on standby. In the year 2022, the University 920 Service Area pumping capacity will need to be increased by 15-MGD (Pump 7). This will provide a rated pumping capacity of 65-MGD (three 15-MGD + two 10-MGD Pumps) and firm pumping capacity of 50-MGD with one large pump on standby. The buildout firm pumping capacity of the University 920 Service Area pumps is 75-MGD. This will require adding a 15-MGD pump to Pump Slot 8 and further expanding the pump station with an additional pump slot capable of supporting a 10-MGD pump. The final expansion of the University Pump Station 920 Zone pumps will provide a rated capacity of 90-MGD (three 10-MGD + four 15-MGD Pumps). With one large pump reserved for standby, the firm pumping capacity of the University Pump Station 920 Zone pumps will be 75-MGD.

The University Pump Station currently has an existing 6-MG and an existing 10-MG ground storage reservoir. A third ground storage reservoir with a capacity of 10-MG is required in the year 2014. The pump station site has room to accommodate a total of one 6-MG and four 10-MG ground storage reservoirs. Based on meeting maximum hourly pumping rates and the City's target criterion to provide at least 90% of 400 gallons of combined ground storage and elevated storage per person, a total of 36-MG (one 6-MG + three 10-MG Reservoirs) is required. This ultimate capacity allows space for one additional reservoir if the City elects to exceed the 90% volume criteria above. However, the remaining space may be cost prohibitive, as the underlying soil conditions will require a fifth reservoir to be constructed on piers.

The University Pump Station has an existing 2,250-kw diesel driven standby emergency generator set capable of operating two 920 Service Area 15-MGD Pumps and one 850 Service Area 15-MGD pump or two 850 Service Area 15-MGD pumps and one 920 Service Area pump.

A second 2,250-kw diesel driven standby emergency generator set is proposed for the year 2034 capable of simultaneously running six 15-MGD pumps, three in the 920 Service Area and three in the 850 Service Area, when running in parallel with the existing emergency standby generator. The generators will allow the City to pump average day demands. A schematic of the existing and proposed improvements at the University Pump Station is shown on Figure 6 at the end of Section I of this report.

4) <u>Proposed Bloomdale Pump Station</u>

The proposed Bloomdale Pump Station will be located east of U.S. 75 and south of Bloomdale Road on a 100-acre site purchased by the City. It is recommended the City reserve approximately 20-acres of this site for the proposed pump station and ground storage reservoirs. The location of this pump station is shown on the Master Plan Map included at the end of this report. The layout of the pump station is shown on Figure 7 at the end of Section I of this report.

The NTMWD plans to deliver supply to the proposed Bloomdale Pump Station site in 2018. The initial 850 Service Area Bloomdale Pump Station will need to provide a minimum of two pump slots. Both pump slots will be sized for a 10-MGD pump and with the second pump reserved for standby. This will provide the Bloomdale Pump Station 850 Service Area Pumps a rated capacity of 20.0-MGD and firm pumping capacity of 10.0-MGD. With additional expansions at the University Pump Station, the initial rated pump capacity of the 850 Service Area Bloomdale Pump Station will provide the 850 Service Area the required pumping capacity through the year 2045.

The proposed Bloomdale Pump Station will also need to begin serving the 794 Service Area in the year 2018. The initial rated capacity of the 794 Service Area pumps is sized at 20-MGD and a firm capacity of 10-MGD (two 10-MGD Pumps with one reserved for standby).

Ultimately, the 794 Service Area Bloomdale Pump Station is sized for 6 pump slots consisting of 10.0-MGD pumps. With one large pump reserved for standby, a firm pumping capacity of 50-MGD will be provided. The ultimate size of the 850 Service Area Bloomdale Pump Station pumps includes five pump slots. Each pump slot is sized for 10-MGD pumps, providing a rated pump capacity of 50-MGD and a firm pumping capacity of 40-MGD.

In 2018, the first ground storage reservoir will need to be constructed with a capacity of 6-MG. This volume of ground storage will meet peak hour pumping and the City's target criteria of

90% of 400 gallons of combined ground storage and elevated storage per person. Ultimately, the Bloomdale Pump Station will need to contain one 6-MG and three 10-MG ground storage reservoirs (36-MG Total).

It is envisioned, emergency generation for the Bloomdale Pump Station will include one 1,000-KW and one 2,250-KW diesel driven standby emergency generator sets. The first emergency generator (1,000-KW) will initially provide emergency average day pumping capacity to the 794 and 850 Service Areas and is scheduled for the year 2018 in the 10-year Capital Improvement Plan. The second emergency generator will be required in the year 2045 following the installation of two additional pumps in the 794 Service Area and one additional pump in the 850 Service Area.

5) Proposed 840 Booster Pump Station

Due to the ground elevations located in the far northeast portion of the planning boundary, a booster pump station with a pneumatic tank is recommended. The area supported by the proposed 840 Booster Pump Station is identified on the Master Plan Map at the end of this report.

The booster pump station will consist of an inline duplex or triplex pumping station that receives flow from the 794 Service Area and pumps into a pneumatic tank. The pneumatic tank pressurizes the system. The pneumatic tank is designed in the model to provide system pressure ranging between 65-psi at the highest ground elevation (Node J-2028) and 90-psi at the lowest ground elevation (Node J2095) in the proposed 840 Service Area.

The booster pump station will need to have a capacity equivalent to the maximum hourly demand of the area being served with one pump reserved for standby. The maximum hourly demand of the area identified in the 840 Service Area is 2.6-MGD. Figure No. 8 represents the pump station modeled as a duplex pump station with each pump having a capacity of 2.6-MGD.

A fire flow analysis of the 840 Service Area was completed to determine if an elevated tank should be utilized in lieu of a pneumatic tank. The analysis showed a fire flow up to 3,500-gallons per minute with a 20-psi residual could be achieved with the pneumatic tank. Therefore, an elevated storage tank for the proposed 840 Service Area was not considered.

Table 14 shows a summary of maximum daily demand and maximum hourly demand pumping capacities, by service area, for each pump station at buildout. The timing of proposed pump station improvements between the years 2012 and 2022 is summarized in Section II of this report.

TABLE 14
BUILDOUT PUMP STATION CAPACITY PER SERVICE AREA & PUMP STATION

Pump Stations	794 Service Area		850 Service Area		920 Service Area		Total by Pump Station
	Max Day (MGD)	Max Hour (MGD)	Max Day (MGD)	Max Hour (MGD)	Max Day (MGD)	Max Hour (MGD)	
McKinney Ranch Pump Sta.	0.0	0.0	19.9	5.1	20.1	14.6	59.7 MGD
Gerrish St. Pump Sta.	18.1	0.0	0.0	0.0	0.0	0.0	18.1 MGD
University Pump Sta.	0.0	0.0	20.0	25.0	66.7	8.3	120.0 MGD
Bloomdale Pump Sta.	35.5	14.5	40.0	0.00	0.0	0.0	90.0 MGD
Required Max. Day/ Max. Hour Pumping	**53.6**	**14.5**	**79.9**	**30.1**	**86.8**	**22.9**	**288.5 MGD**
Total Pumping By Service Area	**68.1 MGD**		**110.0 MGD**		**109.7 MGD**		**287.8 MGD**

H. GROUND STORAGE

Ground Storage within the system is necessary to provide a dependable supply during periods of high demand or treated water delivery system failure. Table No. 15 summarizes the total volume of ground storage required at buildout by pump station.

TABLE 15
BUILDOUT GROUND STORAGE PER SERVICE AREA AND PUMP STATION

Pump Station	794 Service Area	850 Service Area	920 Service Area	Total
McKinney. Ranch Pump Station	0.0 MG	6.7 MG	9.3 MG	16.0 MG
Gerrish Street Pump Station	4.0 MG	0.0 MG	0.0 MG	4.0 MG
University Pump Station	0.0 MG	13.3 MG	22.7 MG	36.0 MG
Bloomdale Pump Station	20.2 MG	15.8 MG	0.0 MG	36.0 MG
Total Ground Storage By Service Area at Buildout:	**24.2 MG**	**35.8 MG**	**32.0 MG**	**92.0 MG**

In order to verify if the volumes in Table 15 meet the City's requirements for ground storage, the following three criteria were analyzed.

1. Is the volume of storage capable of meeting maximum hourly pumping rates over a 6-hour draw down period, with no interruption of supply from NTMWD?

2. Is the volume of storage capable of meeting average daily demands at an 18-hour draw down, with an interruption of supply from NTMWD?

3. Is the volume of ground storage in combination with the volume of elevated storage capable of providing the City's target of at least 90% of 400 gallons of storage per person in any given year? The City's goal of providing 90% of 400 gallons total storage per person is based on a PowerPoint Presentation delivered to the City Council at the City Council Work Session, dated July 25, 2005.

The first criterion was tested in the hydraulic models by applying the supply rates summarized in Table 10 at each pump station during peak demands. The 2012, 2022 and buildout models showed the ground storage reservoirs could deep cycle and refill following a prolonged period of maximum hourly demands.

The second criterion was tested by assuming there was a period of interruption of supply from NTMWD. Under this condition, it was assumed ground storage reservoirs would be full when the interruption occurred and the City would implement an emergency water management plan to reduce water demand, such as notifying residents and businesses of the supply interruption through television, radio and the City's web-site. Assuming the City could reduce water demand to an average day flow, the following approximate ground storage supply periods could be achieved at each pump station at buildout:

- McKinney Ranch Pump Station–16-MG Storage = 19-Hours Storage at Avg. Day Pumping
- Gerrish Pump Station–4 MG Storage = 10-Hours Storage at Avg. Day Pumping
- University Pump Station-36 MG Storage = 20-Hours Storage at Avg. Day Pumping
- Bloomdale Pump Station-36 MG Storage = 23-Hours Storage at Avg. Day Pumping

This analysis showed the second design criterion for sizing ground storage was met at three of the City's four buildout pump station sites. The Gerrish Street Pump Station property is owned by the NTMWD and space is limited. Therefore, ground storage for the City of McKinney at the Gerrish site was only increased by 2-MG.

At the McKinney Ranch Pump Station, space is available for a third 10-MG ground storage reservoir. The reservoirs at this site are buried and require a large amount of excavation and construction space. The construction of a third 10-MG reservoir at this site may become prohibitive in the future as the land around the pump site develops. If the City wishes to increase the average day storage capacity of the McKinney Ranch Ground Storage Reservoirs, we recommend a reservoir smaller than 10-MG be considered. Since the existing 16-MG of ground storage provides at least 18-hours of average day storage, a third ground storage reservoir was not included in the capacity calculations at the McKinney Ranch Pump Station.

At the University Pump Station site, enough space is available to construct three additional 10-MG ground storage reservoirs. Two of the three remaining pad sites are suitable for standard membrane floor construction. The third and final remaining pad site has an underlying soil condition that requires any size reservoir to be constructed on piers. The 18-hour average day pumping calculation above includes the existing 6-MG, 10-MG and two future 10-MG reservoirs. If a fifth reservoir were to be constructed, the average day storage could be increased. Due to the cost of constructing a fifth reservoir on piers, additional volumes above 36-MG were not considered for the University Pump Station.

If the City elects to provide more than 18-hours of average day storage to the system, the Bloomdale Pump Station may provide a more suitable location. As the City plans its various uses for the 100-acre Bloomdale site, any increases of ground storage volume beyond the recommended 36-MG should include additional acreage reserved for the pump station site.

The third criterion was tested by multiplying the population times 400-gallons per person and calculating if 90% of that volume is provided with the total volume of ground storage and elevated storage. Dividing the total volume of storage provided by the target volume of storage at 400-gallons per person equates to the percentage of the 400-gallon per person volume provided. As shown in Table No. 16, at buildout the combination of elevated storage and ground storage achieves the City's goal of providing at least 90% of 400-gallons of total storage per person in any given year.

TABLE 16
TOTAL STORAGE GROUND STORAGE + ELEVATED STORAGE

Year	COMBINED SYSTEM (794, 850 & 920 SERVICE AREAS)					
	Population Served	Target Storage (POP X 400) (MG)	Elevated Storage Provided (MG)	Ground Storage Provided (MG)	Total Storage Provided (MG)	Total Storage Provided Divided by Target Storage (%)
2012	135,663	54.27	12.5	34.0	46.5	86%
2013	141,853	56.74	14.5	34.0	48.5	85%
2014	148,042	59.22	14.5	44.0	58.5	99%
2015	154,232	61.69	14.5	46.0	60.5	98%
2016	160,421	64.17	17.5	46.0	63.5	99%
2017	166,611	66.64	20.5	46.0	66.5	100%
2018	172,801	69.12	20.5	46.0	66.5	96%
2019	178,990	71.60	20.5	46.0	66.5	93%
2020	185,180	74.07	20.5	52.0	72.5	98%
2021	191,369	76.55	20.5	52.0	72.5	95%
2022	197,559	79.02	20.5	52.0	72.5	92%
Buildout	359,612	143.84	37.0	92.0	129.0	90%

Table 16 was also utilized to determine the timing to add elevated storage or ground storage between the years 2012 through 2022. The timing and opinion of probable construction cost for ground storage reservoirs required between the years 2012 through 2022 is summarized in Section II of this report.

I. ELEVATED STORAGE

The volume of elevated storage in this analysis was based on the difference in the maximum hourly demand and the pumping capacity. The volume of elevated storage must also meet or exceed the Texas Commission on Environmental Quality (TCEQ) minimums. By designing the overall system to meet the maximum hour demand with approximately 65% pumping and 35% elevated storage, TCEQ minimums are exceeded. TCEQ minimums are further explained in Section I, J. of this report.

A 72-hour Extended Period Simulation (EPS) was performed to ensure the existing and proposed elevated tanks would discharge and refill within an acceptable range. The EPS was run by

placing controls on pumps and linking them to the water levels in the elevated tanks. As the water levels in elevated storage tanks drop, pumps begin to turn on according to the pump control settings. When the water level in the elevated storage tanks rise, pumps begin to turn off according to the pump control settings. This allowed the maximum pumping capacity at each pump station to be optimized to the maximum pumping rates summarized in Table 14. The elevated storage requirements at buildout for each service area are provided in Table 17.

TABLE 17
ELEVATED STORAGE REQUIREMENTS PER SERVICE AREA

EXISTING ELEVATED STORAGE			
Service Area	**Tank Name**	**Number of Tanks**	**Total Volume**
794	U.S. 380	1-1.5 MG	3.5 MG
	Industrial	1-2.0 MG	
850	• Wilmeth 2MG (Operating Range is 1.5MG)	1-1.5 MG	1.5 MG
920	Virginia	1-1.5 MG	7.5 MG
	Community & Independence	2-3.0 MG	
	Existing Subtotal:	**6 Tanks**	**12.5 MG**
PROPOSED ELEVATED STORAGE			
794	McKinney East	1-3.0 MG	5.0 MG
	Big Branch	1-2.0 MG	
850	Hardin, Ridge & Erwin	3-2.0 MG	12.0 MG
	Trinity, & Lake Forest	2-3.0 MG	
920	Highland	1-2.0 MG	7.5 MG
	Stonebridge	1-2.5 MG	
	Stacy	1-3.0 MG	
	Proposed Subtotal:	**10 Tanks**	**24.5 MG**
Total Elevated Storage:		**16 Tanks**	**37.0 MG**

- **<u>Wilmeth Elevated Storage Tank</u>**

  The effective storage volume of the Wilmeth 2.0-MG elevated Storage Tank is 1.5-MG because the elevated storage tank was constructed with an overflow of 861 and is operated to a high water level of 850-ft.

J. |WATER DISTRIBUTION LINES

Proposed water lines were sized to provide a hydraulically efficient system capable of delivering water to the distribution system within acceptable velocities and head loss ranges. The proposed water lines were sized for a desirable velocity between 2 and 5-feet per second (fps) and a maximum velocity of 7-fps in isolated locations during maximum hourly demand conditions. Utilizing this methodology minimizes system head losses, reduces pump heads and energy costs. Proposed water line diameters are shown on the Master Plan Map at the end of this report.

K. TCEQ MINIMUMS

The methodology and assumptions utilized in this master plan result in TCEQ minimum capacities being exceeded. The TCEQ requirements for elevated storage are 100-gallons per connection if 2.0-gallons per minute per connection of pumping is provided, or 200-gallons per connection if 0.6-gallons per minute per connection of pumping is provided. Table 18 summarizes the minimum TCEQ requirements for pumping and elevated storage per service area.

TABLE 18
TCEQ MINIMUM REQUIREMENTS FOR
PUMPING AND ELEVATED STORAGE PER SERVICE AREA

Service Area	+ Population	++Estimated Number of Connections	+++ Min. Pumping (0.6-Gpm/Conn.)	Min. Volume Elev. Storage (200-Gal/Conn.)
2012				
794 Service Area	30,391	10,130	8.8-MGD	2.0-MG
850 Service Area	32,708	10,902	9.4-MGD	2.2-MG
920 Service Area	73,714	24,571	21.2-MGD	4.9-MG
2022				
794 Service Area	35,095	11,698	10.1-MGD	2.3-MG
850 Service Area	57,729	19,243	16.6-MGD	3.8-MG
920 Service Area	106,179	35,393	30.6-MGD	7.1-MG
BUILDOUT				
794 Service Area	68,589	22,863	19.8-MGD	4.6-MG
850 Service Area	138,354	46,118	38.9-MGD	9.2-MG
920 Service Area	151,024	50,342	42.5-MGD	10.1-MG

\+ *Service Area Population Includes Estimate of Population for Wholesale Customers*
++ *Per TCEQ Definition of Connections, the Number of Connections is Population Divided by 3*
+++ *Minimum Pumping converted to Million Gallons per Day by multiplying gpm X 1,440*

The results in Table No. 18 shows the 2012, 2022 and buildout pumping rates and elevated storage volumes meet TCEQ minimums. The volume of elevated storage in the 850 Service Area is approaching TCEQ minimums. The proposed Hardin 2-MG Elevated Storage Tank is

under construction and is anticipated to be operational in late 2013. Once in service, the TCEQ minimums will be exceeded. In the 794 Service Area, the Gerrish Street Pump Station is also approaching TCEQ minimums. With the proposed 794 Service Area Bloomdale Pump Station not scheduled to be in service until the year 2022, the 10-Year CIP (Section II) recommends the City move forward with increasing capacity at the Gerrish Pump Station by the year 2015 and construct the proposed 850/794 Service Area Pressure Reducing Valve (PRV) located on Community Ave. in the year 2014. These improvements will increase capacity in the 794 Service Area above TCEQ minimums.

L. 2006 and 2012 Master Plan Comparison

Table No. 19 provides a summary of the difference in the major design parameters between the 2006 and 2012 Water Distribution System Master Plans. Based on the Land Use Assumptions and a reduction of per capita demands in the system, most design parameters have experienced a decrease.

TABLE 19
2006 TO 2012 MASTER PLAN COMPARISON

	Unit	2006 MP	2012 MP	Difference
Population	Persons	387,964	357,970	-29,994
Max Day Per Capita	gpcd	500	495	-5
Max Hour Per Capita	gpcd	1100	990	-110
Max Day Demand	MGD	257.87	221.05	-36.82
Max Hour Demand	MGD	491.63	418.31	-73.32
University PS 920 Pumping	MGD	95	75	-20
University PS 850 Pumping	MGD	45	45	0
McKinney Ranch PS 920 Pumping	MGD	50	34.7	-15.3
McKinney Ranch PS 850 Pumping	MGD	15	25	+10
Gerrish PS 794 Pumping	MGD	10.8	18.8	+8
Bloomdale PS 850 Pumping	MGD	88	40	-48
Bloomdale PS 794 Pumping	MGD	75	50	-25
TOTAL PUMPING	**MGD**	**378.8**	**288.5**	**-90.3**
University Ground Storage	MG	36	36	0
McKinney Ranch Ground Storage	MG	16	16	0
Gerrish Ground Storage	MG	2	4	+2
Bloomdale Ground Storage	MG	43	36	-7
TOTAL GROUND STORAGE	**MG**	**97**	**92**	**-5**
920 Elevated Storage	MG	16.5	15	-1.5
850 Elevated Storage	MG	18.0	13.5	-4.5
794 Elevated storage	MG	8.5	8.5	0
TOTAL ELEVATED STORAGE	**MG**	**43.0**	**37.0**	**-6.0**

PUMP STATION SCHEMATICS

Figure No. 4 – McKinney Ranch Pump Station

Figure No. 5 – Gerrish Pump Station

Figure No. 6 – University Pump Station

Figure No. 7 – Proposed Bloomdale Pump Station

Figure No. 8 – Proposed 840 Booster Pump Station

(Not Shown In Council Presentation)

Section II - 10-Year Capital Improvement Plan

2012 Through 2022

A. GENERAL

2012 and 2022 Hydraulic Models were created to simulate the immediate growth and 10-year growth anticipated within the planning boundary. It is envisioned that as new development occurs within the Planning Boundary, the City will annex the proposed developments into the City and acquire the CCN to serve the area. The existing water distribution system will require significant improvements over the next ten years to meet the projected water demands resulting from the anticipated growth.

B. PROPOSED WATER LINES

Proposed water lines are identified on the Master Plan Map at the end of this report. Proposed water lines required to be constructed between 2012 and 2022 are summarized in Table No. 20 and illustrated on Figure No. 9. The projects listed with a "*" before the proposed pipe diameter in Table No. 20 are water lines that will be initiated by development where the City will participate in the cost oversize between the size of line required to support the development and the buildout size. These lines are colored green on Figure No. 9. All other projects in Table No. 20 are system wide projects the City will construct. These lines are colored red on Figure No. 9.

C. PROPOSED PUMP STATIONS, GROUND STORAGE AND ELEVATED STORAGE

The water distribution system's capabilities of meeting projected increases in water demands are dependent on expansions in pumping, ground storage volume, elevated storage volume and transmission mains.

1) 794 Service Area

Ultimately, the 794 Service Area will be served by the Gerrish Street Pump Station and the Bloomdale Pump Station. The North Texas Municipal Water District (NTMWD) has recently notified the City of McKinney additional supply will be available at the Gerrish Street Pump Station in 2015. In order to meet the short term needs of the 794 Service Area until the proposed Bloomdale Pump Station becomes operational, it is recommended the City expand the Gerrish Street Pump Station by replacing the existing 1,500-gpm Pump 4

with a 3,300-gpm pump The Gerrish Street Pump Station expansion will require the addition of 2-MG of ground storage.

Further, it is recommended the City construct a Pressure Reducing Valve (PRV) between the 794 and 850 Service Area at Community Ave. and Bloomdale Road in the year 2014. The PRV will allow growth to occur in the 794 Service Area and the ability to continue supplying the GTUA until the expansion at Bloomdale Pump Station is complete. Supplying the 794 Service Area with the proposed PRV could prevent the need for the GTUA to construct a contractually required supply line from their S.H. 5 Pump west to Hardin Road in the 850 Service Area. Based on the GTUA flow projections from 2013 to 2018 the PRV would need to be upsized from an 8-inch diameter to a 12-inch diameter to meet the City's and the GTUA's needs. We recommend the City coordinate with the GTUA to participate in the cost for oversizing the PRV to meet their projected supply needs.

Construction of the 794 Service Area Bloomdale Pump Station is anticipated in 2018 with an initial pumping capacity of 10.0-MGD and a ground storage volume shared with the 850 Service Area of 6-MG. It is anticipated this initial capacity will provide the required pumping capacity to serve the 794 Service Area through the year 2032. No additional elevated storage volume is required for the 794 Service Area for the C.I.P. period (2012 through 2022).

2) <u>850 Service Area</u>

The 850 Service Area is currently served by the McKinney Ranch and University Pump Stations. It is envisioned the 850 Service Area Bloomdale Pump Station will be in service in the year 2018 with an initial capacity of 10-MGD and 6-MG of ground storage. With the addition of the proposed Bloomdale Pump Station, no further expansions are anticipated at the 850 Service Area McKinney Ranch or University Pump Stations during the 10-year CIP period (2012 through 2022).

The proposed Hardin Road 2.0-MG Elevated Storage Tank is under construction and is anticipated to be in service by the end of 2013. It is anticipated the proposed Trinity Falls 3.0-MG Elevated Storage Tank will be in service by 2017 to support the proposed Trinity Falls M.U.D. development. The addition of these two elevated storage tanks will provide elevated storage capacity in the 850 Service Area until approximately the year 2040.

3) 920 Service Area

The 920 Service Area is served by the McKinney Ranch and University Pump Stations. The third ground storage reservoir at University Pump Station will need to be added in the year 2014 with a volume of 10-MG to provide a total system storage of 400-gallons per person. The third University ground storage reservoir will also provide the City an emergency supply buffer in the event of a supply interruption and until the NTMWD completes the looping of their system. In the year 2020 a 15-MGD pump will need to be added to one of the two remaining empty 920 Zone pump slots at the University Pump Station.

Elevated storage volumes will need to be increased in the 920 Service Area by the year 2016 with the proposed Stacy 3.0-MG Elevated Storage Tank. The addition of the Stacy Elevated Storage Tank will provide elevated storage capacity to the 920 Service Area until approximately the year 2029.

Tables No. 20 and Table No. 21 summarize the proposed CIP projects that are required to meet the anticipated water demands between 2012 and 2022. The capital improvements in Tables 20 and 21 are consistent with the 2012 Impact Fee Capital Improvement Plan. Figure No. 9 illustrate these projects.

Table No. 22 summarizes recommended improvements to the existing distribution system. The proposed 12-inch Virginia Parkway Looping Line will remove a dead-end line from the system. It is anticipated this project would be constructed at the time Virginia Parkway is widened. The proposed 8-inch Country Club Replacement Water Line will replace an existing water line that is located in an easement behind fences making maintenance difficult for the City. At the time the existing water line begins to experience the need for maintenance the 8-inch replacement water line will need to be constructed. These projects have been included on Figure No. 9.

Table No. 23 summarizes the distribution system improvements required to support the proposed redevelopment of the McKinney Town Center (MTC) and Cotton Mill District. These improvements are required to provide a minimum 3,500-gpm fire flow within the redevelopment zones. It is envisioned individual segments of the recommended improvements will be constructed at the time of redevelopment. MTC improvements are highlighted on Figure No. 10. Cotton Mill District Improvements are shown on Figure No. 9.

Figures 11A through 11C provide a graphical representation of the timing for the addition of pumping and elevated storage capacity based on projected flows over time.

TABLE 20
10-YEAR CAPITAL IMPROVEMENT PLAN – WATER LINES
ELIGIBLE FOR IMPACT FEES

Year	1=City Participation in Cost Oversize 2=City Initiated and Funded Service Area		Project	Length (FT)	Size	Opinion of Construction Cost (A)
2014	2	794	Industrial BLVD. 12" Water Line (Pipe Burst 8" to 12") (Pipes 1399,1402,1403)	2,332	12"	$ 610,868
2014	2	794	Couch Drive 12" Water Line Loop (Pipe 1406)	4,120	12"	$ 700,000
2015	2	920	US 380 / Independence Loop (Pipes 5757,5758,5763,5767,6083,6084,6086,6087)	10,834	12",16",20",24"	$ 2,173,617
2014	1	920	US 380 / Coit Subdivision Offsite (Pipes 6074,6089,6239)	3,302	16", 20", 24"	$ 235,861
2015	1	920	Bluestem 16" Water Line (Pipe 6067)	2,375	16"	$ 42,750
2015	1	920	Westridge 16" Water Line (Pipe 6061)	1,630	16"	$ 29,349
2015	1	794	S.H. 5 36" Water Line & Willowwood 36" & 24" Water Line (Pipes 2000,2008)	10,862	24", 36"	$ 2,307,387
2016	1	920	Hardin South 16" Water Line (Pipe 6010)	1,515	16"	$ 27,264
2017	1	920	Stonebridge 48" Water Line (Pipes 6092,6100,6101,6111,6112)	16,128	48"	$ 6,096,215
2017	1	850	Hardin 30" Water Line - (Trinity Falls West Feed) (Pipes 4017,4034,4035,4036,4044)	13,510	30"	$ 2,188,580
2017	1	850	F.M. 543 24" & 16" Water Line (Pipes 4051, 4052)	5,802	16", 24"	$ 402,059
2017	1	920	F.M. 1461 (Future E/W Thoroughfare) 24" & 18" Water Line (Pipes 4164,6132,6133,6140,6141,6176,6178)	10,760	18", 24"	$ 861,612
2018	1	850	Hardin 24" & 16" (Trinity Falls West Feed North) (Pipes 4069,4070)	8,505	16", 24"	$ 425,132
2018	1	850	County Road 227 16" Water Line (Pipe 4072)	5,256	16"	$ 94,617
2018	2	794	Airport Water Line North Loop (Pipes 2017,2018,2043,2044)	13,789	20", 36"	$ 3,569,134
2018	2	920	Custer 18" North Water Line (Pipes 6052,6093,6096,6097,6102,6103,6210,6211)	15,986	18"	$ 2,301,937
2018	1	850	Bloomdale 850 Pump Station 42 & 54" Discharge Line (Pipes 4024,4075,4077,4118)	8,309	42", 54"	$ 4,029,477
2019	1	850	Ridge 20" & 24" Water Line (Pipes 4007,4008,4109)	5,290	20", 24"	$ 498,838
2019	1	920	Ridge 16" Water Line (Loop To Old Danville System) (Pipes 6134,6135)	5,162	16"	$ 92,909
2019	1	850	Lake Forest 30" Water Line (Pipes 4025,4026,4027)	5,619	30"	$ 910,261
2019	1	850	Bloomdale 16" Water Line - 850 Phase 1 (Pipes 4018,4019)	3,413	16"	$ 61,438
2019	1	850	Bloomdale 16" Water Line - 850 Phase 2 (Pipes 4020,4021)	5,286	16"	$ 95,152
2020	2	794	Bloomdale 794 Pump Station 54" Discharge Line (Pipes 2112,2114)	6,898	54"	$ 3,890,601
2020	2	794	Airport 24" Water Line South Loop (Pipes 2086,2087,2120,2121)	6,028	24"	$ 1,356,344
2020	2	794	Old Mill Road 24" Water Line (Future Thoroughfare) (Pipes 2082,2083,2085)	8,928	24"	$ 2,008,863
2021	1	850	Future 850 East / West Thoroughfare 20" & 24" Water Line (Pipes 4037,4038,4039,4047,4118)	17,261	20", 24"	$ 1,541,297
2021	1	850	Bloomdale Pump Station 850 Discharge Line (Trinity Falls East Feed) (Pipes 4049,4050,4076,4091,4092)	17,250	24", 30", 48"	$ 4,127,908
2022	1	794	F.M. 2933 30" Water Line (Pipes 2047,2048,2049,2050)	10,036	30"	$ 1,625,879
2022	1	794	McIntyre / Woodlawn 36" Water Line (Pipes 2020,2021)	5,581	36"	$ 1,540,425
2022	1	794	U.S. 380 East Water Line (Pipes 2075,2076,2077)	16,581	12", 24"	$ 1,859,159
2022	1	794	Future North / South Thoroughfare 16" Water Line (Pipes 2079,2080)	9,023	16"	$ 162,415
			Total: Proposed Water Lines			**$ 45,867,348**

(A) Opinion of Cost includes:

a) Engineer's Opinion of Construction Cost

b) Professional Services Fees (Survey, Engineering, Testing, Legal

c) Cost of Easement or Land Acquisitions

TABLE 21
10-YEAR CAPITAL IMPROVEMENT PLAN
PUMP STATIONS, GROUND STORAGE RESERVOIRS & ELEVATED TANKS

Year	Service Area	Project		Capacity	Opinion of Construction Cost (A)
2013	850	Hardin Elevated Storage Tank		2 MG	$ 5,202,788
2014	850/920	University 10-MG Ground Storage Reservoir No. 3		10 MG	$ 4,950,000
2014	794/850	794/850 PRV			$ 183,920
2015	794	Gerrish 2-MG Ground Storage Reservoir No. 2		2 MG	$ 2,200,000
2015	794	Gerrish Pump Station Expansion - Replace Pump 4 + Electrical		4.8 MGD	$ 1,000,000
2016	920	Stacy Elevated Storage Tank		3 MG	$ 6,700,000
2017	850	Trinity Falls Elevated Storage Tank		3 MG	$ 6,700,000
2018	850	Bloomdale Pump Station - Phase I (850)		20 MGD	$ 4,730,149
2018	794/850	Bloomdale 6-MG Ground Storage Reservoir No. 1		6 MG	$ 2,640,000
2018	794	Bloomdale Pump Station - Phase II (794)		20 MGD	$ 4,730,149
2018	794/850	Bloomdale Pump Station - Emergency Generator No. 1		1000 kW	$ 660,000
2022	920	University Pump Station Phase III Improvements - Add Pump		15 MGD	$ 550,000
		Total: Pumping and Storage Facilities			**$ 40,247,006**

(A) Opinion of Cost includes:
a) Engineer's Opinion of Construction Cost
b) Professional Services Fees (Survey, Engineering, Testing, Legal
c) Cost of Easement or Land Acquisitions

TABLE 22
MISCELLANEOUS CAPITAL IMPROVEMENTS
EXISTING SYSTEM IMPROVEMENTS

Service Area	Project	Length (FT)	Size (In)	Opinion of Construction Cost (A)
794	Virginia Parkway Looping Line- From S. Westpark Drive, West 285-ft (Pipe 3374)	285	8	$ 42,750
850	Country Club Replacement Water Line from Trenton to Ticonderoga (Existing Water Line is Not Accessible for Maintenance) (Pipe 3414)	510	8	$ 76,500
	Total: Existing System Improvements			**$ 119,250**

(A) Opinion of Cost includes:
a) Engineer's Opinion of Construction Cost
b) Professional Services Fees (Survey, Engineering, Testing, Legal
c) Cost of Easement or Land Acquisitions

(B) Refer to Master Plan Map, Insets H & I for Loaction of Existing System Improvments

TABLE 23
CAPITAL IMPROVEMENT PLAN
MCKINNEY TOWN CENTER

MTC Area	Project	Length (FT)	Size (In)	Opinion of Construction Cost (A)
Town Center	Walker - From Benge to Church (Pipe 4182)	225	8	$ 33,750
Town Center	Walker - From Kentucky to Tennessee (Pipe 1485)	230	8	$ 34,500
Town Center	Lamar - From Church to Wood (Pipe 1471)	230	8	$ 34,500
Town Center	Kentucky - From Hunt to Logan (Pipe 1478)	313	12	$ 53,210
Town Center	Church - From Virginia to Hunt (Pipes 1475,1476)	479	12	$ 81,430
Town Center	Davis - From Benge to Tennessee (Pipes 1486,1487,1488,1490)	970	8 & 12	$ 159,500
Town Center	Kentucky - From Davis to Standifer (Pipe 4179)	980	8	$ 147,000
Town Center	Chestnut - From Tennessee to Anthony (Pipes 1491,1492)	650	12	$ 110,500
Town Center	Standifer - From Kentucky to Tennessee (Pipe 1480)	285	12	$ 48,450
Town Center	Throckmorton - From Broad to Seneca (Pipes 1497, 1498)	875	12	$ 148,750
Town Center	Seneca - From Main to Washington (Pipes 1496,1510,1527)	1,440	8 & 12	$ 222,500
Town Center	Washington - From Seneca to Virginia (Pipes 1528,1529,1530)	1,535	8	$ 230,250
Town Center	Virginia - From McDonald to Washington (Pipes 1495,1505,1506)	2,650	12	$ 450,500
Town Center	Greenville - From Throckmorton to Airport (Pipes 1472,1473)	3,434	12	$ 583,780
Town Center	Wilcox - From Louisiana to Short (Pipes 1507,1508,1509)	2,058	12	$ 349,860
Cotton Mill	Puckett - From Wilson Creek Pkwy. to Dud Perkins (Pipes 1470,1518)	1,450	12	$ 246,500
Cotton Mill	Dud Perkins - From Fowler to Puckett (Pipe 1517)	820	12	$ 139,400
Cotton Mill	Amscott - From Wilson Creek Pkwy to Dud Perkins (Pipes 1514,1515,1516)	1,690	12	$ 287,300
	Total: McKinney Town Center Water Distribution Improvements			**$ 3,361,680**

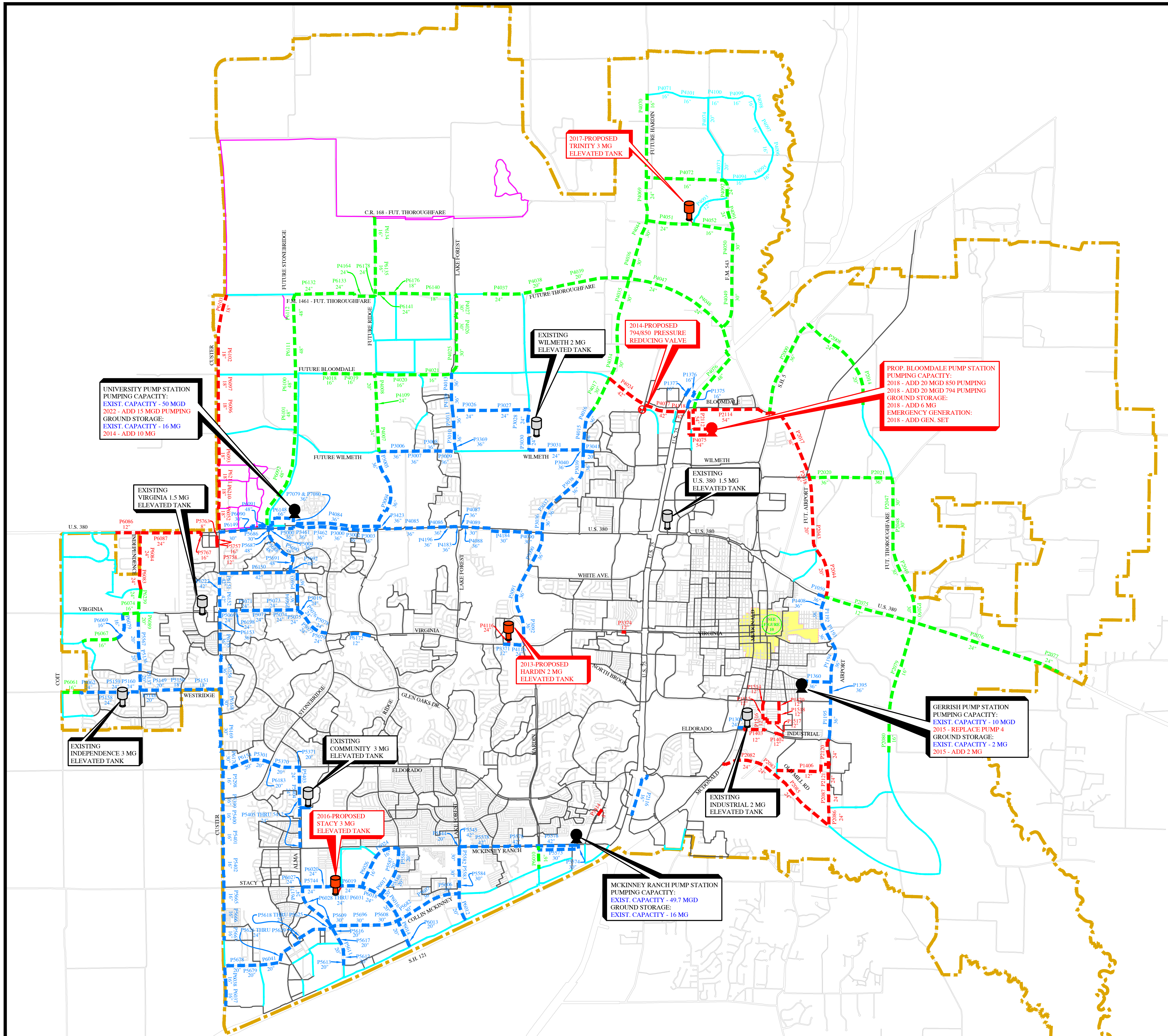
(A) Opinion of Cost includes:

a) Engineer's Opinion of Construction Cost
b) Professional Services Fees (Survey, Engineering, Testing, Legal
c) Cost of Easement or Land Acquisitions

(B) a) Refer to Master Plan Map for Loaction of Cotton Mill Improvments
b) Refer to Master Plan Map Inset A and Master Plan Report Figure 21 for Town Center Improvements

2012 - 2022 WATER MASTER PLAN
10-YEAR CAPITAL IMPROVEMENT PLAN

BIRKHOFF, HENDRICKS & CARTER, L.L.P.
PROFESSIONAL ENGINEERS
Dallas, Texas
AUGUST 2013



2017-PROPOSED TRINITY 3 MG ELEVATED TANK
2014-PROPOSED 794/850 PRESSURE REDUCING VALVE
EXISTING WILMETH 2 MG ELEVATED TANK
PROP. BLOOMDALE PUMP STATION PUMPING CAPACITY: 2018 - ADD 20 MGD 850 PUMPING 2018 - ADD 20 MGD 794 PUMPING GROUND STORAGE: 2018 - ADD 6 MG EMERGENCY GENERATION: 2018 - ADD GEN. SET
UNIVERSITY PUMP STATION PUMPING CAPACITY: EXIST. CAPACITY - 50 MGD 2022 - ADD 15 MGD PUMPING GROUND STORAGE: EXIST. CAPACITY - 16 MG 2014 - ADD 10 MG
EXISTING VIRGINIA 1.5 MG ELEVATED TANK
EXISTING U.S. 380 1.5 MG ELEVATED TANK
2013-PROPOSED HARDIN 2 MG ELEVATED TANK
GERRISH PUMP STATION PUMPING CAPACITY: EXIST. CAPACITY - 10 MGD 2015 - REPLACE PUMP 4 GROUND STORAGE: EXIST. CAPACITY - 2 MG 2015 - ADD 2 MG
EXISTING INDEPENDENCE 3 MG ELEVATED TANK
EXISTING COMMUNITY 3 MG ELEVATED TANK
EXISTING INDUSTRIAL 2 MG ELEVATED TANK
2016-PROPOSED STACY 3 MG ELEVATED TANK
MCKINNEY RANCH PUMP STATION PUMPING CAPACITY: EXIST. CAPACITY - 49.7 MGD GROUND STORAGE: EXIST. CAPACITY - 16 MG
NOT TO SCALE

LEGEND

- EXIST. WATER LINE
- DANVILLE SYSTEM REMAINING IN 2022
- EXIST. IMPACT FEE LINE
- PROP. WATER LINE (DEVELOPER CONSTRUCTED 12-INCH UNLESS OTHERWISE NOTED)
- PROP. IMPACT FEE WATER LINE (DEVELOPER INITIATED - CITY OVERSIZE)
- PROPOSED IMPACT FEE WATER LINE (CITY INITIATED & CONSTRUCTED)
- PLANNING BOUNDARY
- EXISTING PUMP STATION
- PROPOSED PUMP STATION
- EXISTING ELEVATED STORAGE TANK
- PROPOSED ELEVATED STORAGE TANK
- PROPOSED PRESSURE REDUCING VALVE

FIGURE 9

McKINNEY™
TEXAS
Unique by nature.℠

N.T.S.

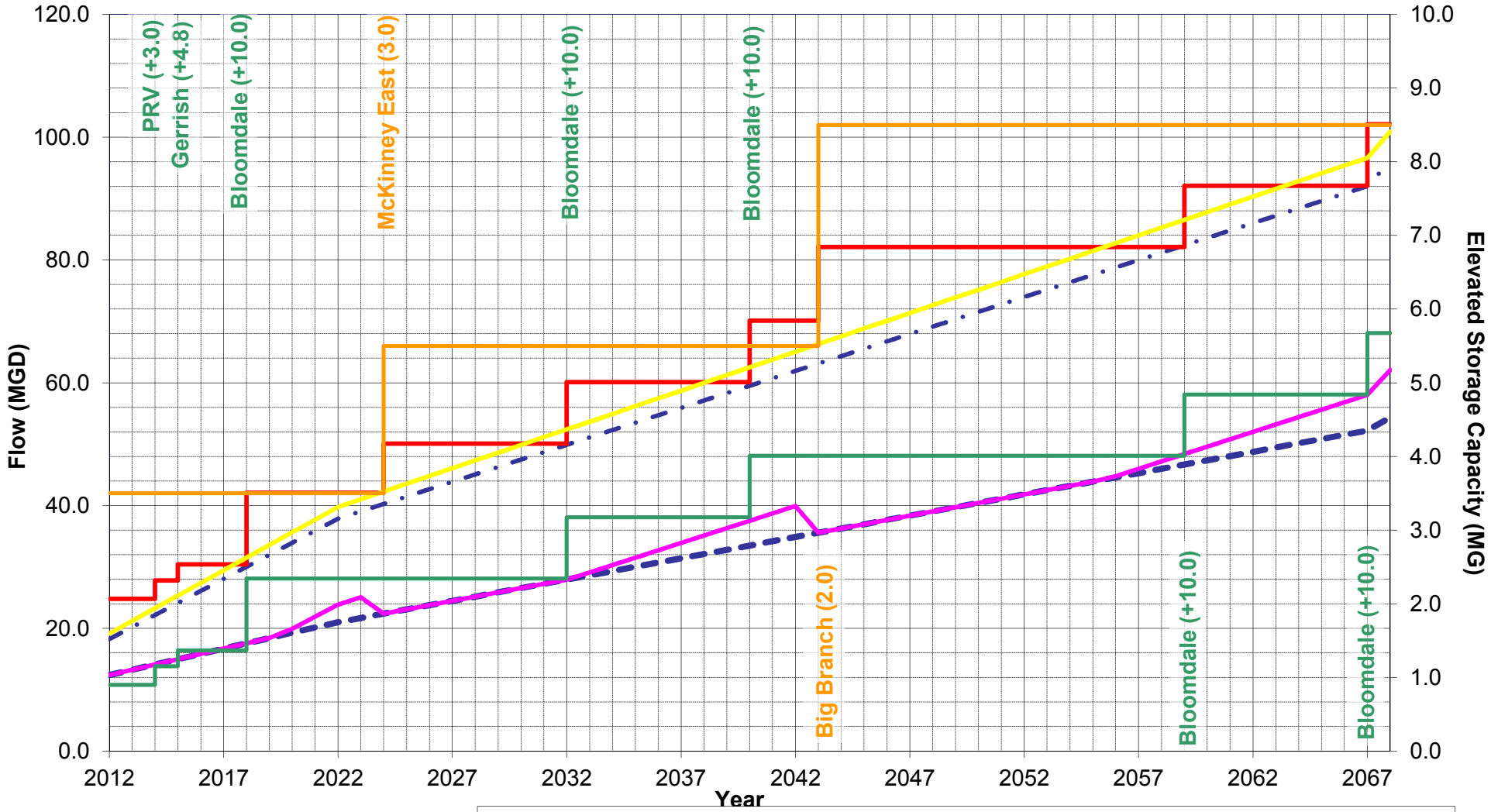
LEGEND

- EXISTING PIPE & SIZE
- PROPOSED PIPE & SIZE – MCKINNEY TOWN CENTER FIRE FLOW PIPE IMPROVEMENTS
- EXISTING PIPE TO BE ABANDONED FOLLOWING IMPROVEMENTS
- MCKINNEY TOWN CENTER REDEVELOPMENT ZONE

WATER DISTRIBUTION SYSTEM MASTER PLAN DOWNTOWN AREA 10-YEAR CAPITAL IMPROVEMENT PLAN

FIGURE 10

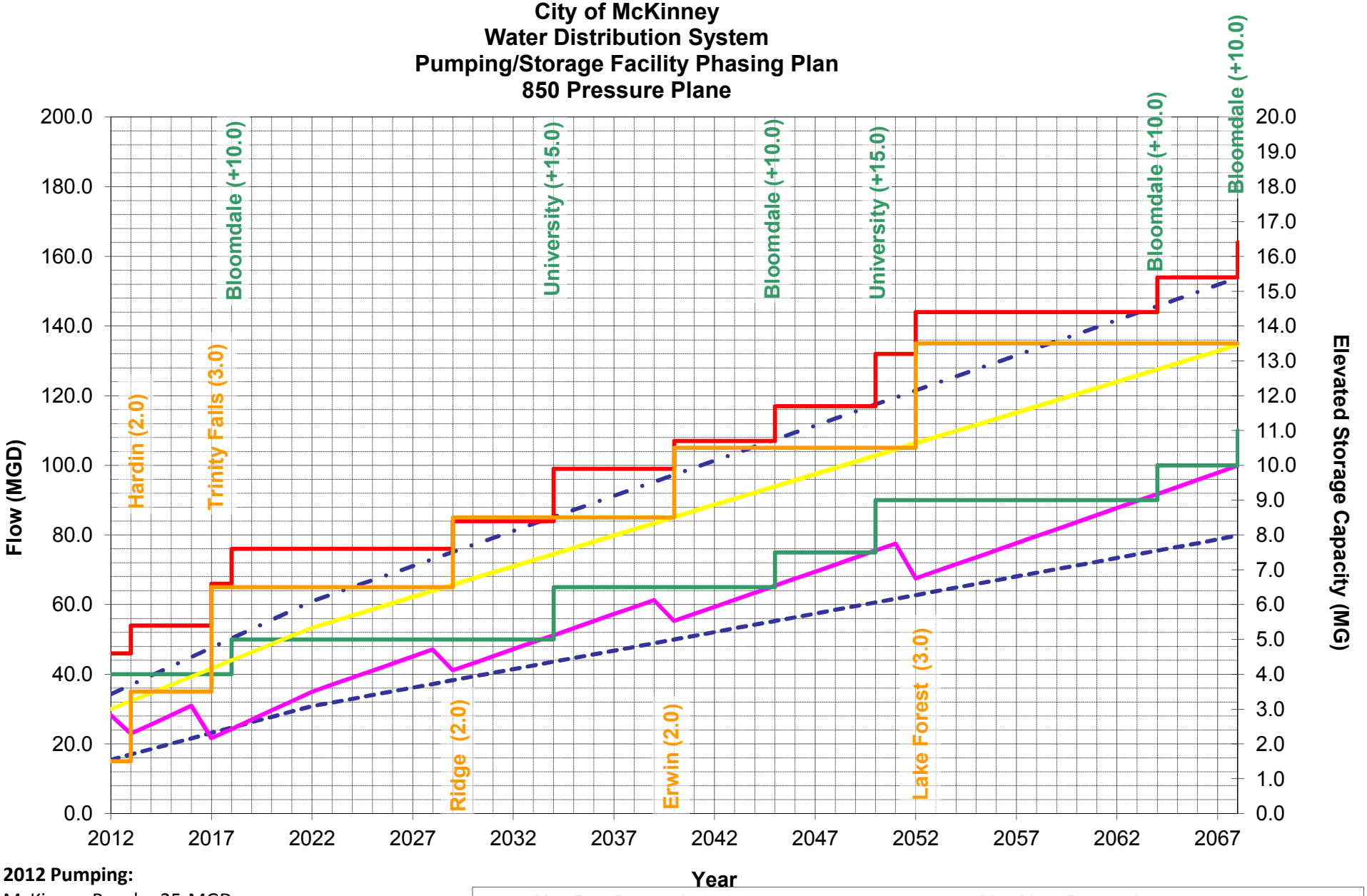
Figure 11A
City of McKinney
Water Distribution System
Pumping/Storage Facility Phasing Plan
794 Pressure Plane



2012 Pumping:
Gerrish- 10.8-MGD
2012 Elevated Storage:
U.S. 380 1.5 MG
Industrial 2.0 MG

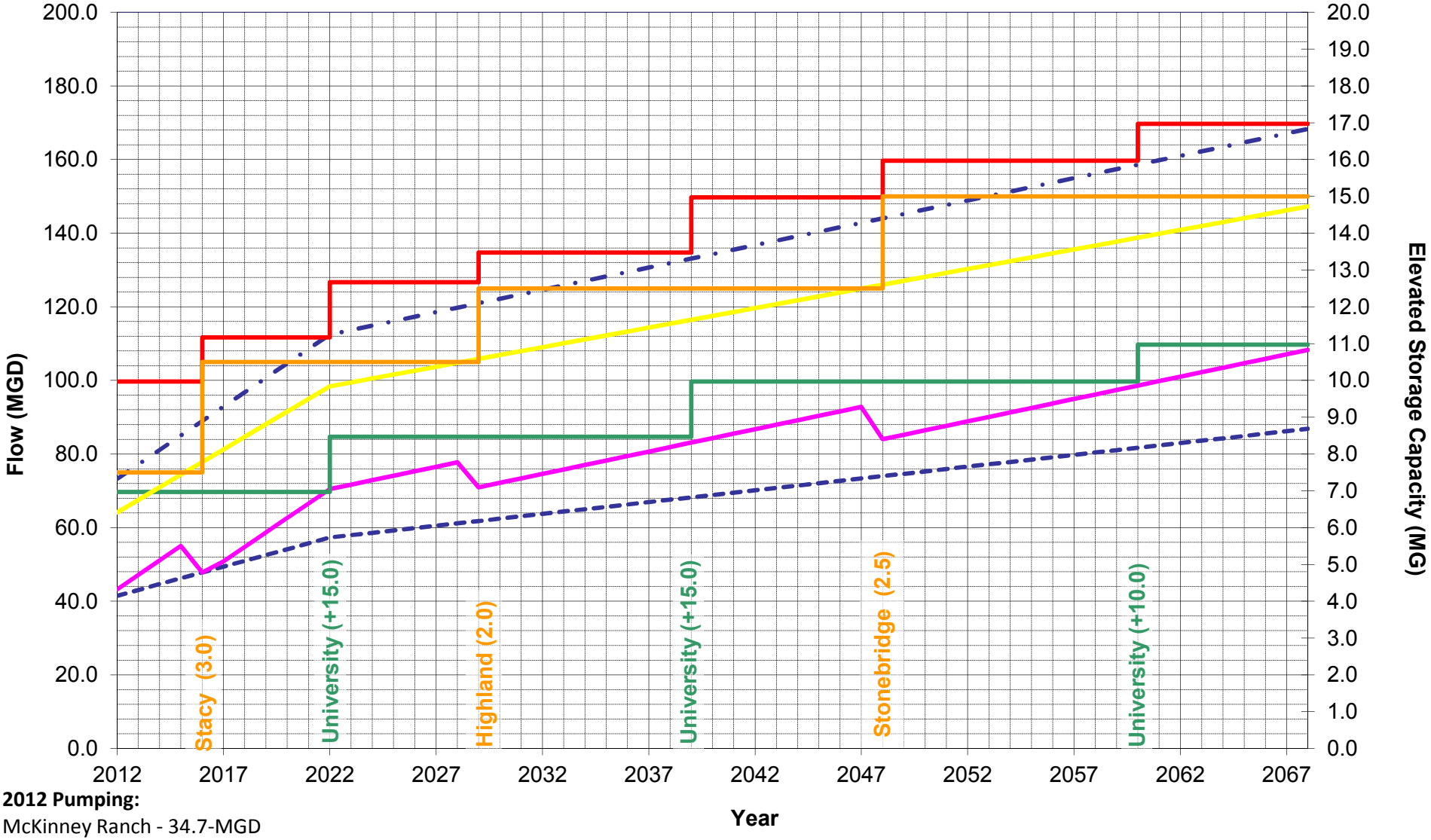
2014-2018 Pumping:
Supplemented by
3-MGD 794/850 PRV
2015 Puming:
Replace Gerrish Pump 4
(-1,500-gpm + 3,300-gpm)

Figure 11B
City of McKinney
Water Distribution System
Pumping/Storage Facility Phasing Plan
850 Pressure Plane



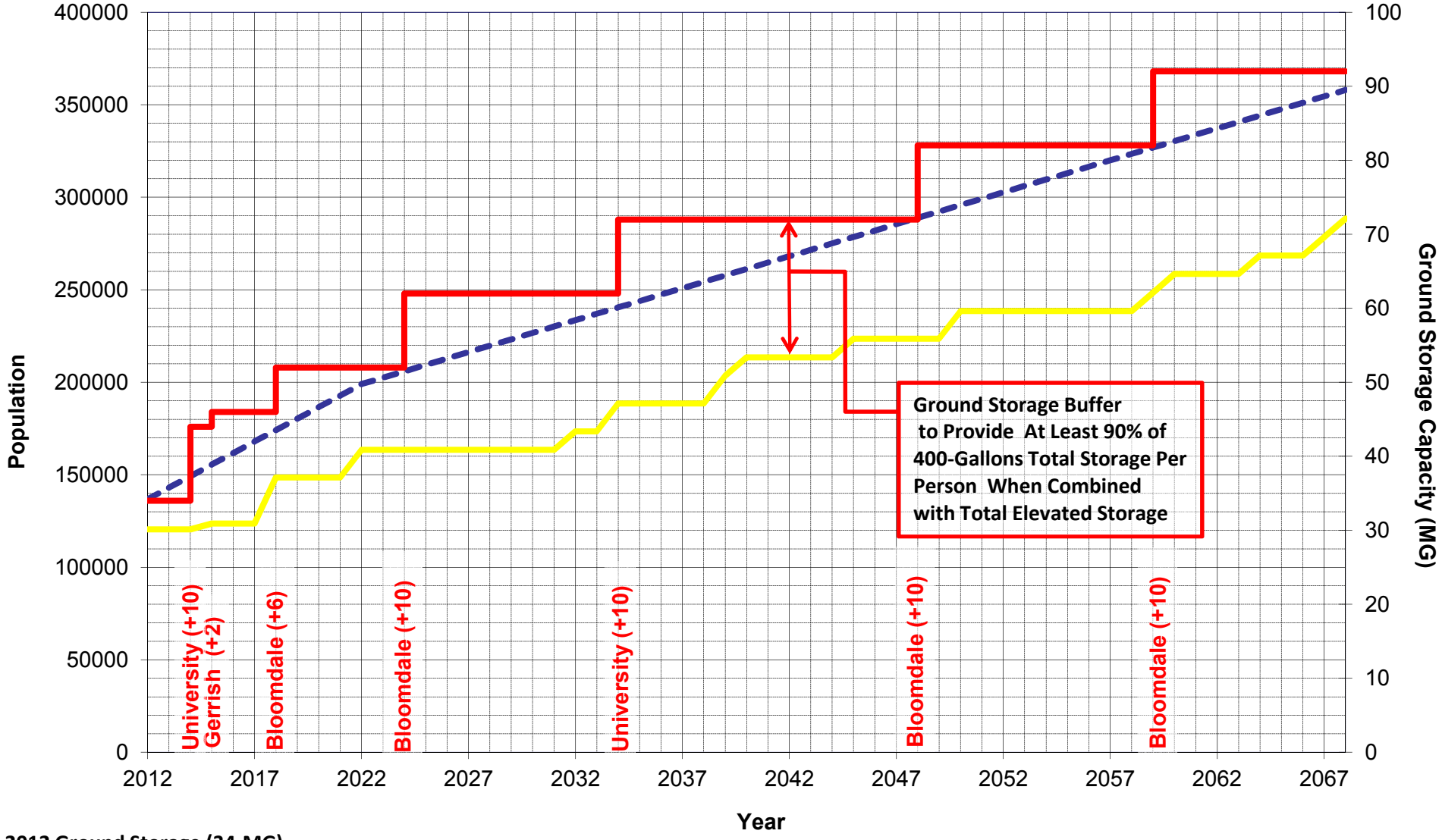
2012 Pumping:
McKinney Ranch - 25-MGD
University - 15-MGD (W/ 1 Pump on Standby)
2012 Elevated Storage:
Wilmeth 2MG (1.5 MG Capacity to 850 HWL)

Figure 11C
City of McKinney
Water Distribution System
Pumping/Storage Facility Phasing Plan
920 Pressure Plane



2012 Pumping:
McKinney Ranch - 34.7-MGD
University - 35-MGD (W/ 1 Pump on Standby)
2012 Elevated Storage:
Virginia 1.5 MG ; Community 3.0 MG
Independence 3.0 MG

Figure 11D
City of McKinney
Water Distribution System
System Ground Storage Phasing Plan
794, 850, 920 Pressure Plane



2012 Ground Storage (34-MG)
Gerrish - 2-MG
McKinney Ranch - 16-MG
University - 16-MG

Total Population 794, 850 & 920 Service Areas
Required Ground Storage Capacity for Pumping
Ground Storage Capacity Provided for Pumping and 400 Gallons Total Storage Per Person

Section III - Fire Flow Analysis

A. GENERAL

A fire flow analysis was completed for the 2012, 2022 and Buildout Models utilizing the H_2ONET Fire Flow Module. A fire flow was added at each demand junction node location. The simulation added the fire flow at each individual junction node and determined if the required residual pressure at the fire location was achieved, while system pressure and pipe velocity constraints at all other locations in the system were maintained. This process was repeated for each junction node in the system. If the system constraints are achieved, the model reports the residual pressure results and the maximum available fire flow at the junction node. If the constraints are not achieved, the model will utilize the input residual pressure, system pressure and velocity constraints, and calculate the fire flow that can be delivered under the set constraints.

B. FIRE FLOW CONSTRAINTS

The following constraints were utilized for the fire flow analysis:

- Base system demands at the time of fire – maximum daily demand conditions
- Base fire flow – 3,500 gallons per minute (gpm) = 5.04 million gallons per day (mgd)
- Minimum residual pressure at the fire location – 20 psi
- Minimum system pressure at all other locations in the system – 35 psi
- Maximum pipe velocity during a fire flow event – 10 feet per second (fps)

C. FIRE FLOW RESULTS

Figures 12A, 13 and 14 illustrate the available fire flow range at each junction node in the 2012, 2022 and Buildout Models, respectively. An additional fire flow scenario was run to simulate increases in available fire flow with improvements to the existing distribution system in the proposed McKinney Town Center area (Figure 12B). Each of these figures shows a majority of locations exceed the available fire flow of 3,500-gpm. In all locations, a single fire hydrant flow of 750-gpm was achieved.

Figure 12A represents the available fire flow results in the 2012 Model. Figure 12B illustrates improvements in available fire flow in the McKinney Town Center when the recommended improvements in Table No. 23, Section II, of this report are completed.

As shown on Figures 12A through 14, areas that experience available fire flow in the 750 to 1,500-gpm and 1,500 it 2,500-gpm ranges were sporadically located. Generally, these locations occur where pipe diameters are less than 12-inches in diameter inside single family residence subdivisions, at non-looped locations or in locations where ground elevations are in the upper thresholds of a pressure service area. The areas in the lower available fire flow range at buildout can be improved by increasing existing 6 to 8-inch pipe diameters to 8 to 12-inches when a street is rehabilitated or expanded in the future. Fire Flows along major transmission mains exceed 3,500-gpm.

Available pumping, ground storage or elevated storage capacities did not limit available fire flows in the fire flow scenarios.

McKINNEY™
TEXAS
Unique by nature.℠

N.T.S.

LEGEND

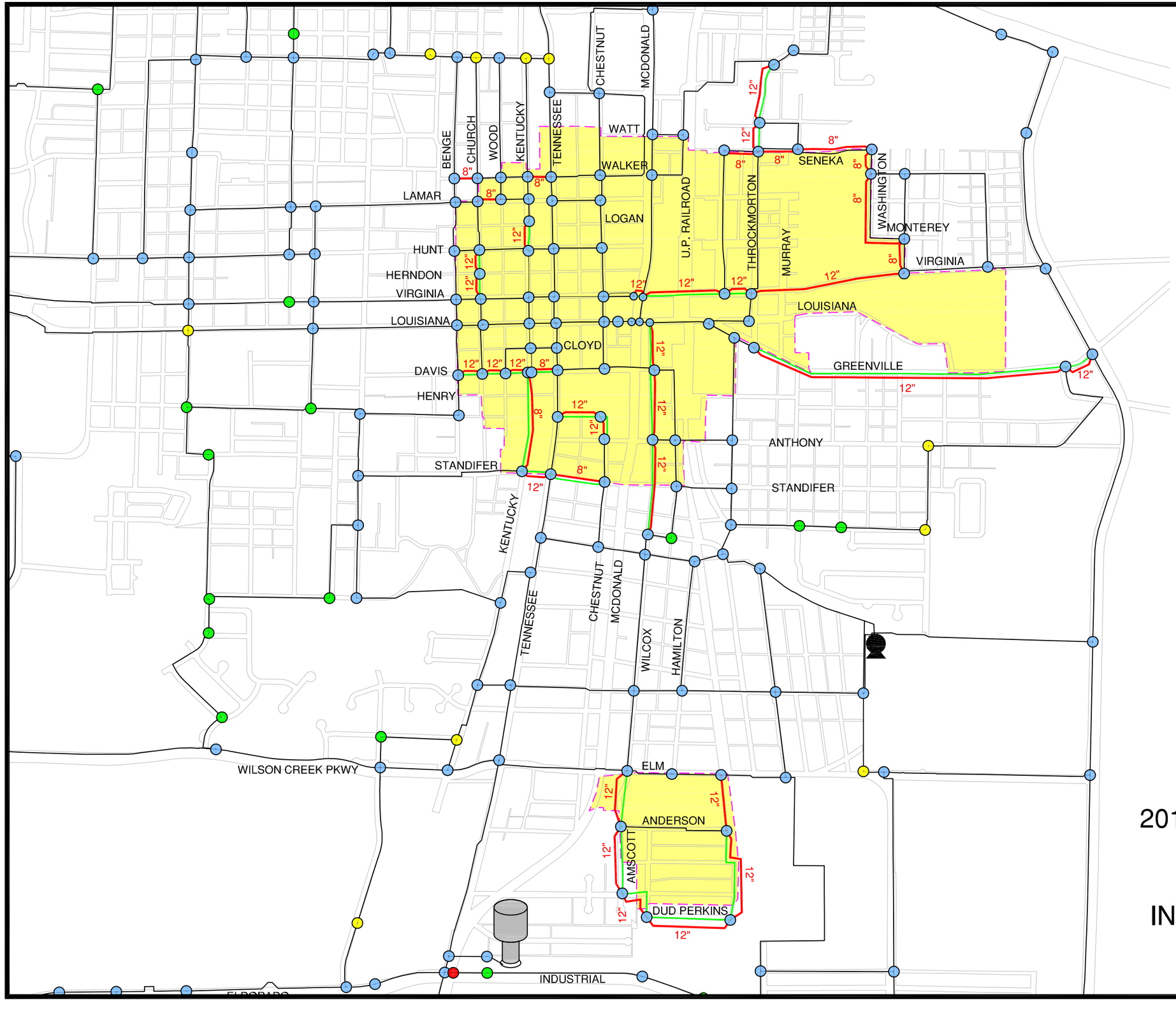
- FIRE FLOW 750–1,500 GPM
- FIRE FLOW 1,500–2,500 GPM
- FIRE FLOW 2,500–3,500 GPM
- FIRE FLOW >3,500 GPM
- PIPES
- EXISTING SERVICE AREA PRESSURE DIVIDE
- PUMP STATION
- ELEVATED STORAGE TANK

2012 FIRE FLOW ANALYSIS NOTES:

1. MAX DAY DEMAND CONDITION EPS MODEL HR–55.

2012 MAXIMUM DAILY DEMAND FIRE FLOW ANALYSIS AVAILABLE FIRE FLOW

FIGURE 12A



McKINNEY™ TEXAS
Unique by nature.℠

N.T.S.

LEGEND

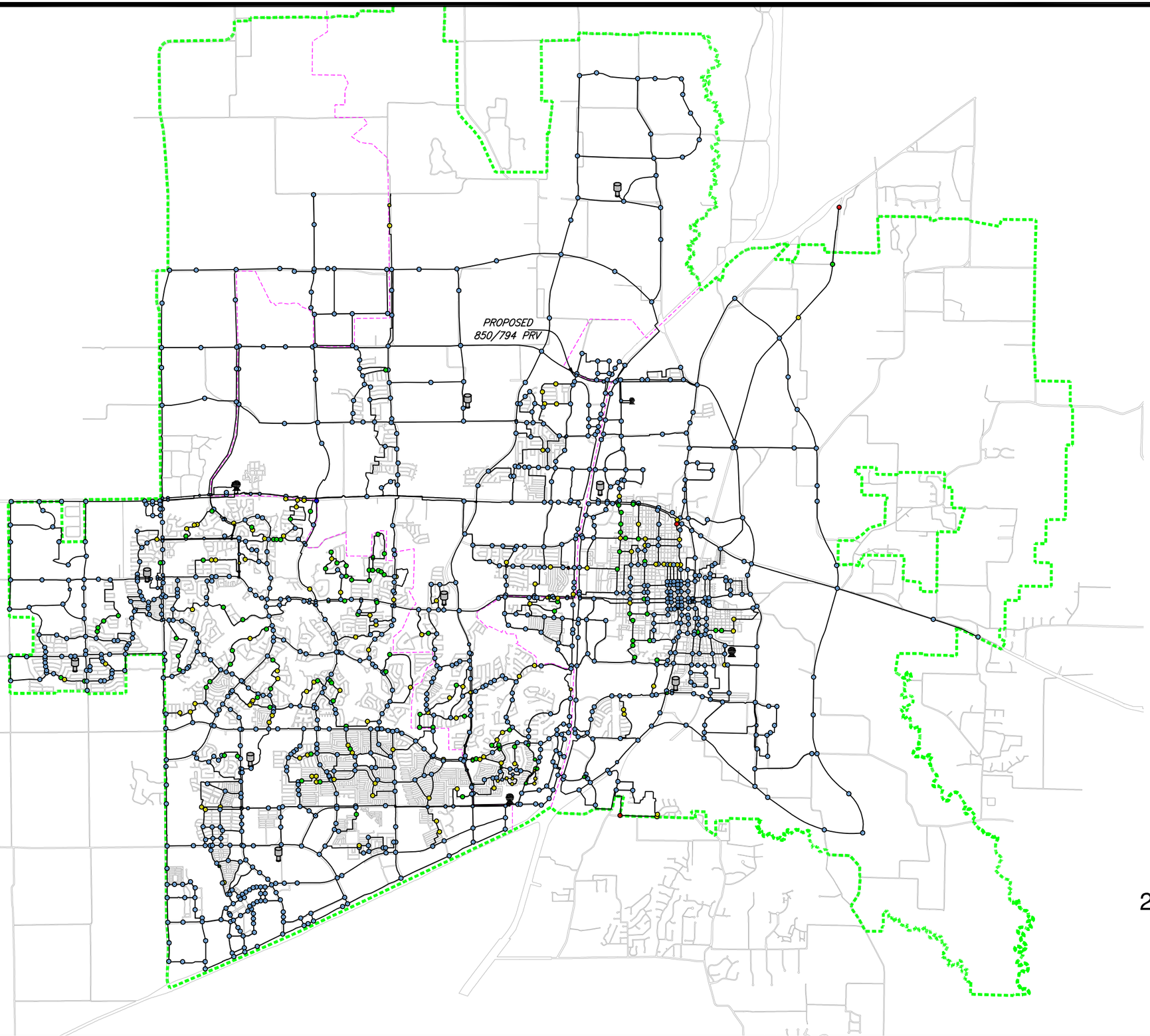
- FIRE FLOW 750–1,500 GPM
- FIRE FLOW 1,500–2,500 GPM
- FIRE FLOW 2,500–3,500 GPM
- FIRE FLOW >3,500 GPM
- EXISTING PIPES
- PROPOSED PIPE & SIZE – MCKINNEY TOWN CENTER FIRE FLOW PIPE IMPROVEMENTS
- EXISTING PIPES TO BE ABANDONED FOLLOWING IMPROVEMENTS
- MCKINNEY TOWN CENTER REDEVELOPMENT ZONES
- PUMP STATION
- ELEVATED STORAGE TANK

2012 FIRE FLOW ANALYSIS NOTES:

1. MAX DAY DEMAND CONDITION EPS MODEL HR–55.

2012 MAXIMUM DAILY DEMAND FIRE FLOW ANALYSIS AVAILABLE FIRE FLOW IN MCKINNEY TOWN CENTER WITH IMPROVEMENTS

FIGURE 12B



McKINNEY™
TEXAS
Unique by nature.℠

N.T.S.

LEGEND

- FIRE FLOW 750–1,500 GPM
- FIRE FLOW 1,500–2,500 GPM
- FIRE FLOW 2,500–3,500 GPM
- FIRE FLOW >3,500 GPM
- PIPES
- PLANNING BOUNDARY
- SERVICE AREA PRESSURE DIVIDE
- PUMP STATION
- ELEVATED STORAGE TANK

2022 FIRE FLOW ANALYSIS NOTES:

1. MAX DAY DEMAND CONDITION EPS MODEL HR–55.
2. RECOMMENDED TOWN CENTER FIRE FLOW IMPROVEMENTS IN PLACE.

2022 MAXIMUM DAILY DEMAND FIRE FLOW ANALYSIS AVAILABLE FIRE FLOW

FIGURE 13

McKINNEY™
TEXAS
Unique by nature.℠

N.T.S.

LEGEND

- FIRE FLOW 750–1,500 GPM
- FIRE FLOW 1,500–2,500 GPM
- FIRE FLOW 2,500–3,500 GPM
- FIRE FLOW >3,500 GPM
- PIPES
- PLANNING BOUNDARY
- SERVICE AREA PRESSURE DIVIDE
- PUMP STATION
- ELEVATED STORAGE TANK

BUILDOUT FIRE FLOW ANALYSIS NOTES:

1. MAX DAY DEMAND CONDITION EPS MODEL HR–55.

BUILDOUT MAXIMUM DAILY DEMAND FIRE FLOW ANALYSIS AVAILABLE FIRE FLOW

FIGURE 14

APPENDIX A
CITY OF McKINNEY, TEXAS
2012 WATER DISTRIBUTION SYSTEM MASTER PLAN
PER CAPITA DEMAND ANALYSIS

A. GENERAL

A per capita demand analysis was completed for the summer and winter of 2012. The purpose of the per capita analysis is to determine maximum daily, maximum hourly and average daily residential per capita demand rates for use in calculating existing water demands and to project demands for 10-year and buildout water models. The per capita analysis also defines hourly peaking factors in the form of a 72-hour diurnal curve that is applied to hydraulic model's base demands.

A similar per capita analysis was completed with City's 2006 Water Master Plan update. The 2006 per capita analysis was completed just prior to water restrictions set by the City's water supplier, the Texas Municipal Water District (NTMWD). In response to the NTMWD restrictions, the City implemented water conservation strategies that included twice weekly outdoor watering between midnight and 10:00 am and 6:00 pm to midnight according to a location's trash pick up day. In September 2007, a second day of watering was allowed on the third day following a trash pickup day.

In order to determine water use, the City provided water consumption records from the summer of 2012 and winter of 2012. July through September data was compiled to determine maximum daily and maximum hourly water use. January data was compiled to determine average daily water use.

B. ANALYSIS

The analysis consisted of obtaining daily raw data from City's SCADA system and compiling that data into a useful format. Once compiled, the data was tabulated and graphed. The compiled data consisted of thirty minute pumping volumes and volume changes in elevated storage tanks. The 920 Service Area data consisted of the Community 3.0-MG, Independence 3.0-MG and the Virginia 1.5-MG elevated storage tanks and the University and McKinney Ranch 920 Service Area Pump Stations. The 850 Service Area data included the Wilmeth 2.0-MG Elevated Storage Tank and the University and McKinney Ranch 850 Service Area Pump Stations. The 794 Service Area data consisted of the Industrial 2.0-MG and the U.S. 380 1.5-MG elevated storage tanks and the Gerrish Street Pump Station.

Data was tabulated for each 30-minute period of the day from July 1, 2012 through September 30, 2012 and January 1, 2012 through January 31, 2012 for the 794, 850 and the 920 Service Areas. A review of the raw data showed two items that appeared to be erroneous. The September University Pump Station 2 (850 Zone) flow meter recorded flows that exceeded pumping capacity of the combined capacity of both pumps. The FM 720 (McKinney Ranch) Pump Station 1 (850 Zone) recorded consistent daily flows. These two cases were discussed with the Public Works Department and it was determined the City operates only one University Pump Station 2 (850 Zone) pump at a time. The FM 720 Pump Station (850 Zone) pumps are not utilized on a regular basis. Based on this information, the September University Pump Station 2 (850 Zone) flow data was not utilized and the per capita analysis for the 850 Service Area was limited to July and August 2012. For the January data, the University Pump Station (850 Zone) raw data was manipulated to equate to single pump running. The FM 720 Pump Station (850 Zone) pumping data was set to 0-gpm in the 850 Service Area per capita analysis.

Compilation of summer data on an hourly basis allows the maximum daily and maximum hourly demands to be determined. Typically, the maximum demands will occur during the months of July, August or September after extended periods of hot dry weather. The summer of 2012 proved to be a mild summer with above normal rainfall during the summer months. Measurable rainfall occurred 25 days from July 1, 2013 and September 30, 2012. Temperatures were above 100° Fahrenheit 33-days during this period with highs of 107 degrees on July 21, 2012 and August 2, 2012 and a high of 108 degrees on August 9, 2012. The highest number of consecutive days exceeding 100 degrees occurred between July 28, 2012 and August 7, 2012.

The day of maximum water demand occurred on September 6, 2012 in the 920 Service Area, August 2, 2012 in the 850 Service area and August 3, 2012 in the 794 Service Area. For average daily demands, the daily water usage in each service areas was averaged for January 2012 and August 2012 to project average yearly demands.

Once the day of maximum water demand was determined, a deduction was made to remove the non-residential water demand. The non-residential water consumption was determined from the City's 2012 monthly billing records for January and July through September. The monthly non-residential water consumption was divided by the number of days in the corresponding month and an average daily non-residential total was determined. The average daily non-residential total was then subtracted from the overall water consumption for each of the study months.

C. RESULTS

At the time of the Per Capita Analysis, the City's Planning Department reported the 2012 residential population for McKinney was 136,811 persons. The following is the estimated population breakdown in the 794, 850 and 920 Service Areas:

794 Service Area - 2007 Estimated Residential Population 30,391

850 Service Area - 2007 Estimated Residential Population 32,707

920 Service Area - 2007 Estimated Residential Population 73,713

Total - 2012 Residential Population 136,811

Table A provides a summary of the non-residential water demand from the City's billing records in the 794, 850 and 920 Service Areas during the months studied:

TABLE A
2012 NON-RESIDENTIAL DEMAND

Month	Service Area	Total Daily Comm. Demand (Gal/Month)	Average. Daily Comm. Demand (Gal/Day)
Jan. 2012	794	29,748,000	959,613
July 2012		57,484,000	1,854,323
Aug. 2012		91,761,000	2,960,032
Sept. 2012		68,235,000	2,274,500
Jan. 2012	850	9,127,000	294,419
July 2012		36,317,000	1,171,516
Aug. 2012		48,825,000	1,510,484
Sept. 2012		43,796,000	1,412,774
Jan. 2012	920	21,732,000	701,032
July 2012		135,609,000	4,374,484
Aug. 2012		182,827,000	5,897,645
Sept. 2012		159,011,000	5,300,367

1. 794 Service Area Demand

The maximum daily demand rate in the 794 Service Area during the summer of 2012 occurred on Friday, August 3, 2012 (10.65 MGD). The maximum hourly demand occurred on Friday, July 6, 2012 (15.76 MGD). This represents a maximum day to maximum hourly peaking factor of 1.48 in the 794 Service Area.

Removing the August non-residential demand in the 794 Service Area from the calculated maximum daily demand provides an estimated residential maximum daily demand of 7.69

MGD (10.65 MGD – 2.96 MGD). Dividing the residential maximum daily demand by the 794 Service Area population, results in a maximum daily demand of 253-gallons per capita per day (gpcd). Applying a maximum hour peaking factor of 1.48 results in a maximum hourly residential per capita of 374-gpcd. The summer of 2012 residential demands break down to the following gallon per capita per day (gpcd) usage for the 794 Service Area:

794 Service Area - Residential Maximum Daily Demand ..... 253 gpcd
794 Service Area - Residential Maximum Hourly Demand ..... 374 gpcd

A summary of the daily summer of 2012 water demands in the 794 Service Area is presented in Table "D" (Pages 9 thru 11).

794 Service Area average daily demands were calculated by averaging the daily consumption in January 2012 and August 2012 and subtracting each month's non-residential use from each month's total consumption. The Average daily residential demand in the 794 Service Area calculated to 5.96 MGD. Dividing the residential consumption by the population in 794 Service Area, results in an estimated residential average daily water use of 196 gpcd.

2. 850 Service Area Demand

Based on the non-erroneous data available for July and August 2012, the maximum daily demand rate in the 850 Service Area occurred on Thursday, August 2, 2012 (15.50 MGD). The maximum hourly demand also occurred on Thursday, August 2, 2012 (35.54 MGD). This represents a peaking factor of 2.29 in the 850 Service Area. Removing the August non-residential demand in the 850 Service Area from the calculated maximum daily demand provides an estimated residential maximum daily demand of 13.99 MGD (15.50 MGD – 1.51 MGD). Dividing the residential maximum daily demand by the 850 Service Area population, results in a maximum daily demand of 428-gallons per capita per day (gpcd). Applying a maximum hour peaking factor of 2.29 results in a maximum hourly residential per capita of 980-gpcd. The summer of 2012 residential demands break down to the following gallon per capita per day (gpcd) usage for the 850 Service Area:

850 Service Area - Residential Maximum Daily Demand ..... 428 gpcd
850 Service Area - Residential Maximum Hourly Demand ..... 980 gpcd

A summary of the daily summer of 2012 water demands in the 850 Service Area is presented in Table "E" (Pages 12 thru 13).

850 Service Area average daily demands were calculated by averaging the daily consumption in January 2012 and August 2012 and subtracting each month's non-residential use from each month's total consumption. The Average daily residential demand in the 850 Service Area calculated to 5.73 MGD. Dividing the residential consumption by the population in 850 Service Area, results in an estimated residential average daily water use of 175 gpcd.

3. 920 Service Area Demand

The maximum daily demand rate in the 920 Service Area during the summer of 2012 occurred on Thursday, September 6, 2012 (43.84 MGD). The maximum hourly demand also occurred on Thursday, September 6, 2012 (79.00 MGD). This represents a peaking factor of 1.80 in the 920 Service Area. Removing the September non-residential demand in the 920 Service Area from the calculated maximum daily demand provides an estimated residential maximum daily demand of 38.54 MGD (43.84 MGD – 5.30 MGD). Dividing the residential maximum daily demand by the 920 Service Area population, results in a maximum daily demand of 523-gallons per capita per day (gpcd). Applying a maximum hour peaking factor of 1.80 results in a maximum hourly residential per capita of 941-gpcd. The summer of 2012 residential demands break down to the following gallon per capita per day (gpcd) usage for the 920 Service Area:

920 Service Area - Residential Maximum Daily Demand ..... 523 gpcd
920 Service Area - Residential Maximum Hourly Demand ..... 941 gpcd

A summary of the daily summer of 2012 water demands in the 920 Service Area is presented in Table "F" (Pages 14 thru 16).

920 Service Area average daily demands were calculated by averaging the daily consumption in January 2012 and August 2012 and subtracting each month's non-residential use from each month's total consumption. The Average daily residential demand in the 920 Service Area calculated to 21.14 MGD. Dividing the residential consumption by the population in 920 Service area, results in an estimated residential average daily water use of 286 gpcd

D. CONCLUSIONS

While reviewing the calculated residential per capita demand rates for the 794 Service Area, the 850 Service Area and the 920 Service Area, the following items were considered before establishing the residential per capita rates recommended for the 2012 Water Master Plan:

1. The residential per capita rates calculated for the summer of 2012 are higher than the residential per capita rates calculated in 2007, but lower than those calculated in 1999 or 2004. The higher per capita values in 2012 versus 2007 can be contributed warmer weather conditions in 2012 with periods of consecutive days above 100 degrees. The higher values of 1999 and 2004 were during a period prior to water conservation efforts during hot and dry weather conditions. We recommend a composite residential per capita demand rate be considered based on the 2012 data and previous summer data from McKinney. The City should continue to monitor per capita demands rates over the next two to three summers to verify the water demand recommendations for the 2012 Water Master Plan remain valid.

2. Much of the developed area in the 850 and 920 Service Areas consists of newer neighborhoods with landscaping and automatic water sprinklers, while the 794 Service Area consists of a mixture of both newer neighborhoods, established neighborhoods and non-residential uses. In the 794 Service Area, we recommend two different residential per capita rates, one for the existing downtown area land uses and one for the 10-year and buildout models that represent the proposed land uses in the McKinney Town Center redevelopment zone and future undeveloped residential land uses similar to the 850 and 920 Service areas.

Table B illustrates residential per capita demand rates previously used in the City of McKinney's Water Master Plans. Table C summarizes per capita rates from nearby municipalities with similar residential development to the City of McKinney.

TABLE B

RESIDENTIAL PER CAPITA HISTORY

Year	794 Service Area		850 Service Area		920 Service Area	
	Max Day gpcd	Max Hour gpcd	Max Day gpcd	Max Hour gpcd	Max Day gpcd	Max Hour Gpcd
* 1999	450	900			590	1,360
** 2004	418	761			716	1,611
* 2007	229	409	376	842	397	822
* 2012	253	374	428	980	523	941

*** Per Capita Analysis Completed by Birkhoff, Hendricks & Carter**

**** 2004 Per Capita Rates Based On 2004 Master Plan Report Prepared by Alan Plummer & Associates**

TABLE C
PER CAPITA COMPARISON TO OTHER CITIES

City	Max Day gpcd	Max Hour gpcd
Plano	500	1,030
Parker	645	1,160
Carrollton	425	750

Although the 2007 per capita analysis shows a residential maximum daily rate of 376-gpcd in the 850 Service Area and 397-gpcd in the 920 Service Area, the 2007 Master Plan was designed around a residential maximum daily demand per capita rate of 500-gpcd. This higher design rate was justified since the summer of 2007 experienced below normal high temperatures during the summer months as compared to previous summers. The summer of 2012 experienced several periods of temperatures exceeding 100 degrees, but not as many experienced in the summers of 1999 or 2011. This can explain the summer of 2012 per capita results being between the per capita rates calculated in 1999 and 2007. The reduction in the 794 Service Area residential per capita demand since 1999 can be contributed to the reduction of residential area from the 794 Service Area when the 850 Service Area was created.

We recommend the design residential per capita rates for maximum daily demands in undeveloped areas of the 794 Service Area and the entire 850 and 920 Service Areas be set at 495-gpcd in the 2012 Master Plan 10-year and buildout models. For maximum hourly demands, we recommend a peaking factor of 2.0 in the 850 and 920 Service Areas. A peaking factor of 2.0 is between the peaking factor of 1.8 experienced in the 920 Service Area and 2.29 experienced in the 850 Service Area during the summer of 2012.

We recommend a 300-gpcd maximum daily demand rate be utilized for the existing Town Center areas of the 794 Service Area with a peaking factor of 1.8 for maximum hourly demands. In the 10-year and buildout models, we recommend per capita rates for areas within the proposed McKinney Town Center (MTC) redevelopment zone be consistent with the 850 and 920 Service Areas.

The following is summary of the recommend design residential per capita rates to be applied in to the 10-year and buildout models:

Proposed Master Plan Residential Maximum Daily Demand ..... 495 gpcd
Proposed Master Plan Residential Maximum Hourly Demand ..... 990 gpcd
Maximum Hourly Peaking Factor 2.0

Existing Town Center Residential Maximum Daily Demand ..... 300 gpcd
Existing Town Center Residential Maximum Hourly Demand ..... 540 gpcd
Maximum Hourly Peaking Factor 1.8

A meeting with the City of McKinney occurred on April 16,2013 to review the recommended residential per capita rates. The City agreed with the recommended and reduced maximum daily and maximum hourly per capita rates based on historical data showing the City of McKinney is making progress in reducing water consumption with the City's continued water conservation efforts.

The existing model scenario will utilize the calculated residential per capita rates for each service area listed in Table B for the year 2012.

TABLE "D"
794 SERVICE AREA – SUMMARY OF JULY 2012 WATER DEMAND DATA

Date	Day	Water Day On Trash Day + 3	Daily Demand (gallons/day)	Maximum Hourly Demand (gallons/day)	Time Max. Hr. Occurred	Daily Peaking Factor	PF Based On Monthly Max. Day	Temperature Degrees Farneheit	Rainfall (in)
1-Jul-12	Sunday		5,715,229	9,028,795	1:00 PM	1.58	0.88	95	0.05
2-Jul-12	Monday	Yes	8,017,922	11,108,517	1:00 AM	1.39	1.08	93	
3-Jul-12	Tuesday		6,621,983	10,447,564	9:30 AM	1.58	1.01	97	
4-Jul-12	Wednesday		5,986,394	10,670,015	3:30 PM	1.78	1.04	98	
5-Jul-12	Thursday		6,743,249	10,706,507	1:00 PM	1.59	1.04	98	
6-Jul-12	Friday	Yes	10,040,768	15,758,887	9:00 PM	1.57	1.53	99	
7-Jul-12	Saturday		5,817,549	10,237,651	3:30 PM	1.76	0.99	101	
8-Jul-12	Sunday		4,808,206	6,072,955	11:30 AM	1.26	0.59	97	
9-Jul-12	Monday	Yes	6,925,715	11,558,051	9:00 PM	1.67	1.12	97	Trace
10-Jul-12	Tuesday		5,683,757	8,141,102	10:00 AM	1.43	0.79	93	0.02
11-Jul-12	Wednesday		5,744,830	9,670,978	4:00 PM	1.68	0.94	96	
12-Jul-12	Thursday		6,165,190	8,708,897	8:00 AM	1.41	0.85	95	
13-Jul-12	Friday	Yes	9,107,508	13,001,598	5:30 AM	1.43	1.26	96	
14-Jul-12	Saturday		5,902,973	10,513,677	11:00 AM	1.78	1.02	96	
15-Jul-12	Sunday		5,243,520	6,366,566	9:30 AM	1.21	0.62	91	Trace
16-Jul-12	Monday	Yes	8,151,461	12,300,458	7:00 AM	1.51	1.19	96	
17-Jul-12	Tuesday		6,780,777	11,828,416	12:30 AM	1.74	1.15	98	
18-Jul-12	Wednesday		6,773,067	8,698,440	9:30 AM	1.28	0.84	99	
19-Jul-12	Thursday		7,147,181	10,490,848	2:00 PM	1.47	1.02	101	
20-Jul-12	Friday	Yes	9,298,561	13,502,224	3:30 AM	1.45	1.31	105	0.71
21-Jul-12	Saturday		5,934,712	9,023,352	10:30 AM	1.52	0.88	107	Trace
22-Jul-12	Sunday		6,088,011	10,894,899	1:00 PM	1.79	1.06	101	
23-Jul-12	Monday	Yes	9,144,825	11,942,086	7:00 AM	1.31	1.16	98	
24-Jul-12	Tuesday		7,132,239	9,083,390	1:00 PM	1.27	0.88	97	
25-Jul-12	Wednesday		7,298,205	11,621,004	4:30 PM	1.59	1.13	101	
26-Jul-12	Thursday		7,604,533	12,994,483	1:00 PM	1.71	1.26	101	
27-Jul-12	Friday	Yes	10,299,066	15,386,319	4:00 AM	1.49	1.49	98	
28-Jul-12	Saturday		6,468,228	9,309,593	12:30 AM	1.44	0.90	103	
29-Jul-12	Sunday		6,547,871	8,155,848	8:30 AM	1.25	0.79	105	
30-Jul-12	Monday	Yes	9,935,201	13,018,496	10:30 PM	1.31	1.26	103	
31-Jul-12	Tuesday		8,413,154	12,714,405	10:30 AM	1.51	1.23	106	
	JULY AVG. DAILY DEMAND		**7,146,512**	**GALLONS PER DAY**					
	JULY MAX. DAY DEMAND		**10,299,066**	**GALLONS PER DAY**					
	JULY MAX. HOUR DEMAND		**15,758,887**	**GALLONS PER DAY**					

TABLE "D" (CONTINUED)
794 SERVICE AREA – SUMMARY OF AUGUST 2012 WATER DEMAND DATA

Date	Day	Water Day On Trash Day + 3	Daily Demand (gallons/day)	Maximum Hourly Demand (gallons/day)	Time Max. Hr. Occurred	Daily Peaking Factor	PF Based On Monthly Max. Day	Temperature Degrees Farneheit	Rainfall (in)
1-Aug-12	Wednesday		7,863,391	11,197,114	2:00 PM	1.42	1.05	106	
2-Aug-12	Thursday		7,527,938	12,572,393	8:00 AM	1.67	1.18	107	
3-Aug-12	Friday	Yes	10,651,358	15,443,207	2:30 AM	1.45	1.45	104	
4-Aug-12	Saturday		7,104,864	11,900,626	11:00 AM	1.67	1.12	102	
5-Aug-12	Sunday		7,346,450	10,540,650	8:30 PM	1.43	0.99	103	
6-Aug-12	Monday	Yes	10,190,367	13,467,470	3:30 AM	1.32	1.26	104	
7-Aug-12	Tuesday		7,971,855	10,005,241	12:30 AM	1.26	0.94	104	
8-Aug-12	Wednesday		7,402,636	10,690,218	12:30 PM	1.44	1.00	96	Trace
9-Aug-12	Thursday		6,804,150	9,516,921	11:30 PM	1.40	0.89	108	
10-Aug-12	Friday	Yes	10,598,372	16,492,156	10:30 PM	1.56	1.55	98	
11-Aug-12	Saturday		7,025,589	11,666,238	12:30 PM	1.66	1.10	99	
12-Aug-12	Sunday		6,584,571	11,275,138	9:00 AM	1.71	1.06	105	Trace
13-Aug-12	Monday	Yes	10,404,969	13,732,667	4:30 AM	1.32	1.29	104	
14-Aug-12	Tuesday		7,766,524	10,419,414	10:00 PM	1.34	0.98	106	0.57
15-Aug-12	Wednesday		6,018,079	7,706,178	8:00 AM	1.28	0.72	95	1.40
16-Aug-12	Thursday		6,274,698	9,464,782	7:00 AM	1.51	0.89	91	Trace
17-Aug-12	Friday	Yes	8,868,207	12,889,482	3:30 AM	1.45	1.21	98	Trace
18-Aug-12	Saturday		5,371,160	8,734,177	12:00 AM	1.63	0.82	87	0.93
19-Aug-12	Sunday		5,161,248	7,417,094	12:30 PM	1.44	0.70	93	
20-Aug-12	Monday	Yes	8,174,084	13,261,485	10:00 PM	1.62	1.25	93	
21-Aug-12	Tuesday		6,846,155	10,227,247	10:00 PM	1.49	0.96	78	0.28
22-Aug-12	Wednesday		6,670,462	9,057,460	7:30 AM	1.36	0.85	90	
23-Aug-12	Thursday		7,048,689	11,169,101	2:30 PM	1.58	1.05	92	
24-Aug-12	Friday	Yes	9,697,253	13,501,079	4:00 AM	1.39	1.27	93	
25-Aug-12	Saturday		5,892,677	9,752,422	2:00 PM	1.66	0.92	94	0.01
26-Aug-12	Sunday		5,688,875	7,526,789	11:30 AM	1.32	0.71	86	Trace
27-Aug-12	Monday	Yes	8,167,562	10,231,503	10:30 PM	1.25	0.96	96	
28-Aug-12	Tuesday		6,961,581	9,434,676	10:00 AM	1.36	0.89	95	Trace
29-Aug-12	Wednesday		7,036,041	11,390,993	3:00 PM	1.62	1.07	96	
30-Aug-12	Thursday		6,999,826	10,887,578	10:00 AM	1.56	1.02	98	
31-Aug-12	Friday	Yes	9,930,039	13,097,737	3:30 AM	1.32	1.23	101	
	AUG. AVG. DAILY DEMAND		**7,614,506**	**GALLONS PER DAY**					
	AUG. MAX. DAY DEMAND		**10,651,358**	**GALLONS PER DAY**					
	AUG. MAX. HOUR DEMAND		**15,443,207**	**GALLONS PER DAY**					

TABLE "D" (CONTINUED)
794 SERVICE AREA – SUMMARY OF SEPTEMBER 2012 WATER DEMAND DATA

Date	Day	Water Day On Trash Day + 3	Daily Demand (gallons/day)	Maximum Hourly Demand (gallons/day)	Time Max. Hr. Occurred	Daily Peaking Factor	PF Based On Monthly Max. Day	Temperature Degrees Farneheit	Rainfall (in)
1-Sep-12	Saturday		6,802,451	11,788,177	9:00 AM	1.73	1.17	99	
2-Sep-12	Sunday		6,441,021	10,882,824	8:00 PM	1.69	1.08	100	
3-Sep-12	Monday	Yes	9,306,942	12,014,286	10:00 PM	1.29	1.19	101	
4-Sep-12	Tuesday		8,014,967	10,743,406	8:30 AM	1.34	1.06	103	
5-Sep-12	Wednesday		7,892,192	10,435,683	2:00 PM	1.32	1.03	103	
6-Sep-12	Thursday		7,726,809	11,893,257	7:00 AM	1.54	1.18	104	
7-Sep-12	Friday	Yes	10,113,199	14,047,417	2:30 AM	1.39	1.39	104	
8-Sep-12	Saturday		6,145,791	8,872,050	12:30 AM	1.44	0.88	87	0.03
9-Sep-12	Sunday		6,681,092	10,972,276	4:30 PM	1.64	1.08	91	
10-Sep-12	Monday	Yes	9,232,758	12,540,620	9:00 PM	1.36	1.24	93	
11-Sep-12	Tuesday		7,190,253	11,505,892	8:00 AM	1.60	1.14	92	
12-Sep-12	Wednesday		7,653,831	12,457,685	6:30 AM	1.63	1.23	94	
13-Sep-12	Thursday		7,215,161	10,527,317	10:30 AM	1.46	1.04	87	Trace
14-Sep-12	Friday	Yes	8,305,214	11,710,011	1:30 AM	1.41	1.16	72	0.01
15-Sep-12	Saturday		5,564,309	9,431,374	8:30 AM	1.69	0.93	77	
16-Sep-12	Sunday		5,198,424	7,420,440	11:30 PM	1.43	0.73	70	0.18
17-Sep-12	Monday	Yes	7,296,386	11,726,672	1:00 AM	1.61	1.16	83	Trace
18-Sep-12	Tuesday		6,271,050	10,032,423	2:30 PM	1.60	0.99	85	
19-Sep-12	Wednesday		7,020,454	11,223,605	12:00 PM	1.60	1.11	88	
20-Sep-12	Thursday		7,587,752	10,910,530	2:00 PM	1.44	1.08	94	
21-Sep-12	Friday	Yes	9,829,701	13,570,736	8:00 AM	1.38	1.34	96	
22-Sep-12	Saturday		6,683,515	9,160,082	12:00 PM	1.37	0.91	97	
23-Sep-12	Sunday		6,595,230	10,141,688	10:00 AM	1.54	1.00	95	
24-Sep-12	Monday	Yes	9,604,009	12,826,088	4:30 AM	1.34	1.27	97	
25-Sep-12	Tuesday		7,093,055	8,856,304	8:00 AM	1.25	0.88	95	
26-Sep-12	Wednesday							94	
27-Sep-12	Thursday		7,739,817	11,583,801	4:00 AM	1.50	1.15	91	
28-Sep-12	Friday	Yes	8,620,991	13,011,605	4:30 AM	1.51	1.29	89	Trace
29-Sep-12	Saturday		5,100,916	7,178,718	12:30 AM	1.41	0.71	73	1.43
30-Sep-12	Sunday		4,836,089	7,065,365	1:30 PM	1.46	0.70	75	0.10
	SEPT. AVG. DAILY DEMAND		**7,371,151**	**GALLONS PER DAY**					
	SEPT. MAX. DAY DEMAND		**10,113,199**	**GALLONS PER DAY**					
	SEPT. MAX. HOUR DEMAND		**14,047,417**	**GALLONS PER DAY**					

TABLE "E"
850 SERVICE AREA – SUMMARY OF JULY 2012 WATER DEMAND DATA

Date	Day	Water Day On Trash Day + 3	Daily Demand (gallons/day)	Maximum Hourly Demand (gallons/day)	Time Max. Hr. Occurred	Daily Peaking Factor	PF Based On Monthly Max. Day	Temperature Degrees Farneheit	Rainfall (in)
1-Jul-12	Sunday	Yes	12,068,196	28,060,309	10:00 PM	2.33	1.94	95	0.05
2-Jul-12	Monday		6,051,706	11,678,039	10:00 PM	1.93	0.81	93	
3-Jul-12	Tuesday		5,643,210	14,747,903	10:30 PM	2.61	1.02	97	
4-Jul-12	Wednesday	Yes	9,659,012	24,566,726	10:30 PM	2.54	1.70	98	
5-Jul-12	Thursday	Yes	13,454,308	26,277,374	5:00 AM	1.95	1.82	98	
6-Jul-12	Friday		6,075,706	13,212,674	12:00 AM	2.17	0.92	99	
7-Jul-12	Saturday	Yes	7,840,025	17,897,548	6:30 AM	2.28	1.24	101	
8-Jul-12	Sunday	Yes	7,895,666	14,650,598	10:30 PM	1.86	1.02	97	
9-Jul-12	Monday		5,086,627	11,403,163	3:30 AM	2.24	0.79	97	Trace
10-Jul-12	Tuesday		4,735,095	13,714,074	8:00 PM	2.90	0.95	93	0.02
11-Jul-12	Wednesday	Yes	8,235,183	23,475,738	6:30 AM	2.85	1.63	96	
12-Jul-12	Thursday	Yes	12,354,516	28,546,095	8:30 PM	2.31	1.98	95	
13-Jul-12	Friday		5,372,803	11,365,282	12:30 AM	2.12	0.79	96	
14-Jul-12	Saturday	Yes	7,438,029	14,147,979	10:30 AM	1.90	0.98	96	
15-Jul-12	Sunday	Yes	8,326,447	20,058,131	5:00 AM	2.41	1.39	91	Trace
16-Jul-12	Monday		5,199,368	8,199,734	1:00 AM	1.58	0.57	96	
17-Jul-12	Tuesday		5,009,714	13,942,916	9:00 PM	2.78	0.97	98	
18-Jul-12	Wednesday	Yes	9,582,354	23,369,469	9:00 PM	2.44	1.62	99	
19-Jul-12	Thursday	Yes	13,375,323	31,287,961	8:30 PM	2.34	2.17	101	
20-Jul-12	Friday		5,667,003	13,071,955	12:00 AM	2.31	0.91	105	0.71
21-Jul-12	Saturday	Yes	8,462,512	19,951,704	9:30 PM	2.36	1.38	107	Trace
22-Jul-12	Sunday	Yes	11,674,397	19,967,269	9:30 PM	1.71	1.38	101	
23-Jul-12	Monday		6,016,076	12,705,109	2:30 PM	2.11	0.88	98	
24-Jul-12	Tuesday		5,951,249	17,203,010	9:30 PM	2.89	1.19	97	
25-Jul-12	Wednesday	Yes	10,004,870	21,258,451	9:00 PM	2.12	1.47	101	
26-Jul-12	Thursday	Yes	13,655,935	24,866,957	5:30 AM	1.82	1.72	101	
27-Jul-12	Friday		7,493,968	15,899,986	9:00 PM	2.12	1.10	98	
28-Jul-12	Saturday	Yes	10,582,635	17,117,437	5:30 AM	1.62	1.19	103	
29-Jul-12	Sunday	Yes	14,427,425	26,500,176	9:00 PM	1.84	1.84	105	
30-Jul-12	Monday		7,546,582	15,922,449	12:00 AM	2.11	1.10	103	
31-Jul-12	Tuesday		10,111,020	18,387,188	9:00 PM	1.82	1.27	106	
	JULY AVG. DAILY DEMAND		**8,548,289**	**GALLONS PER DAY**					
	JULY MAX. DAY DEMAND		**14,427,425**	**GALLONS PER DAY**					
	JULY MAX. HOUR DEMAND		**26,500,176**	**GALLONS PER DAY**					

TABLE "E" (CONTINUED)

850 SERVICE AREA – SUMMARY OF AUGUST 2012 WATER DEMAND DATA

Date	Day	Water Day On Trash Day + 3	Daily Demand (gallons/day)	Maximum Hourly Demand (gallons/day)	Time Max. Hr. Occurred	Daily Peaking Factor	PF Based On Monthly Max. Day	Temperature Degrees Farneheit	Rainfall (in)
1-Aug-12	Wednesday	Yes	12,538,062	22,715,275	8:30 PM	1.81	1.47	106	
2-Aug-12	Thursday	Yes	15,503,756	35,544,720	9:00 PM	2.29	2.29	107	
3-Aug-12	Friday		7,443,874	18,054,928	12:00 AM	2.43	1.16	104	
4-Aug-12	Saturday	Yes	10,908,366	27,986,153	4:30 AM	2.57	1.81	102	
5-Aug-12	Sunday	Yes	15,081,469	27,200,918	4:00 AM	1.80	1.75	103	
6-Aug-12	Monday		7,210,538	17,564,930	3:30 AM	2.44	1.13	104	
7-Aug-12	Tuesday		6,633,108	11,607,142	6:00 AM	1.75	0.75	104	
8-Aug-12	Wednesday	Yes	11,331,792	23,629,775	9:30 PM	2.09	1.52	96	Trace
9-Aug-12	Thursday	Yes	13,999,581	24,597,384	5:30 AM	1.76	1.59	108	
10-Aug-12	Friday		6,968,309	15,830,169	3:30 AM	2.27	1.02	98	
11-Aug-12	Saturday	Yes	10,436,192	17,572,256	5:00 AM	1.68	1.13	99	
12-Aug-12	Sunday	Yes	13,618,500	22,877,706	5:00 AM	1.68	1.48	105	Trace
13-Aug-12	Monday		7,453,803	14,803,605	12:30 AM	1.99	0.95	104	
14-Aug-12	Tuesday		6,743,322	14,565,962	3:00 AM	2.16	0.94	106	0.57
15-Aug-12	Wednesday	Yes	7,183,447	16,469,103	10:00 AM	2.29	1.06	95	1.40
16-Aug-12	Thursday	Yes	12,660,843	25,798,724	9:00 PM	2.04	1.66	91	Trace
17-Aug-12	Friday		5,825,285	13,403,859	3:00 AM	2.30	0.86	98	Trace
18-Aug-12	Saturday	Yes	6,322,030	12,824,442	1:00 PM	2.03	0.83	87	0.93
19-Aug-12	Sunday	Yes	8,501,829	17,446,897	4:00 AM	2.05	1.13	93	
20-Aug-12	Monday		4,915,331	8,936,720	6:30 PM	1.82	0.58	93	
21-Aug-12	Tuesday		5,491,790	18,675,480	7:00 PM	3.40	1.20	78	0.28
22-Aug-12	Wednesday	Yes	8,936,368	25,974,777	10:30 PM	2.91	1.68	90	
23-Aug-12	Thursday	Yes	12,356,630	26,391,411	5:30 AM	2.14	1.70	92	
24-Aug-12	Friday		6,493,237	24,982,570	10:30 PM	3.85	1.61	93	
25-Aug-12	Saturday	Yes	9,401,323	17,977,639	10:00 PM	1.91	1.16	94	0.01
26-Aug-12	Sunday	Yes	10,245,232	18,297,532	5:00 AM	1.79	1.18	86	Trace
27-Aug-12	Monday		6,198,732	14,838,180	6:30 AM	2.39	0.96	96	
28-Aug-12	Tuesday		6,119,903	16,975,895	1:30 PM	2.77	1.09	95	Trace
29-Aug-12	Wednesday	Yes	9,915,000	16,879,973	5:30 AM	1.70	1.09	96	
30-Aug-12	Thursday	Yes	12,079,419	23,511,997	4:30 AM	1.95	1.52	98	
31-Aug-12	Friday		6,465,767	17,859,225	6:00 AM	2.76	1.15	101	
	AUG. AVG. DAILY DEMAND		**9,192,995**	**GALLONS PER DAY**					
	AUG. MAX. DAY DEMAND		**15,503,756**	**GALLONS PER DAY**					
	AUG. MAX. HOUR DEMAND		**35,544,720**	**GALLONS PER DAY**					

TABLE "F"

920 SERVICE AREA – SUMMARY OF JULY 2012 WATER DEMAND DATA

Date	Day	Water Day On Trash Day + 3	Daily Demand (gallons/day)	Maximum Hourly Demand (gallons/day)	Time Max. Hr. Occurred	Daily Peaking Factor	PF Based On Monthly Max. Day	Temperature Degrees Farneheit	Rainfall (in)
1-Jul-12	Sunday		24,754,190	52,089,508	7:00 AM	2.10	1.33	95	0.05
2-Jul-12	Monday	Yes	34,484,983	53,592,560	8:00 PM	1.55	1.37	93	
3-Jul-12	Tuesday	Yes	33,862,714	68,451,838	8:00 PM	2.02	1.74	97	
4-Jul-12	Wednesday		28,683,731	55,549,864	2:00 PM	1.94	1.42	98	
5-Jul-12	Thursday	Yes	34,061,802	70,167,341	4:30 AM	2.06	1.79	98	
6-Jul-12	Friday	Yes	34,914,945	66,924,458	9:30 PM	1.92	1.71	99	
7-Jul-12	Saturday		29,465,743	57,010,049	7:30 AM	1.93	1.45	101	
8-Jul-12	Sunday		25,224,255	53,164,693	10:30 AM	2.11	1.35	97	
9-Jul-12	Monday	Yes	39,228,917	60,112,992	6:00 AM	1.53	1.53	97	Trace
10-Jul-12	Tuesday	Yes	35,260,337	59,140,093	6:30 PM	1.68	1.51	93	0.02
11-Jul-12	Wednesday		31,439,592	58,967,335	8:00 AM	1.88	1.50	96	
12-Jul-12	Thursday	Yes	35,534,624	78,627,599	10:30 PM	2.21	2.00	95	
13-Jul-12	Friday	Yes	33,924,576	61,369,401	5:00 AM	1.81	1.56	96	
14-Jul-12	Saturday		30,881,232	62,761,611	8:30 AM	2.03	1.60	96	
15-Jul-12	Sunday		24,764,470	57,197,498	9:30 PM	2.31	1.46	91	Trace
16-Jul-12	Monday	Yes	36,570,221	60,064,771	9:00 PM	1.64	1.53	96	
17-Jul-12	Tuesday	Yes	36,384,997	65,641,740	9:00 PM	1.80	1.67	98	
18-Jul-12	Wednesday		31,914,195	51,409,449	3:30 AM	1.61	1.31	99	
19-Jul-12	Thursday	Yes	36,497,055	63,599,290	10:00 PM	1.74	1.62	101	
20-Jul-12	Friday	Yes	34,119,658	67,794,079	5:30 AM	1.99	1.73	105	0.71
21-Jul-12	Saturday		28,157,672	53,804,318	11:30 AM	1.91	1.37	107	Trace
22-Jul-12	Sunday		24,618,400	52,446,646	12:00 PM	2.13	1.34	101	
23-Jul-12	Monday	Yes	35,897,364	60,431,649	5:30 AM	1.68	1.54	98	
24-Jul-12	Tuesday	Yes	37,356,860	64,869,928	9:00 PM	1.74	1.65	97	
25-Jul-12	Wednesday		31,569,668	57,481,078	10:00 AM	1.82	1.46	101	
26-Jul-12	Thursday	Yes	38,860,496	63,597,070	1:30 AM	1.64	1.62	101	
27-Jul-12	Friday	Yes	35,906,247	59,950,654	9:00 PM	1.67	1.53	98	
28-Jul-12	Saturday		33,599,834	60,677,173	10:00 AM	1.81	1.55	103	
29-Jul-12	Sunday		26,226,728	55,617,965	12:30 PM	2.12	1.42	105	
30-Jul-12	Monday	Yes	39,242,006	66,123,664	9:30 PM	1.69	1.69	103	
31-Jul-12	Tuesday	Yes	33,119,186	53,794,165	6:00 AM	1.62	1.37	106	
	JULY AVG. DAILY DEMAND		**32,791,184**	**GALLONS PER DAY**					
	JULY MAX. DAY DEMAND		**39,242,006**	**GALLONS PER DAY**					
	JULY MAX. HOUR DEMAND		**66,123,664**	**GALLONS PER DAY**					

TABLE "F" (CONTINUED)

920 SERVICE AREA – SUMMARY OF AUGUST 2012 WATER DEMAND DATA

Date	Day	Water Day For Most of S.A.	Daily Demand (gallons/day)	Maximum Hourly Demand (gallons/day)	Time Max. Hr. Occurred	Daily Peaking Factor	PF Based On Monthly Max. Day	Temperature Degrees Farneheit	Rainfall (in)
1-Aug-12	Wednesday		31,931,609	58,220,689	4:30 AM	1.82	1.37	106	
2-Aug-12	Thursday	Yes	39,240,325	79,248,149	10:30 PM	2.02	1.86	107	
3-Aug-12	Friday	Yes	36,992,672	61,202,932	11:00 PM	1.65	1.44	104	
4-Aug-12	Saturday		31,153,342	59,627,436	10:30 PM	1.91	1.40	102	
5-Aug-12	Sunday		29,754,265	53,218,639	8:00 PM	1.79	1.25	103	
6-Aug-12	Monday	Yes	42,554,994	75,841,878	2:00 AM	1.78	1.78	104	
7-Aug-12	Tuesday	Yes	37,922,760	75,471,200	8:00 PM	1.99	1.77	104	
8-Aug-12	Wednesday		30,747,582	61,285,359	6:30 AM	1.99	1.44	96	Trace
9-Aug-12	Thursday	Yes	38,061,823	68,531,889	12:30 AM	1.80	1.61	108	
10-Aug-12	Friday	Yes	38,178,957	72,567,478	4:30 AM	1.90	1.71	98	
11-Aug-12	Saturday		34,169,525	54,191,845	1:00 PM	1.59	1.27	99	
12-Aug-12	Sunday		27,590,507	59,956,415	9:00 PM	2.17	1.41	105	Trace
13-Aug-12	Monday	Yes	39,664,989	72,110,390	5:30 AM	1.82	1.69	104	
14-Aug-12	Tuesday	Yes	37,844,583	68,583,046	6:00 AM	1.81	1.61	106	0.57
15-Aug-12	Wednesday		29,514,544	66,375,222	8:30 PM	2.25	1.56	95	1.40
16-Aug-12	Thursday	Yes	34,724,508	68,424,662	10:00 PM	1.97	1.61	91	Trace
17-Aug-12	Friday	Yes	32,789,255	62,710,338	6:30 AM	1.91	1.47	98	Trace
18-Aug-12	Saturday		23,804,120	50,574,354	1:30 AM	2.12	1.19	87	0.93
19-Aug-12	Sunday		25,151,937	51,784,152	12:30 PM	2.06	1.22	93	
20-Aug-12	Monday	Yes	34,885,929	78,817,468	2:30 AM	2.26	1.85	93	
21-Aug-12	Tuesday	Yes	30,919,154	55,877,926	10:00 PM	1.81	1.31	78	0.28
22-Aug-12	Wednesday		28,237,512	58,837,189	6:30 AM	2.08	1.38	90	
23-Aug-12	Thursday	Yes	35,209,127	68,338,463	4:00 AM	1.94	1.61	92	
24-Aug-12	Friday	Yes	34,107,964	69,117,628	5:00 AM	2.03	1.62	93	
25-Aug-12	Saturday		28,891,192	55,706,846	5:30 AM	1.93	1.31	94	0.01
26-Aug-12	Sunday		27,386,726	51,082,379	11:00 PM	1.87	1.20	86	Trace
27-Aug-12	Monday	Yes	36,254,703	67,577,602	5:30 AM	1.86	1.59	96	
28-Aug-12	Tuesday	Yes	34,669,905	64,674,858	3:30 AM	1.87	1.52	95	Trace
29-Aug-12	Wednesday		33,737,581	54,508,812	9:30 AM	1.62	1.28	96	
30-Aug-12	Thursday	Yes	38,259,423	73,553,421	2:30 AM	1.92	1.73	98	
31-Aug-12	Friday	Yes	37,493,532	61,756,991	10:30 PM	1.65	1.45	101	
	AUG. AVG. DAILY DEMAND		**33,607,905**	**GALLONS PER DAY**					
	AUG. MAX. DAY DEMAND		**42,554,994**	**GALLONS PER DAY**					
	AUG. MAX. HOUR DEMAND		**75,841,878**	**GALLONS PER DAY**					

TABLE "F" (CONTINUED)

920 SERVICE AREA – SUMMARY OF SEPTEMBER 2012 WATER DEMAND DATA

Date	Day	Water Day For Most of S.A.	Daily Demand (gallons/day)	Maximum Hourly Demand (gallons/day)	Time Max. Hr. Occurred	Daily Peaking Factor	PF Based On Monthly Max. Day	Temperature Degrees Farneheit	Rainfall (in)
1-Sep-12	Saturday		34,163,836	63,053,197	10:00 PM	1.85	1.44	99	
2-Sep-12	Sunday		27,998,731	55,125,697	4:00 PM	1.97	1.26	100	
3-Sep-12	Monday	Yes	39,757,321	69,811,660	9:30 PM	1.76	1.59	101	
4-Sep-12	Tuesday	Yes	36,963,832	67,325,444	7:30 AM	1.82	1.54	103	
5-Sep-12	Wednesday		33,953,847	61,683,454	12:30 AM	1.82	1.41	103	
6-Sep-12	Thursday	Yes	43,838,938	79,005,422	2:30 AM	1.80	1.80	104	
7-Sep-12	Friday	Yes	38,425,362	63,989,464	11:30 PM	1.67	1.46	104	
8-Sep-12	Saturday		34,787,456	74,328,228	9:00 PM	2.14	1.70	87	0.03
9-Sep-12	Sunday		31,845,310	59,051,544	10:30 PM	1.85	1.35	91	
10-Sep-12	Monday	Yes	41,960,273	82,488,783	9:30 PM	1.97	1.88	93	
11-Sep-12	Tuesday	Yes	42,230,342	73,478,048	4:00 AM	1.74	1.68	92	
12-Sep-12	Wednesday		35,343,708	64,532,363	2:30 AM	1.83	1.47	94	
13-Sep-12	Thursday	Yes	43,855,755	78,272,529	2:00 AM	1.78	1.79	87	Trace
14-Sep-12	Friday	Yes	34,257,027	69,901,357	10:00 PM	2.04	1.59	72	0.01
15-Sep-12	Saturday		29,803,921	53,613,679	2:30 AM	1.80	1.22	77	
16-Sep-12	Sunday		33,807,177	65,966,435	2:30 AM	1.95	1.50	70	0.18
17-Sep-12	Monday	Yes	39,326,651	64,036,932	5:00 AM	1.63	1.46	83	Trace
18-Sep-12	Tuesday	Yes	41,596,314	70,784,426	5:30 AM	1.70	1.61	85	
19-Sep-12	Wednesday		32,958,636	53,294,422	8:00 PM	1.62	1.22	88	
20-Sep-12	Thursday	Yes	43,948,651	74,212,374	6:30 AM	1.69	1.69	94	
21-Sep-12	Friday	Yes	39,053,014	61,363,653	9:30 PM	1.57	1.40	96	
22-Sep-12	Saturday		37,018,663	66,886,884	4:30 AM	1.81	1.53	97	
23-Sep-12	Sunday		38,442,772	66,826,257	10:30 PM	1.74	1.52	95	
24-Sep-12	Monday	Yes	42,235,546	67,677,148	5:30 AM	1.60	1.54	97	
25-Sep-12	Tuesday	Yes	38,243,318	66,308,379	11:00 AM	1.73	1.51	95	
26-Sep-12	Wednesday		33,595,719	75,422,131	7:30 AM	2.24	1.72	94	
27-Sep-12	Thursday	Yes	40,074,550	77,465,995	9:30 PM	1.93	1.77	91	
28-Sep-12	Friday	Yes	38,305,597	65,537,263	3:00 AM	1.71	1.49	89	Trace
29-Sep-12	Saturday		35,971,814	63,216,074	8:30 AM	1.76	1.44	73	1.43
30-Sep-12	Sunday		30,352,610	60,165,564	6:00 AM	1.98	1.37	75	0.10
	SEPT. AVG. DAILY DEMAND		**37,137,223**	**GALLONS PER DAY**					
	SEPT. MAX. DAY DEMAND		**43,838,938**	**GALLONS PER DAY**					
	SEPT. MAX. HOUR DEMAND		**79,005,422**	**GALLONS PER DAY**					

The 2012 per capita demand analysis was also utilized to generate daily water use curves known as diurnal curves. Diurnal curves are used to peak model demands over a period of time. Values of 1.0 represent maximum daily demands and the rate of pumping required. Values above 1.0 are demands that represent peak hour demands that are generally met by a combination of pumping and elevated storage tanks. Values below 1.0 are periods of minimum demand where elevated storage tanks are refilled.

Figures A1 through A3 illustrate 72-hour diurnal curves for the 794, 850 and 920 Service Areas, respectively, measured from the actual 30-minute pumping and elevated storage tank SCADA data during the summer of 2012. The three days selected for the diurnal curves generally represent the day prior to and following the day of maximum daily demand during the summer of 2012. The diurnal curves in Figures A1 through A3 are intend for peaking the base maximum daily demand input in the existing (2012) model scenario.

Figures A4 through A5 illustrates recommend composite diurnal curves for use in the 10-year (2022) and buildout scenarios. The diurnal curve in Figure A4 is similar to the diurnal curve in Figure A3, except the peaking factors were adjusted to build to a maximum hourly peaking factor of 2.0. The Figure A4 diurnal curve is intended for the future development areas of the 794 Service area and all of the 850 and 920 Service Areas.

In a similar manner, the diurnal curve in Figure A5 is similar to the diurnal curve in Figure A1, except the peaking factors were modified to build to a peaking factor of 1.8. The diurnal curve in Figure A5 is intended to peak the base model demands in the existing Town Center area of the 794 Service Area that is located outside the redevelopment zone of the proposed McKinney Town Center project in the 10-year and buildout model scenarios.

The modifications to the 2012 measured diurnal curves were made based on a combination of previous demand analysis with higher temperatures and less rainfall than the summer of 2012 and our experience with McKinney's water distribution system.

CITY OF MCKINNEY - 2012 MASTER PLAN

RECOMMENDED 72 HOUR DIURNAL CURVE (10-YEAR AND BUILDOUT MODELS)

EXISTING TOWN CENTER 794 SERVICE AREA OUTSIDE PROPOSED MTC

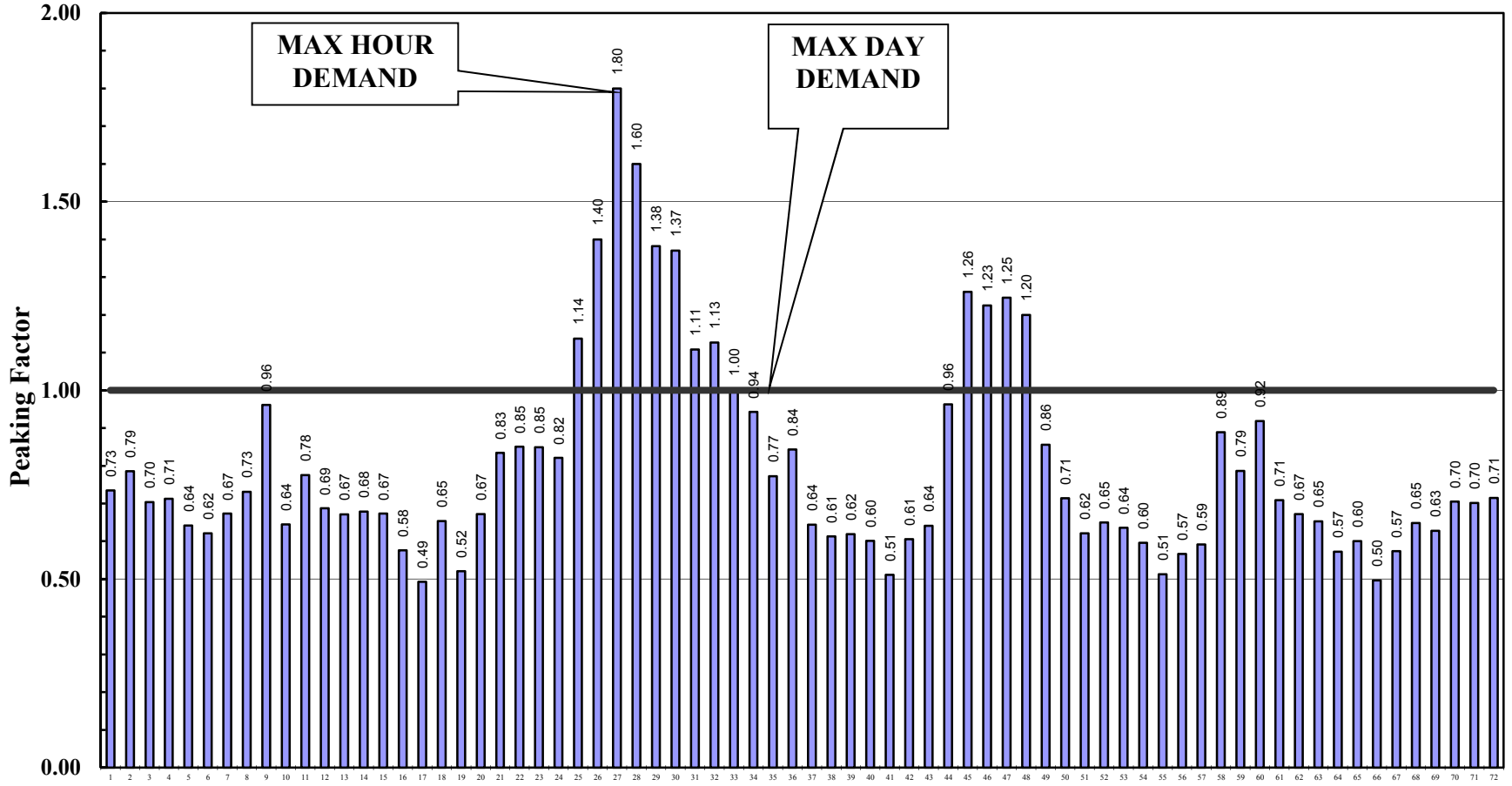


FIGURE A5

CITY OF MCKINNEY - PER CAPITA DEMAND ANALYSIS

72 HOUR DIURNAL CURVE FOR THE 794 SERVICE AREA

(THURSDAY AUGUST 2 THROUGH SATURDAY AUGUST 4, 2012)

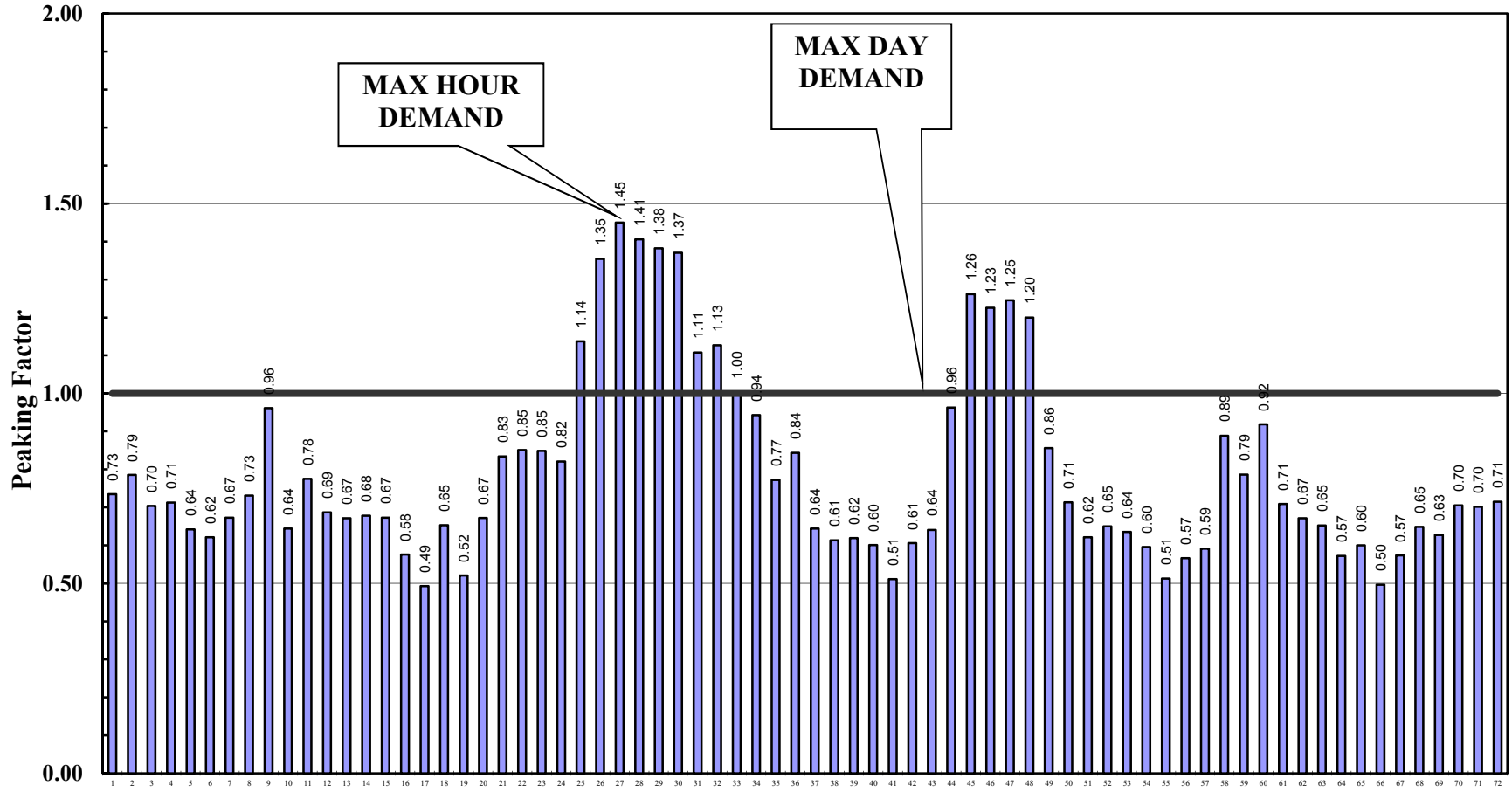


FIGURE A1

CITY OF MCKINNEY - PER CAPITA DEMAND ANALYSIS

72 HOUR DIURNAL CURVE FOR THE 850 SERVICE AREA

(WEDNESDAY AUGUST 1 THROUGH FRIDAY AUGUST 3, 2012)

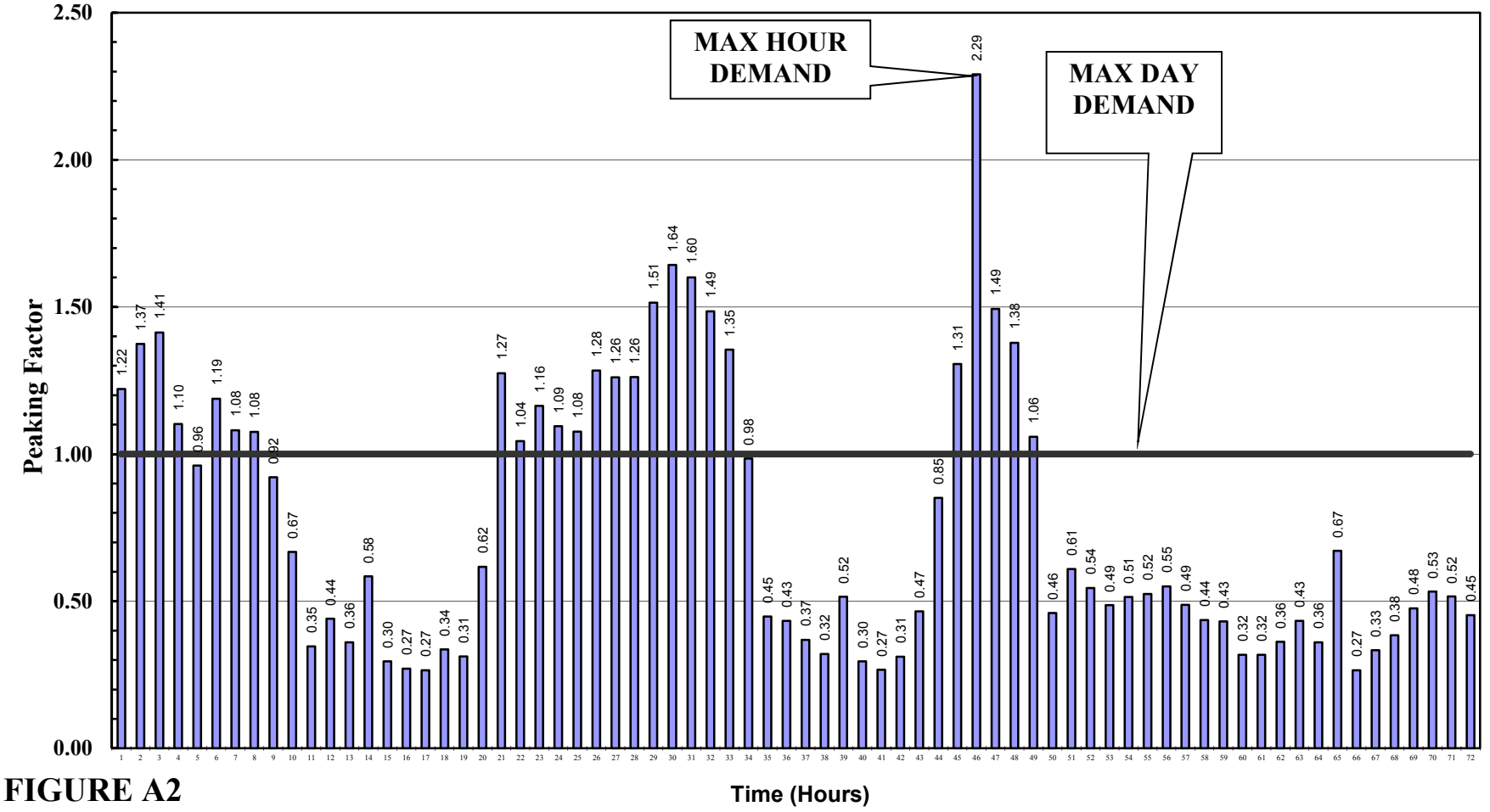


FIGURE A2

CITY OF MCKINNEY - PER CAPITA DEMAND ANALYSIS

72 HOUR DIURNAL CURVE FOR THE 920 SERVICE AREA

(WEDNESDAY SEPTRMBER 5 THROUGH FRIDAY SEPTEMBER 8, 2012)

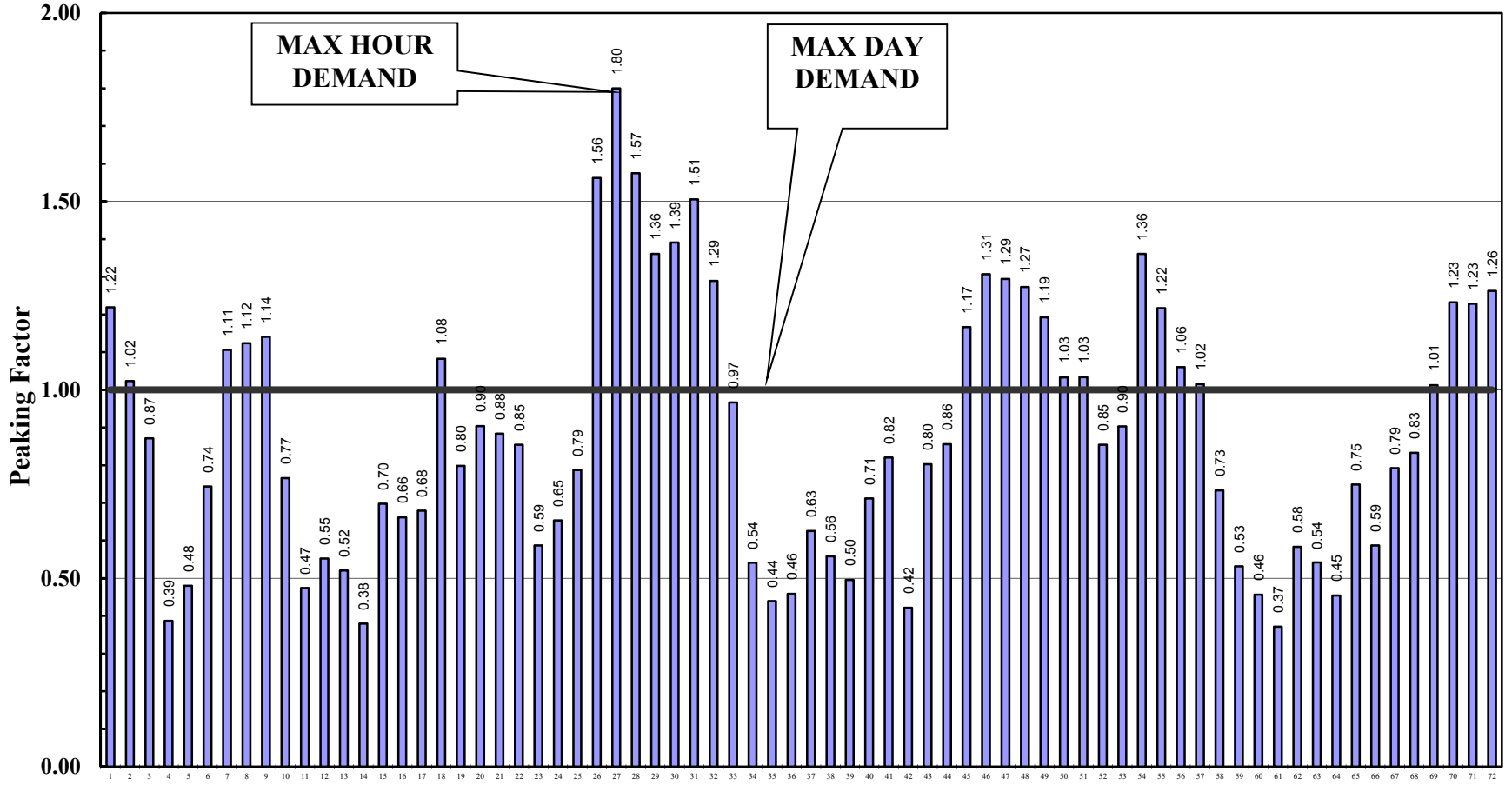


FIGURE A3

CITY OF MCKINNEY - 2012 MASTER PLAN

RECOMMENDED 72 HOUR DIURNAL CURVE (10-YEAR AND BUILDOUT MODELS) FOR THE 920, 850 AND NEW DEVELOPMENT IN THE 794 SERVICE AREA

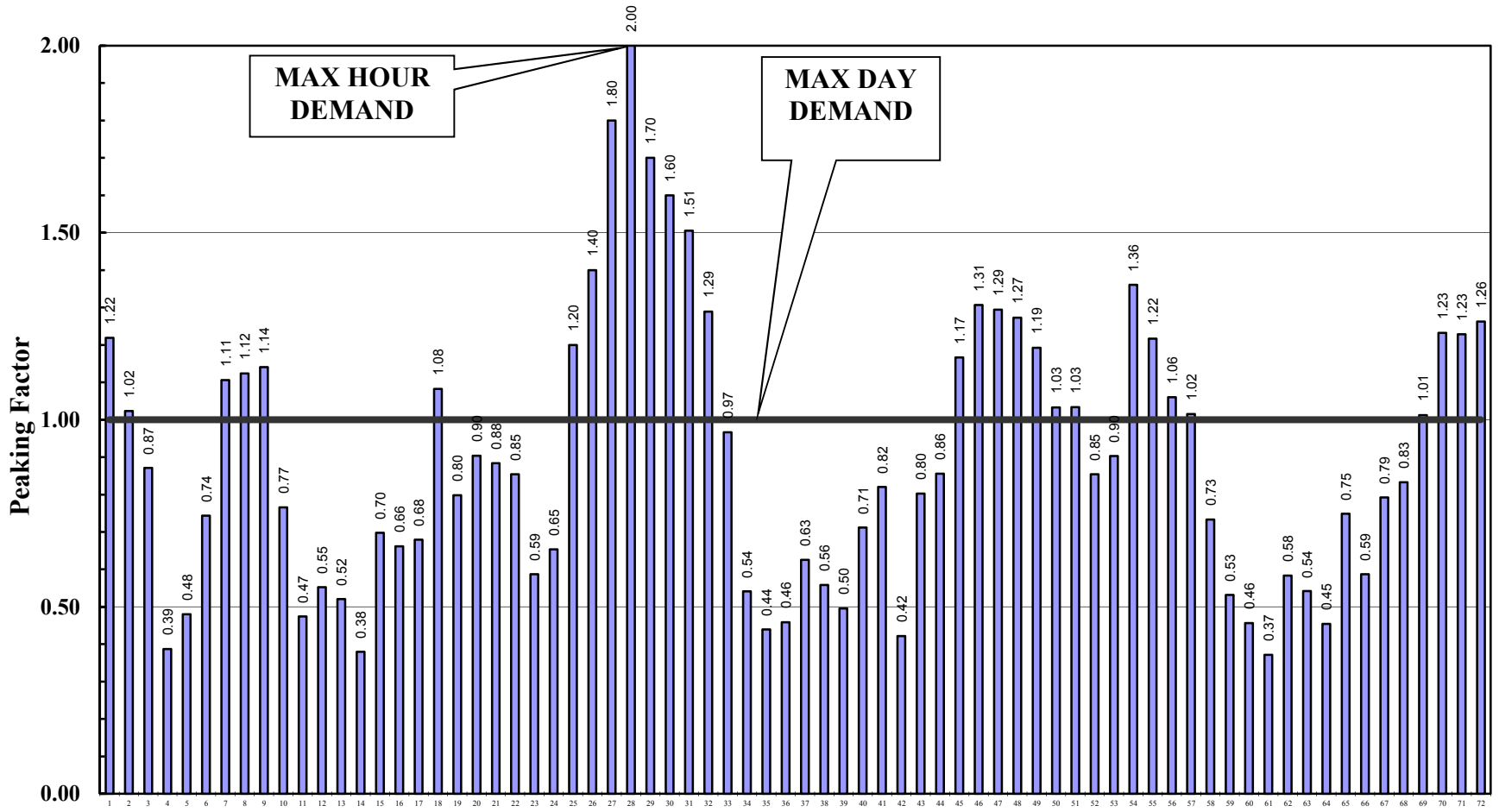


FIGURE A4

WATER DISTRIBUTION SYSTEM MASTER PLAN

BIRKHOFF, HENDRICKS & CARTER, L.L.P.
PROFESSIONAL ENGINEERS
DALLAS, TEXAS

August 2013