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MASTER PLAN

FOR

WATER AND SEWER SYSTEM IMPROVEMENTS

FOR THE

CITY OF BEDFORD

CITY OF BEDFORD
A MAIN STREET CITY

DEPARTMENT OF PUBLIC WORKS

PHONE (540) 586-7181
FAX (540) 586-7182

702 ORANGE STREET
BEDFORD, VIRGINIA 24523

INTEROFFICE MEMORANDUM

TO: WILLIE JONES

FROM: CLARKE GIBSON, P.E.

SUBJECT: CITY OF BEDFORD WATER AND SEWER MASTER PLAN AND 460 EAST WATER AND SEWER PRELIMINARY ENGINEERING REPORT

DATE: 11/21/00

CC:

Attached you will find the City of Bedford Water and Sewer Master Plan and 460 East Water and Sewer Preliminary Engineering Report. After you have had a chance to review these documents, please give me a call so we can set up a meeting for discussion.

Happy Thanksgiving!

MASTER PLAN

FOR

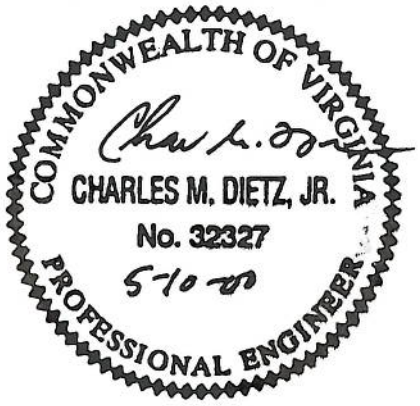
WATER AND SEWER SYSTEM IMPROVEMENTS

FOR THE

CITY OF BEDFORD

PREPARED FOR

CITY OF BEDFORD, VIRGINIA



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RADFORD, VIRGINIA 24141

COMMISSION NO. 6552-00

APRIL, 2000

Radford Corporate Campus West
203C Rock Road
Radford, Virginia 24141
540 633-1897
Fax 540 633-1896
E-mail: T-L@T-L.com
www.T-L.com

May 31, 2002

Mr. Clarke Gibson, P.E.
Director of Public Works
City of Bedford
P.O. Drawer 807
Bedford, VA 24523

RE: Amendment No. 1
Master Plan for Water and Sewer Improvements for the City of Bedford
T+L Project No. 6552-01

Thompson +Litton
Engineers
Architects
Planners

Dear Mr. Gibson:

In accordance with your request, Thompson + Litton (T+L) has prepared Amendment No. 1 for the "Master Plan for Water and Sewer Improvements for the City of Bedford" (Master Plan) dated May 2000. The primary purpose of the Amendment is to update the water and wastewater demand/flow projections presented in the original Master Plan. The basis for this revision is the loss of several major industrial users within the City's existing service area. Additionally, the Amendment updates the capacity analysis associated with the City's water and wastewater treatment plants with respect to the revised 20-year demand/flow projections.

BACKGROUND INFORMATION/ INDUSTRIAL USER ANALYSIS

In February 2000, T+L was commissioned to prepare a Master Plan addressing existing and future water and sewer system needs for the City of Bedford, Virginia, with regard to economic development and growth within the City limits. A major component of the Master Plan was the development of 20-year projections for water demand and wastewater flow. The 20-year projections were based on available production/billing records, house counts, previous capacity studies, an economic development review, and a growth rate of approximately 0.6% per year for the City.

Since the completion of the Master Plan in May 2000, the City has experienced the loss of several major industrial water and sewer customers (i.e., Bunker Hill Packing Co., Bondtex, Inc., Rubatex Corporation and Waltex Corporation) within its existing service area. Due to the fact that the original 20-year projections were based on information available at that time, it was necessary to identify the portion of existing demand/flow that was attributable to the aforementioned industrial users. In order to identify this demand/flow it was necessary to review past billing and recent water/wastewater treatment plant

production/flow records.

Billing Records Review

Water and wastewater billing records for the period of April 2000 to September 2000 were utilized to estimate the average daily water demand and wastewater flow associated with the previously identified users. These demands/flows are summarized as follows:

User	Average Daily Water Demand	Average Daily Wastewater Flow
Bunker Hill Packing Co.	52,790 gpd	42,180 gpd
Bondtex, Inc.	500 gpd	500 gpd
Rubatex Corporation	146,280 gpd	146,280 gpd
Waltex Corporation	4,890 gpd	4,890 gpd

The total average daily water demand and wastewater flow associated with the industrial users is approximately 204,460 gpd and 193,850 gpd, respectively.

Production/Flow Records Review

Based on the assumption that the demand/flow associated with the industrial users terminated in September 2000, it was necessary to evaluate water/wastewater treatment plant production/flow records corresponding to a time frame after the termination of service. A review of water production and wastewater flow records for the period of October 2001 through March 2002 indicates average daily water production of approximately 1,021,000 gpd and average daily wastewater flow of approximately 910,000 gpd. In comparison to the average daily water production and wastewater flow reported in the original Master Plan (May 2000) decreases of approximately 232,900 gpd in water production and 213,000 gpd in wastewater flow were noted.

A comparison of the billing and production/flow records indicate that the reductions in water/wastewater treatment plant production/flow, noticed over the time frame of October 2001 to March 2002, are related to the loss of the industrial users within the City's existing service area. It should be noted that there was a difference of approximately 10 to 15 percent between the demands/flows determined through the billing and production/flow record reviews. In order to remain conservative with respect to updating the 20-year

projections for the City, it was determined that the existing water demands and wastewater flows utilized in the Master Plan should be decreased by 204,460 gpd and 193,850 gpd, respectively. Appendix A contains detailed information regarding the average daily water demand and wastewater flow analyses.

PROJECTED WATER DEMANDS & WASTEWATER FLOWS

Based on the reduction of the existing water demand by 204,460 gpd and existing wastewater flow by 193,850 gpd the revised 20-year projections for the City are summarized as follows:

- The total average and peak water demands will be approximately 1,647,800 gpd and 3,295,600 gpd; and
- The total average and peak wastewater flows will be approximately 1,637,480 gpd and 4,308,630 gpd.

Tables 1 and 2, which are contained in Appendix B, present the revised 20-year flow projections. It should be noted that these tables were also revised to omit flow projections associated with the Little Otter Joint Economic Development Area/Regional Industrial Park - Alternative II scenario.

PROJECTED TREATMENT PLANT CAPACITIES

The projected water demands will be supplied by the City of Bedford Water Treatment Plant (WTP) which has a capacity of 3.0 million gallons per day (mgd) and is currently operating at approximately 35% of capacity. Based on the 20-year demand projections as presented in this amendment, the existing WTP will have the capacity to support the projected demands of approximately 1,647,800 mgd, which is approximately 55% of the existing WTP capacity.

The projected wastewater flows will be treated at the City's 2.0 mgd Wastewater Treatment Plant (WWTP). With regard to the present average daily flow and the original assumptions regarding infiltration and inflow (I&I) the WWTP is operating at a capacity of approximately 78%. Based on the 20-year demand projections as presented in this amendment and the original assumptions regarding the reduction of I&I, the existing WWTP will have the capacity to support the treatment of the projected demands of approximately 1,637,480 mgd, which is approximately 82% of the existing WWTP capacity.

Based on the aforementioned it appears that approximately 1,352,200 gpd (45%) of WTP and approximately 362,520 gpd (18%) of WWTP capacity would be available to potential customers outside of the City's projected 20-year service

area. The projected 20-year service area as identified in the original Master Plan includes the following: growth within the City, the 460 East - Joint Economic Development Area (JEDA), the 460 West - JEDA, the 122 South - JEDA, the Little Otter - JEDA(Alternative I), the Bedford City - JEDA, the Burks Hill - City Economic Development Area (CEDA), and the Independence Boulevard - CEDA.

FINDINGS

The major findings that emerge from this amendment include the following:

- The average daily water demand and wastewater flow associated with Bunker Hill Packing Co., Bondtex Inc., Rubatex Corporation, and Waltex Corporation is approximately 204,460 gpd and 193,850 gpd, respectively.

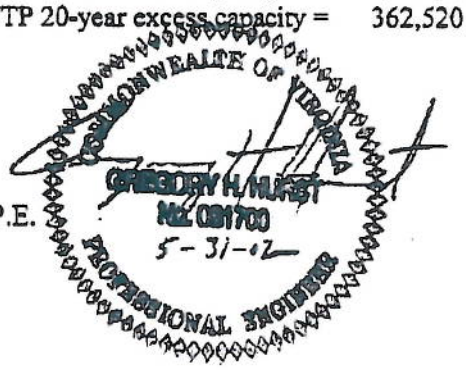
- The loss of the water demand and wastewater flow associated with the identified industrial users corresponds to recent reductions in WTP production and WWTP influent flow.

- The revised average daily 20-year projections for the City are as follows:
  - total average water demands = 1,647,800 gpd
  - total average wastewater flows = 1,637,480 gpd

- The existing WTP and WWTP have the capacity to accommodate the demands/flows associated with the 20-year projections.

- WTP and WWTP capacity in excess of the City's 20-year service area projections are as follows:
  - WTP 20-year excess capacity = 1,352,200 gpd
  - WWTP 20-year excess capacity = 362,520 gpd

Sincerely,



Gregory H. Hurst, P.E.
Associate

Attachments

APPENDIX A

Water Demand Analysis - Amendment No. 1

Customer ID	September 2000 (gallons)	August 2000 (gallons)	July 2000 (gallons)	June 2000 (gallons)	May 2000 (gallons)	April 2000 (gallons)	Monthly Average (gallons)	Monthly Average gpd
Bunker Hill Packing Co	1,503,000	1,298,000	1,543,000	1,999,000	1,209,000	2,077,000	1,604,833	52,791
Bonditex, Inc.	9,000	15,000	16,000	19,000	18,000	14,000	15,167	499
Rubatex Corporation								
Location 2	249,000	150,000	318,000	385,000	394,000	146,000	273,667	9,002
Location 1	1,000	0	0	0	1,000	0	333	11
Location 4	6,000	10,000	13,000	23,000	23,000	87,000	27,000	888
Location 3	0	0	0	0	0	0	0	0
Location 5	1,698,000	3,028,000	4,418,000	6,188,000	4,805,000	4,564,000	4,116,833	135,422
Location 6	2,000	12,000	8,000	9,000	10,000	10,000	8,500	280
Monroe St. A	1,000	2,000	2,000	2,000	3,000	2,000	2,000	66
Woolen Mill	7,000	9,000	3,000	1,000	1,000	0	3,500	115
W.Mill Grove St	9,000	7,000	8,000	10,000	12,000	7,000	8,833	291
Park St	1,000	3,000	5,000	8,000	6,000	0	3,833	126
Monroe St. A	1,000	5,000	5,000	2,000	1,000	1,000	2,500	82
Waltex Corporation								
Adams St	1,000	1,000	2,000	4,000	2,000	1,000	1,833	60
Broad St	54,000	182,000	132,000	261,000	143,000	110,000	147,000	4,836
					Monthly Average Total	=	**204,468**	**gpd**

Wastewater Flow Analysis - Amendment No. 1

Customer ID	September 2000 (gallons)	August 2000 (gallons)	July 2000 (gallons)	June 2000 (gallons)	May 2000 (gallons)	April 2000 (gallons)	Monthly Average (gallons)	Monthly Average gpd
Bunker Hill Packing Co	1,327,000	1,063,000	982,000	1,676,000	1,016,000	1,631,000	1,282,500	42,188
Bondtex, Inc.	9,000	15,000	16,000	19,000	18,000	14,000	15,167	499
Rubatex Corporation								
Location 2	249,000	150,000	318,000	385,000	394,000	146,000	273,667	9,002
Location 1	1,000	0	0	0	1,000	0	333	11
Location 4	6,000	10,000	13,000	23,000	23,000	87,000	27,000	888
Location 3	0	0	0	0	0	0	0	0
Location 5	1,698,000	3,028,000	4,418,000	6,188,000	4,805,000	4,564,000	4,116,833	135,422
Location 6	2,000	12,000	8,000	9,000	10,000	10,000	8,500	280
Monroe St. A	1,000	2,000	2,000	2,000	3,000	2,000	2,000	66
Woolen Mill	7,000	9,000	3,000	1,000	1,000	0	3,500	115
W.Mill Grove St	9,000	7,000	8,000	10,000	12,000	7,000	8,833	291
Park St	1,000	3,000	5,000	8,000	6,000	0	3,833	126
Monroe St. A	1,000	5,000	5,000	2,000	1,000	1,000	2,500	82
Waltex Corporation								
Adams St	1,000	1,000	2,000	4,000	2,000	1,000	1,833	60
Broad St	54,000	182,000	132,000	261,000	143,000	110,000	147,000	4,836
					Monthly Average Total	=	**193,865**	**gpd**

Water Production & Wastewater Flow Record Summary - Amendment No. 1

May 2000 Master Plan:

WTP Average Daily Production = 1.2543 MGD
WWTP Average Daily Flow = 1.1234 MGD

WTP Production Records for October thru December 2001:

Month	Average Flow (MGD)
October	1.081
November	1.07
December	0.913

Monthly Average = 1.021 MGD

WWTP Flow Records for October 2001 thru March 2002:

Month	Average Flow (MGD)
October '01	0.821
November '01	0.829
December '01	0.871
January '02	0.995
February '02	0.922
March '02	1.019

Monthly Average = 0.910 MGD

APPENDIX B

TABLE 1

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

PROJECTED WATER DEMANDS
(AMENDMENT NO. 1)

ECONOMIC DEVELOPMENT AREA	EXISTING Q_{AVE}	EXISTING Q_{PEAK}	5-YEAR Q_{AVE}	5-YEAR Q_{PEAK}	10-YEAR Q_{AVE}	10-YEAR Q_{PEAK}	20-YEAR Q_{AVE}	20-YEAR Q_{PEAK}
CITY OF BEDFORD	1,049,840	2,099,680	1,081,800	2,163,600	1,114,800	2,229,600	1,183,700	2,367,400
460 EAST	—	—	57,600	115,200	98,600	197,200	172,600	345,200
460 WEST	—	—	26,000	52,000	45,500	91,000	82,400	164,800
122 SOUTH	—	—	1,000	2,000	22,000	44,000	45,000	90,000
LITTLE OTTER JEDA/REGIONAL INDUSTRIAL PARK								
ALTERNATIVE I	—	—	14,500	29,000	29,000	58,000	84,500	169,000
BEDFORD CITY	—	—	1,000	2,000	2,000	4,000	19,600	39,200
BURKS HILL	—	—	8,500	17,000	33,000	66,000	43,000	86,000
INDEPENDENCE BLVD	—	—	4,500	9,000	9,000	18,000	17,000	34,000
TOTAL ALTERNATIVE I	1,049,840	2,099,680	1,194,900	2,389,800	1,353,900	2,707,800	1,647,800	3,295,600

Notes:

1. All flows are gallons per day (gpd).
2. Q_{AVE} denotes average flow.
3. Q_{PEAK} denotes peak flow ($Q_{PEAK} = 2.0 \times Q_{AVE}$).

TABLE 2

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

PROJECTED WASTEWATER FLOWS
(AMENDMENT NO. 1)

ECONOMIC DEVELOPMENT AREA	EXISTING Q_{AVE}	EXISTING Q_{PEAK}	5-YEAR Q_{AVE}	5-YEAR Q_{PEAK}	10-YEAR Q_{AVE}	10-YEAR Q_{PEAK}	20-YEAR Q_{AVE}	20-YEAR Q_{PEAK}
CITY OF BEDFORD	929,550	1,899,700	957,900	1,957,600	987,000	2,017,200	1,048,100	2,141,900
INFILTRATION	626,400	1,083,800	469,800	812,850	313,200	541,900	125,280	216,760
INFLOW	----	3,948,600	----	2,961,450	----	1,974,300	----	789,720
460 EAST	----	----	57,600	144,000	98,600	246,500	172,600	431,500
460 WEST	----	----	26,000	65,000	45,500	113,750	82,400	206,000
122 SOUTH	----	----	1,000	2,500	22,000	55,000	45,000	112,500
LITTLE OTTER JEDA/REGIONAL INDUSTRIAL PARK								
ALTERNATIVE I	----	----	14,500	36,250	29,000	72,500	84,500	211,250
BEDFORD CITY	----	----	1,000	2,500	2,000	5,000	19,600	49,000
BURKS HILL	----	----	8,500	21,250	33,000	82,500	43,000	107,500
INDEPENDENCE BLVD	----	----	4,500	11,250	9,000	22,500	17,000	42,500
TOTAL ALTERNATIVE I	1,555,950	6,932,100	1,540,800	6,014,650	1,539,300	5,131,150	1,637,480	4,308,630

Notes:

1. All flows are gallons per day (gpd).
2. Q_{AVE} denotes average flow.
3. Q_{PEAK} denotes peak flow (For the Economic Development Areas, $Q_{PEAK} = 2.5 \times Q_{AVE}$).
4. Infiltration and inflow were assumed to be reduced by 25% at 5 years, 50% at 10 years, and 80% at 20 years.

MASTER PLAN

FOR

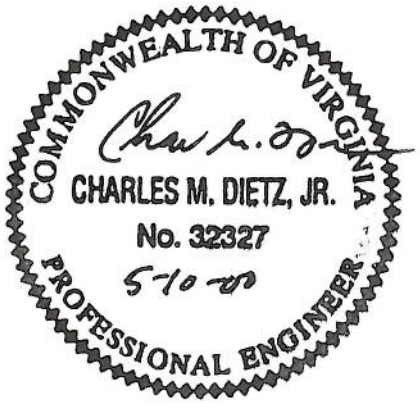
WATER AND SEWER SYSTEM IMPROVEMENTS

FOR THE

CITY OF BEDFORD

PREPARED FOR

CITY OF BEDFORD, VIRGINIA



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ENGINEERS • ARCHITECTS • PLANNERS

RADFORD, VIRGINIA 24141

COMMISSION NO. 6552-00

APRIL, 2000

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INTRODUCTION

The City of Bedford is located in the central portion of Bedford County approximately 25 miles east of Roanoke, Virginia. It is located at the intersection of U.S. Route 460, U.S. Route 221, and State Route 122. The City and its environs lie within the Little Otter River and Goose Creek watersheds. A general location map is presented in Exhibit I.

The City of Bedford and Bedford County have an agreement to develop and promote five Joint Economic Development Areas, which include one industrial park site within the City and four areas of the County immediately outside the City limits. As part of this agreement, "...the City and the County covenant and agree to begin... the formulation of a strategic long range plan for future water and sewer development in the City and the central area of Bedford County." Additionally, the City has recognized that this planning effort must also consider residential, commercial, and industrial development within the City limits.

Presently, the City operates and maintains both water and sewer systems that serve residential, commercial, and industrial areas within the City limits. The City also provides these services to several users outside the City limits adjacent to U.S. Route 460 and U.S. Route 221. Due to recent drought events and the resulting impacts on the City's reservoir and Big Otter River sources, the City has identified a need to develop supplemental water sources to increase the capacity/flexibility of the existing sources.

Recent studies and reports have indicated significant I/I problems with respect to the City's existing sewer system. This problem has resulted in the City entering into a consent agreement with the Virginia Department of Environmental Quality to reduce/eliminate I/I from

the system. The City has recognized that the overall development of a long-range water and sewer plan must consider this problem.

As a result of the aforementioned economic development opportunities and the resulting potential for growth within the City, Thompson + Litton was commissioned by the City of Bedford to prepare this Water and Sewer Master Plan.

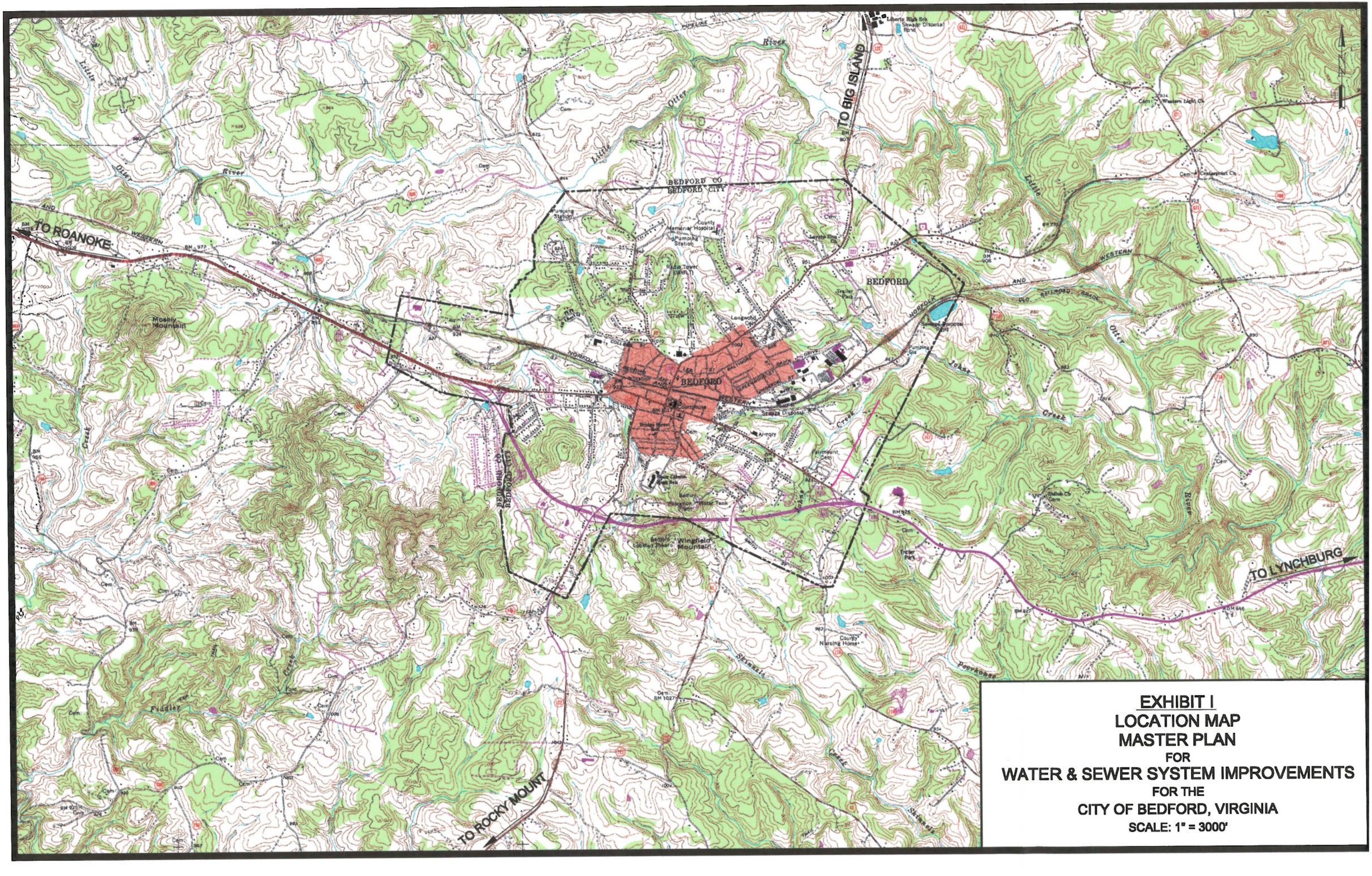

EXHIBIT I

LOCATION MAP
MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA
SCALE: 1" = 3000'

GENERAL INFORMATION

Purpose and Scope

The purpose of this Master Plan is to address the existing and future water and sewer system needs of the City of Bedford, Virginia with regard to economic development and growth within the City limits. Additionally, this Master Plan will evaluate two potential supplemental water sources for the City's existing reservoir. Preliminary project cost estimates are included in this report as a means of establishing financing requirements and to assess the economic feasibility of the proposed water and sewer improvements. The information contained herein will provide the basis for preliminary and final designs for the proposed system improvements.

Service Area Descriptions

The primary areas that will be considered by this Master Plan include the City, the five Joint Economic Development Areas (JEDA), and the two City Economic Development Areas (CEDA). A service area map, which depicts the planning area, is presented in Exhibit II. The service areas illustrated in Exhibit II can be described as follows:

City of Bedford

The major developments within the City of Bedford include the central business district, commercial areas along U.S. Route 460 Business and U.S. Route 221, industrial areas along U.S. Route 221, and residential areas.

460 East - Joint Economic Development Area

The 460 East JEDA extends along both sides of U.S. Route 460 from the eastern City limits to the vicinity of the intersection of State Route 777 and consists of approximately 500 acres of land. The majority of the JEDA is relatively open and level with development consisting primarily of commercial and mobile home parks.

460 West - Joint Economic Development Area

The 460 West JEDA extends along both sides of U.S. Route 460 and the Norfolk Southern tracks westwards from the western City limits for approximately 2/3 of a mile and consists of approximately 300 acres. The majority of the JEDA is relatively level and/or gently sloping with development consisting primarily of commercial and some industrial type facilities.

122 South - Joint Economic Development Area

The 122 South JEDA extends along State Route 122 southwards from the southern City limits for approximately half a mile and consists of approximately 128 acres of land. The majority of the JEDA is relatively level and/or gently sloping with development consisting of small commercial facilities and single-family residences.

Little Otter - Joint Economic Development Area/Regional Industrial Park (Alternatives I and II)

The existing Little Otter Business Park JEDA (Alternative I) is located to the east of the City limits, primarily west of the Little Otter River between U.S. Route 221 and the Norfolk Southern tracks and consists of approximately 74 acres. Current development within the Park consists of two industrial service type businesses. Additionally, this service area includes the

proposed Little Otter Regional Industrial Park (Alternative II), consisting of approximately 486 acres of open and gently rolling topography situated adjacent to U.S. Route 221.

Bedford City - Joint Economic Development Area

The Bedford City JEDA includes the property east of the center of town within the City limits between the Norfolk Southern tracks to the south and U.S. Route 221 to the north and consists of approximately 110 acres. The majority of development within the JEDA consists of industrial (Rubatex) and small industrial support service facilities.

Burks Hill - City Economic Development Area

The Burks Hill CEDA is located on the western side of State Route 122 near the U.S. Route 460 interchange. Current development within the CEDA consists of the D-Day Memorial, small commercial facilities, and a school. The majority of the CEDA consists of open land surrounding the memorial, the school, and residential properties.

Independence Boulevard - City Economic Development Area

The Independence Boulevard CEDA is located along the section of Independence Boulevard between U.S. Route 460 Business and State Route 718. Current development consists of the Dawn Drive Industrial Park, a business center, and several small industrial support service facilities. The majority of the CEDA consists of rolling topography with convenient access to both U.S. Route 460 and State Route 221.

CITY OF BEDFORD LIMITS

460 WEST
JEDA

BEDFORD CITY
JEDA

LITTLE OTTER REGIONAL
INDUSTRIAL PARK
(ALTERNATIVE II)

INDEPENDENCE
BOULEVARD
CEDA

LITTLE OTTER REGIONAL
INDUSTRIAL PARK
JEDA
(ALTERNATIVE I)

460 EAST
JEDA

BURKS HILL
CEDA

122 SOUTH
JEDA

N

EXHIBIT II
SERVICE AREA MAP
MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA
SCALE: 1" = 3000'

Economic Development Review

The *Economic Development Review* presented in Appendix B considers the development potential of each of the five JEDA's and two CEDA's. Each Economic Development Area is evaluated according to the following criteria: existing development, site conditions, developable parcels, transportation access, existing water and sewer service, and potential utilities requirements for development. Based upon their relative development potentials, the Economic Development Areas are prioritized into three tiers, with the First Tier areas considered those under the most development pressure and the Third Tier areas being under the least development pressure. The three tier prioritization is as follows:

First Tier

460 East JEDA
Independence Boulevard CEDA
Burks Hill CEDA

Second Tier

460 West JEDA
122 South JEDA

Third Tier

Little Otter JEDA/Regional Industrial Park
Bedford City JEDA

Projected Water Demands and Wastewater Flows

Utilizing available planning information, previous studies, the *Economic Development Review*, and design criteria, 20-year projections for water demands and wastewater flows have

been developed for the service areas. The supporting design calculations and methodologies utilized for the development of the water demands and wastewater flows are included in Appendices A, B, C and D. These projections will be utilized to develop the proposed water and sewer system improvements considered herein.

Existing water demands for the City of Bedford were based on production records, metered sales records, and house counts from the City's aerial mapping and U.S.G.S. topographic quadrangles. The projected average water demands for the Joint Economic Development Areas and City Economic Development Areas were established in accordance with the Virginia Department of Health (VDH) regulations, the *Economic Development Review* presented in Appendix B, and the Preliminary Engineering Report *Two Potential Industrial Park Sites for Virginia's Region 2000*. Projected peak water demands were based on the following formula:

$$Q_{PEAK}\ (gpd) = 2 \times Q_{AVE}\ (gpd)$$

where

Q_{AVE} = average daily water demand

Q_{PEAK} = peak daily water demand

Based on the 20-year planning period, a growth rate of approximately 0.6% per year for the City, and the *Economic Development Review* projections, the total average and peak water demands for the service area will be approximately 1,878,300 gpd and 3,756,600 gpd, respectively, considering the Little Otter Joint Economic Development Area/Regional Industrial Park Alternative I scenario, and 2,243,300 gpd and 4,486,600 gpd considering the Little Otter

Joint Economic Development Area/Regional Industrial Park Alternative II scenario. The projected demands for each service area are presented in Table 1. Design calculations and information utilized in determining these demands are presented in Appendices B and C.

Existing wastewater flows for the City of Bedford sanitary sewer system were developed from flow data presented in the *Bedford Capacity Study*. The projected average wastewater flows for the JEDA's and CEDA's were established in accordance with the Virginia Department of Health (VDH) regulations, the *Economic Development Review* presented in Appendix B, and the Preliminary Engineering Report *Two Potential Industrial Park Sites for Virginia's Region 2000*. Projected peak wastewater flows were based on the following formula:

$$Q_{PEAK}\ (gpd) = P \times Q_{AVE}\ (gpd)$$

where

Q_{AVE} = average daily wastewater flow

Q_{PEAK} = peak daily wastewater flow

P = peak factor = 2.5

(Note: Peak factors for the existing system varied by basin as presented in the *Bedford Capacity Study*.)

Based on the 20-year planning period, a growth rate of approximately 0.6% per year for the City, and the *Economic Development Review* projections, the total average and peak wastewater flows for the service area will be approximately 1,878,300 gpd and 3,756,600 gpd, respectively, considering the Little Otter Joint Economic Development Area/Regional Industrial Park Alternative I scenario and 2,243,300 gpd and 4,486,600 gpd considering the Little Otter

TABLE 1

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

PROJECTED WATER DEMANDS

ECONOMIC DEVELOPMENT AREA	EXISTING Q_{AVE}	EXISTING Q_{PEAK}	5-YEAR Q_{AVE}	5-YEAR Q_{PEAK}	10-YEAR Q_{AVE}	10-YEAR Q_{PEAK}	20-YEAR Q_{AVE}	20-YEAR Q_{PEAK}
CITY OF BEDFORD	1,254,300	2,508,600	1,292,500	2,585,000	1,331,900	2,663,800	1,414,200	2,828,400
460 EAST	-----	-----	57,600	115,200	98,600	197,200	172,600	345,200
460 WEST	-----	-----	26,000	52,000	45,500	91,000	82,400	164,800
122 SOUTH	-----	-----	1,000	2,000	22,000	44,000	45,000	90,000
LITTLE OTTER JEDA/REGIONAL INDUSTRIAL PARK								
ALTERNATIVE I	-----	-----	14,500	29,000	29,000	58,000	84,500	169,000
ALTERNATIVE II	-----	-----	77,100	154,200	154,300	308,600	449,500	899,000
BEDFORD CITY	-----	-----	1,000	2,000	2,000	4,000	19,600	39,200
BURKS HILL	-----	-----	8,500	17,000	33,000	66,000	43,000	86,000
INDEPENDENCE BLVD	-----	-----	4,500	9,000	9,000	18,000	17,000	34,000
TOTAL ALTERNATIVE I	1,254,300	2,508,600	1,405,600	2,811,200	1,571,000	3,142,000	1,878,300	3,756,600
TOTAL ALTERNATIVE II	1,254,300	2,508,600	1,468,200	2,936,400	1,696,300	3,392,600	2,243,300	4,486,600

Notes:

1. All flows are gallons per day (gpd).
2. Q_{AVE} denotes average flow.
3. Q_{PEAK} denotes peak flow ($Q_{PEAK} = 2.0 \times Q_{AVE}$).

Joint Economic Development Area/Regional Industrial Park Alternative II scenario. The projected flows for each service area are presented in Table 2. Design calculations and information utilized in determining these flows are presented in Appendices B and D.

To account for future contributions to the sewer system from inflow and infiltration (I/I), it was assumed that any growth in these flows would be moderated by the City's efforts to remedy the I/I problems in the system. As presented in Table 2, it was assumed that 80% of the existing I/I was removed over the 20-year planning period, with 25% removed after the first five years and 50% after the first ten years. For the purpose of sizing and evaluating sewer system improvements, inflows and peak infiltration for the 20-year planning period were assumed to be at 50% of their existing levels.

TABLE 2

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

PROJECTED WASTEWATER FLOWS

ECONOMIC DEVELOPMENT AREA	EXISTING Q_{AVE}	EXISTING Q_{PEAK}	5-YEAR Q_{AVE}	5-YEAR Q_{PEAK}	10-YEAR Q_{AVE}	10-YEAR Q_{PEAK}	20-YEAR Q_{AVE}	20-YEAR Q_{PEAK}
CITY OF BEDFORD	1,123,400	1,899,700	1,157,600	1,957,600	1,192,900	2,017,200	1,266,600	2,141,900
INFILTRATION	626,400	1,083,800	469,800	812,850	313,200	541,900	125,280	216,760
INFLOW	-----	3,948,600	-----	2,961,450	-----	1,974,300	-----	789,720
460 EAST	-----	-----	57,600	144,000	98,600	246,500	172,600	431,500
460 WEST	-----	-----	26,000	65,000	45,500	113,750	82,400	206,000
122 SOUTH	-----	-----	1,000	2,500	22,000	55,000	45,000	112,500
LITTLE OTTER JEDA/REGIONAL INDUSTRIAL PARK								
ALTERNATIVE I	-----	-----	14,500	36,250	29,000	72,500	84,500	211,250
ALTERNATIVE II	-----	-----	77,100	192,750	154,300	385,750	449,500	1,123,750
BEDFORD CITY	-----	-----	1,000	2,500	2,000	5,000	19,600	49,000
BURKS HILL	-----	-----	8,500	21,250	33,000	82,500	43,000	107,500
INDEPENDENCE BLVD	-----	-----	4,500	11,250	9,000	22,500	17,000	42,500
TOTAL ALTERNATIVE I	1,749,800	6,932,100	1,740,500	6,014,650	1,745,200	5,131,150	1,855,980	4,308,630
TOTAL ALTERNATIVE II	1,749,800	6,932,100	1,803,100	6,171,150	1,870,500	5,444,400	2,220,980	5,221,130

Notes:

1. All flows are gallons per day (gpd).
2. Q_{AVE} denotes average flow.
3. Q_{PEAK} denotes peak flow (For the Economic Development Areas, $Q_{PEAK} = 2.5 \times Q_{AVE}$).
4. Infiltration and inflow were assumed to be reduced by 25% at 5 years, 50% at 10 years, and 80% at 20 years.

EXISTING WATER SYSTEM FACILITIES

The City of Bedford presently owns and operates a water system that supplies all City users as well as some users located outside the City limits. The City system provides water supplied primarily from the Stoney Creek Reservoir through a distribution system consisting of approximately 471,000 linear feet of 12-, 10-, 8-, 6-, 4-, and 2-inch water lines. Additionally, the City can supplement its reservoir supply with water from the Big Otter River. The City's Water Treatment Plant (WTP) has a capacity of 3.0 mgd and currently operates at approximately 42% capacity or 1.25 mgd. The WTP is located off of State Route 43 approximately 2.7 miles to the northwest of the City limits. Additionally, the City's water system contains three water storage tanks with a combined capacity of approximately 3,500,000 gallons. Two of the water storage tanks are located within the City limits adjacent to Helm Street and the other water storage tank is located at the WTP site. An existing facilities map, which depicts the existing City of Bedford water distribution system, is presented in Exhibit III.

Existing water facilities located within or adjacent to the Joint Economic Development Areas and City Economic Development Areas consist of the following:

460 East- 8- and 6-inch water lines extending approximately 2,850 linear feet east of the City limits along U.S. Route 460.

460 West- 8-inch water line located at the eastern boundary of the JEDA on U.S. Route 460.

122 South- 12-inch water line extending through the JEDA along State Route 122 approximately 14,300 linear feet south of the City limits.

Little Otter JEDA/Regional Industrial Park -

10-inch water line extending to the JEDA along State Route 221 approximately 3,700 linear feet east of the City limits.

Bedford City- 12-, 10-, 8- and 6- water lines located within the JEDA.

Burks Hill-	10-, 8-, and 6- water lines located within the CEDA.
Independence Boulevard-	10-inch water line extending from East Main Street approximately 900 linear feet into the southern portion of the CEDA.

N

LEGEND

- 3/4" WATER LINE
- 1" WATER LINE
- 1 1/2" WATER LINE
- 2" WATER LINE
- 3" WATER LINE
- 4" WATER LINE
- 6" WATER LINE
- 8" WATER LINE
- 10" WATER LINE
- 12" WATER LINE

SCALE: 1" = 1000'

Thompson +Litton
Engineers
Architects
Planners

MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA

EXISTING WATER SYSTEM FACILITIES

No.	Date	Revision

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Date: APRIL, 2000

Project No.
6552-00

Sheet No.
EXHIBIT III

PROPOSED WATER SYSTEM IMPROVEMENTS

The water system improvements necessary to accommodate the projected demands resulting from the 20-year development of the Joint Economic Development Areas (JEDA), City Economic Development Areas (CEDA), and growth within the existing City limits consist of both extensions of and upgrades to the City's existing water distribution system. Additionally, the facilities were sized to ensure ample capacity to provide varying levels of fire protection dependent upon the type of development targeted for the JEDA or CEDA. The City's Cybernet model was utilized to evaluate the effects of the projected demands on the existing system and to size the proposed facilities within the JEDA's and CEDA's. Brief descriptions of the proposed water system improvements are provided in this section and are depicted in Exhibit IV. Design information and assumptions pertaining to the proposed improvements are presented in Appendix C.

460 East- Extension of approximately 5,400 linear feet of 10-inch water line from the existing water line located at the intersection of East Main Street and Piedmont Street to the east along East Main Street and U.S. Route 460, connecting to the existing water line in the vicinity of the Wal-Mart Shopping Plaza. Additionally, the extension of approximately 3,000 linear feet of 12-inch water line from the termination of the proposed 10-inch water line and the extension of approximately 2,200 linear feet of 6-inch water line from the termination of the existing 6-inch water line located on the south side of U.S. Route 460 in the vicinity of Wal-Mart will be required to the east along U.S. Route 460 to its intersection with State Route 777.

460 West- Extension of approximately 6,500 linear feet of 12-inch water line from the existing water line located in the vicinity of the intersection of 4th Street and Macon Street west adjacent to Macon Street connecting to the existing water line in the vicinity of Abrasive Avenue.

Additionally, approximately 1,600 linear feet of 10-inch water line will be installed adjacent to Baldwin Street connecting the existing water lines located in the vicinity of U.S. Route 460 and the proposed 12-inch water line extension. The installation of approximately 3,600 linear feet of 12-inch water line will be required adjacent to U.S. Route 460 from the City limits to the west, through the JEDA, to the intersection of U.S. Route 460 and State Route 680.

122 South/Burks Hill - Installation of approximately 1,050 linear feet of 8-inch water line adjacent to Burks Hill Road extending from the existing water line in the vicinity of the school/D-Day Memorial site to the existing water line located to the south of the U.S. Route 460 interchange.

Little Otter JEDA/Regional Industrial Park (Alternative I)/Independence Boulevard JEDA-

Installation of approximately 300 linear feet of 8-inch, 7,100 linear feet of 10-inch, and 2,100 linear feet of 12-inch water lines adjacent to Independence Boulevard from the existing water line located in the vicinity of the intersection of East Main and Independence north to the existing water line located in the vicinity of the Independence and Forest Road intersection. These water lines would also provide for connections to the existing water system in the vicinity of Orange Street, Dawn Drive, and Shady Knoll Avenue (Note: these improvements will create a system loop within the eastern portion of the City's distribution system). Additionally, the installation of approximately 3,500 linear feet of 12-inch and 3,800 linear feet of 8-inch water line will be required adjacent to Forest Road/Route 221 from the intersection of Forest and Independence east to the entrance of the Little Otter Business Park.

Little Otter JEDA/Regional Industrial Park (Alternative II)-

Extension of approximately 3,800 linear feet of 12-inch water line from the entrance of the Little Otter Business Park east along Route 221 to the limits of the proposed Regional Industrial Park.

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Planners

MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA

PROPOSED WATER SYSTEM IMPROVEMENTS

No.	Date	Revision

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Project No.
6552-00

Sheet No.
EXHIBIT IV

SUPPLEMENTAL SOURCE EVALUATION

Due to recent droughts and the resulting impact on the City's reservoir and Big Otter sources, the City has identified the need for supplemental water sources. Two supplemental source options were investigated as part of this study. These options include the following: a raw water intake at the James River and a connection to the existing Bedford County Public Service Authority (BCPSA) system. The proposed water system facilities necessary for the transfer of water from these supplemental sources to the City's system were preliminarily sized based on the projected demands resulting from the 20-year development of the Joint Economic Development Areas (JEDA), City Economic Development Areas (CEDA), growth within the existing City limits, and the capacity of the City of Bedford Water Treatment Plant (WTP). Brief descriptions of the proposed water system facilities are provided in this section and are depicted in Exhibits V and VI. Design information and assumptions pertaining to the proposed facilities are presented in Appendix C.

Raw Water Intake at the James River

The facilities necessary to permit the transfer of raw water from the James River to the City's Stoney Creek Reservoir will consist of the following: construction of a raw water intake/pump station on the James River in the vicinity of the community of Big Island, construction of an in-line raw water pump station adjacent to State Route 640 in the vicinity of its intersection with State Route 122, installation of approximately 74,000 linear feet of 24-inch raw water line adjacent to State Routes 122 and 640 from Big Island to the City's reservoir, and

construction of discharge facilities at the headwaters of the City's reservoir. The proposed facilities are depicted in Exhibit V, and a preliminary cost estimate is presented in Appendix F.

Preliminary discussions with the Virginia Department of Environmental Quality have indicated that a withdrawal from the James River in the vicinity of Big Island would more than likely not incur any significant environmental impacts, but further investigations and studies, to include involvement of state and federal regulatory agencies, would be required if this option is to be further pursued by the City. Additionally, a detailed study supporting the withdrawal limit, which will be based on the amount of water that can be shown to be put to "reasonable use," may be required. The proposed facilities, as presented herein, have been preliminarily sized to accommodate the full development of the City's Water Treatment Plant to 6.0 mgd, although initially the facilities would more than likely be operated to permit the transfer of the 20-year flow projections (i.e., 1.9 mgd to 2.3 mgd, dependent on the development of the Little Otter alternatives) identified in this report. Further justification for the ultimate withdrawal limit from the James River may also consider the possibility of the City's system supporting/supplementing portions of the Bedford County Public Service Authority's service area.

Connection to the Bedford County Public Service Authority System

The facilities necessary to permit the transfer of water from the Bedford County Public Service Authority's (BCPSA) existing water system to the City's water distribution system will consist of the following: construction of a water pump station in the vicinity of the intersection of U.S. Route 460 and State Route 668, construction of a master meter vault in the vicinity of the eastern limits of the 460 East Joint Economic Development Area at the intersection of U.S. Route 460 and State Route 777, and installation of approximately 59,600 linear feet of 14-inch

water line adjacent to U.S. Route 460 from the existing BCPSA system in the vicinity of the intersection of U.S. Route 460 and State Route 643 to the proposed system for the 460 East Joint Economic Development Area in the vicinity of the intersection of U.S. Route 460 and State Route 777. The proposed facilities are depicted in Exhibit VI, and a preliminary cost estimate is presented in Appendix F.

Further investigation of this alternative should address the following issues: the capacity of the existing BCPSA and City of Lynchburg distribution systems with regard to transferring the supplemental flows, the capacity of the City of Lynchburg water treatment facilities to supply the projected demands, and the negotiation of a bulk water purchase agreement with the BCPSA and/or the City of Lynchburg.

EXISTING STONEY CREEK RESERVOIR

PROPOSED 24" RAW WATER LINE

PROPOSED RAW WATER PUMP STATION

PROPOSED RAW WATER INTAKE AND PUMP STATION

EXHIBIT V

SUPPLEMENTAL SOURCE EVALUATION - RAW WATER INTAKE AT THE JAMES RIVER MASTER PLAN

FOR

WATER & SEWER SYSTEM IMPROVEMENTS

FOR THE

CITY OF BEDFORD, VIRGINIA

SCALE: 1" = 4000'

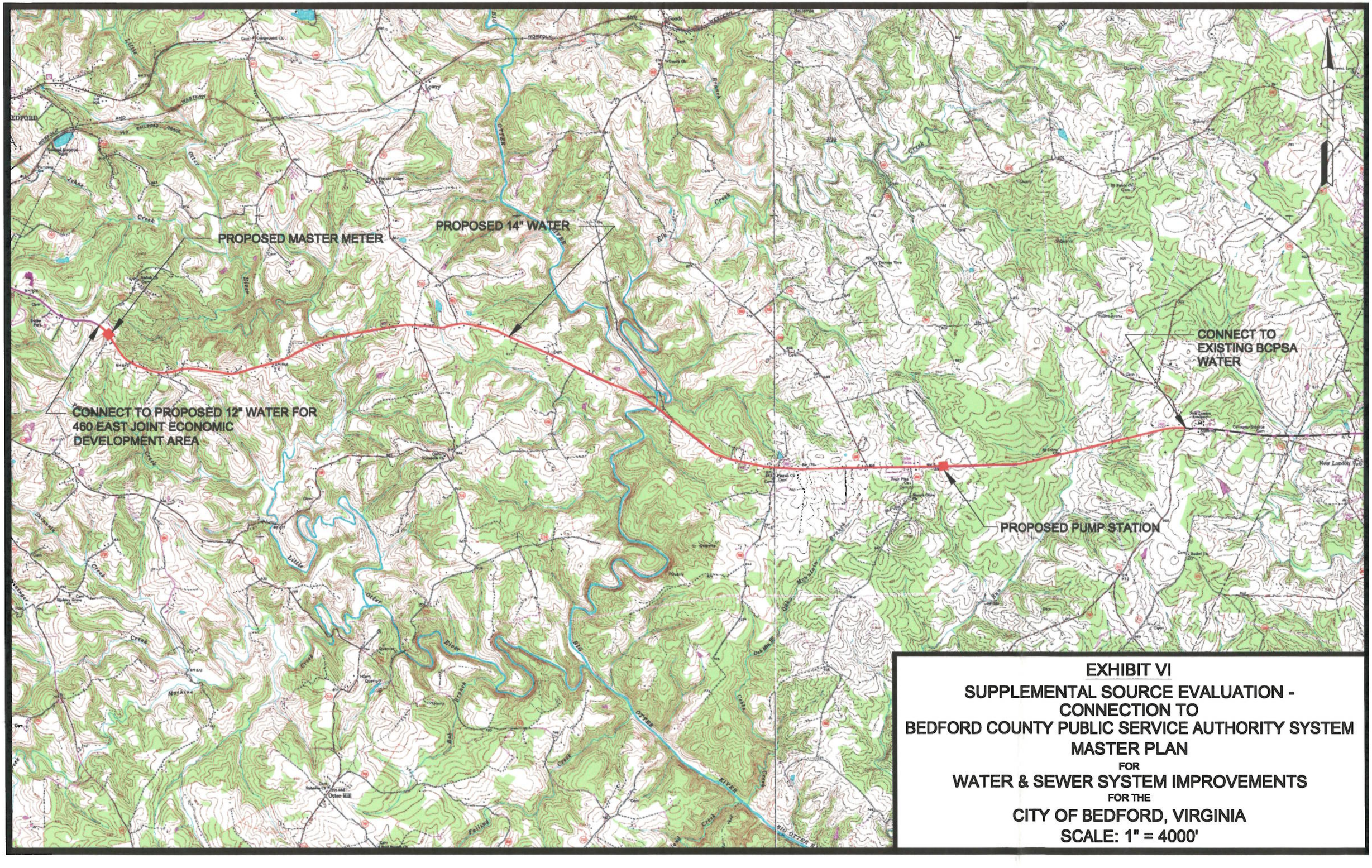

EXHIBIT VI

SUPPLEMENTAL SOURCE EVALUATION - CONNECTION TO BEDFORD COUNTY PUBLIC SERVICE AUTHORITY SYSTEM MASTER PLAN

FOR

WATER & SEWER SYSTEM IMPROVEMENTS

FOR THE

CITY OF BEDFORD, VIRGINIA

SCALE: 1" = 4000'

EXISTING SEWER SYSTEM FACILITIES

Existing Sewage Collection Facilities

The City of Bedford owns and operates a sewage collection system that primarily serves City users. As presented in Exhibit VII, the collection system has approximately 330,000 linear feet of sewer line and nine pump stations. Existing sewer facilities located within or adjacent to the Economic Development Areas consist of the following:

460 East- 4-inch force main privately owned by Wal-Mart discharging into an 8-inch gravity sewer at the City limits.

460 West- 8-inch gravity sewer inside the City limits at the intersection of Baldwin Street and U.S. Route 460.

122 South- 4-inch force main privately owned by Bunker Hill Foods. The force main runs adjacent to State Route 122 approximately 2.7 miles prior to discharging into a 10-inch gravity sewer at the City limits.

Little Otter JEDA/Regional Industrial Park- The City system extends to within 1.2 miles of the site.

Bedford City- 15-inch gravity sewer in the vicinity of the site.

Burks Hill- 15- and 8-inch gravity sewer at the western and eastern boundaries of the site.

Independence Boulevard- 15- and 8-inch gravity sewer segments throughout the site.

The infiltration and inflow (I/I) problem in the City's existing sewer system is severe enough that the City has entered into a consent agreement with the Virginia Department of Environmental Quality to reduce/eliminate I/I from the system. Previous studies (i.e., *Bedford Capacity Study* and *Sewage Pump Station Evaluation*) have indicated that the amount of I/I is

significant enough to cause capacity problems in certain segments of the collection, pumping, and treatment facilities. The Eagle Point model of the existing system indicates that during heavy rainfall events, certain sections of the existing gravity sewer are prone to surcharge. Additionally, the model indicates that the capacities of two of the three primary sewage pump stations (Pump Stations No. 1 and No. 3) are inadequate during these events.

Existing Wastewater Treatment Facilities

The City of Bedford Wastewater Treatment Plant has recently been upgraded to a capacity of 2.0 mgd. According to data presented in the *Bedford Capacity Study*, existing average daily influent flow to the plant is approximately 1,749,800 gpd, of which approximately 626,400 gpd is attributed to infiltration. This average daily flow amounts to approximately 87% of plant capacity. The same study indicates that inflow to the collection system during 1-year storm events can result in an additional 3,948,600 gpd of influent at the plant.

N

LEGEND

- MANHOLE
- GRAVITY SEWER
- FORCE MAIN
- PUMP STATION

SCALE: 1" = 1000'

Thompson + Litton
Engineers
Architects
Planners

MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA

EXISTING SEWER SYSTEM FACILITIES

No.	Date	Revision

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6552-00

Sheet No.
EXHIBIT VII

PROPOSED SEWER SYSTEM IMPROVEMENTS

The sewer system improvements necessary to accommodate the projected wastewater flows resulting from the 20-year development of the Joint Economic Development Areas, City Economic Development Areas, and growth within the existing City limits consist of both extensions of and upgrades to the City's existing sewage collection system. Additionally, the proposed upgrades to the existing system include the effects of infiltration and inflow and consider the City's mandated reduction of excessive infiltration and inflow. Brief descriptions of the proposed sewage system improvements are provided in this section and are depicted in Exhibits VIII through XVII. It should be noted that the City's Eagle Point model was utilized to evaluate the existing system with respect to the projected wastewater flows and is further addressed in the Construction Issues and Constraints section of this report. Design information and assumptions pertaining to the proposed improvements are presented in Appendix D.

City of Bedford, Alt. I- Upgrade of existing Pump Station No. 1 to 1,600 gpm, existing Pump Station No. 2 to 1,970 gpm, and existing Pump Station No. 3 to 1,490 gpm.
Replacement of the following lines: 732 linear feet of 8-inch of gravity sewer with 12-inch gravity sewer, 91 linear feet of 10-inch of gravity sewer with 12-inch gravity sewer, 1,827 linear feet of 12-inch of gravity sewer with 15-inch gravity sewer, 214 linear feet of 18-inch of gravity sewer with 30-inch gravity sewer, and 553 linear feet of 21-inch of gravity sewer with 24-inch gravity sewer (Exhibit VIII).

City of Bedford, Alt. II- Upgrade of existing Pump Station No. 1 to 1,600 gpm, existing Pump Station No. 2 to 1,970 gpm, and existing Pump Station No. 3 to 2,090 gpm.
Replacement of the following lines: 732 linear feet of 8-inch of gravity sewer with 12-inch gravity sewer, 91 linear feet of 10-inch of gravity sewer with 12-inch gravity sewer, 1,827 linear feet of 12-inch of gravity sewer with 15-inch gravity sewer, 214 linear feet of 18-inch of gravity sewer

with 30-inch gravity sewer, 218 linear feet of 21-inch of gravity sewer with 30-inch gravity sewer, and 319 linear feet of 21-inch of gravity sewer with 36-inch gravity sewer (Exhibit IX).

460 East- Installation of approximately 31,400 linear feet of 8-inch gravity sewer, 3,000 linear feet of 4-inch force main, 5,600 linear feet of 6-inch force main, and three sewage pump stations. The proposed system will connect to an existing 8-inch gravity sewer located within the City in the vicinity of the U.S. Route 460 interchange at State Route 714 (Exhibit X).

460 West- Installation of approximately 33,400 linear feet of 8-inch gravity sewer. The proposed system will connect to existing Pump Station No. 1 located within the City limits (Exhibit XI).

122 South- Installation of approximately 10,200 linear feet of 8-inch gravity sewer, 6,300 linear feet of 4-inch force main, and two sewage pump stations. The proposed system will connect to an existing 10-inch gravity sewer located within the City limits in the vicinity of State Route 122 (Exhibit XII).

Little Otter JEDA/Regional Industrial Park (Alternative I)-

Installation of approximately 6,900 linear feet of 8-inch gravity sewer, 6,200 linear feet of 6-inch force main, and one sewage pump station. The proposed system will connect to an existing 15-inch gravity sewer located within the City limits in the vicinity of Pump Station No. 3 (Exhibit XIII).

Little Otter JEDA/Regional Industrial Park (Alternative II)-

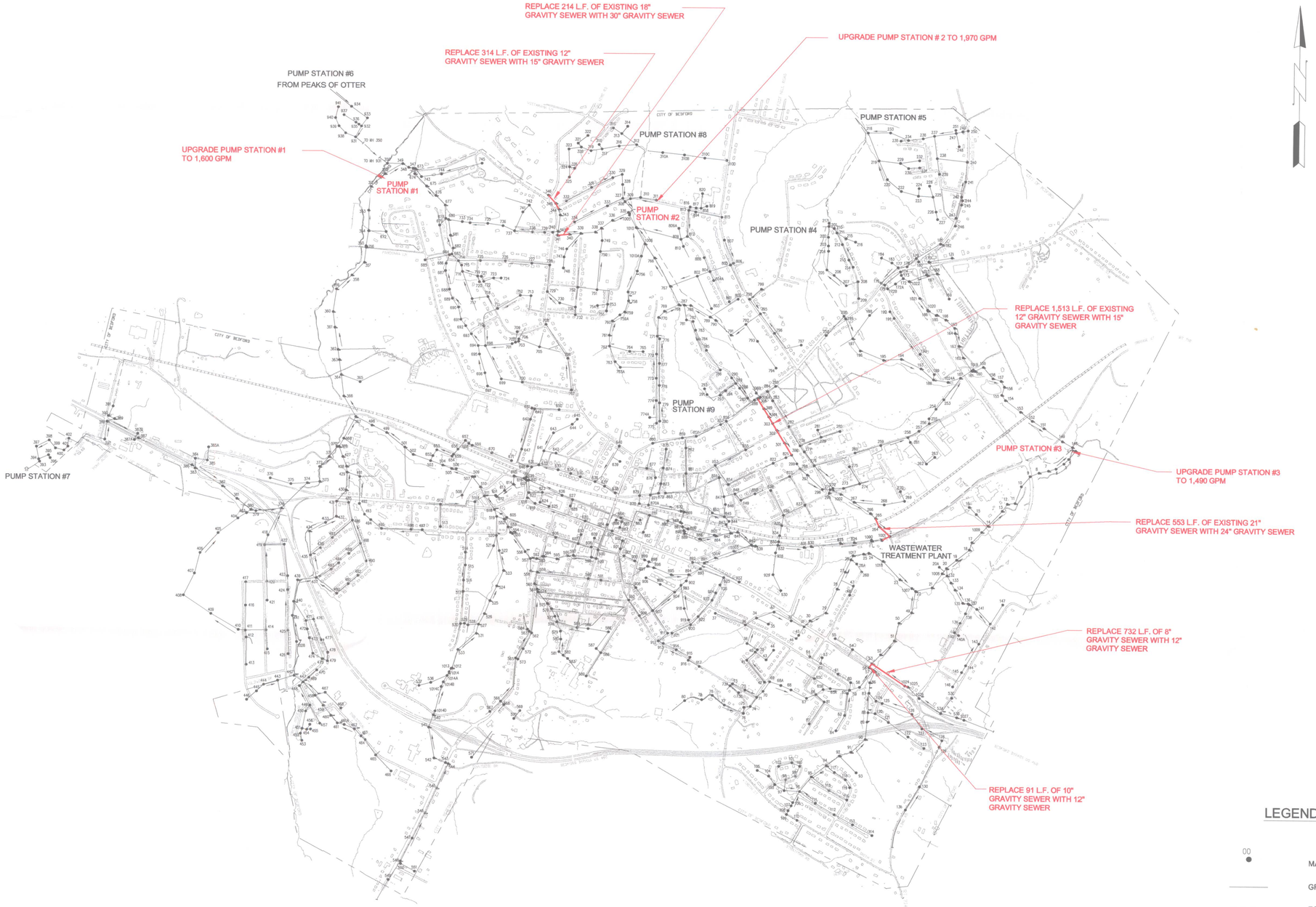
Installation of approximately 13,800 linear feet of 8-inch gravity sewer, 1,900 linear feet of 10-inch gravity sewer, 6,200 linear feet of 10-inch force main, and one sewage pump station. The proposed system will connect to an existing 15-inch gravity sewer located within the City limits in the vicinity of Pump Station No. 3 (Exhibit XIV).

Bedford City- Installation of approximately 10,500 linear feet of 8-inch gravity sewer. The eastern section of line will connect to the proposed Little Otter Regional Industrial Park system.

The western sections of line will connect to existing 10-inch and 15-inch gravity sewers located east of Independence Boulevard within the existing City limits (Exhibit XV).

Burks Hill- Installation of approximately 1,400 linear feet of 8-inch gravity sewer. The proposed system will connect to an existing 15-inch gravity sewer located west of State Route 122 within the existing City limits (Exhibit XVI).

Independence Boulevard- Installation of approximately 8,700 linear feet of 8-inch gravity sewer. The proposed system will connect to several existing 15-inch gravity sewers located in the vicinity of Independence Boulevard within the City limits (Exhibit XVII).



LEGEND

- MANHOLE
- GRAVITY SEWER
- FORCE MAIN
- PUMP STATION
- PROPOSED GRAVITY SEWER

SCALE: 1" = 1000'

Thompson + Litton
Engineers
Architects
Planners

MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA

PROPOSED SEWER SYSTEM FACILITIES - ALTERNATIVE I

No.	Date	Revision

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Date: APRIL, 2000

Project No.
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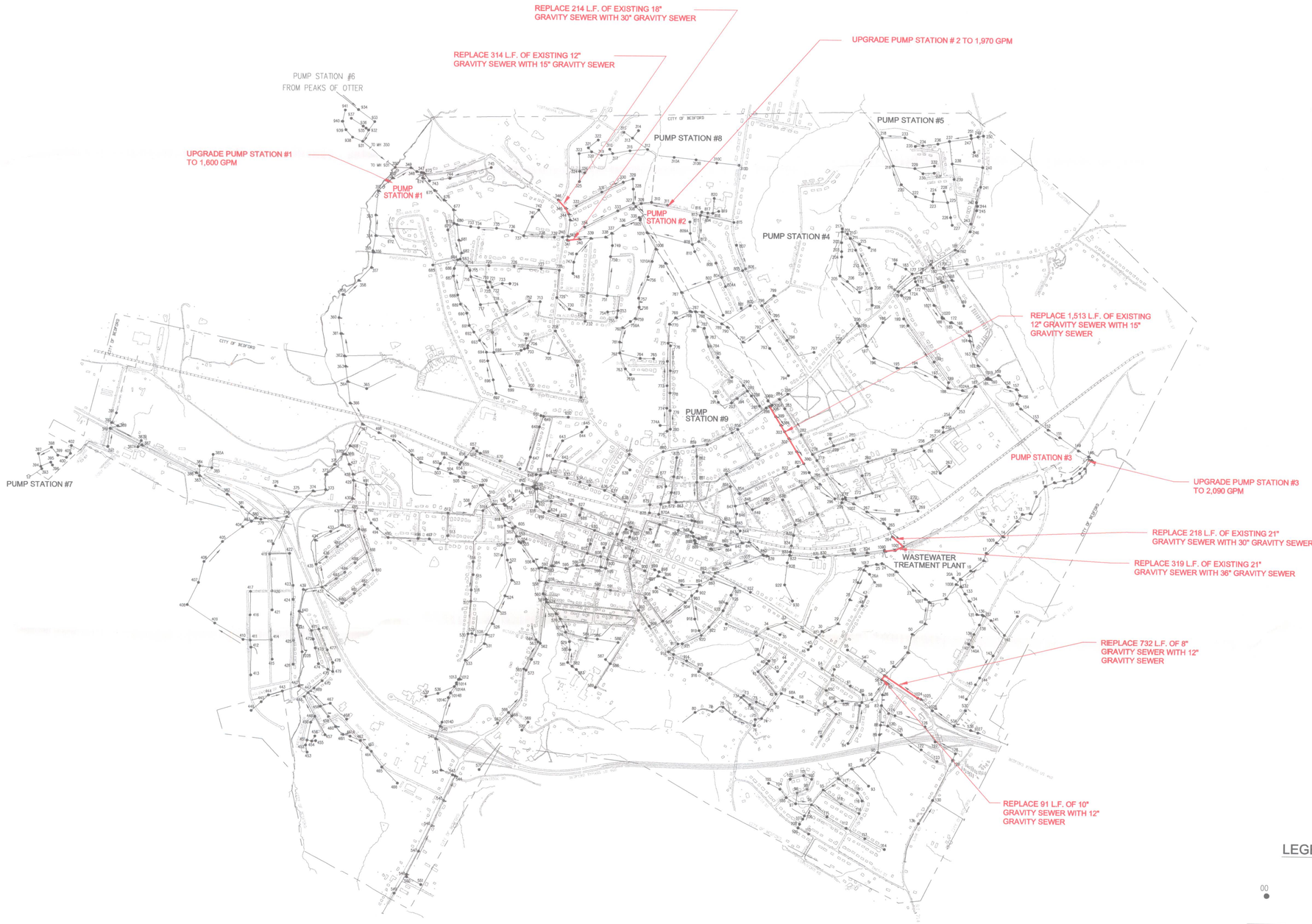
Sheet No.
EXHIBIT VIII



SCALE: 1" = 1000'

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Architects
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MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA
PROPOSED SEWER SYSTEM FACILITIES - ALTERNATIVE II

No.	Date	Revision

Designed:
Drawn:
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Date: APRIL, 2000

Project No.
6552-00

Sheet No.
EXHIBIT IX

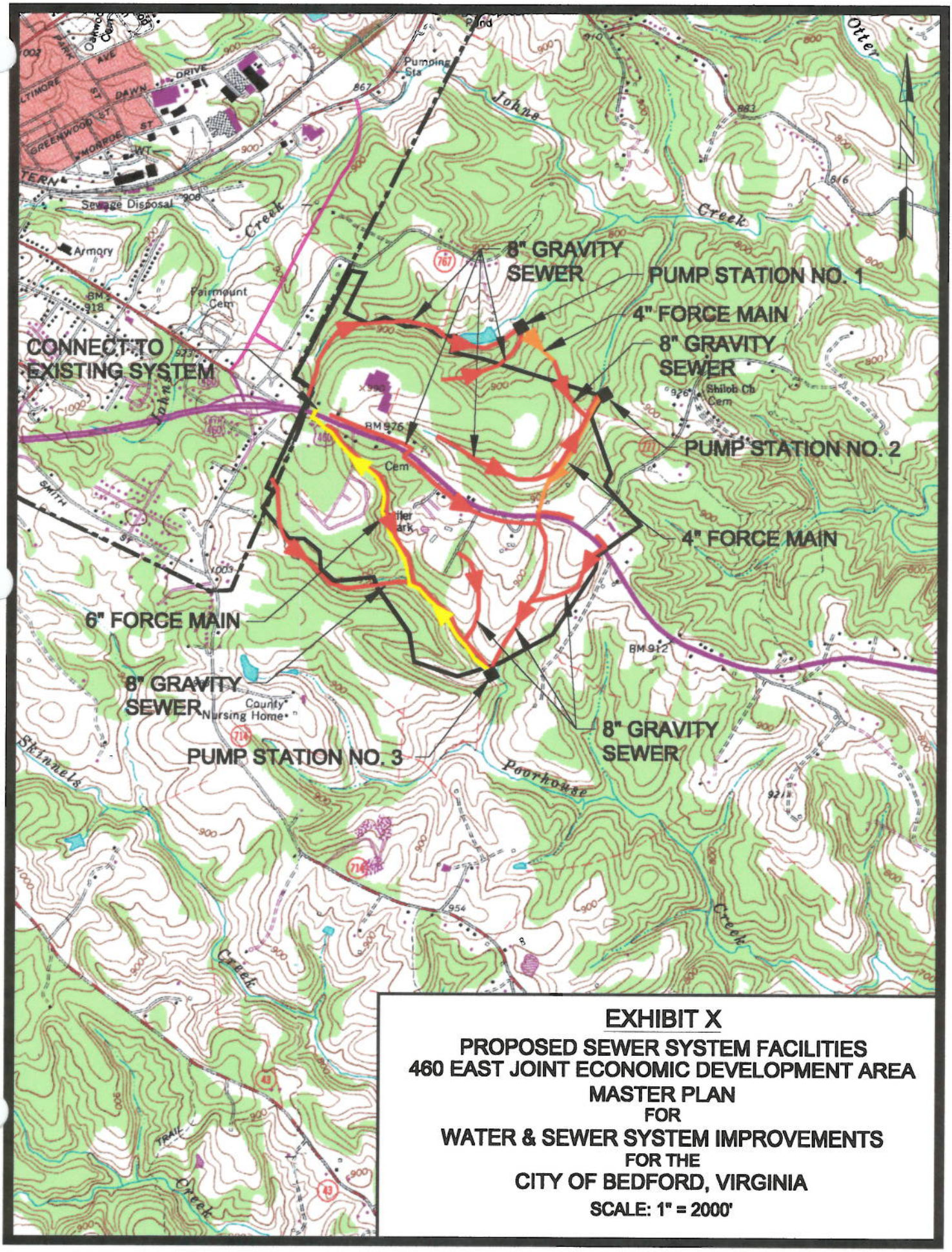

EXHIBIT X

PROPOSED SEWER SYSTEM FACILITIES
460 EAST JOINT ECONOMIC DEVELOPMENT AREA
MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA
SCALE: 1" = 2000'

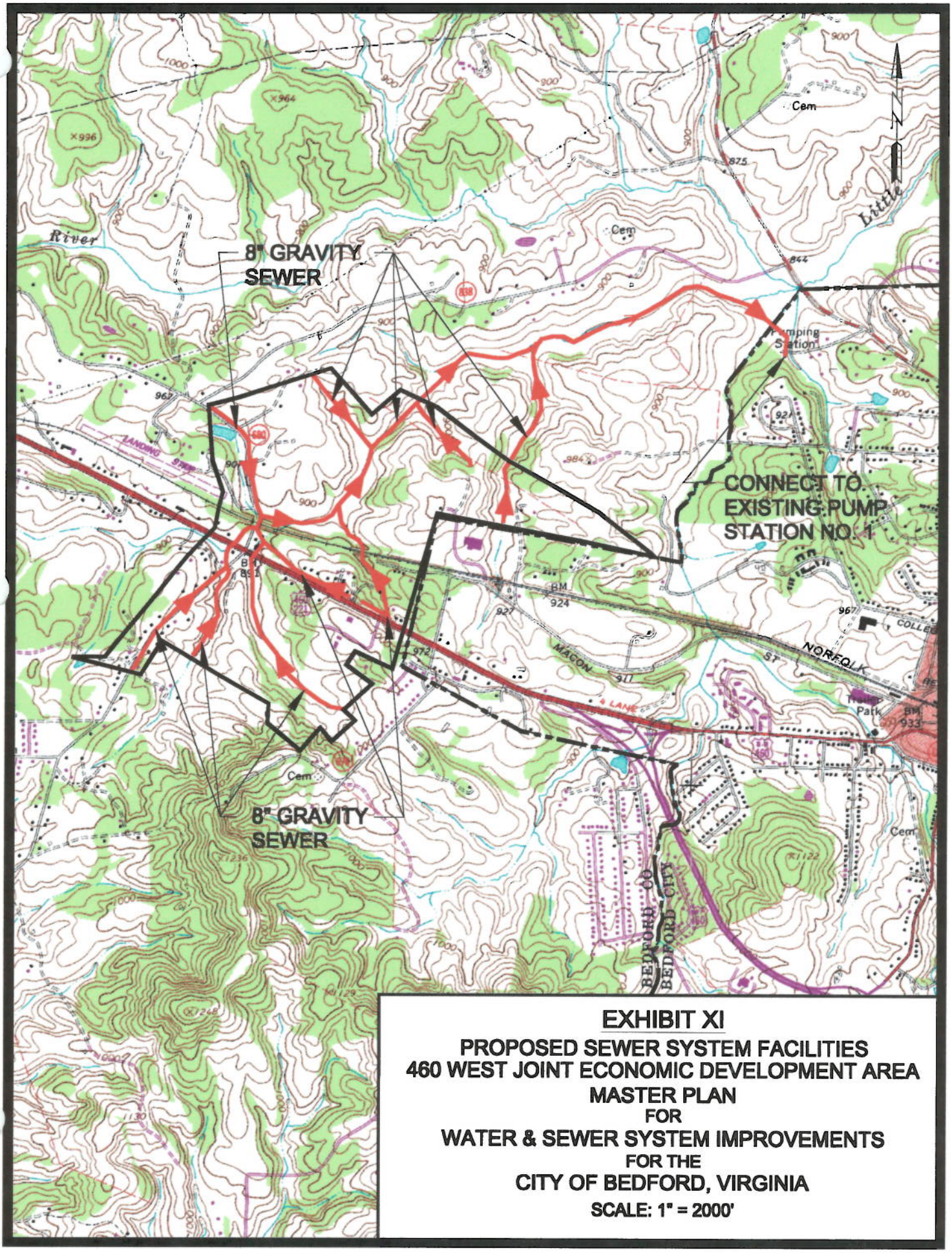

EXHIBIT XI

PROPOSED SEWER SYSTEM FACILITIES
460 WEST JOINT ECONOMIC DEVELOPMENT AREA
MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA
SCALE: 1" = 2000'

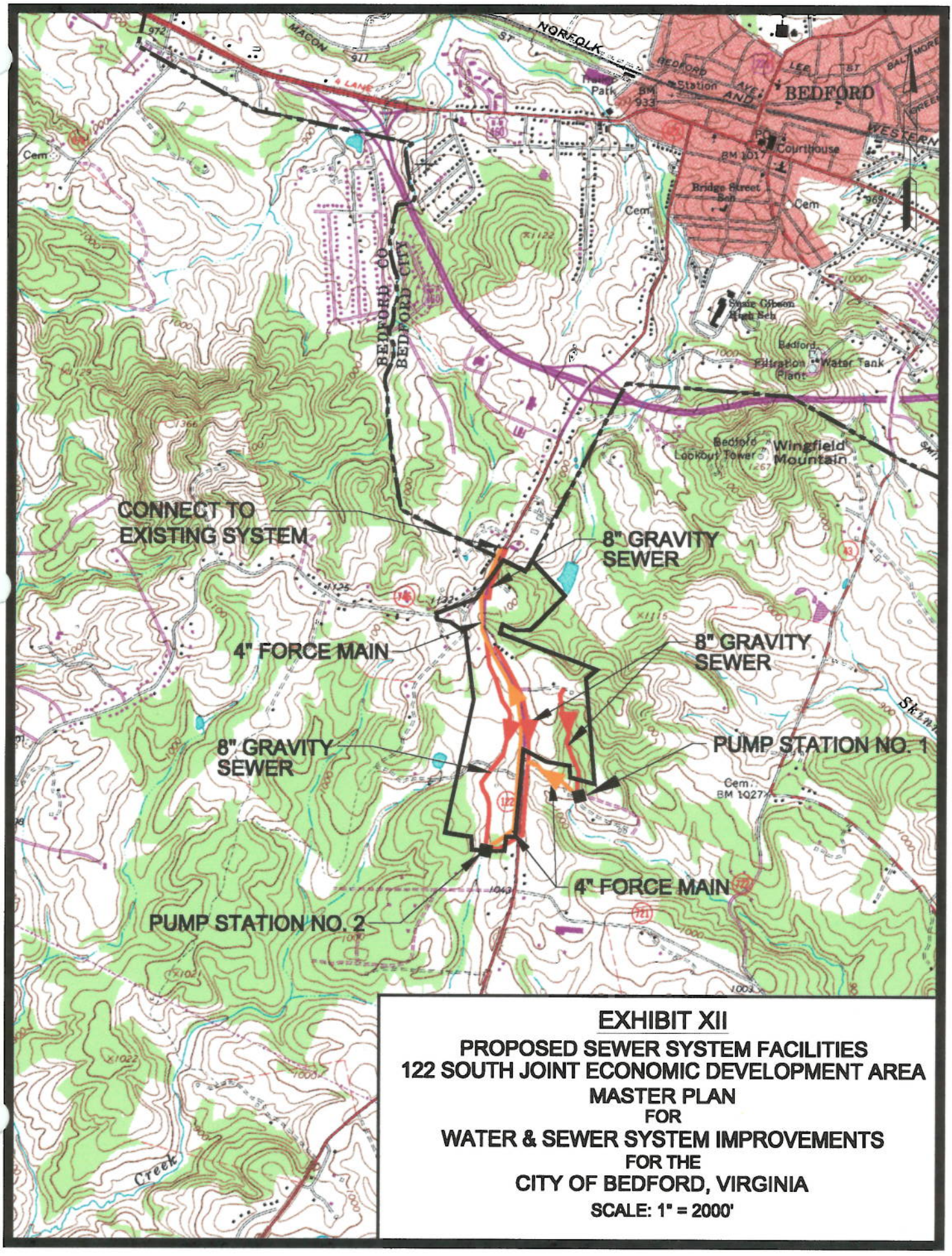

EXHIBIT XII

PROPOSED SEWER SYSTEM FACILITIES
122 SOUTH JOINT ECONOMIC DEVELOPMENT AREA
MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA
SCALE: 1" = 2000'

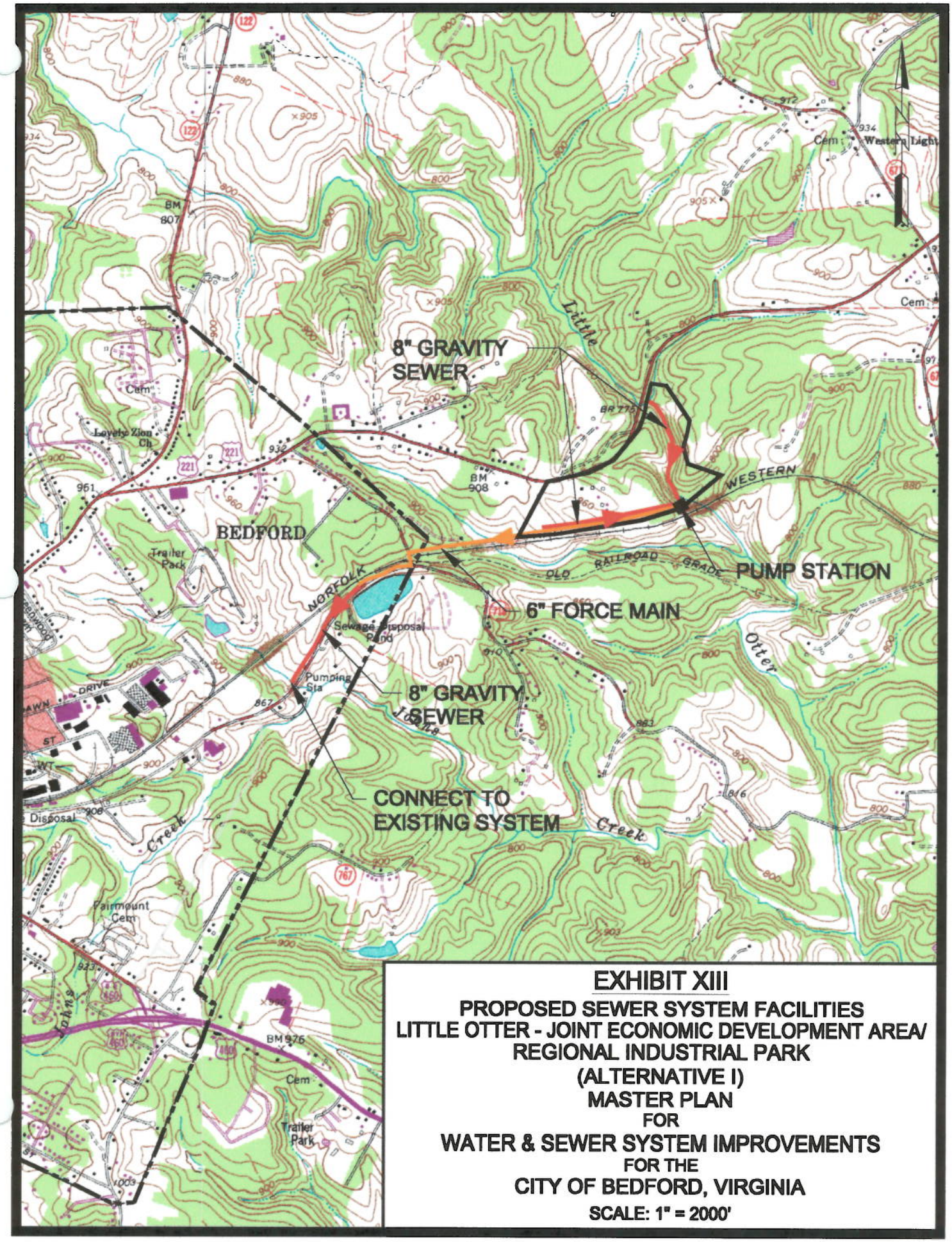

EXHIBIT XIII

PROPOSED SEWER SYSTEM FACILITIES
LITTLE OTTER - JOINT ECONOMIC DEVELOPMENT AREA/
REGIONAL INDUSTRIAL PARK
(ALTERNATIVE I)
MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA
SCALE: 1" = 2000'

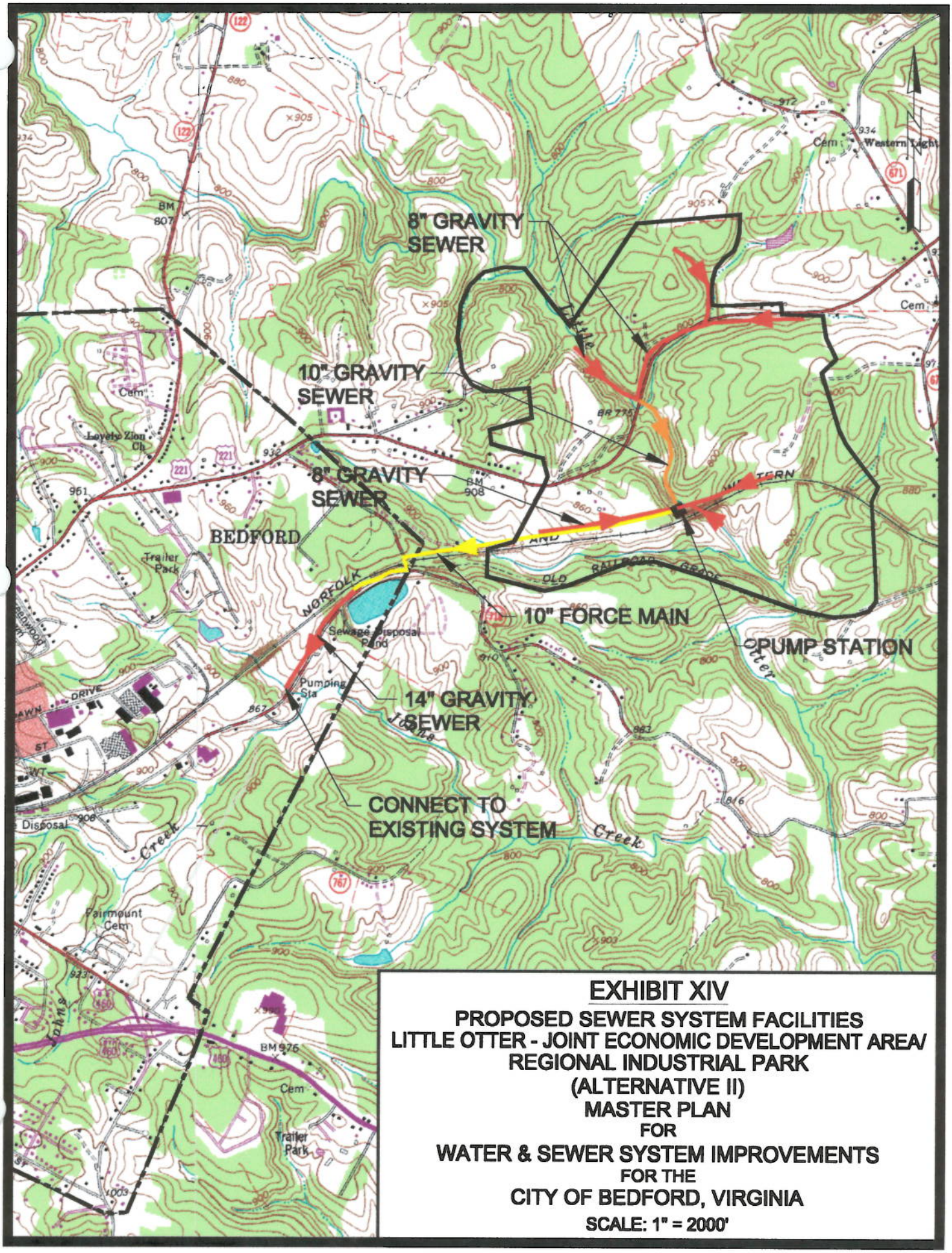

EXHIBIT XIV

PROPOSED SEWER SYSTEM FACILITIES
LITTLE OTTER - JOINT ECONOMIC DEVELOPMENT AREA/
REGIONAL INDUSTRIAL PARK
(ALTERNATIVE II)
MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA
SCALE: 1" = 2000'

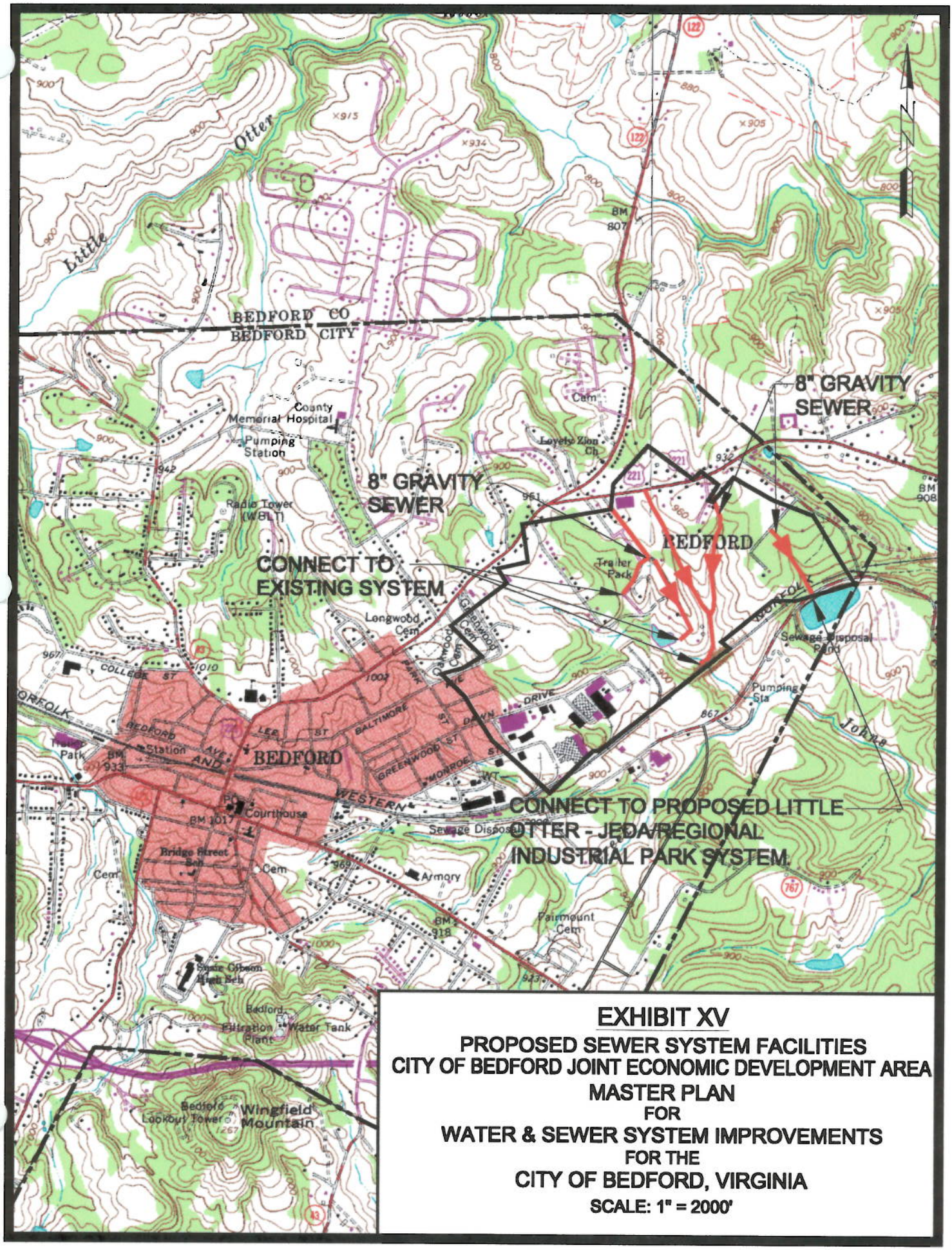

EXHIBIT XV

PROPOSED SEWER SYSTEM FACILITIES
CITY OF BEDFORD JOINT ECONOMIC DEVELOPMENT AREA
MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA

SCALE: 1" = 2000'

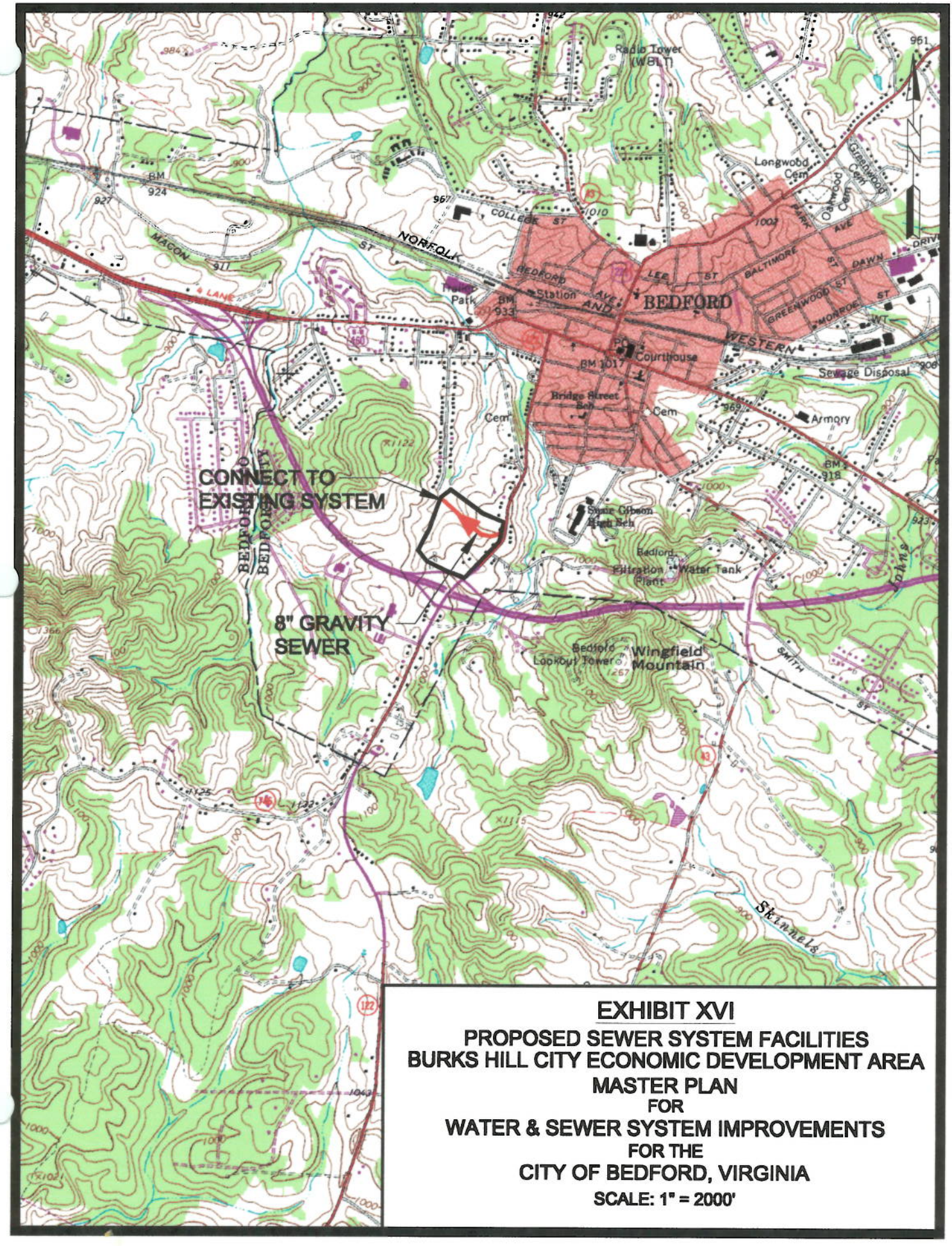

EXHIBIT XVI

PROPOSED SEWER SYSTEM FACILITIES
BURKS HILL CITY ECONOMIC DEVELOPMENT AREA
MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA
SCALE: 1" = 2000'

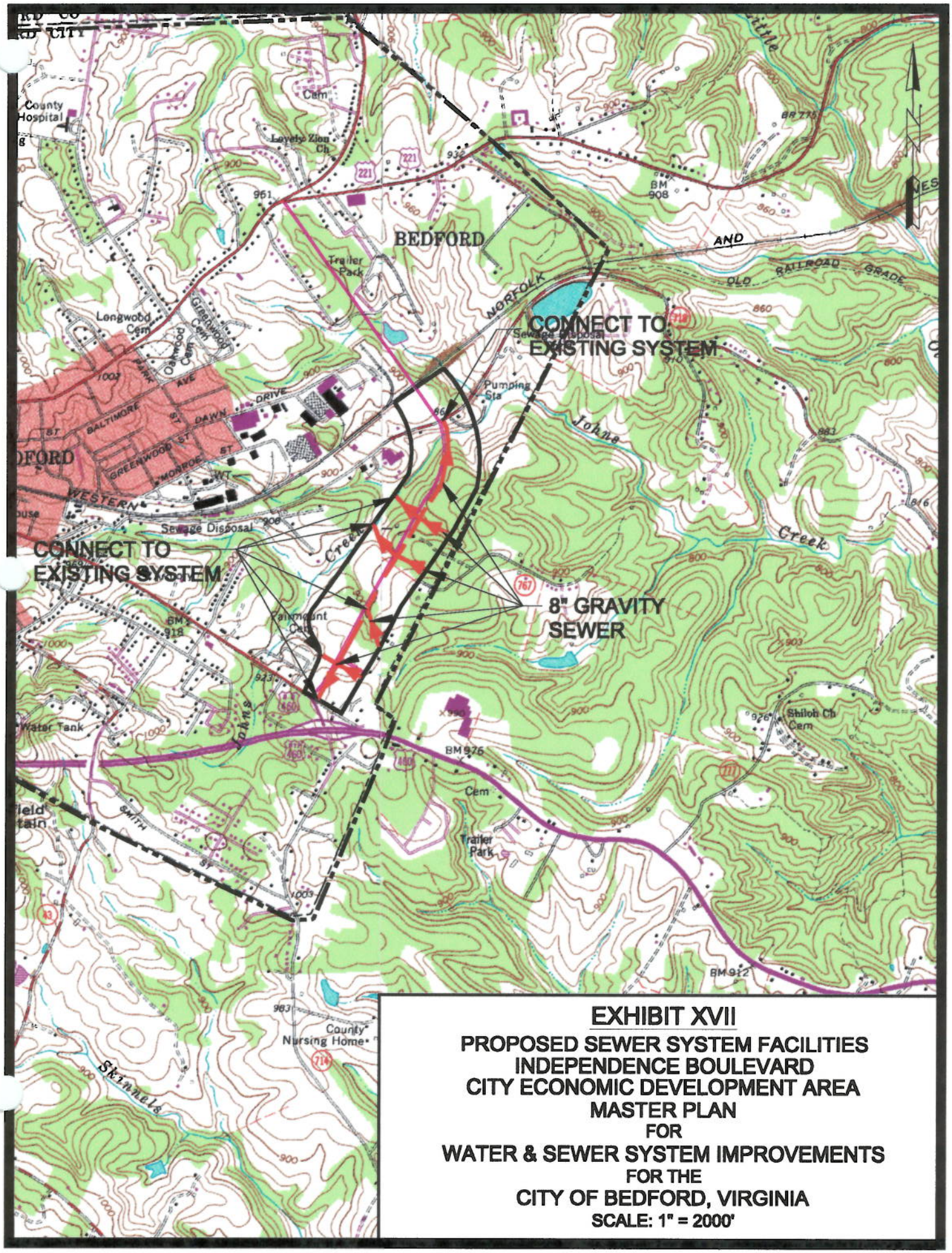

EXHIBIT XVII

PROPOSED SEWER SYSTEM FACILITIES
INDEPENDENCE BOULEVARD
CITY ECONOMIC DEVELOPMENT AREA
MASTER PLAN
FOR
WATER & SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD, VIRGINIA

SCALE: 1" = 2000'

CONSTRUCTION ISSUES AND CONSTRAINTS

Water Demands and Capacity

As previously discussed, the Cybernet model of the existing City of Bedford water distribution system was utilized to evaluate the effects of the 20-year demand projections for the Joint Economic Development Areas (JEDA), City Economic Development Areas (CEDA), and growth within the existing City limits. The model results indicate the requirements for the aforementioned water system improvements to support the overall 20-year development of the JEDA's and CEDA's, although the existing system appears to adequately accommodate growth within the existing City limits. It should be noted that there are several areas within the City's existing distribution system that consist of significant amounts of older 2- and 4- inch water lines that result in periodic pressure fluctuations dependent upon the overall demand on the entire system. Upgrades and replacements in these areas should be considered as part of the annual operation and maintenance of the water distribution system and do not appear to have significant impact on the capabilities of the existing system to support the identified 20-year demand projections.

An evaluation of the existing storage capacity of the City's water distribution system was conducted based on the following parameters:

1. Provide for the storage of 200 gallons per equivalent residential connection (ERC) per VDH regulations.

    a. Per 1999 Water Survey existing ERC's equal 3,785.
    b. Projecting ERC growth for the 20-year planning period results in projected ERC's of approximately 4,277.
    c. Therefore, provide for approximately 855,400 gallons storage.

2. Provide for the storage of fire protection equivalent to a 2,000 gpm fire event for a duration of two hours (i.e., 240,000 gallons).
3. Provide for the storage of the projected 20-year average demands associated with the development of the JEDA's and CEDA's (i.e., Alternative I = 464,100 gallons; Alternative II = 829,100 gallons).
4. Total required storage capacity for the projected overall development, considering Alternative II, will be approximately 1,925,000 gallons.

Based on this evaluation and the existing storage capacity of the City's system (i.e., approximately 3,500,000 gallons) it appears that sufficient storage capacity for the 20-year development period addressed by this report is available. It should be noted that development at some of the higher elevations within some of the JEDAs may place limitations on the allowable minimum water level to be maintained within the storage tanks, thereby reducing the effective storage capacity of the system. These concerns should be further addressed as the preliminary and final designs of the proposed improvements are prepared and as the individual sites within the economic development areas are further identified.

The projected demands will be supplied by the City of Bedford Water Treatment Plant (WTP), which has a capacity of 3.0 mgd and is currently operating at approximately 42% of capacity. Based on the 20-year demand projections presented in this report, the existing WTP will have the capacity to support the projected demands of approximately 2.3 mgd (Alternative II), which is approximately 77% of the existing WTP capacity.

Wastewater Flows

Wastewater flows from the Joint Economic Development Areas, the City Economic Development Areas, and growth areas within the City will be treated at the City's 2.0 mgd Wastewater Treatment Plant (WWTP). The present average daily flow to the treatment plant is approximately 1,749,800 gpd (i.e., 87% of plant capacity), of which approximately 626,400 gpd is attributed to infiltration. It should be noted that the Virginia Department of Environmental Quality (DEQ) regulations require a plan of action when average flows exceed 95% of plant capacity for any three consecutive month period. Using this criterion to determine plant capacity (i.e., 1,900,000 gpd), the available capacity of the plant is 150,200 gpd.

As presented in Table 3, the available plant capacity depends upon both the growth of influent flows from projected development and the reduction of infiltration and inflow (I/I). I/I reduction can have a significant effect on the capacity of the treatment plant to serve planned growth. With no I/I reduction, the 1,900,000 gpd capacity of the WWTP is exceeded within approximately 5 years. With a 50% reduction, the plant capacity is not exceeded for 10 to 20 years. Only complete elimination of I/I would allow the planned development to proceed for Alternative II of the Little Otter JEDA/Regional Industrial Park development.

Evaluation of Receiving Sewer System

The Eagle Point model of the existing City sewer system indicates that at present there are capacity problems in the collection system and the pumping facilities. During heavy rainfall events, certain sections of the existing gravity sewer are prone to surcharge, and the capacities of two of the three primary sewage pump stations (Pump Stations No. 1 and No. 3) are inadequate.

TABLE 3

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR
THE CITY OF BEDFORD

EXISTING AND PROJECTED WASTEWATER FLOWS
TO THE CITY OF BEDFORD WASTEWATER TREATMENT PLANT

SERVICE AREA ALTERNATIVE I/I REMOVAL	EXISTING Q_{AVE} (gpd)	5-YEAR Q_{AVE} (gpd)	10-YEAR Q_{AVE} (gpd)	20-YEAR Q_{AVE} (gpd)
ALT. I - NO I/I REMOVAL	1,749,800	1,897,200	2,058,400	2,357,300
ALT. II - NO I/I REMOVAL	1,749,800	1,959,800	2,183,700	2,722,300
ALT. I - 50% I/I REMOVAL	1,436,600	1,584,000	1,745,200	2,044,100
ALT. II - 50% I/I REMOVAL	1,436,600	1,646,600	1,870,500	2,409,100
ALT. I - 100% I/I REMOVAL	1,123,400	1,270,800	1,432,000	1,730,900
ALT. II - 100% I/I REMOVAL	1,123,400	1,333,400	1,557,300	2,095,900

Notes:

1. Q_{AVE} denotes average flow.

The Eagle Point model of the existing City system was revised to include the 20-year development flows and a 50% reduction in infiltration and inflow (I/I). The results indicate that the collection system as a whole is still under capacity. There are no new sections of gravity sewer surcharge, but none of the original areas of surcharge are alleviated of the surcharge problems. Additionally, Pump Stations No. 1 and No. 3 remain under capacity.

Although the existing sewage collection system and pumping facilities do not have adequate capacity to convey the increased wastewater flows from the proposed project, the limited number of surcharge areas indicates that the majority of the collection system has the capacity to handle the projected flows.

PROJECT COSTS

The project costs associated with the proposed water and sewer system improvements are based upon the proposed facility descriptions, preliminary layouts, and service area design calculations discussed in this Master Plan and, therefore, represent preliminary cost estimates for the proposed facilities. These cost estimates were based on the quantities of major facilities, such as lines and pump stations. The line cost utilized assumed a set amount of appurtenances, such as valves, manholes, fire hydrants, road crossings, and stream crossings per 10,000 linear feet of line. Information supporting the calculations of the line costs utilized in this report is presented in Appendix H.

Project costs for the water system improvements are summarized in Table 4, while the project costs for the sewer system improvements are summarized in Table 6. Additionally, annual operation and maintenance costs have been developed for both the water and sewer system improvements and are summarized in Tables 5 and 7, respectively. Detailed estimates of probable project costs for all of the proposed water and sewer system improvements are presented in Appendices E and G, respectively.

Project costs are defined as the sum of estimated construction costs and related costs. Related costs may include, but are not limited to, lands and rights, basic and additional engineering, construction administration, construction inspection, and permit fees. In this cost analysis, related costs have been generated by using a percentage of the total construction cost typically utilized by funding agencies. It should also be noted that 20 percent of the estimated construction cost has been added to cover contingency items. Preliminary and conceptual cost estimates require these contingencies until final design information is available. It is important

to stress that these cost estimates are preliminary in nature and have been developed without the benefit of final design information and details. Additionally, itemized cost estimates for each of the proposed improvements should be prepared during the "Preliminary Engineering Report" phase of the project. Therefore, the costs presented in this report are subject to further revision as the improvement projects progress toward the design stage.

TABLE 4

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

PRELIMINARY STATEMENT OF PROBABLE PROJECT COSTS FOR WATER SYSTEM IMPROVEMENTS

ECONOMIC DEVELOPMENT AREA	TOTAL CONSTRUCTION COST	TOTAL RELATED COST	TOTAL PROJECT COST
460 EAST	$391,200	$117,400	$508,600
460 WEST	495,800	148,700	$644,500
122 SOUTH/BURKS HILL	31,550	9,500	$41,050
LITTLE OTTER JEDA/REGIONAL INDUSTRIAL PARK			
ALTERNATIVE I/INDEPENDENCE BOULEVARD	629,000	188,700	$817,700
ALTERNATIVE II	164,200	49,300	$213,500
TOTAL ALTERNATIVE I	$1,547,550	$464,300	$2,011,850
TOTAL ALTERNATIVE II	$1,711,750	$513,600	$2,225,350
RAW WATER INTAKE AT JAMES RIVER	$6,135,600	$1,840,700	$7,976,300
CONNECTION TO BCPSA SYSTEM	$3,208,300	$962,500	$4,170,800

Note: Refer to Appendices E and F for the detailed cost estimates.

TABLE 5

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

ESTIMATED OPERATION AND MAINTENANCE COSTS FOR WATER SYSTEM IMPROVEMENTS

ECONOMIC DEVELOPMENT AREA	ANNUAL OPERATION AND MAINTENANCE COST
460 EAST	$2,330
460 WEST	2,570
122 SOUTH/BURKS HILL	230
LITTLE OTTER JEDA/REGIONAL INDUSTRIAL PARK	
ALTERNATIVE I/INDEPENDENCE BOULEVARD	3,700
ALTERNATIVE II	840
TOTAL ALTERNATIVE I	$8,830
TOTAL ALTERNATIVE II	$9,670

Note: Refer to Appendix E for the detailed cost estimates.

TABLE 6

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

PRELIMINARY STATEMENT OF PROBABLE PROJECT COSTS FOR SEWER SYSTEM IMPROVEMENTS

ECONOMIC DEVELOPMENT AREA	TOTAL CONSTRUCTION COST	TOTAL RELATED COST	TOTAL PROJECT COST
CITY OF BEDFORD			
ALTERNATIVE I	$435,000	$130,500	$565,500
ALTERNATIVE II	467,300	140,200	607,500
460 EAST	2,327,550	698,300	3,025,850
460 WEST	1,680,800	504,200	2,185,000
122 SOUTH	887,020	266,100	1,153,120
LITTLE OTTER JEDA/REGIONAL INDUSTRIAL PARK			
ALTERNATIVE I	685,980	205,800	891,780
ALTERNATIVE II	1,355,380	406,600	1,761,980
BEDFORD CITY	527,640	158,300	685,940
BURKS HILL	72,060	21,600	93,660
INDEPENDENCE BLVD	439,020	131,700	570,720
TOTAL ALTERNATIVE I	$7,055,070	$2,116,500	$9,171,570
TOTAL ALTERNATIVE II	$7,756,770	$2,327,000	$10,083,770

Note: Refer to Appendix G for the detailed cost estimates.

TABLE 7

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS FOR SEWER SYSTEM IMPROVEMENTS

ECONOMIC DEVELOPMENT AREA	ANNUAL OPERATION AND MAINTENANCE COST
CITY OF BEDFORD	
ALTERNATIVE I	-----
ALTERNATIVE II	-----
460 EAST	25,500
460 WEST	3,340
122 SOUTH	11,980
LITTLE OTTER JEDA/REGIONAL INDUSTRIAL PARK	
ALTERNATIVE I	8,140
ALTERNATIVE II	18,380
BEDFORD CITY	1,050
BURKS HILL	140
INDEPENDENCE BLVD	870
TOTAL ALTERNATIVE I	$51,020
TOTAL ALTERNATIVE II	$61,260

Note: Refer to Appendix G for the detailed cost estimates.

FUNDING ALTERNATIVES AND FINANCING

To construct the proposed water and sewer improvements associated with the 20-year development projections presented in this report, significant financing will be required. Financial assistance, in the form of grants and low interest loans, may be available from agencies of both the Federal and State governments. The primary public funding sources typically utilized for water and sewer improvement projects consist of: Rural Development (RD), the Virginia Department of Health (VDH) Drinking Water State Revolving Fund, the Virginia Department of Environmental Quality (DEQ) Revolving Loan Fund, the Economic Development Administration (EDA), the Community Development Authority (CDA), and the Virginia Resource Authority (VRA). The City of Bedford may also consider a conventional loan from a local financial institution.

Each of the potential funding sources has advantages and disadvantages to be carefully evaluated at the time of project initiation. Each is discussed in greater detail in the following sections.

Rural Development

Rural Development (formerly Farmer's Home Administration), sponsors a program to aid in the construction of rural water and wastewater systems. In addition to grant awards of up to 70% of the project cost, RD also awards loans at, or slightly below, current market interest rates if a low interest loan cannot be obtained from local sources. The interest rate for a municipality depends on a number of factors, including retained earnings on hand and the income levels of residents in the project area. The repayment period may be up to 40 years.

Virginia Department of Health (VDH) Revolving Loan Fund

The Virginia Department of Health offers low interest loans and grants for water projects. The purpose of this program is to assist in improving water sources that do not comply with the Safe Drinking Water Act. Water sources and water distribution systems with regulatory compliance, water quality, or operational problems may qualify for low interest loans or grants.

Virginia Department of Environmental Quality (DEQ) Revolving Loan Fund

The Virginia Department of Environmental Quality offers low interest loans for various types of publicly owned wastewater treatment and collection projects. The main focus of the DEQ program is to improve water quality. Typically, the rates have been in the 3-5% range with a repayment period of 20 years.

Economic Development Administration (EDA)

The Economic Development Administration can provide grants ranging between $750,000 and $1,250,000 for utility projects. The grant must be linked to the creation of new jobs and/or the retention of existing jobs.

Community Development Authority (CDA)

Funding from the Community Development Authority involves the formation of a special utility area, which would be controlled by a private not for profit cooperation (501-3C). The cooperation could then in turn issue tax exempt bonds to provide the utility service. Once the debt is retired, the system would revert to the City of Bedford.

Virginia Resource Authority

The Virginia Resource Authority (VRA) issues bonds in the national market and loans the proceeds to political subdivisions of the state. By using the "moral obligation" of the state, favorable rates are achieved by the small borrower on revenue bonds. This source of funds is limited to water, sewer and drainage projects and may be either general obligation or revenue backed bonds. The VRA may issue up to $300 million in revenue bonds to localities for water and/or sewer facilities improvements. The bonds may be either short term or long term and fixed or variable rate. Financing is structured on current market conditions and investor preference. In general, due to state backing of bonds, the VRA can obtain more attractive rates than most local governments. There are no limits on how much money a locality can receive, but the locality must demonstrate the ability to repay the bonds.

Private Market

The private market is another alternative for funding the proposed water and sewer system improvements. As a first step, the City would issue a Request for Proposal (RFP) for the needed funds. The RFP's could be structured to obtain proposals for a 10-year bond, 15-year bond, and a 20-year bond. The proposal would be not only for interest rates but also for projected fees (cost of issuance). Typically, the rates fall in the 4.5% to 5.25% range for long term bonds.

As presented in the previous paragraphs, there are numerous funding sources available that provide both grants and/or low interest loans for water and sewer system improvement

projects. In an effort to illustrate the significance of the financing of the water and sewer system improvements identified in this report and the effect of potential financing scenarios, Tables 8 and 9 present the following debt calculations:

Scenario 1 - 100% loan at 4.5 percent interest for 40 years.

Scenario 2 - 50% grant and 50% loan at 4.5 percent interest for 40 years.

As illustrated in the aforementioned Tables, the amount and type of funding significantly impacts the potential debt associated with the development of the proposed water and sewer system improvements.

TABLE 8

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

DEBT REPAYMENT FOR WATER SYSTEM IMPROVEMENTS

ECONOMIC DEVELOPMENT AREA	TOTAL PROJECT COST	ANNUAL OPERATION AND MAINTENANCE COST	ANNUAL DEBT REPAYMENT 1	ANNUAL DEBT REPAYMENT 2
460 EAST	$508,600	$2,330	$27,563	$13,782
460 WEST	644,500	2,570	34,908	17,454
122 SOUTH/BURKS HILL	41,050	230	2,227	1,113
LITTLE OTTER REGIONAL INDUSTRIAL PARK				
ALTERNATIVE I/INDEPENDENCE BOULEVARD	817,700	3,700	44,313	22,156
ALTERNATIVE II	213,500	840	11,563	5,782
TOTAL ALTERNATIVE I	$2,011,850	$8,830	$109,011	$54,505
TOTAL ALTERNATIVE II	$2,225,350	$9,670	$120,574	$60,287

Notes:

1. The loan amount equals the sum of Total Project Cost and Annual Operation and Maintenance Cost.
2. The Debt Repayment 1 plan is 100% loan at 4.5% annual interest rate for 40 years with monthly payments.
3. The Debt Repayment 2 plan is 50% grant and 50% loan at 4.5% annual interest rate for 40 years with monthly payments.

TABLE 9

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

DEBT REPAYMENT FOR SEWER SYSTEM IMPROVEMENTS

ECONOMIC DEVELOPMENT AREA	TOTAL PROJECT COST	ANNUAL OPERATION AND MAINTENANCE COST	DEBT REPAYMENT 1	DEBT REPAYMENT 2
CITY OF BEDFORD				
ALTERNATIVE I	$565,500	-----	$30,507	$15,254
ALTERNATIVE II	607,500	-----	32,773	16,387
460 EAST	3,025,850	25,500	164,613	82,306
460 WEST	2,185,000	3,340	118,056	59,028
122 SOUTH	1,153,120	11,980	62,854	31,427
LITTLE OTTER JEDA/REGIONAL INDUSTRIAL PARK				
ALTERNATIVE I	891,780	8,140	48,548	24,274
ALTERNATIVE II	1,761,980	18,380	96,046	48,023
BEDFORD CITY	685,940	1,050	37,061	18,531
BURKS HILL	93,660	140	5,060	2,530
INDEPENDENCE BLVD	570,720	870	30,836	15,418
TOTAL ALTERNATIVE I	$9,171,570	$51,020	$497,536	$248,768
TOTAL ALTERNATIVE II	$10,083,770	$61,260	$547,299	$273,650

Notes:

1. The loan amount equals the sum of Total Project Cost and Annual Operation and Maintenance Cost.
2. The Debt Repayment 1 plan is 100% loan at 4.5% annual interest rate for 40 years with monthly payments.
3. The Debt Repayment 2 plan is 50% grant and 50% loan at 4.5% annual interest rate for 40 years with monthly payments.
4. The cost of the gravity sewer that connects the eastern section of gravity sewer in the Bedford City JEDA to the existing City system is included in the cost of the Little Otter JEDA/Regional Industrial Park sewer system.

CONCLUSIONS AND RECOMMENDATIONS

Based upon the information presented in this Master Plan, it can be concluded that the overall development of the Joint Economic Development Areas, the City Economic Development Areas, and the City of Bedford will require significant water and sewer system improvements over the next 20 years. Due to the substantial cost associated with constructing the proposed water and sewer improvements identified in this Master Plan, it will be necessary to prioritize the implementation of the proposed facilities improvements and to further investigate project financing. Financing options may include, but are not necessarily limited to, utility rate increases, accessibility fees, and/or the pursuit of funding in the form of grants.

In consideration of the information presented in the *Economic Development Review*, it is recommended that the City prioritize the implementation of the proposed facilities improvements in accordance with the three development tiers, thereby placing the highest priority on the first tier areas. The first tier areas, as presented in the Master Plan, include the 460 East JEDA, Independence Boulevard CEDA, and the Burks Hill CEDA. The implementation of the proposed facilities improvements for these and subsequent areas would consist of the following steps:

Project Implementation by Phases

1. Prepare Preliminary Engineering Report (PER).
2. Submit the PER to the Virginia Department of Health for review and approval.
3. Secure approval of the PER from all regulatory authorities.
4. Evaluate and secure the necessary funds and/or financing for the project.
5. Design the project.

6. Submit the plans and specifications to the Virginia Department of Health, the Virginia Department of Environmental Quality, and the appropriate funding agencies for review and approval.

7. Secure approval of the plans and specifications from all regulatory authorities.

8. Secure all necessary permits and rights from federal, state, and local authorities to enable construction of the necessary facilities.

9. Advertise, open bids, and award the contract for construction.

10. Complete the construction of the facilities.

11. Secure a certificate to operate the facilities from the regulatory authorities.

12. Complete steps 4 through 11 for each area with regard to the Economic Development prioritization.

APPENDICES

APPENDIX A

CITY OF BEDFORD GROWTH PROJECTIONS

CITY OF BEDFORD GROWTH PROJECTIONS

City of Bedford Growth Projections

Two sources were used to determine an estimated annual population growth rate for the City of Bedford. According to data in the 1998 *City of Bedford Comprehensive Plan*, the City of Bedford population grew from 6,073 in 1990 to an estimated 6,200 in 1996, an average growth rate of approximately 0.3%. Data available from the years 1994, 1996, 1997, and 1999 on the numbers of water and sewer connections in the City show an increase of approximately 0.90% in the number of service connections. These two estimated growth rates were averaged to arrive at the projected 0.6% average annual growth rate used for water demands and wastewater flows generated from sources within the City limits.

APPENDIX B

ECONOMIC DEVELOPMENT REVIEW

CITY OF BEDFORD

BEDFORD COUNTY

WATER & SEWER MASTER PLAN

ECONOMIC DEVELOPMENT REVIEW

Brian Wishneff & Associates
March 20, 2000

Description of Study

This study consisted of the initial review of five proposed joint economic development areas located in the City of Bedford or in Bedford County near the city limits. These areas are:

1. 460 East
2. 460 West
3. 122 South
4. Little Otter Business Park
5. City of Bedford Industrial Park

The development potential of these five areas has been determined using the following criteria:

1. Development to date – absorption and existing firms
2. Site conditions – general
3. Locational issues – transportation
4. Utilities – existing and possible future needs
5. Developable parcels

The proposed joint economic development areas are subject to the mutual development agreement between the City of Bedford and Bedford County, which has also been reviewed.

The end result of this economic development review was to provide development estimates and the resultant demand estimates for water and sewer over the 20 year horizon to be used by Thompson + Litton in its master planning process.

Expansion of Scope

The initial review of the City of Bedford and Bedford County development areas in proximity to the municipal boundary showed that there are two to three (depending upon how defined) additional economic development areas not listed in the five joint areas that need to be considered in the master planning. They are:

1. Little Otter Regional Industrial Park – The 486 acre proposed site surrounding Little Otter Park on U. S. Route 221. For planning purposes, it has been added to Little Otter Business Park listed above.

2. Burks Hill – This is the area immediately surrounding the new D-Day Memorial and the access to the site from Route 460.

3. Independence Boulevard – This is the city street that was constructed in 1993 and includes the Bedford Center for Business.

All three of these additional areas are not currently included under the joint economic development agreement. The total seven (consolidation of Little Otter) are included in this review.

Development Potential

1. 460 East – Planned Commercial District

Development to date consists of a number of commercial ventures mixed with mobile home parks and sales. The major retailers are WalMart, AutoZone, CVS and some food services such as McDonalds, Frank's Pizza and Arby's (pending).

The area has many acres of level land which was former agricultural land, much of which is open. There are elevation changes to the South of 460 which create some topographic limits for easy development. From the municipal boundary East to Route 777 (VDOT) there are approximately 500 acres of land.

The economic development area is well situated just outside the city with major route to Lynchburg. It is served by an 8" water line and an 8" sewer line.

There has been discussion of constructing a frontage road on the eastbound side of Route 460 from AutoZone easterly. This would assist in the opening up of additional parcels for development.

A Super Wal-Mart proposal is currently pending adjacent to the current store. This project (155,000 sf) will immediately add to the demand for water and sewer in this economic development area.

VDOT is aware of a study to make U.S. Route 460 into an interstate from Blacksburg to Suffolk. This Trans-America study and possible project, although it would have a significant impact on this area and the others, is anticipated beyond this 20-year planning horizon.

2. 460 West – Commercial and Industrial Zoning

Development to date consists of a number of commercial businesses on Route 460 and some industrial users on the north side. The major commercial businesses are the Super 8 Motel, Golden Corral restaurant, Clayton Homes, Hillman Auto, Best Western, YMCA and Oak Tree Business Center. Salem Court, a residential project, is secondary to the commercial/retail. On the industrial side of Route 460 is a mini-storage facility, a wood mill, a steel yard and Wheelabrator Abrasives.

The land has many acres of level and gently sloping land with little topographic limits for development. Overall, the 460 West area has over 300 acres, much of which has access to rail.

This economic development area is well situated just outside the city on the major route to Roanoke. It is served by an 8" water line and an 8" sewer line.

The Blue Stone Industrial Park, the 40 acres of land on the north side of Route 460, is in this economic development area and has been proposed as a site for B&B Printing. The project developer is requesting water and sewer upgrades for that project and additional development.

3. 122 South – Commercial Zoning

Development to date consists of commercial development scattered between single-family residential. Retailers include Aqua Pro's, Bedford Plumbing and Electric Supply, Blue Ridge Animal Hospital, a Shell Station and nearby RUS Uniform Company.

The land is level and gently rolling with little topographical limits for development. There are approximately 128 acres in this development area.

This area is located along the major travel route to Smith Mountain Lake, and it is the access to downtown Bedford for residents at the Lake and the access for city residents to the recreational areas at the Lake.

It is currently served by a 12" water line and a 10" sewer line.

A windshield survey conducted of traffic and types of retail shoppers in the area (2/00) confirmed the local resident aspects of this economic development area. Summer residents at the Lake would increase this traffic. In general, it is felt that because of the resident aspect of the area, further commercial development of the 122 South economic development area would curtail a certain percentage of shoppers from downtown destinations.

4. Little Otter Business Park – Including Little Otter Regional Business Park – Industrial Zoning

Development to date has been slow in the existing park. Only two projects have been undertaken in the park since its inception in 1989. Those projects are REO Enterprises (Texaco) and South Chem, Inc. Nearby on Route 221 are Parkway Steel, Regal Medical and Red Machine Co. plus many single-family residencies.

The Little Otter Park itself (included in the joint economic development agreement) has 74 acres, and the proposed regional park site includes approximately 486 acres. This land is open and has gently rolling topography.

As an economic development area it is well situated on Route 221 between the City of Bedford and Lynchburg. Route 221 is not the major route that 460 is, and residential development has occurred all along the route, excepting immediately at the park site.

Little Otter is not served by public sewer and has a 10" water line. The lack of public sewer is a major reason for the slow development of the park.

The proposed regional park has received a great deal of focus in the past few months. Regional industrial parks with large acreages are seen as an important economic

development tool for Virginia and the region of the state where one is located. Large (100+ acres) industrial sites in the Bedford region are not available. Rail service could also be available to these large sites. The demand for these sites is undetermined but inquiries to the state do occur. The proposed development of a regional park would be undertaken by more than the City of Bedford and Bedford County. There would be as many as seven participating jurisdictions.

The extension of sewer to Little Otter is an important part of the policy decision to proceed with a regional industrial park.

5. Bedford City Industrial Park – Industrial Zoning

Development of this older industrial area of the City of Bedford has been ongoing since the beginnings of the city. Currently the majority of the area is occupied by Rubatex and small industrial support service companies to the Rubatex plant. J. C. Nickens and Boitnot Sheet Metal are located here.

There is some open land for development in the 110 acres comprising this area. It borders along the Norfolk Southern rail lines, making rail service available to projects. The area has 8" and 10" water lines and 15" sewer lines.

Redevelopment either through adaptive reuse of older buildings, or demolition, site clearance, or new construction are the ways to develop this area.

6. Burks Hill (D-Day Memorial) – General Business Zoning

Development of the land surrounding the D-Day Memorial is primarily residential, and includes a new school. Gas stations have been built at the interchange of 460 north towards the school/memorial access.

This is an area of open land surrounding the memorial and older residential development immediately adjacent to it. It is a highly visible location with easy access from Route 460 heading east or west. The area is currently served by 12" water and 8" sewer lines.

There are parcels of land under municipal control and currently residences are being purchased with a commercial/retail use change idea. It is estimated that within the next few years 100,000+ visitors will come to Bedford annually to see the D-Day Memorial.

7. Independence Boulevard – Manufacturing/General Business Zoning

Development along the newly built Independence Boulevard has been steady. Major projects include the Bedford Co-op and Taylor Building Center. On the lower (Route 221) end of Independence Boulevard is Dawn Drive Industrial Park and the new Bedford Center for Business on Venture Boulevard. Golden West Foods and Piedmont Metal Products are located in this area.

This area has a rolling to hilly topography with some development constraints. The area has easy access to both routes 460 and 221. It is served by 10" water and 8" sewer lines.

There are many smaller (1-5 acre) parcels which can be developed along Independence Boulevard and the new park is attractively laid out encouraging development.

Prioritization Suggestions

Of the economic development areas, both in and out of the joint economic development agreement, there are ones that are under higher development pressure. This is due, in part, to the developability of an area, its site factors, as well as market factors, and the need for projects that are economically viable.

The following is a prioritization of the seven economic development areas into three tiers, the highest being under the most pressure, the lowest the least development pressure. This is offered not as the definitive description of how development will proceed over the next 20 years, but rather as a guide for making policy and financial decisions relative to the expansion and/or upgrades of water and sewer services. Final prioritization is the authority of local decision makers.

The economic development areas prioritize as follows:

First Tier

460 East
Independence Boulevard*
Burks Hill*

Second Tier

460 West
122 South

Third Tier

Little Otter Park/Regional Park*
Bedford City Industrial Park

*Not included in Joint Economic Development Agreement

Demand Estimates

Given the attributes of the various economic development areas, and the level of development pressure in the near future and looking beyond, we have broken the 20 year plan into three time frames for analysis.

In each time frame, an estimate has been made of the types of development, amount of development and the resulting demand on water and sewer. Sewer demand is the limiting factor for the plan.

Each of the seven areas has been broken down in this manner. Again, this is offered as a guide for planning purposes.

See Charts #2 – #8

These growth estimates are based on the anticipated possible projects are made in keeping with the Land Use Standards of the *City of Bedford Comprehensive Plan, 1998.* The demand for water and sewer are based upon Virginia Department of Health Waste Water requirements.

SUMMARY

Demand estimates for water and sewer have been generated for the identified seven economic growth areas. These have been determined by a review of each area's growth pattern and potential, an estimate of specific future projects and a calculation of the resultant demands.

The summary of demand estimates is shown on Chart #1. A review of building permits, both in the city and county, show a constant level of contribution activity, including retail and commercial. The rates of demand increases shown on Chart #1 are less than the past five years (1995-1999) growth in water production. However, the actual rates of demand increases shown on Chart #1 are similar to growth in population which is anticipated to be 3.2% in the next 5 years in the City of Bedford and 8.3% in the next five years in Bedford County.

In conclusion, in order to meet the development needs of a growing region, water and sewer must be expanded, and capacities which will be required, met.

This review offers estimates, and prioritization guides to help assure adequate future levels of services. Decision makers are encouraged to utilize the information combined with safety factors and financial concerns to develop the overall master plan.

Bedford Master Plan

SUMMARY

Total Growth 1,800,000 GPD current demand

Years	Demand	Growth Rate
1-5	113,100 GPD	6.3%
5-10	126,000 GPD	6.7%
10-20	225,000 GPD	11%

NOTES:

All of this development is unlikely, however sizing to this demand capacity is important. Individual projects may not proceed in this sequence.

Bedford Master Plan

Area Name: 460 East to Route 777

Notes: In joint economic development areas. Pressure for development is at hand, and will be increasing due to VDOT improvements and current projects.

Location: Along Route 460, at city line

Development Tier: 1st

Planning Period	Projected Development	Estimated Square Footage	Water & Sewer Demand
1-5 years	WalMart Express Service Station/Conv. Store Misc. Commercial	155,000 sf	31,100 GPD 21,500 GPD 5,000 GPD Subtotal: 57,600
5-10 years	Restaurant Shopping Office Misc. Commercial Apartment Complexes (2)	100 seat 20,000 sf 10,000 sf 50-50 units	5,000 GPD 4,000 GPD 5,000 GPD 5,000 GPD 22,000 GPD Subtotal: 41,000 GPD
10-20 years	Shopping Service Station/Conv. Store Office Misc. Commercial Apartment/Condo	30,000 100,000 10,000 75 units	6,000 GPD 20,000 GPD 21,500 GPD 5,000 GPD 5,000 GPD 16,500 GPD Subtotal: 74,000
TOTALS			172,600

Bedford Master Plan

Area Name: 460 West **Notes:** Included in joint economic development area. Development anticipated to proceed only a short way from the city limits.

Location: On Route 460, from city line west

Development Tier: 2nd

Planning Period	Projected Development	Estimated Square Footage	Water & Sewer Demand
1-5 years	Industrial/Service Shopping Service Station/Conv.	5,000 sf	3,500 GPD 1,000 GPD 21,500 GPD Subtotal: 26,000
5-10 years	Shopping Office Service Station Industrial/Service (1) 100 emp.	5,000 sf	1,000 GPD 5,000 GPD 10,000 GPD 3,500 GPD Subtotal: 19,500 GPD
10-20 years	Motel Shopping Office Industrial/Service (2) Housing	150 x 5,000 sf 20 units	19,500 GPD 2,000 GPD 5,000 GPD 7,000 GPD 4,400 GPD Subtotal: 36,900 GPD
TOTALS			82,400

Bedford Master Plan

Area Name: 122 South **Notes:** Included in joint economic development area. Development anticipated to proceed not too far from interchange with 460.

Location: From 460 south toward Smith Mountain Lake

Development Tier: 2nd

Planning Period	Projected Development	Estimated Square Footage	Water & Sewer Demand
1-5 years	Commercial	5,000 sf	1,000 GPD Subtotal: 1,000 GPD
5-10 years	Commercial Gas Station Fast Food	5,000 sf	1,000 GPD 20,000 GPD Subtotal: 21,000 GPD
10-20 years	Motel Commercial	100 rooms 5,000 sf	22,000 GPD 1,000 GPD Subtotal: 23,000 GPD
TOTALS			45,000

Bedford Master Plan

Area Name: Little Otter/Regional Park

Notes: Little Otter Park in joint economic development area. Proposed regional park not currently in joint economic development area. Policy maker decision relative to support for future regional park.

Location: Route 221, .7 miles outside city limit

Development Tier: 3rd

Planning Period	Projected Development	Estimated Square Footage	Water & Sewer Demand
1-5 years	Industrial/Service Commercial Housing	 5,000 sf 30 units x 400 GPD	1,500 GPD 1,000 GPD 12,000 GPD Subtotal: 14,500 GPD
5-10 years	Industrial/Service Misc. Commercial along Rt. 221 Housing	 30 units x 400 GPD	1,500 GPD 5,000 GPD 12,000 GPD Subtotal: 14,500 GPD
10-20 years	Large Industrial 450 employees 2+ shifts Industrial/Service (2) Misc. Commercial Office Housing	 50 units	31,500 GPD 3,000 GPD 5,000 GPD 5,000 GPD 11,000 GPD Subtotal: 55,500 GPD
TOTALS			84,500

Bedford Master Plan

Area Name: Bedford City **Notes:** Included in joint economic development area.
Specific redevelopment projects anticipated.

Location: Within city limits in proximity to existing industrial uses.

Development Tier: 3rd

Planning Period	Projected Development	Estimated Square Footage	Water & Sewer Demand
1-5 years	Industrial/Service - small	30 or less emp.	1,000 GPD Subtotal: 1,000 GPD
5-10 years	Industrial/Service – small	30 or less emp.	1,000 GPD Subtotal: 1,000 GPD
10-20 years	Housing - Reuse	80 units	17,600 GPD Subtotal: 17,600 GPD
TOTALS			19,600

Bedford Master Plan

Area Name: Burks Hill

Notes: Limited land for development, but D-Day Memorial will be focus of growth. Not in joint economic development areas.

Location: North of 460, in city limits

Development Tier: 1st

Planning Period	Projected Development	Estimated Square Footage	Water & Sewer Demand
1-5 years	Visitor's Center Restaurant Misc.	100 seat	2,500 GPD 5,000 GPD 1,000 GPD Subtotal: 8,500 GPD
5-10 years	Motel Some Commercial	150 room	19,500 GPD 5,000 GPD Subtotal: 24,500 GPD
10-20 years	Some Commercial Fast Food Restaurant		5,000 GPD 5,000 GPD Subtotal: 10,000 GPD
TOTALS			43,000

Bedford Master Plan

Area Name: Independence Blvd. **Notes:** Not part of joint economic development area. Anticipated full development over next 20 years.

Location: Within city limits

Development Tier: 1st

Planning Period	Projected Development	Estimated Square Footage	Water & Sewer Demand
1-5 years	Industrial/Service Transportation Misc. Commercial	1 per year/20 employees @ 35 gm/emp.	3,500 GPD 1,000 GPD Subtotal: 4,500 GPD
5-10 years	Industrial Misc.		 4,500 GPD Subtotal: 4,500 GPD
10-20 years	Industrial Misc.		7,000 GPD 1,000 GPD Subtotal: 8,000 GPD
TOTALS			17,000

APPENDIX C

DESIGN CALCULATIONS – WATER

DESIGN CALCULATIONS – WATER

Demands

The existing demands for the City of Bedford Cybernet model were based on production records from 1988 through 1997, consumption records, and house counts from aerial and USGS topographic mapping. The growth within the City was incorporated in the model by applying 0.6 % per year for 20 years to the existing demand on each node. The demand utilized in the model to evaluate the effects of the JEDA's and CEDA's was developed in the *Economic Development Review*.

Modeling

The City's Cybernet model was utilized to evaluate the proposed water system improvements. Each evaluation consisted of developing the layout for the main trunk line throughout the JEDA or CEDA (this routing primarily consisted of following the major thoroughfare in the area) and then evaluating if the extension of the existing system along this route would provide for adequate service. Adequate service was considered maintaining a minimum of 20 psi throughout the system and within the EDA with a fire flow event in the EDA and peak flows on the entire system. If these extensions resulted in inadequate areas within the EDA or the existing system, upgrades were considered until an adequate scenario was developed.

The fire flow events evaluated for the various EDA's are summarized below and were determined based on the type of most likely development considered for the EDA (*Economic Development Review*).

2000 gpm - 460 East, Little Otter, 460 West, Independence Blvd and Bedford City

1000 gpm - 122 South and Burks Hill

Supplemental Source Evaluations

Raw Water from James River –

Elevation at J.R. = 615'
Elevation at high spot along route = 1559' (3,500' east of reservoir)
Static = 944' , round-off to 950'
74,000 linear feet of line, h_L @ 6MGD w/ 24" pipe = 106'
Estimated total head on system = 1056' (457 psi)
Use two pump stations.

BCPSA System –

Hydraulic Grade line @ Campbell County = 1055'
Elevation at high spot along route (prior to 460E JEDA) = 895'
City of Bedford Tank Levels are equal to or greater than 1191'
Water will have to be pumped from the BCPSA system into the City System.
59,600 linear feet of line, h_L @ 2.3 MGD w/ 14" pipe = 171'
Difference between HGL BCPSA and Tank Level = 136'
Estimated total head = 307' (133 psi) – this will also need to account for h_L in existing BCPSA and City Systems (City = 142' (61 psi))
Use one pump station from the connection to BCPSA system to 460 East.

Existing Facilities

WTP = 3.0 MGD

WTP Tank = 1,000,000 gallons
O/F = 1200.17'
R/W= 1179'

Helm Street

1,000,000 gallon tank
O/F = 1191.13'
R/W = 1178.63'

1,500,000 gallon tank
O/F = 1193.45'
R/W = 1180.95'

APPENDIX D

DESIGN CALCULATIONS – SEWER

DESIGN CALCULATIONS – SEWER

Projected Wastewater Flows

The wastewater flows for the entire project service area are a combination of flows from the following individual service areas: the City of Bedford, the Joint Economic Development Areas, and the City Economic Development Areas. The City flows include infiltration and inflows from the existing City sewer system. The existing City flows were developed from flow data in the *Bedford Capacity Study*. The projected City flows were established by applying the projected City growth rate developed in Appendix A to the existing flows. Projected flows for the JEDA's and CEDA's were developed in the *Economic Development Review* in Appendix B. The 365,000 gpd average flow for the full development of Alternative II of the Little Otter Regional JEDA/Regional Industrial Park was taken from the 1999 Preliminary Engineering Report *Two Potential Industrial Park Sites for Virginia's Region 2000*.

The growth rates for flows within the project service area vary. The estimated average annual growth rate of sewer flows within the City was assumed to be a constant 0.6% and is derived in Appendix A. As developed in the *Economic Development Review*, the growth rates of flows in the individual JEDA's and CEDA's are dependent upon the type of development anticipated and the potential for growth. The projected growth rate for Alternative II of the Little Otter Regional JEDA/Regional Industrial Park was assumed to match that of Alternative I. In the analysis of the effect of projected flows on the existing sewer system, growth in the infiltration and inflow (I/I) was assumed to be moderated by the City's mandated efforts to reduce I/I, to the extent that approximately 50% of I/I would be removed at the end of the 20-year planning period.

Average wastewater flows in the project service area include the average wastewater flows from within the City, the average wastewater flows from the JEDA's and CEDA's, and the

average infiltration flows within the City. Peak wastewater flows in the project service area include the peak sewer flows from within the City, the peak wastewater flows from the JEDA's and CEDA's, the peak infiltration flows within the City, and the additional inflows caused by a typical one-year storm event. The peak factors for the City flows and the average infiltration flows vary from basin to basin within the City and were developed in the *Bedford Capacity Study*. The peak factor for the Economic Development Areas was the 2.5 peak residential factor recommended by the VDH regulations.

The wastewater flows utilized to evaluate the existing City sewage collection system and to design the system upgrades are the peak wastewater flows with the 50% reduction of both peak infiltration and inflow. The wastewater flows utilized to evaluate the capacity of the City's Wastewater Treatment Plant are the average wastewater flows with the 50% reduction of average infiltration.

Proposed Sewer Facility Design

The design of the gravity sewer in the JEDA's and CEDA's was based on the VDH regulations and the capacities of the pipe at minimum slope, as presented in Table D.1. Collector lines 8-inch and 10-inch in diameter with a capacity of 493,900 gpd and 749,300 gpd, respectively, can be utilized for the gravity sewer in these Economic Development Areas.

The preliminary pump stations and force mains for the Economic Development Areas were designed to meet Virginia Department of Health regulations requiring a minimum velocity of 2.0 feet per second in force mains.

Existing System Evaluations and Upgrades

Projected peak flows for the 20-year planning period were input into the Eagle Point model of the existing sewer system to determine the effects of growth and 50% I/I reduction on

the existing system and to design the proposed system upgrades. The gravity sewer lines with surcharges or transitional flow were upgraded in the model to eliminate these problems. The only exception was Line 86, directly upstream of Pump Station No. 1, into which flow from the pump station backs up. Primary Pump Stations No. 1, No. 2, and No. 3 were upgraded to accommodate the higher 20-year peak flows received. The pump configurations and wet well levels in the existing model were maintained.

Existing System Facilities

In *The City of Bedford Sewage Pump Station Evaluation*, the actual capacities of Pump Stations No. 1, No. 2, and No. 3, the three primary pump stations in the City sewage system, were determined. The following list details the design, actual, and proposed upgrade capacities of these pump stations.

Pump Station No. 1 –

Design Capacity = 600 gpm (1 pump)
Actual Capacity = 830 gpm (1 pump); 1,300 gpm (2 pumps)
Upgraded Pump Station Capacity = 1,600 gpm

Pump Station No. 2 –

Design Capacity = 900 gpm (1 pump)
Actual Capacity = 1,050 gpm (1 pump); 1,670 gpm (2 pumps)
Upgraded Pump Station Capacity = 1,970 gpm

Pump Station No. 3 –

Design Capacity = 607 gpm (1 pump)
Actual Capacity = 800 gpm (1 pump); 1,000 gpm (2 pumps)
Upgraded Pump Station Capacity = 1,490 gpm (Little Otter JEDA/Regional Industrial Park Alternative I)
Upgraded Pump Station Capacity = 2,090 gpm (Little Otter JEDA/Regional Industrial Park Alternative II)

TABLE D.1

MASTER PLAN
FOR
WATER AND SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD

SEWER PIPE CAPACITIES

PIPE DIA. (in)	MIN. SLOPE (%)	Manning 'n'	Q_{FULL} (cfs)	Q_{FULL} (gpd)
8	0.40	0.013	0.76	493,900
10	0.28	0.013	1.16	749,300
12	0.22	0.013	1.67	1,080,000
15	0.15	0.013	2.50	1,616,900
24	0.08	0.013	6.40	4,135,200
30	0.06	0.013	9.88	6,384,000
36	0.05	0.013	14.31	9,245,100

APPENDIX E

ECONOMIC DEVELOPMENT AREA WATER SYSTEM IMPROVEMENTS

COST ESTIMATES

TABLE E.1

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
WATER SYSTEM IMPROVEMENTS
FOR THE
460 EAST JOINT ECONOMIC DEVELOPMENT AREA

CONSTRUCTION COST:

3,000 L.F. 12-inch Water Line @	$36 L.F.	$108,000
5,400 L.F. 10-inch Water Line @	$31 L.F.	$167,400
2,200 L.F. 6-inch Water Line @	$23 L.F.	$50,600
	Subtotal	$326,000
	Construction Contingency (20%)	$65,200
	TOTAL CONSTRUCTION COST	**$391,200**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$117,400
TOTAL PROJECT COST	**$508,600**

TABLE E.2

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
WATER SYSTEM IMPROVEMENTS
FOR THE
460 EAST JOINT ECONOMIC DEVELOPMENT AREA

WATER LINE:

10,600 L.F. Water Line @	$0.22 L.F./Year	$2,330
	Subtotal	$2,330
	Annual O&M Cost	**$2,330**

TABLE E.3

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
WATER SYSTEM IMPROVEMENTS
FOR THE
460 WEST JOINT ECONOMIC DEVELOPMENT AREA

CONSTRUCTION COST:

10,100 L.F. 12-inch Water Line @	$36 L.F.	$363,600
1,600 L.F. 10-inch Water Line @	$31 L.F.	$49,600
	Subtotal	$413,200
	Construction Contingency (20%)	$82,600
	TOTAL CONSTRUCTION COST	**$495,800**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$148,700
TOTAL PROJECT COST	**$644,500**

TABLE E.4

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
WATER SYSTEM IMPROVEMENTS
FOR THE
460 WEST JOINT ECONOMIC DEVELOPMENT AREA

WATER LINE:

11,700 L.F. Water Line @	$0.22 L.F./Year	$2,570
	Subtotal	$2,570
	Annual O&M Cost	**$2,570**

TABLE E.5

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
WATER SYSTEM IMPROVEMENTS
FOR THE
122 SOUTH/BURKS HILL JOINT ECONOMIC DEVELOPMENT AREAS

CONSTRUCTION COST:

1,050 L.F. 8-inch Water Line @	$25 L.F.	$26,250
	Subtotal	$26,250
	Construction Contingency (20%)	$5,300
	TOTAL CONSTRUCTION COST	**$31,550**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$9,500
TOTAL PROJECT COST	**$41,050**

TABLE E.6

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
WATER SYSTEM IMPROVEMENTS
FOR THE
122 SOUTH/BURKS HILL JOINT ECONOMIC DEVELOPMENT AREAS

WATER LINE:

1,050 L.F. Water Line @	$0.22 L.F./Year	$230
	Subtotal	$230
	Annual O&M Cost	**$230**

TABLE E.7

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST FOR WATER SYSTEM IMPROVEMENTS FOR THE LITTLE OTTER JOINT ECONOMIC DEVELOPMENT AREA REGIONAL INDUSTRIAL PARK ALTERNATIVE I INDEPENDENCE BOULEVARD JOINT ECONOMIC DEVELOPMENT AREA

CONSTRUCTION COST:

5,600 L.F. 12-inch Water Line @	$36 L.F.	$201,600
7,100 L.F. 10-inch Water Line @	$31 L.F.	$220,100
4,100 L.F. 8-inch Water Line @	$25 L.F.	$102,500
	Subtotal	$524,200
	Construction Contingency (20%)	$104,800
	TOTAL CONSTRUCTION COST	**$629,000**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$188,700
TOTAL PROJECT COST	**$817,700**

TABLE E.8

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
WATER SYSTEM IMPROVEMENTS
FOR THE
LITTLE OTTER JOINT ECONOMIC DEVELOPMENT AREA
REGIONAL INDUSTRIAL PARK ALTERNATIVE I
INDEPENDENCE BOULEVARD JOINT ECONOMIC DEVELOPMENT AREA

WATER LINE:

16,800 L.F. Water Line @	$0.22 L.F./Year	$3,700
	Subtotal	$3,700
	Annual O&M Cost	**$3,700**

TABLE E.9

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
WATER SYSTEM IMPROVEMENTS
FOR THE
LITTLE OTTER JOINT ECONOMIC DEVELOPMENT AREA
REGIONAL INDUSTRIAL PARK
ALTERNATIVE II

CONSTRUCTION COST:

3,800 L.F. 12-inch Water Line @	$36 L.F.	$136,800
	Subtotal	$136,800
	Construction Contingency (20%)	$27,400
	TOTAL CONSTRUCTION COST	**$164,200**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$49,300
TOTAL PROJECT COST	**$213,500**

TABLE E.10

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
WATER SYSTEM IMPROVEMENTS
FOR THE
LITTLE OTTER JOINT ECONOMIC DEVELOPMENT AREA
REGIONAL INDUSTRIAL PARK
ALTERNATIVE II

WATER LINE:

3,800 L.F. Water Line @	$0.22 L.F./Year	$840
	Subtotal	$840
	Annual O&M Cost	**$840**

APPENDIX F

SUPPLEMENTAL WATER SOURCE COST ESTIMATES

TABLE F.1

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
SUPPLEMENTAL WATER SOURCE DEVELOPMENT
RAW WATER INTAKE AT THE JAMES RIVER

CONSTRUCTION COST:

74,000 L.F. 24-inch Water Line @	$62 L.F.	$4,588,000
1 EA. Raw Water Intake/Pump Station @	$250,000 EA.	250,000
1 EA. Raw Water Pump Station @	$175,000 EA.	175,000
1 EA. Discharge Facility @	$100,000 EA.	100,000
	Subtotal	$5,113,000
	Construction Contingency (20%)	$1,022,600
	TOTAL CONSTRUCTION COST	**$6,135,600**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$1,840,700
TOTAL PROJECT COST	**$7,976,300**

TABLE F.2

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
SUPPLEMENTAL WATER SOURCE DEVELOPMENT
CONNECTION TO BEDFORD COUNTY PSA SYSTEM

CONSTRUCTION COST:

59,600 L.F. 14-inch Water Line @	$41 L.F.	$2,443,600
1 EA. Pump Station @	$200,000 EA.	200,000
1 EA. Master Meter Vault @	$30,000 EA.	30,000
	Subtotal	$2,673,600
	Construction Contingency (20%)	$534,700
	TOTAL CONSTRUCTION COST	**$3,208,300**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$962,500
TOTAL PROJECT COST	**$4,170,800**

APPENDIX G

ECONOMIC DEVELOPMENT AREA SEWER SYSTEM IMPROVEMENTS

COST ESTIMATES

TABLE G.1

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD
ALTERNATIVE I

CONSTRUCTION COST:

214 L.F. 30-inch Gravity Sewer Line @	$75 L.F.	$16,100
553 L.F. 24-inch Gravity Sewer Line @	$66 L.F.	$36,500
1,827 L.F. 15-inch Gravity Sewer Line @	$54 L.F.	$98,700
823 L.F. 12-inch Gravity Sewer Line @	$50 L.F.	$41,200
1 EA. Pump Station No. 1 Upgrade (1,600 gpm) @	$60,000 EA.	$60,000
1 EA. Pump Station No. 2 Upgrade (1,970 gpm) @	$50,000 EA.	$50,000
1 EA. Pump Station No. 3 Upgrade (1,490 gpm) @	$60,000 EA.	$60,000
	Subtotal	$362,500
	Construction Contingency (20%)	$72,500
	TOTAL CONSTRUCTION COST	**$435,000**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$130,500
TOTAL PROJECT COST	**$565,500**

TABLE G.2

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
CITY OF BEDFORD
ALTERNATIVE II

CONSTRUCTION COST:

319 L.F. 36-inch Gravity Sewer Line @	$85 L.F.	$27,100
432 L.F. 30-inch Gravity Sewer Line @	$75 L.F.	$32,400
1,827 L.F. 15-inch Gravity Sewer Line @	$54 L.F.	$98,700
823 L.F. 12-inch Gravity Sewer Line @	$50 L.F.	$41,200
1 EA. Pump Station No. 1 Upgrade (1,600 gpm) @	$60,000 EA.	$60,000
1 EA. Pump Station No. 2 Upgrade (1,970 gpm) @	$50,000 EA.	$50,000
1 EA. Pump Station No. 3 Upgrade (2,090 gpm) @	$80,000 EA.	$80,000
	Subtotal	$389,400
	Construction Contingency (20%)	$77,900
	TOTAL CONSTRUCTION COST	**$467,300**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$140,200
TOTAL PROJECT COST	**$607,500**

TABLE G.3

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
460 EAST JOINT ECONOMIC DEVELOPMENT AREA

CONSTRUCTION COST:

31,370 L.F. 8" Gravity Sewer Line @	$42 L.F.	$1,317,540
1 EA. Sewage Pump Station (300 gpm) @	$200,000 EA.	200,000
1 EA. Sewage Pump Station (120 gpm) @	$150,000 EA.	150,000
1 EA. Sewage Pump Station (80 gpm) @	$100,000 EA.	100,000
5,590 L.F. 6" Force Main @	$21 L.F.	117,390
3,040 L.F. 4" Force Main @	$18 L.F.	54,720
	Subtotal	$1,939,650
	Construction Contingency (20%)	$387,900
	TOTAL CONSTRUCTION COST	**$2,327,550**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$698,300
TOTAL PROJECT COST	**$3,025,850**

TABLE G.4

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
460 EAST JOINT ECONOMIC DEVELOPMENT AREA

PUMP STATIONS:

Power		$9,160
Maintenance Labor/Pump Replacement		$7,500
Materials		$3,800
	Subtotal	$20,460

SEWER LINE:

31,370 L.F. Gravity Sewer Line @	$0.10 L.F./Year	$3,140
8,630 L.F. Force Main @	$0.22 L.F./Year	$1,900
	Subtotal	$5,040
	Annual O&M Cost	**$25,500**

TABLE G.5

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
460 WEST JOINT ECONOMIC DEVELOPMENT AREA

CONSTRUCTION COST:

33,350 L.F. 8" Gravity Sewer Line @	$42 L.F.	$1,400,700
	Subtotal	$1,400,700
	Construction Contingency (20%)	$280,100
	TOTAL CONSTRUCTION COST	**$1,680,800**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$504,200
TOTAL PROJECT COST	**$2,185,000**

TABLE G.6

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
460 WEST JOINT ECONOMIC DEVELOPMENT AREA

SEWER LINE:

33,350 L.F. Gravity Sewer Line @	$0.10 L.F./Year	$3,340
	Subtotal	$3,340
	Annual O&M Cost	**$3,340**

TABLE G.7

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
122 SOUTH JOINT ECONOMIC DEVELOPMENT AREA

CONSTRUCTION COST:

10,160 L.F. 8-inch Gravity Sewer Line @	$42 L.F.	$426,720
2 EA. Sewage Pump Station (80 gpm) @	$100,000 EA.	200,000
6,250 L.F. 4-inch Force Main @	$18 L.F.	112,500
	Subtotal	$739,220
	Construction Contingency (20%)	$147,800
	TOTAL CONSTRUCTION COST	**$887,020**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$266,100
TOTAL PROJECT COST	**$1,153,120**

TABLE G.8

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
122 SOUTH JOINT ECONOMIC DEVELOPMENT AREA

PUMP STATIONS:

Power		$4,580
Maintenance Labor/Pump Replacement		$3,300
Materials		$1,700
	Subtotal	$9,580

SEWER LINE:

10,160 L.F. Gravity Sewer Line @	$0.10 L.F./Year	$1,020
6,250 L.F. Force Main @	$0.22 L.F./Year	$1,380
	Subtotal	$2,400
	Annual O&M Cost	**$11,980**

TABLE G.9

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
LITTLE OTTER JOINT ECONOMIC DEVELOPMENT AREA
REGIONAL INDUSTRIAL PARK
ALTERNATIVE I

CONSTRUCTION COST:

6,940 L.F. 8" Gravity Sewer Line @	$42 L.F.	$291,480
1 EA. Sewage Pump Station (177 gpm) @	$150,000 EA.	150,000
6,200 L.F. 6" Force Main @	$21 L.F.	130,200
	Subtotal	$571,680
	Construction Contingency (20%)	$114,300
	TOTAL CONSTRUCTION COST	**$685,980**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$205,800
TOTAL PROJECT COST	**$891,780**

TABLE G.10

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
LITTLE OTTER JOINT ECONOMIC DEVELOPMENT AREA
REGIONAL INDUSTRIAL PARK
ALTERNATIVE I

PUMP STATION:

Power		$2,290
Maintenance Labor/Pump Replacement		$2,500
Materials		$1,300
	Subtotal	$6,090

SEWER LINE:

6,940 L.F. Gravity Sewer Line @	$0.10 L.F./Year	$690
6,200 L.F. Force Main @	$0.22 L.F./Year	$1,360
	Subtotal	$2,050
	Annual O&M Cost	**$8,140**

TABLE G.11

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
LITTLE OTTER JOINT ECONOMIC DEVELOPMENT AREA
REGIONAL INDUSTRIAL PARK
ALTERNATIVE II

CONSTRUCTION COST:

2,150 L.F. 14" Gravity Sewer Line @	$53 L.F.	$113,950
1,890 L.F. 10" Gravity Sewer Line @	$47 L.F.	88,830
11,700 L.F. 8" Gravity Sewer Line @	$43 L.F.	503,100
1 EA. Sewage Pump Station (790 gpm) @	$250,000 EA.	250,000
6,200 L.F. 10" Force Main @	$28 L.F.	173,600
	Subtotal	$1,129,480
	Construction Contingency (20%)	$225,900
	TOTAL CONSTRUCTION COST	**$1,355,380**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$406,600
TOTAL PROJECT COST	**$1,761,980**

TABLE G.12

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
LITTLE OTTER JOINT ECONOMIC DEVELOPMENT AREA
REGIONAL INDUSTRIAL PARK
ALTERNATIVE II

PUMP STATION:

Power		$9,150
Maintenance Labor/Pump Replacement		$4,200
Materials		$2,100
	Subtotal	$15,450

SEWER LINE:

15,740 L.F. Gravity Sewer Line @	$0.10 L.F./Year	$1,570
6,200 L.F. Force Main @	$0.22 L.F./Year	$1,360
	Subtotal	$2,930
	Annual O&M Cost	**$18,380**

TABLE G.13

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST FOR SEWER SYSTEM IMPROVEMENTS FOR THE BEDFORD CITY JOINT ECONOMIC DEVELOPMENT AREA

CONSTRUCTION COST:

10,470 L.F. 8" Gravity Sewer Line @	$42 L.F.	$439,740
	Subtotal	$439,740
	Construction Contingency (20%)	$87,900
	TOTAL CONSTRUCTION COST	**$527,640**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$158,300
TOTAL PROJECT COST	**$685,940**

TABLE G.14

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
BEDFORD CITY JOINT ECONOMIC DEVELOPMENT AREA

SEWER LINE:

10,470 L.F. Gravity Sewer Line @	$0.10 L.F./Year	$1,050
	Subtotal	$1,050
	Annual O&M Cost	**$1,050**

TABLE G.15

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
BURKS HILL CITY ECONOMIC DEVELOPMENT AREA

CONSTRUCTION COST:

1,430 L.F. 8" Gravity Sewer Line @	$42 L.F.	$60,060
	Subtotal	$60,060
	Construction Contingency (20%)	$12,000
	TOTAL CONSTRUCTION COST	**$72,060**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$21,600
TOTAL PROJECT COST	**$93,660**

TABLE G.16

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
BURKS HILL CITY ECONOMIC DEVELOPMENT AREA

SEWER LINE:

1,430 L.F. Gravity Sewer Line @	$0.10 L.F./Year	$140
	Subtotal	$140
	Annual O&M Cost	**$140**

TABLE G.17

PRELIMINARY STATEMENT OF PROBABLE PROJECT COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
INDEPENDENCE BOULEVARD CITY ECONOMIC DEVELOPMENT AREA

CONSTRUCTION COST:

8,710 L.F. 8" Gravity Sewer Line @	$42 L.F.	$365,820
	Subtotal	$365,820
	Construction Contingency (20%)	$73,200
	TOTAL CONSTRUCTION COST	**$439,020**

RELATED COST:

(Land and rights, basic and additional engineering, construction administration, resident inspection, permit fees, etc.)

Total Related Cost (30%)	$131,700
TOTAL PROJECT COST	**$570,720**

TABLE G.18

ESTIMATED ANNUAL OPERATION AND MAINTENANCE COST
FOR
SEWER SYSTEM IMPROVEMENTS
FOR THE
INDEPENDENCE BOULEVARD CITY ECONOMIC DEVELOPMENT AREA

SEWER LINE:

8,710 L.F. Gravity Sewer Line @	$0.10 L.F./Year	$870
	Subtotal	$870
	Annual O&M Cost	**$870**

APPENDIX H

UNIT COST ESTIMATES FOR

GRAVITY SEWERS, FORCE MAINS, AND WATER LINES

TABLE H.1

ESTIMATED UNIT COSTS
FOR
GRAVITY SEWER

36-INCH GRAVITY SEWER:

10,000	L.F. 36-inch Gravity Sewer Line @	$75 L.F.	$750,000
34	EA. Standard Manholes @	$2,000 EA.	68,000
1	EA. 36-inch Road Crossing @	$15,000 L.F.	15,000
1	EA. 36-inch Stream Crossing @	$5,000 L.F.	5,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$847,000
		Cost per Linear Foot of 36-inch Sanitary Sewer	**$85**

30-INCH GRAVITY SEWER:

10,000	L.F. 30-inch Gravity Sewer Line @	$65 L.F.	$650,000
34	EA. Standard Manholes @	$2,000 EA.	68,000
1	EA. 30-inch Road Crossing @	$15,000 L.F.	15,000
1	EA. 30-inch Stream Crossing @	$5,000 L.F.	5,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$747,000
		Cost per Linear Foot of 30-inch Sanitary Sewer	**$75**

24-INCH GRAVITY SEWER:

10,000	L.F. 24-inch Gravity Sewer Line @	$56 L.F.	$560,000
34	EA. Standard Manholes @	$2,000 EA.	68,000
1	EA. 24-inch Road Crossing @	$15,000 L.F.	15,000
1	EA. 24-inch Stream Crossing @	$5,000 L.F.	5,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$657,000
		Cost per Linear Foot of 24-inch Sanitary Sewer	**$66**

15-INCH GRAVITY SEWER:

10,000	L.F. 15-inch Gravity Sewer Line @	$44 L.F.	$440,000
34	EA. Standard Manholes @	$2,000 EA.	68,000
1	EA. 15-inch Road Crossing @	$10,000 L.F.	10,000
1	EA. 15-inch Stream Crossing @	$5,000 L.F.	5,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$532,000
		Cost per Linear Foot of 15-inch Sanitary Sewer	**$54**

12-INCH GRAVITY SEWER:

10,000	L.F. 12-inch Gravity Sewer Line @	$40 L.F.	$400,000
34	EA. Standard Manholes @	$2,000 EA.	68,000
1	EA. 12-inch Road Crossing @	$10,000 L.F.	10,000
1	EA. 12-inch Stream Crossing @	$5,000 L.F.	5,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$492,000
		Cost per Linear Foot of 12-inch Sanitary Sewer	**$50**

10-INCH GRAVITY SEWER:

10,000	L.F. 10-inch Gravity Sewer Line @	$37 L.F.	$370,000
34	EA. Standard Manholes @	$2,000 EA.	68,000
1	EA. 10-inch Road Crossing @	$10,000 L.F.	10,000
1	EA. 10-inch Stream Crossing @	$5,000 L.F.	5,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$462,000
		Cost per Linear Foot of 10-inch Sanitary Sewer	**$47**

8-INCH GRAVITY SEWER:

10,000	L.F. 8-inch Gravity Sewer Line @	$33 L.F.	$330,000
34	EA. Standard Manholes @	$2,000 EA.	68,000
1	EA. 8-inch Road Crossing @	$5,000 L.F.	5,000
1	EA. 8-inch Stream Crossing @	$5,000 L.F.	5,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$417,000
		Cost per Linear Foot of 8-inch	**$42**

TABLE H.2

ESTIMATED UNIT COSTS
FOR
FORCE MAIN

10-INCH FORCE MAIN:

10,000	L.F. 10-inch Force Main @	$25 L.F.	$250,000
3	EA. Standard Manholes @	$2,000 EA.	6,000
1	EA. 10-inch Road Crossing @	$8,000 L.F.	8,000
1	EA. 10-inch Stream Crossing @	$5,000 L.F.	5,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$278,000
		Cost per Linear Foot of 10-inch Force Main	**$28**

6-INCH FORCE MAIN:

10,000	L.F. 6-inch Force Main @	$18 L.F.	$180,000
3	EA. Standard Manholes @	$2,000 EA.	6,000
1	EA. 6-inch Road Crossing @	$5,500 L.F.	5,500
1	EA. 6-inch Stream Crossing @	$5,000 L.F.	5,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$205,500
		Cost per Linear Foot of 6-inch Force Main	**$21**

4-INCH FORCE MAIN:

10,000	L.F. 4-inch Force Main @	$15 L.F.	$150,000
3	EA. Air Release Valves @	$2,000 EA.	6,000
1	EA. 4-inch Road Crossing @	$4,500 L.F.	4,500
1	EA. 4-inch Stream Crossing @	$4,500 L.F.	4,500
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$174,000
		Cost per Linear Foot of 4-inch Force Main	**$18**

TABLE H.3

ESTIMATED UNIT COSTS
FOR
WATER LINE

24-INCH WATER LINE:

10,000	L.F. 24-inch Water Line @	$55 L.F.	$550,000
5	EA. 24-inch Gate Valves @	$2,500 EA.	12,500
3	EA. 24-inch Air Release Valves @	$1,500 EA.	4,500
3	EA. Blow Off Valves @	$1,000 EA.	3,000
10	EA. Fire Hydrants @	$1,500 EA.	15,000
1	EA. 24-inch Road Crossing @	$15,000 L.F.	15,000
1	EA. 24-inch Stream Crossing @	$6,000 L.F.	6,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$615,000
		Cost per Linear Foot of 24-inch Water Line	**$62**

14-INCH WATER LINE:

10,000	L.F. 14-inch Water Line @	$35 L.F.	$350,000
5	EA. 14-inch Gate Valves @	$1,500 EA.	7,500
3	EA. 14-inch Air Release Valves @	$1,500 EA.	4,500
3	EA. Blow Off Valves @	$1,000 EA.	3,000
10	EA. Fire Hydrants @	$1,500 EA.	15,000
1	EA. 14-inch Road Crossing @	$15,000 L.F.	15,000
1	EA. 14-inch Stream Crossing @	$6,000 L.F.	6,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$410,000
		Cost per Linear Foot of 14-inch Water Line	**$41**

12-INCH WATER LINE:

10,000 L.F. 12-inch Water Line @	$30 L.F.	$300,000
5 EA. 12-inch Gate Valves @	$1,200 EA.	6,000
3 EA. 12-inch Air Release Valves @	$1,500 EA.	4,500
3 EA. Blow Off Valves @	$1,000 EA.	3,000
10 EA. Fire Hydrants @	$1,500 EA.	15,000
1 EA. 12-inch Road Crossing @	$15,000 L.F.	15,000
1 EA. 12-inch Stream Crossing @	$6,000 L.F.	6,000
100 Tons Miscellaneous Aggregate @	$15 Ton	1,500
50 C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
	TOTAL	$358,500
	Cost per Linear Foot of 12-inch Water Line	**$36**

10-INCH WATER LINE:

10,000 L.F. 10-inch Water Line @	$25 L.F.	$250,000
5 EA. 10-inch Gate Valves @	$900 EA.	4,500
3 EA. 10-inch Air Release Valves @	$1,500 EA.	4,500
3 EA. Blow Off Valves @	$1,000 EA.	3,000
10 EA. Fire Hydrants @	$1,500 EA.	15,000
1 EA. 10-inch Road Crossing @	$10,000 L.F.	10,000
1 EA. 10-inch Stream Crossing @	$5,500 L.F.	5,500
100 Tons Miscellaneous Aggregate @	$15 Ton	1,500
50 C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
	TOTAL	$301,500
	Cost per Linear Foot of 10-inch Water Line	**$31**

8-INCH WATER LINE:

10,000 L.F. 8-inch Water Line @	$20 L.F.	$200,000
5 EA. 8-inch Gate Valves @	$700 EA.	3,500
3 EA. 8-inch Air Release Valves @	$1,500 EA.	4,500
3 EA. Blow Off Valves @	$1,000 EA.	3,000
10 EA. Fire Hydrants @	$1,500 EA.	15,000
1 EA. 8-inch Road Crossing @	$7,000 L.F.	7,000
1 EA. 8-inch Stream Crossing @	$5,000 L.F.	5,000
100 Tons Miscellaneous Aggregate @	$15 Ton	1,500
50 C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
	TOTAL	$247,000
	Cost per Linear Foot of 8-inch Water Line	**$25**

6-INCH WATER LINE:

10,000	L.F. 6-inch Water Line @	$18 L.F.	$180,000
5	EA. 6-inch Gate Valves @	$500 EA.	2,500
3	EA. 6-inch Air Release Valves @	$1,500 EA.	4,500
3	EA. Blow Off Valves @	$1,000 EA.	3,000
10	EA. Fire Hydrants @	$1,500 EA.	15,000
1	EA. 6-inch Road Crossing @	$5,500 L.F.	5,500
1	EA. 6-inch Stream Crossing @	$5,000 L.F.	5,000
100	Tons Miscellaneous Aggregate @	$15 Ton	1,500
50	C.Y. Miscellaneous Concrete @	$150 C.Y.	7,500
		TOTAL	$224,500
		Cost per Linear Foot of 6-inch Water Line	**$23**