Knoxville Uilities Board
Capacity Assurance Program

Submitted to EPA on February 8, 2006

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A 10-year Program to Improve Our Waterways

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Contents

Appendices

Section 1
Introduction

This section describes the goals of the Capacity Assurance Program (CAP) including the Consent Decree requirements, an overview of the program, the relationship of the CAP to other Consent Decree programs, and the plan for implementation.

1.1 Consent Decree Requirements

On February 11, 2005, a Consent Decree with Tennessee Department of Environment and Conservation, United States Environmental Protection Agency (EPA), Tennessee Clean Water Network and the City of Knoxville became effective with the goal of eliminating Sanitary Sewer Overflows (SSOs) in KUB's wastewater collection system. As part of this Consent Decree, KUB has submitted a Phase 1 Corrective Action Plan/Engineering Report to document system capacity evaluations and identify facility improvements required to address reported SSOs in accordance with the Consent Decree. However, the required improvements will take many years to implement. While these improvements are being implemented, requests for additional flows to the system are being made by developers, individual homeowners, and other entities. The Consent Decree specifies that KUB must respond to these requests for new connections to the sewer system or increases in flow from existing connections through a Capacity Assurance Program (CAP).

In accordance with the Consent Decree, the CAP will assess the peak flow capacity of all major system components (collector sewers, interceptor sewers, pump stations, and treatment plants). Any requests for increased flow to the collection system must be compared to the peak flow capacity of these components. If KUB is unable to certify capacity of the major system components downstream of the proposed flow addition, it may still authorize the additional flow through a system of banked flow credits and other requirements, which are further described in Section 3 of this report.

The CAP contains

- The technical information, methodology, and analytical techniques to be used to (1) calculate the peak flow capacity of system components, (2) calculate the increase in peak flows from new service connections, and (3) calculate the increase in peak flow capacity resulting from specific system improvements projects.

- The means by which KUB will integrate the CAP with approvals of City and County building permits or acquisition of sewers from other owners.

- An information management system (IMS) capable of tracking chronic overflow locations and the credit banking system including both earned credits from specific projects and credit expenditures on approved wastewater flow additions.

- All evaluation protocols to be used.

1.2 CAP Objective

Providing wastewater collection, conveyance, and treatment that meet the needs of KUB customers while protecting the environment is the top priority of KUB's facility improvement efforts. Since 1987, KUB has performed several studies and made many improvements in a majority of the service area basins. However, capacity remains a problem during wet weather when rainfall-dependent inflow and infiltration (RDI/I) is problematic. RDI/I is the infiltration and inflow that occurs in the system as a result of rain events.

Because of existing concerns about wet weather capacity and the time it will take to implement the complete improvements plan, KUB and the Consent Decree stakeholders are concerned about the addition of new flows to the system. The objective of the CAP is to enable KUB to authorize new sewer service connections or increases in flow from existing sewer service connections while making system improvements in accordance with the Consent Decree requirements.

1.3 CAP Overview

The CAP is divided into three major sections:

1) Certification of Capacity

2) Approval in Lieu of Certification

3) Special Conditions.

Under Certification of Capacity, KUB may authorize additional flow to the system, only after it certifies that there is adequate treatment capacity, transmission capacity, and collection capacity. The definitions of adequate capacity are further discussed in Section 3; however, based on the evaluations of the treatment, transmission, and collection systems that have taken place, it is anticipated that initially, few locations in KUB's system will meet the Consent Decree capacity certification requirements. This means that KUB will likely authorize most new sewer service connections via the Approval in Lieu of Certification procedure.

Under Approval in Lieu of Certification, KUB may authorize additional flow to the system using a credit banking system. If KUB completes specific projects that increase capacity by reducing peak wet weather flows through either sewer rehabilitation or system storage, then KUB will receive flow credits. These credits can then be used to offset proposed additional flows. Additional criteria must also be met, and these criteria are further discussed in Section 3.

Several special conditions are included related to minor sewer connections, essential services, existing illicit connections, and reconnections following temporary suspension. These special conditions are further discussed in Section 3.

1.4 Relationship of CAP to Other Consent Decree Programs

Several other Consent Decree programs are related to the CAP. These include the Corrective Action Plan/Engineering Report (CAP/ER), the Comprehensive Performance Evaluation and subsequent Composite Correction Program (CPE/CCP), and the Continuing Sewer System Assessment Program (CSSAP), which are further discussed below.

1.4.1 CAP/ER

The objective of KUB's CAP/ER is to identify facility improvements required to address reported SSOs in accordance with the Consent Decree. SSOs reported on the Long-Term List are addressed by this eight-year plan. Most capacity related SSOs were evaluated using a hydraulic modeling analysis, which included a capacity evaluation using peak wet weather flows from a representative 2-year, 24-hour planning storm event.

Since the program will not be completed for eight years, certification of collection system capacity from the proposed introduction of additional flow is unlikely for a number of years in most locations. However, as the rehabilitation and storage projects in the Phase 1 CAP/ER are implemented, KUB will earn flow credits that will be tracked and may be applied towards additional flows into the system.

1.4.2 CPE/CCP

Comprehensive Performance Evaluation (CPE) - For each of its three affected wastewater treatment plants (WWTPs), KUB is completing a comprehensive performance evaluation using flow modeling and other appropriate evaluation techniques to determine capacity and ability to meet permits. To the extent applicable, the CPE is being developed consistent with EPA publications "Improving POTW Performance Using the Composite Correction Approach" - EPA CERI, October 1984 and "Retrofitting POTW's" - EPA CERI, July 1989. The CPE is a thorough, structured review of a WWTP's process performance capabilities and associated administrative, operational, and maintenance practices. The objectives are to identify potential improvements in process performance that can be achieved without significant capital improvements, and to identify process components that will require capital improvements to maintain or achieve permit compliance. [Ref. CD Section VII.D.1.(a).(iv)]

Composite Correction Program (CCP) - The CCP is the performance improvement phase that follows the CPE. It is a systematic approach to implementing administrative, operational, and maintenance improvements as well as rehabilitation and/or upgrades to the WWTPs to address the problems identified in the CPE. The CCP will also be consistent with the EPA publications "Improving POTW Performance Using the Composite Correction Approach" - EPA CERI, October 1984 and "Retrofitting POTWs" - EPA CERI, July 1989; and the "Tennessee Design Criteria", to the extent applicable. The CCP will (A) address all factors which limit or which could limit the WWTP's operating efficiency or the ability to achieve NPDES permit compliance; (B) address the peak flow handling procedures and peak flow capacity of the WWTP; and (C) identify specific actions and schedules to correct each limiting factor, including capital improvements to the existing WWTP where appropriate. The CCP will evaluate all appropriate alternatives and provide schedules for achieving permit compliance. [Ref. CD Section VII.D.1.(a).(v)]

1.4.3 CSSAP

The primary function of KUB's CSSAP, which has been approved by EPA, is to provide decision-support information for implementation of the Infrastructure Rehabilitation Program (IRP), along with KUB's other capital improvements to restore and maintain system hydraulic capacity, restore and maintain structural integrity of system components and reduce corrective maintenance costs. The primary objectives of the IRP are to address RDI/I and other conditions causing SSOs through:

- Capacity restoration – This objective is aimed at keeping assets functioning at their full, original capacity. Examples include removing sediment or debris from a pipeline system, reducing inflow and infiltration (I/I) in a wastewater collection system, and/or repairing system defects that would limit flow capacity through a system. In some cases, it is cost effective and/or necessary due to growth to provide increased capacity or storage to attain desired system hydraulic capacity.

- Damage repair – This objective is aimed at repairing structural damage and failures in the system that are the result of wear, corrosion, age, and/or construction-related damage to extend the useful life of the component. This function reduces the risk of system failure which could cause interruption in service which could result in impacts to the community and would increase costs as compared to scheduled rehabilitation.

- Maintenance reduction – This objective is aimed at repairing portions of the system that are subject to known, repeated maintenance problems that increase maintenance costs and keep crews from conducting more productive preventive maintenance. Examples in a wastewater collection system are the repair of conditions such as root intrusion, offset joints, pipe sags, improper service connections, and other system deficiencies that typically lead to recurring problems for system operators.

Many of the CSSAP projects are included in the Phase 1 CAP/ER. These projects can and will be used to provide flow credits into the credit banking system. In particular, the removal of I/I through CSSAP capacity restoration projects will be critical to the CAP.

0001384

1.5 CAP Implementation

After review and approval of this CAP report by the EPA, KUB intends to complete development of the tools required to implement the program - specifically the Information Management System (IMS) and a Procedures Manual. KUB has not completed development of these tools required for implementation, pending comments from EPA on the process and procedures discussed in this report. After all the processes and procedures are agreed to and approved, KUB will complete the necessary production of these tools. The Information Management System and the Procedures Manual are anticipated to be completed within sixty days of approval of this CAP report by EPA.

1.6 Organization of Report

This CAP report is organized into 6 sections as listed below. Sections 1 through 3 describe the CAP Program in terms of the Consent Decree requirements. Sections 4 and 5 describe the detailed evaluation procedures, analytical techniques, software, and methodologies KUB will use to meet the CAP requirements. Section 6 documents the implementation plan for the CAP.

Section 1 - Introduction

Section 2 - Definitions

Section 3 - Program Description

Section 4 - Capacity Certification Procedures

Section 5 - Approval in Lieu of Certification Procedures

Section 6 - Implementation Plan

Appendix A – Collection, Transmission, and Treatment Capacity Maps

Appendix B – Pump Station Capacity Spreadsheet

Appendix C – Average Dry Weather Flow Estimates for Building Permit Applications

Appendix D –Protocol for Pre/Post Rehabilitation Flow Monitoring

Section 2
Definitions

This section presents definitions of terms used throughout this report and in the Consent Decree related to the CAP Program.

Basin: Basins are small portions of the sanitary sewer system separated by boundaries of natural topography or system configuration. Separating the system into basins allows KUB to better identify and monitor system performance in those smaller areas.

Bypass: Bypass is defined as in 40 C.F.R. 122.41(m).

Chronic SSO: Per the CAP, a chronic SSO is defined as those locations within 500 yards of each other that have collectively experienced five or more SSOs within the 12 months prior to certification. SSOs occurring within 500 yards of each other that are caused by a single rain event are counted as one SSO. A single rain event is defined as accumulation of .01 inches of rain or greater, preceded by 10 or more hours without precipitation.

Cleanout: A cleanout is a vertical pipe with a removable cap extending from a sewer service lateral to the surface of the ground. It is used for access to the service lateral for inspection and maintenance.

Collection Capacity: The capacity of the network of KUB pipes and manholes that conveys flow by gravity from homes and businesses.

Collector Sewer: Sewers generally eight-inch that are not modeled.

Credits: KUB will earn credits upon completion of specific projects (performed after January 17, 2003) that will add sewer capacity or reduce peak flows to the wastewater collection and transmission systems, treatment plants, or chronic overflow locations. One gallon per day (gpd) of peak flow credit will be given for each gpd of peak flow removed or capacity added. The credits will then be applied as follows:

- For projects that provide additional off-line storage, the credits used will be equal to the proposed new flow added.
- For projects that will add sewer capacity or reduce peak flows related to a chronic overflow location, the credits used will equal or exceed the new flow added by a ratio of 4:1.
- For other projects that will add sewer capacity or reduce peak flows to the collection system, transmission system, and/or treatment plants, the credits used will equal or exceed the new flow added by a ratio of 3:1.

Diversion: Per the Consent Decree, diversion shall have meaning as defined in Part II.C.6 of KUB's 1994 NPDES Permits, which provides: "(a) 'Diversion' is the intentional rerouting of wastewater within a treatment facility away from a biological portion of the treatment facility. (b) A [D]iversion is permissible only when necessary to protect the active biomass from a washout due to peak flow events and when this action does not cause effluent limitations to be exceeded." In the event that the definition of this term is changed or replaced in subsequent final NPDES permits issued during the term of the Consent Decree, the definition in the subsequent final NPDES Permits shall apply.

EPA: Per the Consent Decree, EPA shall mean the United States Environmental Protection Agency, including any departments or agencies of the United States.

Essential Services: Per the Consent Decree, essential services are defined as health care facilities, public safety facilities, public schools, other government facilities (subject to EPA review and approval), and in cases where a pollution or sanitary nuisance exists (as determined by the Knox County Health Department) in relation to on-site septic systems.

Firm Pump Station Capacity: Maximum amount of wastewater flow pumped by a pump station with the largest pump out of service.

Force Main: A pressurized line that conveys wastewater from a pump station.

Gravity or Main Lines: Gravity or main lines represent the largest portion of the KUB system. They use changes in elevation to transport sewage between points.

I/I: Inflow and infiltration, per the Consent Decree, shall mean the total quantity of water from inflow, infiltration, and rainfall-dependent inflow and infiltration, without distinguishing the source.

IMS: Per the Consent Decree, Information Management System.

Infiltration: Infiltration is the introduction of groundwater into a sanitary sewer system through cracks, pipe joints, manholes, or other system defects.

Inflow: Inflow is the introduction of extraneous water into a sanitary sewer system by direct or inadvertent connections with stormwater infrastructure, such as gutters and roof drains, uncapped cleanouts, and cross-connections with storm drains.

KUB: Knoxville Utilities Board.

Lift or Pump Station: A lift or pump station is a mechanical method of conveying wastewater to higher elevations.

Manhole or Junction Box: A manhole or junction box provides a connection point for gravity lines, service laterals, or force mains, as well as an access point for maintenance and repair activities.

Minor sewer connection: Per the Consent Decree, a minor sewer connection is defined as a connection with an average flow not to exceed 2,500 gallons per day.

NPDES: National Pollutant Discharge Elimination System.

Peak Flow: Per the Consent Decree the greatest flow in a sewer averaged over a sixty minute period at a specific location expected to occur as a result of a representative 2-year, 24-hour storm event.

R Value: Used in the hydraulic model to represent the fraction of rainfall in a basin that enters the sewer system as RDI/I.

RDI/I: Rain-dependent inflow and infiltration. It is I/I that occurs as a result of rain events and does not account for groundwater infiltration.

Sewer Service Laterals: Per the Consent Decree, a sewer service lateral is that portion of a sanitary sewer conveyance pipe, including that portion in the public right of way, that extends from the wastewater main to the single-family, multi-family, apartment or other dwelling unit or structure to which wastewater service is or has been provided. Connector joints installed by KUB are not included. A Sewer service lateral is also referred to as a private lateral.

SSO: Per the Consent Decree, a sanitary sewer overflow is defined as an overflow, spill, or release of wastewater from the wastewater collection and treatment system including all unpermitted discharges; overflows, spills, or releases of wastewater, that may not have reached the waters of the United States or State; and building backups.

Surcharge Condition: Per the Consent Decree, a surcharge condition is defined as the condition that exists when the supply of wastewater resulting from the one (1) hour peak flow is greater than the capacity of the pipes to carry it and the surface of the wastewater in manholes rises to an elevation greater than twenty-four (24) inches above the top of the pipe or within three (3) feet of the manhole rim, and the sewer is under pressure or head, rather than at atmospheric pressure. The exception would be if KUB has, pursuant to Section VII.D.1.(a).(iii).(A).(6), identified that pipe segment and manhole as designed to operate in that condition, in which case the identified level of surcharge will be used. However, any rise in elevation above the top of the pipe shall be considered a Surcharge Condition if the manhole has experienced a wet weather SSO since January 1, 2001, excluding those SSOs that occurred in February 2003 or those caused by severe natural conditions. The exception would be if KUB engineers can certify that the cause of the SSO has been corrected.

Transmission Capacity: The capacity of pump stations and force mains that convey flow to the collection system or treatment plants.

Trunk Sewer: Sewers, generally larger than eight-inch, that are modeled.

Section 3
Program Description

The CAP can be divided into three major sections:

1) Certification of Capacity

2) Approval in Lieu of Certification

3) Special Conditions.

Each of these sections is described below in terms of the Consent Decree Requirements. Sections 4 and 5 describe the detailed evaluation procedures, analytical techniques, software, and methodologies that will be used by KUB to meet the CAP requirements. Section 6 documents the implementation plan for the CAP.

3.1 Capacity Certification

Under Certification of Capacity, KUB may authorize the contribution of additional flow to the system only after it certifies that there is adequate collection capacity, transmission capacity, and treatment capacity. All certifications must be made by a registered professional engineer in the State of Tennessee and approved by a responsible party in KUB.

Based on the evaluations of the collection, transmission, and treatment that have taken place to date, it is anticipated that initially, few locations in KUB's system will meet the Consent Decree capacity certification requirements. This means that KUB will likely authorize most new sewer service connections via the Approval in Lieu of Certification procedure discussed in Section 3.2.

3.1.1 Wastewater Collection Capacity

Certification of adequate collection capacity shall confirm that each gravity sewer through which the proposed additional flow would pass has the capacity to transmit the proposed peak one hour flow plus the existing peak one hour flow from all new or existing service connections, without causing a surcharge condition. Existing "one (1) hour peak flow" is defined as the greatest flow in a sewer averaged over a 60-minute period at a specific location expected to occur as a result of a representative 2-year, 24-hour storm event. A surcharge condition is defined as any of the following conditions:

- If the manhole has experienced a wet weather SSO since January 1, 2001, during a representative storm event (i.e. excluding severe conditions such as the February 2003 event or those SSOs caused by severe natural conditions, such as hurricanes, tornadoes, widespread flooding, earthquakes, and other similar natural conditions), then any rise in elevation above the top of the pipe is considered a surcharge condition, unless KUB can certify the cause of the SSO has been corrected.

- For all other manholes, a surcharge condition is defined as water surface level greater than twenty-four (24) inches above the top of the pipe or within three (3) feet of the manhole rim, while the sewer is under pressure head, rather than atmospheric pressure. However, if KUB has, pursuant to the Capacity Assurance Program, identified pipe segments or manholes designed to operate under a pressure condition (such as siphons), then the capacity of these pipe segments or manholes shall be evaluated based on their design criteria.

An additional criteria for certification of collection system capacity is related to chronic overflow locations. A chronic overflow location is defined as those locations within 500 yards of each other that have collectively experienced five or more SSOs within the 12 months prior to certification. SSOs occurring within 500 yards of each other that are caused by a "single rainfall event" are counted as one SSO. A single rainfall event is defined as any occurrence of rain, preceded by ten (10) hours without precipitation, that results in an accumulation of 0.01 inches of rain or more. Certification of collection system capacity shall confirm the cause of the chronic overflow location has been or will be eliminated by the time the proposed additional flow passes by said location.

3.1.2 Wastewater Transmission Capacity

Certification of adequate transmission capacity shall confirm that each pump station through which the proposed additional flow would pass has the capacity to transmit the proposed peak one hour flow plus the existing peak one hour flow from all new or existing service connections, with the largest pump out of service. Existing peak one hour flow is defined as the greatest flow in a sewer averaged over a sixty minute period at a specific location expected to occur as a result of a representative 2-year, 24-hour storm event.

3.1.3 Wastewater Treatment Plant (WWTP) Capacity

Certification of adequate treatment capacity shall confirm that at the time the WWTP receives the proposed increased flow, the WWTP (assuming flow from all new or existing connections plus the proposed flow) will not be in non-compliance for quarterly reporting and that the new or increased flow will not result in bypasses or diversions prohibited by the NPDES permits. Treatment capacities for the Kuwahee, Fourth Creek, and Loves Creek WWTPs are being established under the CPE Program.

3.2 Approval in Lieu of Certification

Under Approval in Lieu of Certification, KUB may authorize additional flow to the system using a credit banking system. If KUB completes specific projects that restore capacity by reducing peak wet weather flows or constructing additional capacity, then KUB will receive flow credits. These credits can then be used to offset proposed additional flows.

The Consent Decree lists the provisions that must be satisfied for approval in lieu of certification. These provisions are re-stated here in a condensed format for clarification purposes:

- KUB is in substantial compliance with the Consent Decree.
- The facilities that do not meet the collection, transmission, and/or treatment capacity certifications described in Section 3.1 are identified.
- Additional provisions outlined in 3.2.1 and 3.2.2.

3.2.1 Credit Banking System

KUB will earn credits upon completion of specific projects (performed after January 17, 2003) that will add sewer capacity or reduce peak flows to the collection system, transmission system, treatment plants, or chronic overflow locations. One gpd of credit will be given for each gpd of peak flow removed or gallon of capacity added. The credits will then be applied as follows:

- For projects that provide additional off-line storage, the credits used will be equal to the proposed new flow added.
- For projects that will add sewer capacity or reduce peak flows related to a chronic overflow location, the credits used will equal or exceed the new flow added by a ratio of 4:1.
- For other projects that will add sewer capacity or reduce peak flows to the collection system, transmission system, and/or treatment plants, the credits used will equal or exceed the new flow added by a ratio of 3:1.

As an example, if a project reduces peak flow by 1000 gpd then a credit of 1000 gpd will be given. If the estimated flow from a new customer is unrelated to a chronic overflow location, and the flow from the new customer is 200 gpd, then 600 gpd of credits will be subtracted from the total available credits at all components downstream of where the new flow is introduced.

3.2.2 Additional Requirements

The following additional requirements must be met prior to approval in lieu of certification:

- The sewer lines that will convey the proposed additional flow have not experienced dry weather SSOs due to inadequate capacity within the previous 12 months or the causes of these SSOs have been eliminated.

0001391

- Credits must be in place prior to the time the proposed additional flow is introduced to the system.
- KUB has identified chronic overflow locations (per section 3.1.1).
- KUB has and will perform annual reviews of estimated peak flow reductions or peak capacity additions and adjust current available credits and future credits achieved, as appropriate.

3.3 Special Conditions

Several special conditions are included related to minor sewer connections, essential services, existing illicit connections, and reconnections following temporary suspension.

Minor Sewer Connections

A minor sewer connection is defined as a connection with an average flow not to exceed 2,500 gallons per day. For minor sewer service connections, KUB may elect to perform a monthly capacity analysis for all projected approved flows in the subsequent month. For any sewer basin or portion of a sewer basin that can be certified, KUB may approve minor connections without performing individual certifications for each connection.

Essential Services

KUB may authorize a request for additional flow to the system from essential service facilities, even if adequate capacity cannot be certified. Essential services are defined as health care facilities, public safety facilities, public schools, other government facilities (subject to EPA review and approval), and in cases where a pollution or sanitary nuisance exists (as determined by the Knox County Health Department) in relation to on-site septic systems. However, a subtraction shall be made from the credit bank in an amount equal to the average projected flow from these essential services.

Existing Illicit Connections

KUB may authorize a request for additional flow to the system, provided the additional flow eliminates illicit connections or discharges of wastewater to the stormwater system or waters of the State, even if adequate capacity cannot be certified. However, a subtraction shall be made from the credit bank in an amount equal to the average projected flow from the removal of illicit connections or discharges created after February 11, 2005, the Date of Entry of the Consent Decree.

Reconnection Following Temporary Suspension

In the event of a temporary suspension or interruption of a customer's service as a result of KUB's Private Lateral Program, any service resumed shall not be deemed a new service connection or an additional flow from an existing connection.

Section 4
Capacity Certification Procedures

As discussed in Section 3, KUB may authorize additional flow to the system, only after it certifies that there is adequate collection capacity, adequate transmission capacity, and adequate treatment capacity. If capacity cannot be certified, KUB may approve additional flow in lieu of certification using a credit banking system and meeting several additional requirements as discussed in Section 5. All certifications must be made by a registered professional engineer in the State of Tennessee and approved by a responsible party in KUB.

4.1 Overview

Figure 4-1 presents the capacity assurance certification process diagram for new building permits. A step-by-step description of the process is described below, with reference to the numbered boxes in Figure 4-1.

1. Review City of Knoxville/Knox County Building Permit Application
As part of the CAP Procedures Manual submitted to TDEC on May 27, 2004, KUB established a procedure to integrate its internal capacity review process with the building permit application review process of each entity. This procedure is further discussed in Section 4.2.1.

2. Calculate New Flow
For each building permit application, KUB will estimate the average daily flow and the peak wet weather flow. The flow calculation procedure is further discussed in Section 4.2.2.

3. Determine Location of New Flow
Using the most recent version of the sewer maps, KUB will identify the sewer manhole that will receive the new flow and the most upstream trunk sewer manhole that will convey the new flow.

4. Enter Data in Capacity Assurance Program Database
KUB has an established Access database to track new flows and flow removal credits. The database is being modified for the CAP as discussed in Section 6.

5. Is Treatment Capacity Adequate?
Check WWTP capacity page of IMS database (described in Section 6). If WWTP does not have capacity, proceed to Step 12. If WWTP does have capacity, proceed to Step 6.

6. Is the New Flow Upstream of a Chronic Overflow Location?
Using the most recent version of the chronic overflow database, identify all downstream chronic overflow locations. If there are no chronic overflow locations downstream from the proposed new flow, proceed to Step 7. If there are chronic overflow locations downstream, proceed to Step 12.

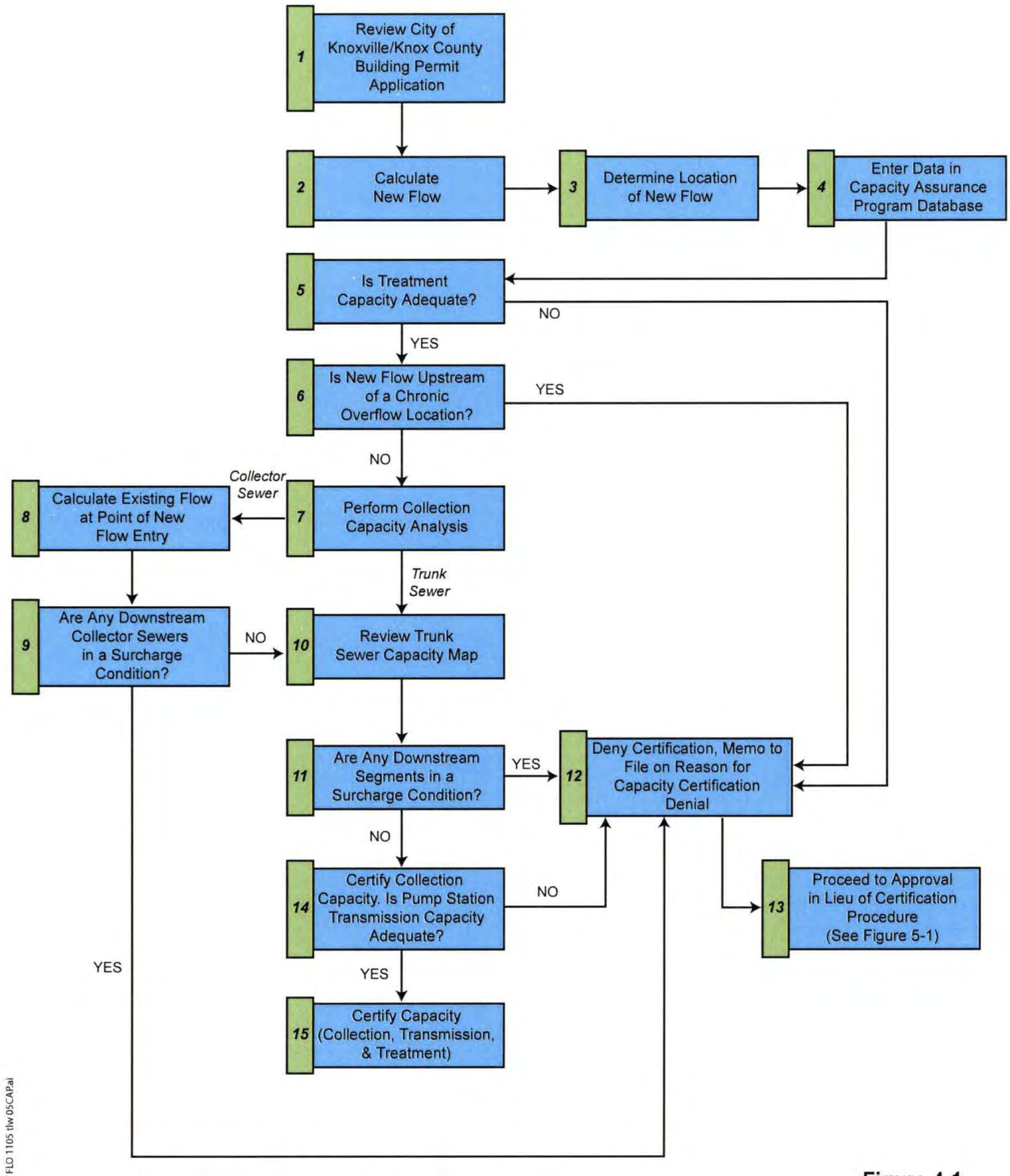

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Figure 4-1
Capacity Certification Procedures

0001394

7. Perform Capacity Analysis
The capacity analysis procedure will depend on whether the new flow will enter the system at a collector sewer or at a trunk sewer. If a collector sewer, go to Step 8; if a trunk sewer, go to Step 10.

8. Calculate Existing Flow at Point of New Flow Entry
For new flows entering a collector sewer, estimate the existing peak flow at that point in the sewer, add the new peak flow, and then check capacity of critical downstream segment(s) prior to discharge to the trunk sewer.

Peak flow in the collector sewer is calculated by summing all of the current average flows in upstream mini-basins from the connection to the trunk sewer, adding the new flow (average daily flow), and multiplying by a peaking factor of 4.

9. Are Any Downstream Collector Sewers in a Surcharge Condition?
Capacity of critical downstream segments of the collector is determined by checking capacity of the downstream segment(s) with the lowest grade (slope). Since collector sewers are eight-inch and 10-inch, first check the capacity (flowing full) of the downstream segment(s) with the lowest grade. If capacity at the lowest grade exceeds the existing plus new flows, then capacity exists in the collector sewer. If capacity at minimum grade is less than existing plus new flows, it will be necessary to perform a more detailed segment-by-segment analysis considering surcharged conditions. If downstream collector sewers are not in a surcharge condition (defined in Section 3.1), proceed to Step 10. If downstream collector sewers are in a surcharge condition (defined in Section 3.1), proceed to Step 12.

10. Review Trunk Sewer Capacity Map
The trunk sewer capacity maps (presented in **Appendix A**) are color-coded to indicate whether the trunk sewer meets or does not meet the CAP definition of a surcharge condition (defined in Section 3.1).

11. Are Any Downstream Segments in a Surcharge Condition?
If any segments downstream of the new flow location are in a surcharge condition, then proceed to Step 12. Some short surcharged segments may be ignored that have been specifically designed to be surcharged, such as siphons. If no downstream trunk sewers are in a surcharge condition, then proceed to Step 14.

12. Deny Certification of Capacity
If adequate capacity cannot be certified, create memo to file documenting reason capacity certification was denied, then proceed to step 13.

13. Proceed to Approval in Lieu of Certification Procedure
If adequate capacity cannot be certified, proceed to Approval in Lieu of Certification Procedure described in Section 5.

0001395

14. Certify Collection Capacity, Check Transmission Capacity
Although collection system capacity is certified, transmission capacity must also be checked. Check pump station spreadsheet to certify transmission capacity. The spreadsheet (presented in **Appendix B**) contains a table of all pump stations along with the current peak flow and the CAP capacity (pump station capacity with the largest pump out of service). If downstream pump stations do not have capacity, proceed to Step 12. If downstream pump stations do have capacity proceed to Step 15.

15. Certify Capacity
Certify capacity by completing the Capacity Certification Form provided in the Procedures Manual. The procedures manual is further discussed in Section 6.

4.2 Flow Estimates for New Connections

4.2.1 Integration of CAP with the City of Knoxville and Knox County

KUB, the City of Knoxville, and Knox County have developed a process for reviewing all building permit applications that are located in KUB's service area. A KUB representative is responsible for reviewing all building permits and obtaining the pertinent information in order for KUB to determine if the wastewater system has adequate capacity to accept the proposed wastewater flows. The capacity assurance review process that has been developed is intended to provide the least inconvenience possible to KUB's customers and all building permit applicants.

4.2.2 Calculation of Proposed Additional Flows

For each building permit application, KUB will estimate the average daily flow and the peak wet weather flow. The average daily flow from a typical single-family residence in the KUB service area has been determined to be 167 gpd. A peaking factor of 4 will be applied to average daily flows to determine peak wet weather flows in collector sewers.

New flows for building permit applications for buildings other than a single-family residence should be based on the average flow values in **Appendix C**.

4.3 Capacity Analysis of Collector Sewers

KUB has not developed a hydraulic model for its collector sewers (typically eight-inch and some 10-inch sewers). Therefore, a calculation will need to be made for both the existing peak flow in the collector sewer and the capacity of the collector sewer. The existing peak flow in the collector sewer will be determined by calculating the average dry weather flow to the sewer by adding the average dry weather flows from all mini-basins or portions of mini-basins contributing to the sewer. This average dry weather flow will then be peaked by a factor of 4 to account for peak wet weather flow conditions.

The collector sewer capacity will be determined by first estimating the capacity of the downstream collector sewer with the lowest grade. If capacity at the lowest grade exceeds the existing plus new flows, then capacity exists in the collector sewer. If capacity at minimum grade is less than existing plus new peak flows, it will be necessary to perform a more detailed segment-by-segment analysis. This analysis may include an analysis of the surcharged condition as defined in Section 3.1.

4.4 Capacity Analysis of Trunk Sewers

The recently completed trunk sewer hydraulic model serves as KUB's primary tool for evaluating available system capacity and corrective actions. The model can evaluate both dry and wet weather flows for any proposed connection of additional flows to the system. It can also assess capacity improvements and their impact on the performance of the entire system all the way to the treatment facility. The model allows KUB to evaluate hydraulic performance and impacts at a level of detail not previously available.

The calibrated hydraulic model was used to analyze peak weather flows for current trunk sewer conditions in the KUB system. The model results were used to determine which trunk sewers meet the CAP surcharge criteria (and which do not) for the First Creek, Second Creek, Third Creek, Fourth Creek, South Knoxville/Knob Creek, and Williams Creek basins. Models for the Loves Creek and Eastbridge basins are being developed.

Appendix A presents thematic maps for these basins. These maps will be updated annually to reflect system improvements and changes in flows. Also, periodically, the KUB trunk sewer models will be re-calibrated based on new permanent and temporary flow monitoring data. The maps will then be updated with changes to capacity certification.

If a trunk sewer downstream of a proposed new flow addition is labeled as "not satisfying CAP criteria" on the map, then collection capacity cannot be certified. As capacity improvements and model updates are made, the status of the downstream trunk sewer may change and collection capacity may be certified in the future.

4.5 Capacity Analysis of Pump Stations

Pump stations should provide sufficient capacity for peak flow with the largest pump out of service. Available capacity determination requires an estimate of peak flow entering the station. Larger pump stations were modeled, and, therefore, peak flows (1-hour peak based on 2-yr, 24-hr event) entering those stations have been determined. For pump stations that were not modeled, peak flows to each station have been estimated based on peaking the average dry weather flows to the station from upstream mini-basins (or portions of mini-basins) by 4. All pump station information has been recorded in a spreadsheet presented in **Appendix B**. The spreadsheet includes information on each pump (design capacity and revised capacity based on drawdown tests, if available), pump station capacity with the largest pump out of service (CAP Capacity), estimated peak flows to each pump station (Average Dry and Peak Wet Weather Flows), and whether the pump station has available capacity.

Pump station capacities are based on design capacities unless more detailed draw-down test information is available. The pump station spreadsheet will be updated periodically to reflect major system improvements and annually to reflect changes in flows.

If a pump station downstream of a proposed new flow addition does not have available capacity, then transmission capacity cannot be certified.

4.6 Capacity Analysis of WWTPs

The Information Management System (discussed in Section 6) will provide a method of tracking the following requirements at each treatment plant:

1) Plants are in compliance for quarterly reporting (as defined in 40 C.F.R. Part 123.45, Appendix A.)

2) Available treatment plant capacities that will not result in bypasses or diversions prohibited by the NPDES permits.

Treatment capacities for the Kuwahee, Fourth Creek, and Loves Creek WWTPs are being established under the CPE program. Treatment capacity of the Eastbridge WWTP is 0.85 mgd average daily flow. Peak wet weather treatment capacity at the Eastbridge WWTP is being established.

If the treatment plant downstream of a proposed new flow addition does not have available capacity, then treatment capacity cannot be certified.

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Section 5
Approval in Lieu of Certification Procedures

As discussed in Section 3, KUB may authorize additional wastewater flow to the system using a credit banking system. If KUB completes specific projects that increase capacity by reducing peak wet weather flows then KUB will receive flow credits. These credits can then be used to offset proposed additional flows.

5.1 Overview

Figure 5-1 presents the approval in lieu of certification process diagram for new building permits. A step-by-step description of the process is described below with reference to the numbered boxes in Figure 5-1.

1. Confirm Capacity Certification Process Was Performed

The Capacity Certification Process discussed in Section 4 must be performed prior to the Approval in Lieu of Certification Process. Two important pieces of information from the capacity certification process are required: 1) Location and estimated flows from the proposed additional flow, 2) Memo to file noting why capacity certification was denied. If this information is not available, complete per capacity certification procedures (Figure 4-1) before proceeding to Step 2.

2. Do Available Collection System Credits in Basin Exceed New Flow?

Using the IMS system (**Section 6**), determine if sufficient credits from collection system projects are available in the basin to offset the proposed new flow. The determination of available flow credits is further discussed in Section 5.2. If credits are available, proceed to Step 3. If credits are not available, proceed to Step 7.

3. Is New Flow Location Downstream of Available Credits That Exceed New Flow?

Is the proposed additional flow located downstream of a collection system pipes with credits available that exceed the new flow? If so, proceed to Step 6. If not, proceed to Step 4. The determination of available flow credits is further discussed in Section 5.2.

4. Will New Flow Pass Through Facilities Anywhere Downstream Where Credits Apply?

Is the proposed additional flow located upstream of available credits that exceed the new flow? If so, proceed to Step 5. If not, proceed to Step 7. The determination of available flow credits is further discussed in Section 5.2.

5. Can Collection and Transmission Capacity Be Approved Between the New Flow Location and Where the Credits Apply?

Can collection and transmission capacity be certified between the new connection and the downstream facilities where the credits apply? If so, proceed to Step 6. If collection system capacity cannot be certified, proceed to Step 7.

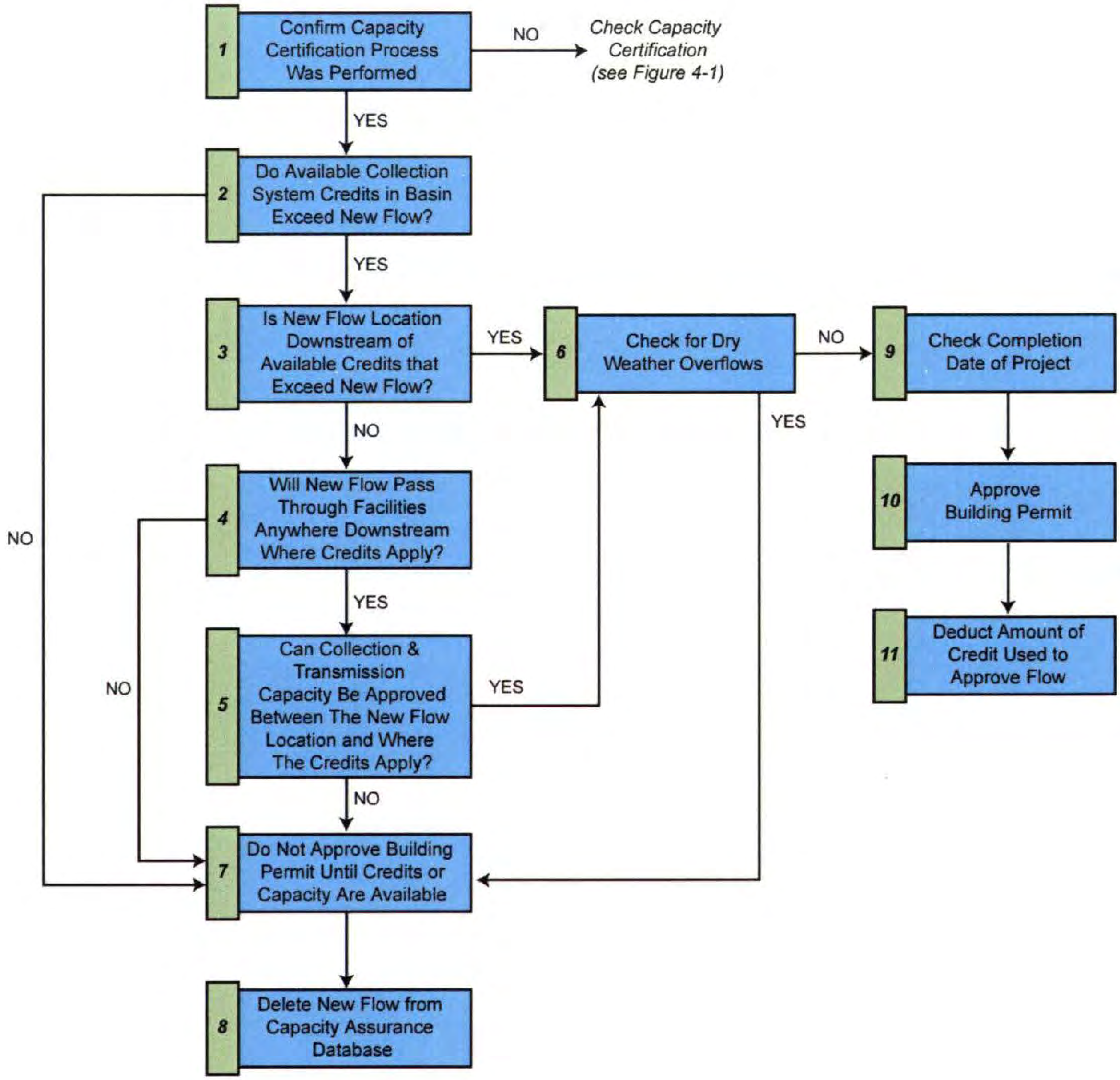

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Figure 5-1
Approval In Lieu of Certification Process Diagram

6. Check for Dry Weather Flow Overflows
If any gravity sewer through which the proposed additional flow would pass has experienced dry weather SSOs due to inadequate capacity within the previous 12 months, and if the causes of these SSOs have not been eliminated, then proceed to Step 7. If not, proceed to Step 9.

7. Do not Approve Building Permit Until Credits or Capacity are Available
Building permits should not be approved unless sufficient credits or capacity are available. Proceed to Step 8.

8. Delete New Flow From Capacity Assurance Database
If a building permit is denied, delete the proposed new flow from the database to maintain accuracy.

9. Check Completion Date of Project
Building permit may be approved prior to capacity restoration project being completed as long as approval is conditional based on no connections prior to completion date of project. If project supplying credits has not been completed, make approval for addition of new flow dependent on completion date of project.

10. Approve Building Permit
Approve building permit by completing the Approval in Lieu of Certification Form in the Procedures Manual. The Procedures Manual is further discussed in Section 6.

11. Deduct Amount of Credit Used to Approve Flow
Once the building permit is approved, deduct the amount of credit used to approve the flow from the credit tracking database (discussed in Section 6).

5.2 Determination of Available Flow Credits

The impact of CAP/ER projects and other related rehabilitation projects must be quantified and documented to maintain an accurate record of capacity restoration. One gpd of credit will be given for each gpd of peak flow removed or each gallon of capacity added. The trading of credits will follow the Consent Decree criteria presented in Section 3.2; for example, for projects that provide additional off-line storage, the flow credit applied will be equal to proposed new flow. However, for projects that reduce peak flows to a chronic overflow location, the flow credit applied will be four times the proposed new flow.

Several examples to illustrate these procedures are provided below using the Third Creek Basin as an example. For each type of improvement made to the system, the corresponding application of credits is discussed.

Find and Fix Sewer Rehabilitation
Depending on the exact rehabilitation performed, the estimated peak flow reduction from each type of rehabilitation would be calculated as discussed in Section 5.3. This value would be the credit for the project entered into the database. The amount of

credit subtracted from the database to offset a proposed new flow addition will be determined based on the CD criteria discussed in Section 3.2. Any proposed new flow addition located downstream of the point where this credit applies would be eligible to use the credit. A proposed new flow addition located upstream of the point where this credit applies would also be eligible to use the credit, provided capacity could be certified between the new connection and where the credits apply.

As an example, the Phase 1 CAP/ER specifies Project 3-11 in the Third Creek Basin as a find and fix sewer rehabilitation project. Assuming the project reduces peak flows by 1000 gpd, then a flow credit of 1000 gpd is entered into the database. Figure 5-2 shows the locations of new flow additions that are eligible to use this flow credit in green and orange. These locations include all points downstream of the find and fix area (shown in green), as well as locations on other sewers (shown in orange) that flow to the main trunk sewer through which flow is reduced, provided capacity can be certified between the new connection and the trunk sewer. Assuming the project is not related to a chronic overflow location, then three times the flow credit will be subtracted from the database to offset a proposed new flow addition. If the proposed new flow addition is a single family residence of 167 gpd, then 501 gpd would be subtracted from the total available credits at all components downstream of where the new flow is introduced.

Comprehensive Sewer Rehabilitation
Depending on the exact rehabilitation performed, the estimated peak flow reduction from each type of rehabilitation would be calculated as discussed in Section 5.3. This value would be the credit for the project entered into the database. The amount of credit subtracted from the database to offset a proposed new flow addition will be determined based on the CD criteria discussed in Section 3.2. Any proposed new flow addition located downstream of the point where this credit applies would be eligible to use the credit. A proposed new flow addition located upstream of the point where this credit applies would also be eligible to use the credit, provided capacity could be certified between the new connection and where the credits apply.

As an example, the Phase 1 CAP/ER specifies Project 3-3 in the Third Creek Basin as comprehensive sewer rehabilitation of the designated mini-basins. Assuming the project reduces peak flows by 1000 gpd, then a flow credit of 1000 gpd is entered into the database. Figure 5-3 shows the locations of new flow additions that are likely eligible to use this flow credit in green and orange. These locations include all points within and downstream of the rehabilitation area (shown in green), as well as locations on other sewers (shown in orange) that flow to the main trunk sewer through which flow is reduced, provided capacity can be certified between the new connection and the trunk sewer. Assuming the project is not related to a chronic overflow location, then three times the flow credit will be subtracted from the database to offset a proposed new flow addition. If the proposed new flow addition is a single family residence of 167 gpd, then 501 gpd would be subtracted from the credit database.

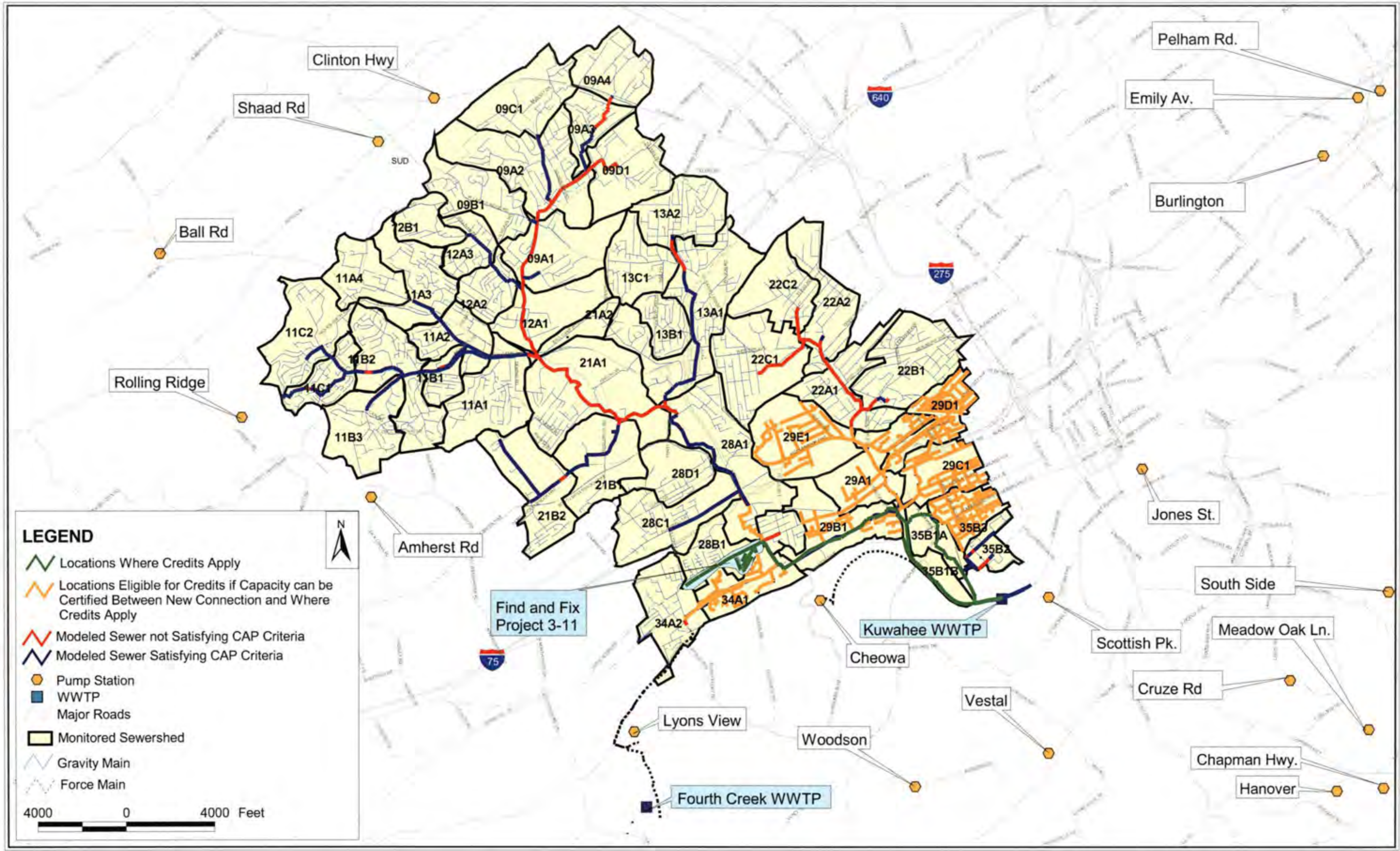

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Figure 5-2
Example Determination of Available Credits from Find and Fix Sewer Rehabilitation Project in Third Creek

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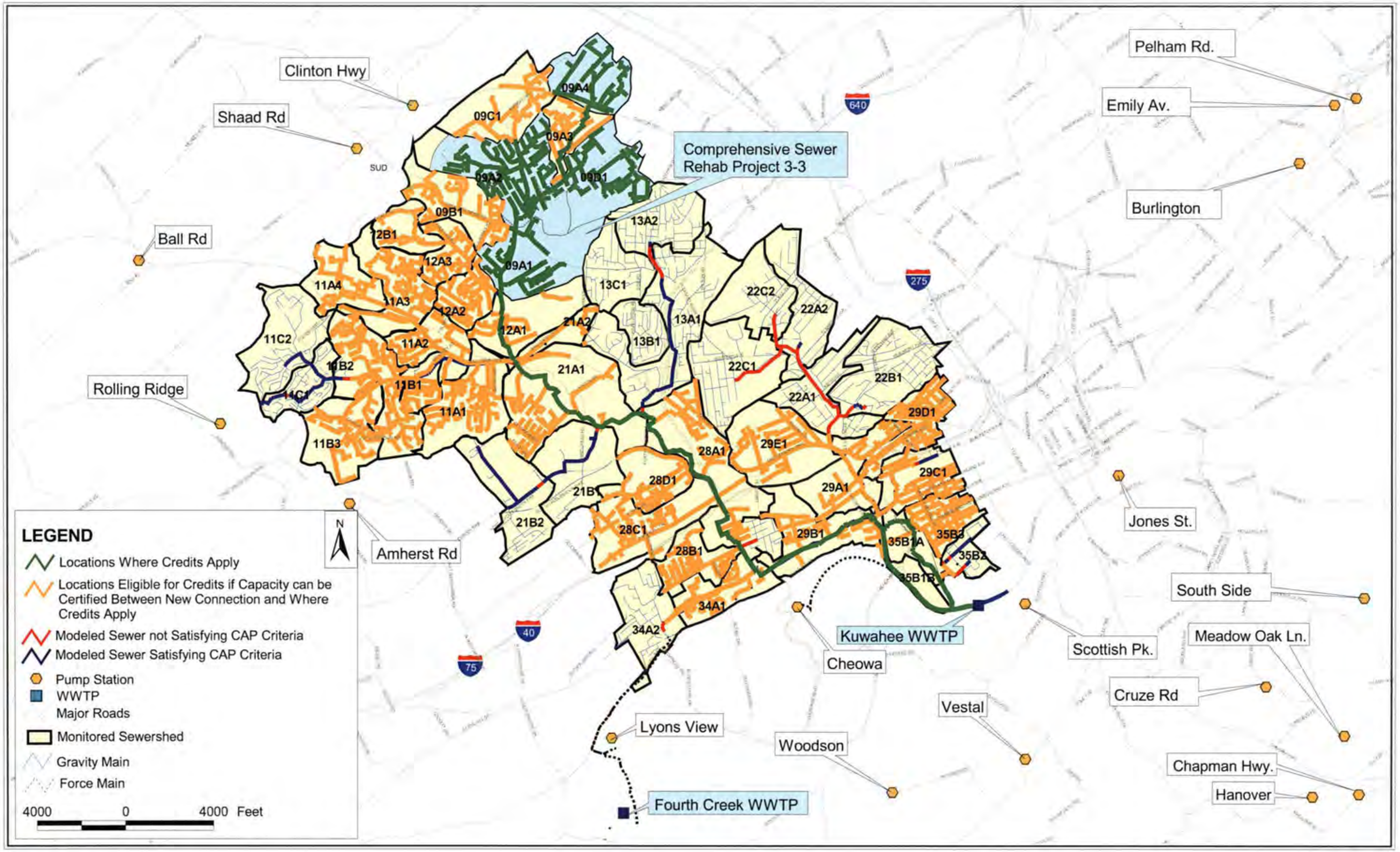

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Figure 5-3
Example of Determination of Available Credits from Comprehensive Sewer Rehabilitation Project in the Third Creek Basin

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Storage Facility
The credit for construction of an off-line storage facility entered into the database will be equal to the added capacity (or volume) of the storage tank. Any proposed new flow addition that flows to any pipe located downstream of this storage facility would be eligible to use the credit.

As an example, the Phase 1 CAP/ER specifies Project 3-5 as construction of a 4 million gallon storage facility. A credit of 4 mgd would be entered into the database after completion of this project . Figure 5-4 shows the locations of new flow additions that are likely eligible to use this flow credit in green and orange. These locations include all points downstream of the storage facility (shown in green), as well as locations on other sewers (shown in orange) that flow to the main trunk sewer through which flow is reduced, provided capacity can be certified between the new connection and the trunk sewer.

5.3 Estimated Flow Reduction or Capacity Increase From Corrective Actions

In order to apply credits for corrective actions the estimated flow reduction, or added capacity from corrective actions, must be calculated. The following types of corrective actions are anticipated, and the calculation of estimated flow reduction or capacity increase from each type is discussed below:

- Find and Fix Sewer Rehabilitation
    - Rehabilitation and/or Modification of Manholes
    - Disconnection of Downspouts, Driveway Drains, Foundation Drains, Sump Pumps, etc.
    - Rehabilitation of Sewers
- Comprehensive Sewer Rehabilitation
- Storage Facility Construction

5.3.1 Find and Fix Sewer Rehabilitation

It is not practical to perform post-project implementation flow monitoring to quantify capacity restoration for every project or maintenance activity. Instead, KUB will use the established removal efficiencies described below. These values were developed for the previous TDEC regulatory action to address sanitary sewer overflows. Until additional data becomes available, these peak flow reduction values will be used. Flow monitoring will still be used in CAP/ER planning and to evaluate resulting R-values and typical I/I removal rates for large-scale rehabilitation projects. This procedure is described in **Appendix D**.

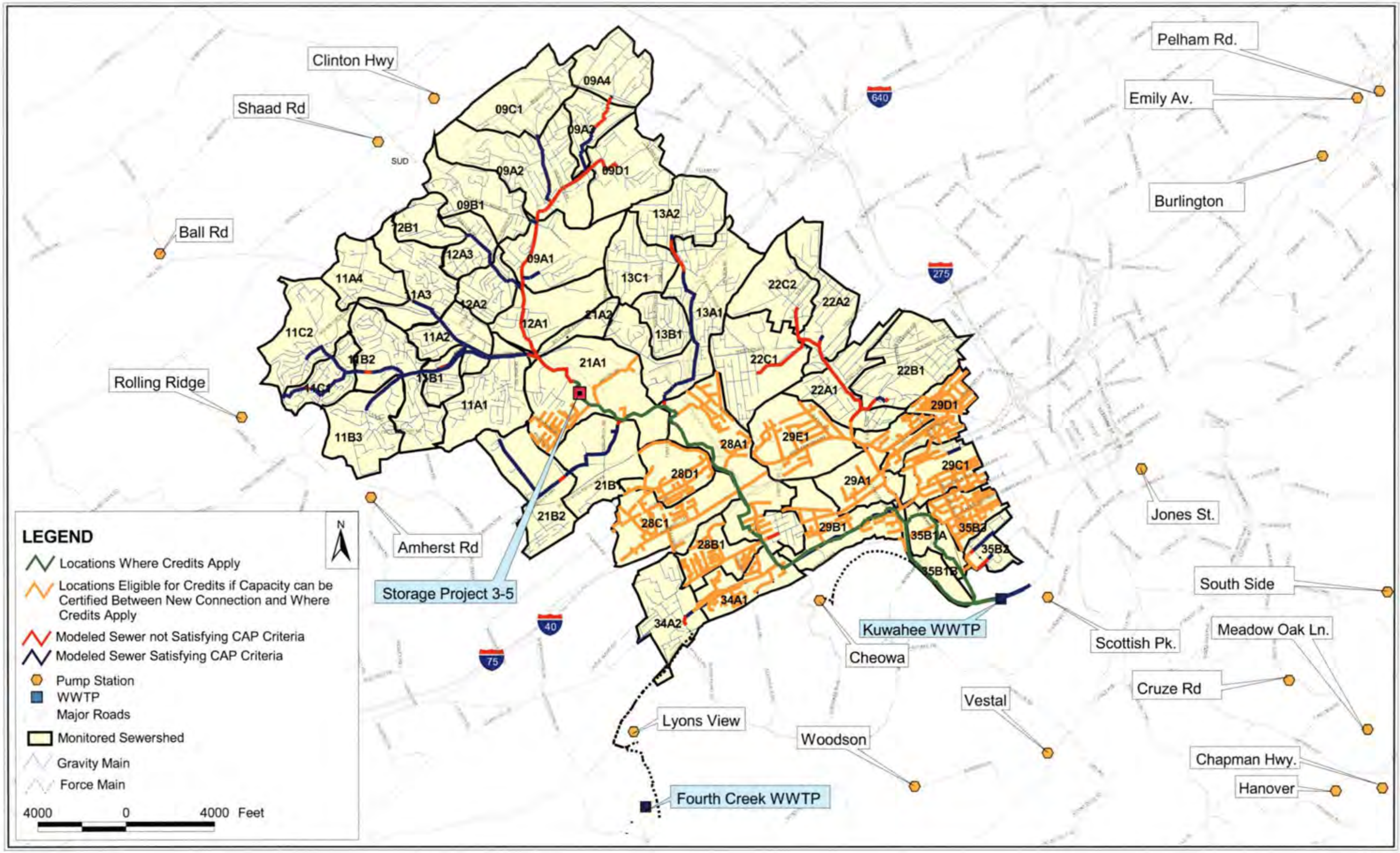

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Figure 5-4
Example of Determination of Available Credits from Storage Facility Project in Third Creek basin

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Find and Fix Sewer Rehabilitation includes several types of sewer system rehabilitation and removal of wet weather flows for which credits will be accumulated, including the following:

- Rehabilitation and/or modification of manholes
- Disconnection of downspouts, driveway drains, foundation drains, sump pumps, etc.
- Rehabilitation of sewers.

Manhole Rehabilitation
The estimated peak flow reduction for manhole rehabilitation is divided into two categories, replacement of vented manhole lids and repair of manhole defects as described below:

1. Replacement of Vented Manhole Lids
   Vented manhole lids will be replaced with the new modified solid lids (with only two pick holes), solid lids, or dish inserts. The estimated peak flow reduction depends on the manhole location and its susceptibility to inundation by rainwater during wet weather as defined here:

   - **Riparian Zone** – Manholes will be considered to be subject to a one-inch inundation when the top of casting is within two feet vertically of the stream bank edge and within 50 feet horizontally of a stream bank edge.
   - **Paved Area** – Manholes in paved areas that completely lie within a distance of the curb no more than one-fourth of the width of the street as measured from curb to curb will be considered "one-eighth-inch inundation." Note that the street must have a formed curb to be considered for this category.
   - **Other** – Manholes in paved areas that lie outside the area defined in one-eighth-inch inundation (above) or manholes in non-paved areas that are flush with the ground are considered "splash." Any manholes in paved areas where there is no formed curb will be considered as "splash."

   The estimated peak flow reductions for vented manhole lid replacement are

Other	Paved Area	Riparian Zone
2,000 gpd	8,000 gpd	40,000 gpd

[Note: These values were developed for the Cincinnati MSD Short-Term Capacity Plan (November 2001) using information reported by Neenah Foundry Company: "A Report on Inflow of Surface Water Through Manhole Covers" (1983).]

2. <u>Repair of Manhole Defects</u>
The second category is the rehabilitation of specific defects in the manhole structure. The estimated peak flow reduction is determined by severity and number of defects as logged, as well as the location of the manhole. The American Society of Civil Engineers, Manual of Practice No. 92 was used as the basis of classification. Tables 5-1 through 5-3 provide the peak flow reduction given for paved areas, riparian areas, and non-riparian areas.

Table 5-1: Peak Flow Reduction for Manholes in Paved Areas

	Minor I/I	Moderate I/I	Heavy I/I	Severe I/I
	gpd	gpd	gpd	gpd
Frame Seal	78	156	311	622
Chimney	78	156	311	622
Cone	78	156	311	622
Wall	39	78	156	311
Pipe Seal	39	78	156	311
Bench	39	78	156	311
Channel	39	78	156	311

Table 5-2: Peak Flow Reduction for Manholes in Non-Riparian Areas

	Minor I/I	Moderate I/I	Heavy I/I	Severe I/I
	gpd	gpd	gpd	gpd
Frame Seal	328	656	1,313	2,626
Chimney	328	656	1,313	2,626
Cone	328	656	1,313	2,626
Wall	164	328	656	1,313
Pipe Seal	164	328	656	1,313
Bench	164	328	656	1,313
Channel	164	328	656	1,313

Table 5-3: Peak Flow Reduction for Manholes in Riparian Areas				
	Minor I/I	Moderate I/I	Heavy I/I	Severe I/I
	gpd	gpd	gpd	gpd
Frame Seal	864	1,728	3,456	6,912
Chimney	864	1,728	3,456	6,912
Cone	864	1,728	3,456	6,912
Wall	432	864	1,728	3,456
Pipe Seal	432	864	1,728	3,456
Bench	432	864	1,728	3,456
Channel	432	864	1,728	3,456

Downspout and Driveway Drain Removals
The estimated peak flow reduction for downspouts and driveway drains are as follows:

Downspouts	4,000 gpd per downspout
Driveway drains	6,000 gpd per driveway drain

Foundation Drain Credits
Removing foundation drain sump pumps from the sanitary sewer system is estimated to reduce peak flow by 4,000 gpd per sump pump.

Rehabilitation of Deteriorated Mainline Sewers or Private Lateral Corrections
The estimated peak flow reductions for mainline sewer rehabilitation or replacement (including service laterals up to the property line) are as follows:

Riparian Areas	34,000 gpd/inch-mile of pipe rehabilitated
Non-Riparian Areas	60 gpd/inch-mile of pipe rehabilitated

The estimated peak flow reduction for private lateral correction is as follows

__(To be determined during procedures manual development)__ gpd/lateral.

5.3.2 Comprehensive Sewer Rehabilitation

A comprehensive sewer rehabilitation program consists of rehabilitation of every foot of sewer within the rehabilitation project area. This type of program has been proven to be effective in other municipal systems at eliminating a large percentage of RDI/I, and is effective at reducing both the volume of RDI/I and the peak flows of RDI/I into the system. CDM has found that a comprehensive rehabilitation program of sewers in the public rights-of-way can result in RDI/I volume reductions of 50 to 80 percent (within the rehabilitated area). While comprehensive rehabilitation is typically aimed at reducing peak RDI/I flows, rehabilitation can also reduce groundwater infiltration (GWI) flows by 85 to 90 percent. A reduction of GWI would be beneficial during dry-weather conditions to reduce daily flows and operational costs at the wastewater treatment plant. In addition to RDI/I and GWI reduction, design of a comprehensive rehabilitation program should also typically include repairing structural defects and maintenance problems within the system.

The reduction in peak wet weather flow will be based initially on an estimated reduction to an R-value of 2 percent. This is based on several studies and experience showing a fully rehabilitated system will not remove all I/I but should not let in more than 2 percent of rainfall that fell over the study area. The I/I model discussed in the Phase 1 CAP/ER is used to calculate the estimated peak flow from a 2-year, 24-hour storm event based on current R-values, as well as the estimated peak flow based on an R-value of two percent.

This peak flow reduction will be checked and revised based on pre-/post-flow monitoring data as discussed in **Appendix D**.

5.3.3 Storage Facility Construction

The construction of a storage facility increases sewer capacity by reducing both the volume and peak flows downstream of the facility. The estimated added capacity eligible for an exchange of credits is equal to the volume of the storage facility. To relate this volume to flow from a new service connection, it is divided by 24 hours. Therefore, a 1 million gallon storage tank would provide 1 mgd of credits. The hydraulic control system would allow KUB the ability to divert equal to or greater than the proposed flow credit (at least 1 mgd in this example) from the sewer system.

Credits would not be applied until the storage tank is operable.

5.4 I/I Removal and New Flow Database

Several tools will need to be in place for implementation of the CAP. These are further discussed in Section 6 - Implementation Plan.

The main tool is a database that tracks proposed new flows, approved new flows, and existing flows. The database must also track I/I removal or capacity restoration projects including the following information:

- Estimated reduction in peak wet weather flow from these projects
- Value of credit for the project
- Date of project completion
- Manholes or pipes where the credits directly apply

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- Manholes or pipes that may be eligible for credits provided capacity can be certified between the new flow location and where the credits apply.

A chronic overflow database and a dry weather overflow database must also be maintained. The GIS will be very useful in assisting with the application of credits from these projects both in terms of quantity of credits available, where these credits apply, and how this is related to the location of the proposed new flow addition.

5.5 Reviews and Updates

KUB has and will perform annual reviews of estimated peak flow reductions or capacity additions and adjust current available credits and future credits achieved, as appropriate.

In addition, KUB will re-run the hydraulic model after major improvements (like construction of a storage facility or major trunk sewer replacement) to determine the effect on the surcharged sewers shown in the current thematic maps in **Appendix A**. Since these maps are based on existing flow with restrictions, an improvement may remove surcharging upstream, but increase surcharging downstream. The hydraulic model will also be updated periodically with additional new flows and estimated I/I reductions. The model will also be re-calibrated with new flow monitoring data periodically.

Section 6
Implementation Plan

KUB is actively working to implement the CAP and will be ready to begin the program within 60 days of approval by EPA. The following sections briefly outline the basis for the implementation plan, which includes the hydraulic model, information management system, procedures manual, and program administration.

6.1 Hydraulic Model

The recently completed trunk sewer hydraulic model serves as KUB's primary tool for evaluating available system capacity and corrective actions. The models were developed using the EXTRAN block of the EPA's Stormwater Management Model (SWMM). EXTRAN is a dynamic flow routing model that routes inflow hydrographs through an open channel and/or closed conduit system computing a time history of flows and heads throughout the system. It uses a link-node representation of the sewer system in an explicit difference solution of the equations of gradually varied, unsteady flow (St. Venant equations).

The model can evaluate both dry and wet weather flows for any proposed connection of additional flows to the system. It can also assess capacity improvements and their impact on the performance of the entire system all the way to the treatment facility. The model allows KUB to evaluate hydraulic performance and impacts at a level of detail not previously available.

Hydraulic models for First, Second, Third, Fourth, and Williams creeks, and South Knoxville have been developed. Models for Loves Creek and Eastbridge basins are under development. Data from the existing 2-year representative design storm will be used in the IMS. Periodic updates to the hydraulic model will be made, but will not be a day-to-day component of the approval in lieu of certification process. Periodic updates are required when major improvements are constructed. The model will also be updated and re-calibrated periodically with revised flow monitoring data. These updates will assess the effectiveness of the rehabilitation projects and will likely change the capacity certification of facilities.

The calibrated hydraulic model was used to analyze peak wet-weather flows for current trunk sewer conditions in the KUB system. The model results were used to determine which trunk sewers meet the surcharge criteria (and which do not). In addition, the model was used to determine the peak flows to modeled pump stations and plants.

6.2 Information Management System

The information management system (IMS) will be used to certify the capacity of the collection system and also as a tool to manage the approval in lieu of certification credit banking program. A key component of the IMS is the geographic information system (GIS) database.

The GIS database will be used to certify capacity and track credits throughout the collection system. Currently the GIS database contains pipe invert, diameter, slope, length, and manhole rim elevations for the vast majority of the trunk sewer system. The vast majority of the collector sewer system (pipes eight to 10-inches in diameter) is also available in GIS format and contains the length of each segment, manhole locations, and a unique identifier for each manhole and pipe. Additional information that is available in GIS format is all of the subbasins, pump stations, and parcels in the KUB service area. This information will be used as the basis for the IMS.

The IMS will have the capability to track and/or calculate several important parameters, including the following:

- New Flow Database – This includes documentation of existing flows, tracking new flows that have been approved, and tracking the testing of proposed new flows using the capacity certification and/or Approval In Lieu of Certification Processes documented in Figures 4-1 and 5-1 in Sections 4 and 5.

- Pump Station Capacity Database – This includes documentation of design capacities, draw-down information (if available), capacity with largest pump out of service, existing peak flow to pump stations, and available capacity at pump stations per CAP criteria. The Pump Station Database is presented in **Appendix B**.

- Treatment Plant Capacity Database – This includes documentation of available capacity at KUB's four treatment plants as discussed in Section 4.6.

- Documentation of anticipated RDI/I flow reductions or added capacity due to capacity restoration projects such as storage tanks or rehabilitation.

- Documentation of credits that apply to capacity restoration projects (i.e. 1000 gpd peak flow reduction equals 1000 gpd credit).

- Tracking the total number of credits available in each basin. Credits will be reduced when they are used to offset a proposed additional flow. For example, if a proposed additional flow is unrelated to a chronic overflow location, then credits will be reduced by a ratio of 3:1 (i.e. if the proposed new flow addition is 167 gpd, then a 501 gpd credit will be removed from the database.)

- Tracking manholes or pipes where credits apply directly.

- Tracking manholes or pipes that will be eligible for credits provided capacity can be certified between the new flow location and the location where credits apply.

- Tracking current chronic overflow locations and corrective actions.

- Tracking dry weather overflow locations and corrective actions.

6.3 Procedures Manual Preparation

A procedures manual is being prepared to detail the exact steps that must be performed to implement the program. This is being prepared in conjunction with the Information Management System. This manual, combined with the Information Management System, will allow KUB to meet the requirements of the Consent Decree consistently even when staff positions change. The knowledge that went into developing the procedures will be well documented and not lost if a key staff member leaves.

6.4 Program Administration

KUB will coordinate building permit approvals with the City of Knoxville and Knox County. Procedures are already in place in response to implementation of the TDEC CAP, and these procedures will continue.

The CAP will be administered by KUB's Collection System Improvement team and supported by other KUB departments including Engineering and Information Services.

Capacity certification will be made by a registered professional engineer registered in the State of Tennessee, and approved by a responsible party in KUB as defined by 40 C.F.R. S. 122.22. Certifications and all data on which the certifications are based will be maintained at KUB offices and will be made available on request for inspection by EPA and TDEC. KUB will provide any and all documentation necessary to support any certification made by KUB and make available, to the extent possible, individuals providing this certification to meet with EPA and TDEC.

KUB will periodically update the capacity information provided in this document as system improvements are made. The system hydraulic model will be maintained and used to update trunk sewer and pump station capacity information.

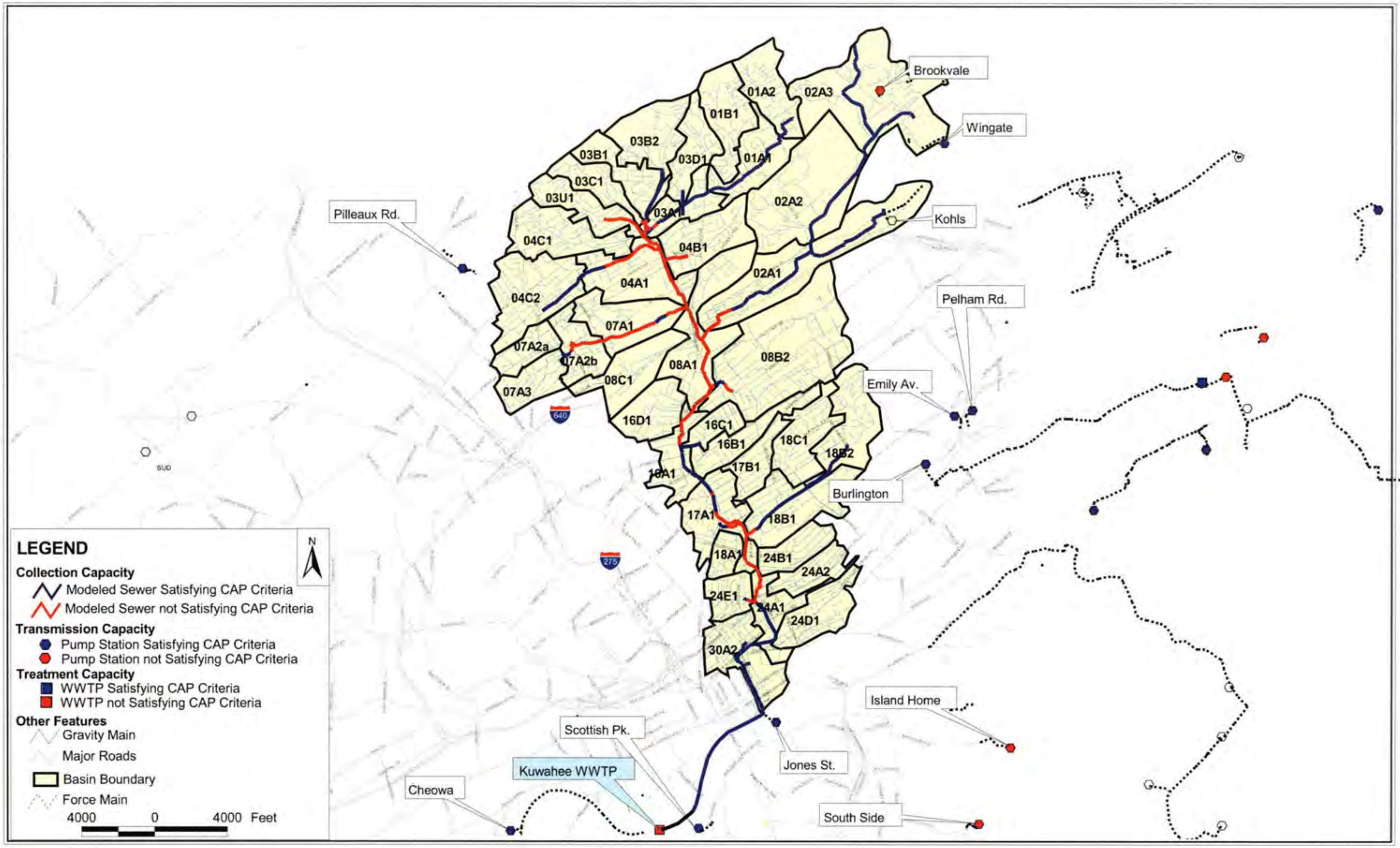

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Figure A-1
First Creek Basin
Collection, Transmission, and Treatment Capacity

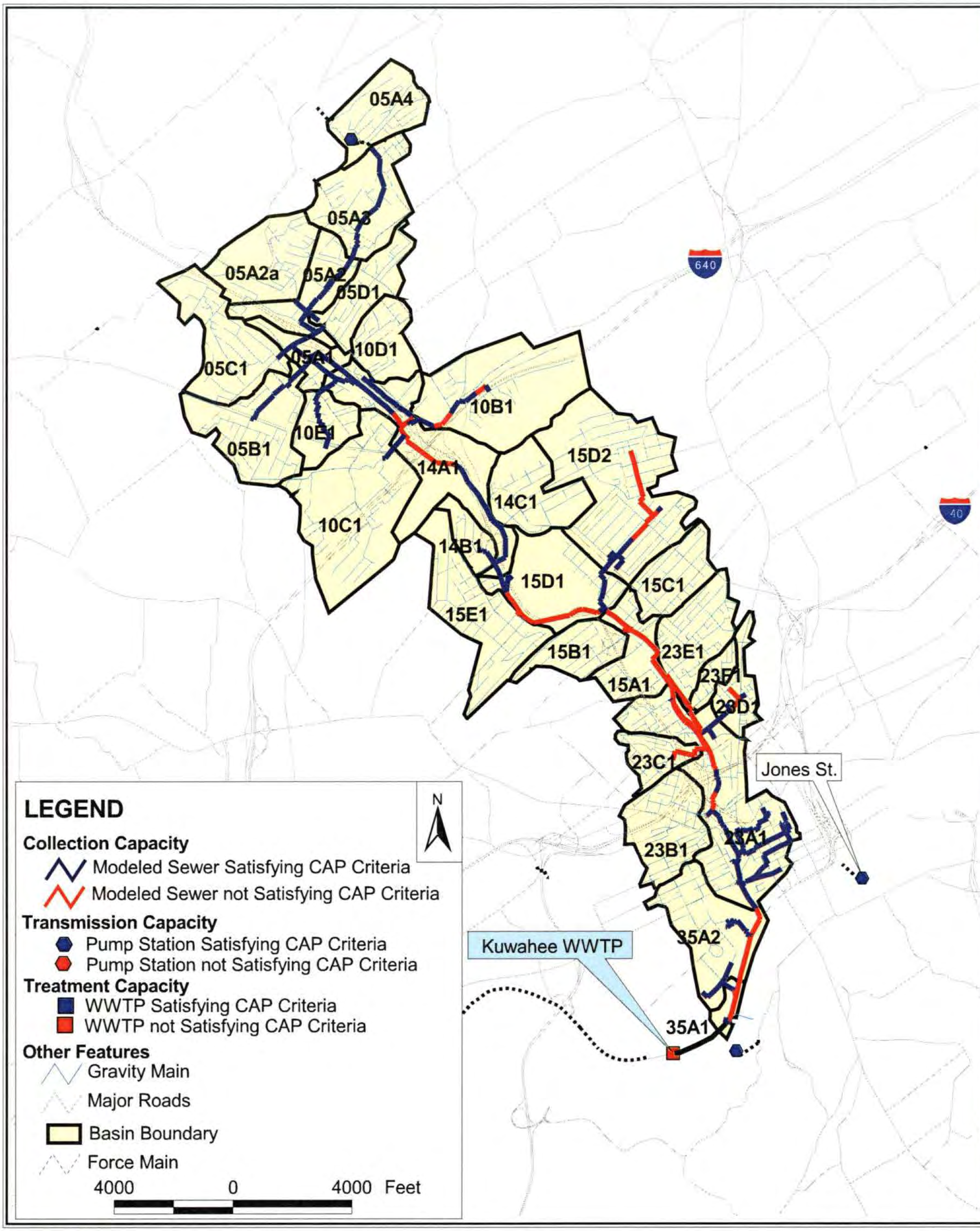

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Figure A-2
Second Creek Basin
Collection, Transmission, and Treatment Capacity

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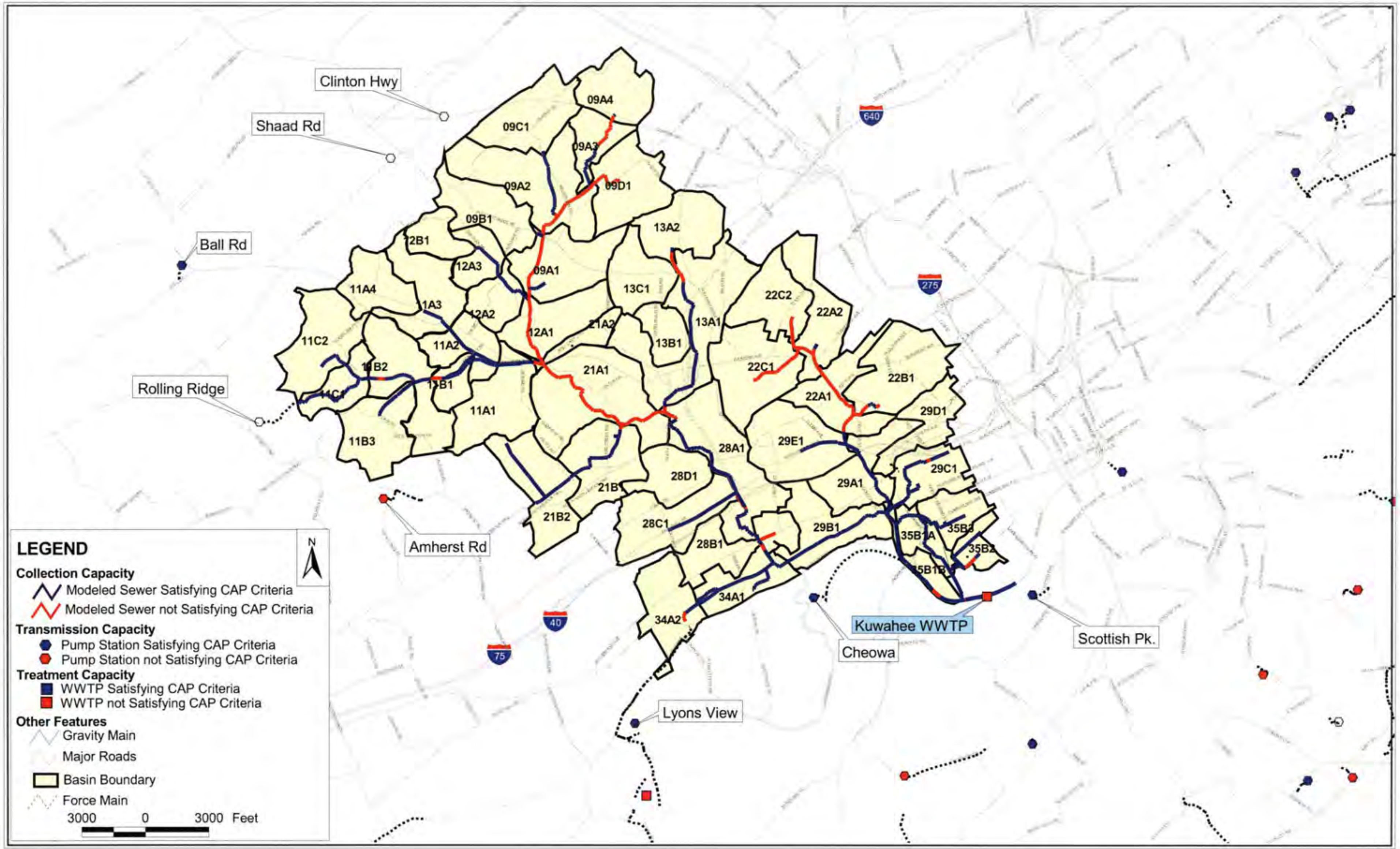

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Figure A-3
Third Creek Basin
Collection, Transmission, and Treatment Capacity

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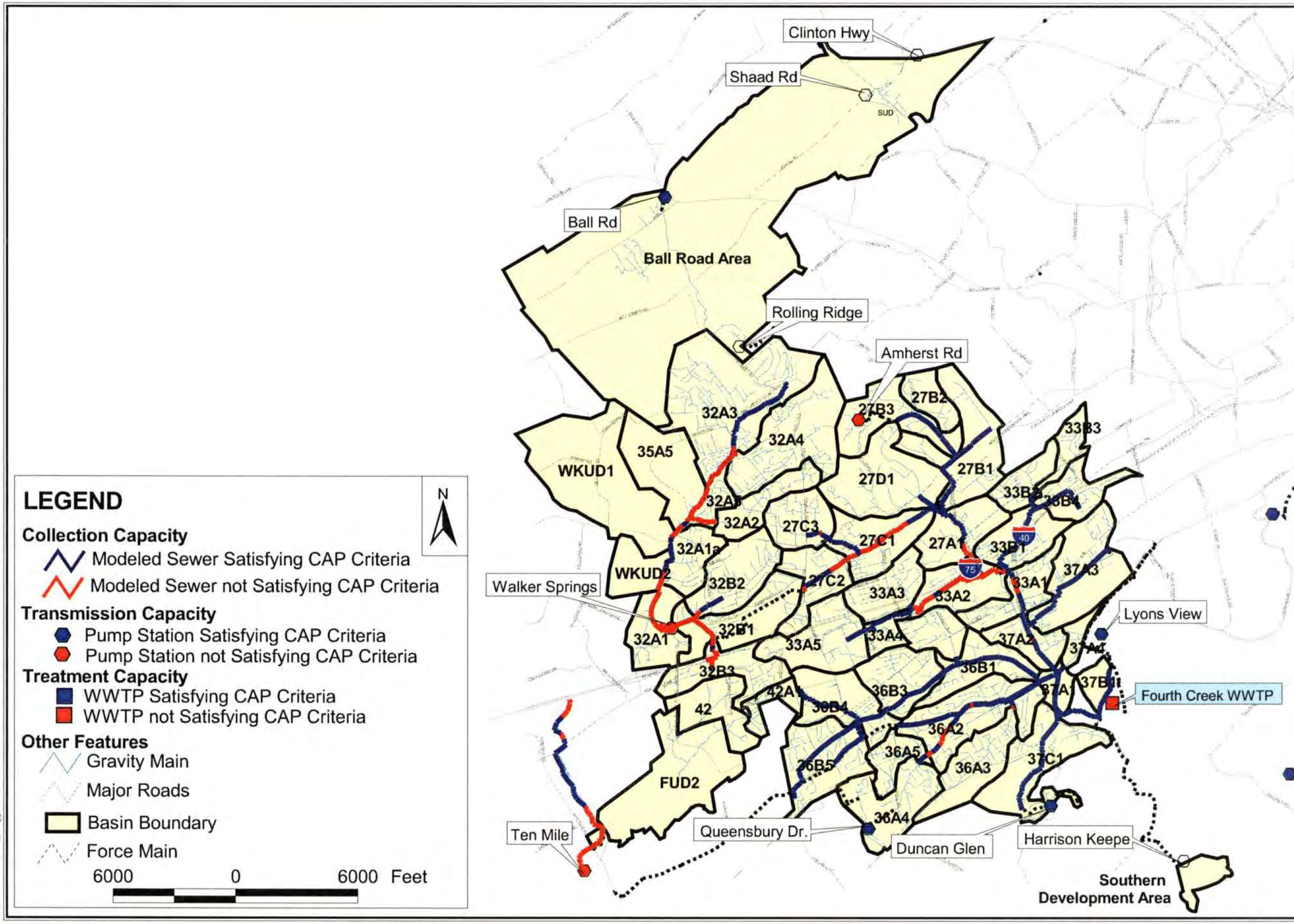

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Figure A-4
Fourth Creek Basin
Collection, Transmission, and Treatment Capacity

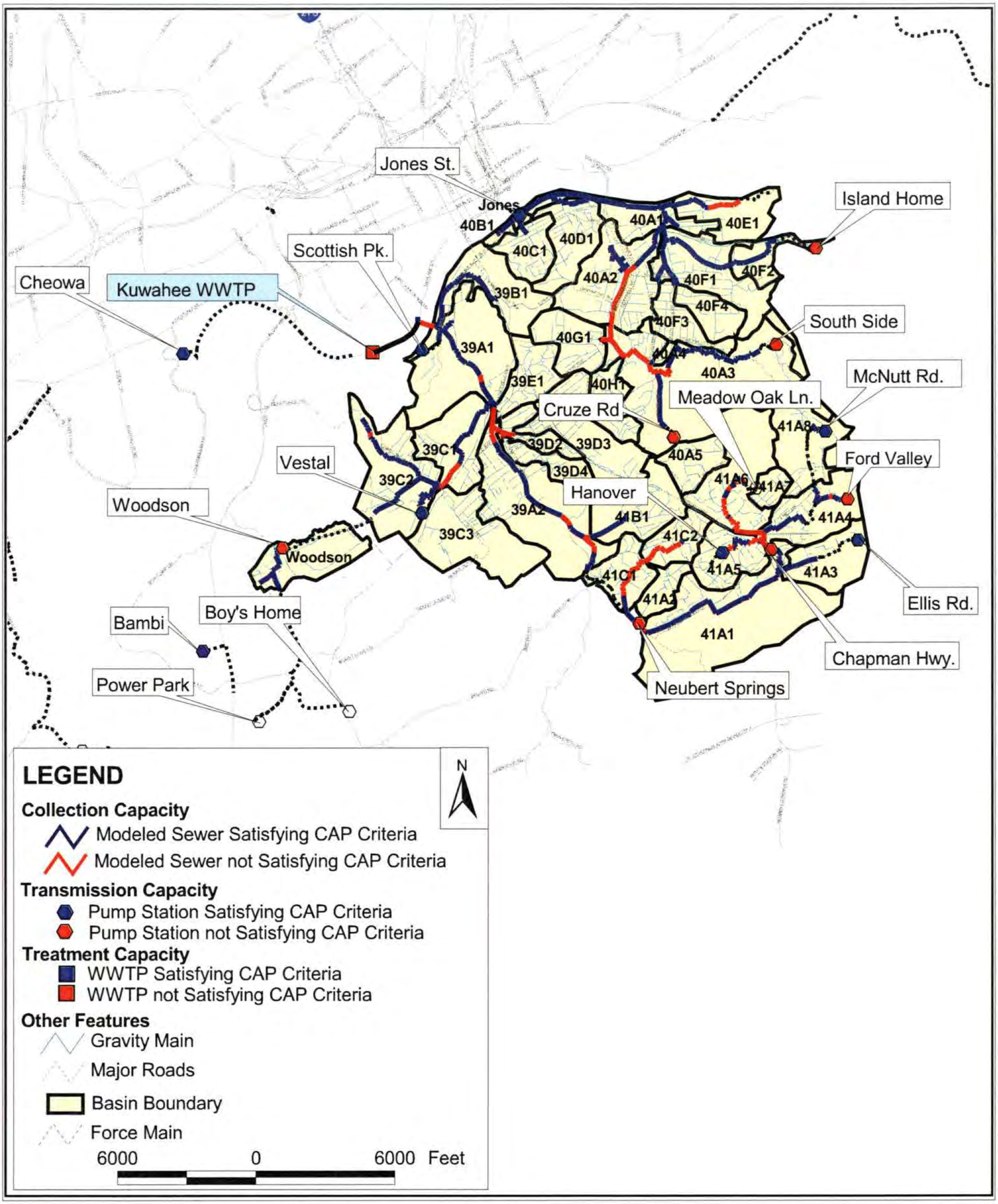

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Figure A-5
South Knox Basin
Collection, Transmission, and Treatment Capacity

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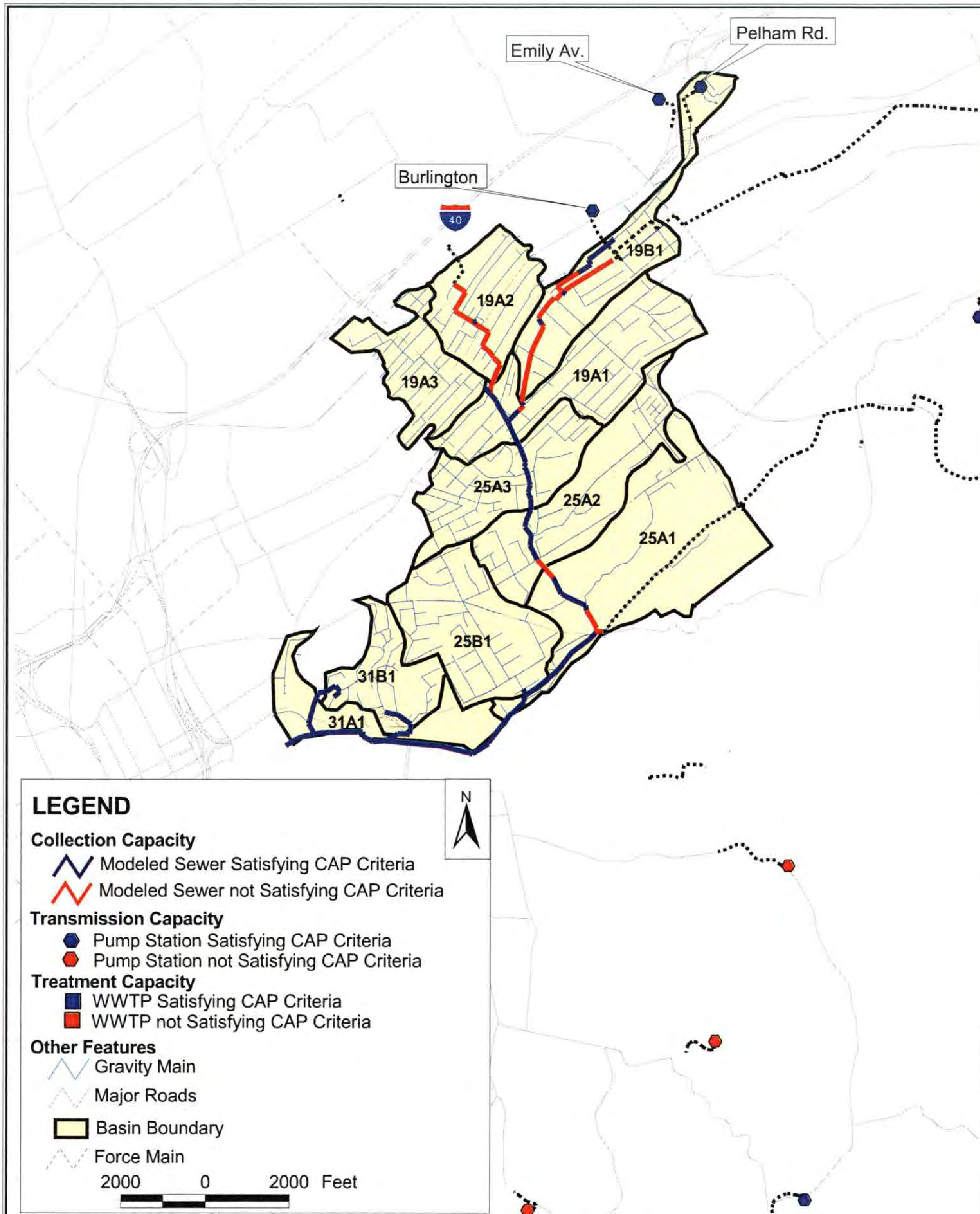

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Figure A-6
Williams Creek Basin
Collection, Transmission, and Treatment Capacity

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Pump Station Capacity Spreadsheet

PUMP STATION	PUMP	MODEL	H/P	Design Capacity[1]	Revised Capacity (gpm)[2]	CAP Capacity (gpm)[3]	Peak WWF to PS (gpm)[4]	ADWF to PS (gpm)[5]	BASIN	Meets CAP Criteria[6]
AMHERST	#1	WEMCO	7.5	150 @ 51.5'					FOURTH CREEK	
	#2	WEMCO	7.5	150 @ 51.5'						
	Combined Pump Capacity		1,2	240		150	170	43		no
BALL ROAD	#1	FLYGT	130	1100 @ 240 '					FOURTH CREEK	
	#2	FLYGT	130	1100 @ 240'						
	Combined Pump Capacity		1,2	1760		1100	118.5	29.6		yes
BOYS HOME[7]	#1	YEOMANS	20	300 @ 100'					SOUTH KNOXVILLE/KNOB	
	#2	YEOMANS	20	300 @ 100'						
	Combined Pump Capacity		1,2	480		300				
BROOKVALE	#1	FLYGT	3	212 @ 19'					FIRST CREEK	
	#2	FLYGT	3	212 @ 19'						
	Combined Pump Capacity		1,2	339		212	500	125		no
BUD HAWKINS	#1	GORMAN RUPP	25	335 @ 109'					EASTBRIDGE	
	#2	GORMAN RUPP	25	335 @ 109'						
	Combined Pump Capacity		1,2		410	335	315	79		yes
BURLINGTON	#1	FAIRBANKS	25	800 @ 77'					LOVES CREEK	
	#2	FAIRBANKS	25	800 @ 77'						
	#1MH	FLYGT	5	480 @ 21'						
	#1MH	FLYGT	5	480 @ 21'						
	Combined Pump Capacity		1,2,3,4	1536		1232	528.3	132.1		yes

Pump Station Capacity Spreadsheet

PUMP STATION	PUMP	MODEL	H/P	Design Capacity[1]	Revised Capacity (gpm)[2]	CAP Capacity (gpm)[3]	Peak WWF to PS (gpm)[4]	ADWF to PS (gpm)[5]	BASIN	Meets CAP Criteria[6]
CHAPMAN HWY.[8]	#1	FAIRBANKS	60	1160 @ 98'	1133.3				SOUTH KNOXVILLE/KNOB	
	#2	FAIRBANKS	60	1160 @ 98'	922					
	Combined Pump Capacity		1, 2		1644	922	1167			no
CHEOWA[9]	#1	FAIRBANKS	7.5	1000 @ 14'					KUWAHEE	
	#2	WORTHINGTON	10	1750 @ 14'						
	#3	WORTHINGTON	15	2500 @ 14'						
	Combined Pump Capacity			3675		2200	1147	287		yes
CHESTNUT RIDGE	#1	GORMAN RUPP	25	250 @ 121'					EASTBRIDGE	
	#2	GORMAN RUPP	25	250 @ 121'						
	Combined Pump Capacity		1, 2	400		250	47.7	11.9		yes
CLINTON HIGHWAY[7]	#1	FLYGT	10	100 @ 65'					THIRD CREEK	
	#2	FLYGT	10	110 @ 65"						
	Combined Pump Capacity		1, 2	168		100				
CRESTWOOD	#1	WEMCO	20	270 @ 93'					LOVES CREEK	
	#2	WEMCO	20	270 @ 93'						
	Combined Pump Capacity		1, 2	432		270	46.4	11.6		yes
CRUZE RD.[8]	#1	WEMCO	10	165 @ 60'	158.6				SOUTH KNOXVILLE/KNOB	
	#2	WEMCO	10	165 @ 60'	99.5					
	Combined Pump Capacity		1,2		169.2	99.5	151			no

0001422

Pump Station Capacity Spreadsheet

PUMP STATION	PUMP	MODEL	H/P	Design Capacity[1]	Revised Capacity (gpm)[2]	CAP Capacity (gpm)[3]	Peak WWF to PS (gpm)[4]	ADWF to PS (gpm)[5]	BASIN	Meets CAP Criteria[6]
DUNCAN GLEN	#1	FAIRBANKS	30	150 @ 180'					FOURTH CREEK	
	#2	FAIRBANKS	30	150 @ 180'						
	Combined Pump Capacity		1,2	240		150	19.9	5.0		yes
EASTON MEADOWS[7]	#1	GORMAN RUPP	15	180 @ 98'					LOVES CREEK	
	#2	GORMAN RUPP	15	180 @ 98'						
	Combined Pump Capacity		1,2	288		180				
EASTWOOD	#1	FAIRBANKS	20	800 @ 202'					LOVES CREEK	
	#2	FAIRBANKS	20	800 @ 202'						
	Combined Pump Capacity		1,2	1280		800	229.4	57.4		yes
ELLIS ROAD	#1	ALLISCHALMR	5	100 @ 42'					SOUTH KNOXVILLE/KNOB	
	#2	ALLISCHALMR	5	100 @ 42'						
	Combined Pump Capacity		1,2	160		100	48.9	12.2		yes
EMILY	#1	FLYGT	15	200 @ 95'					LOVES CREEK	
	#2	FLYGT	15	200 @ 95'						
	Combined Pump Capacity		1,2	320		200	8.2	2.0		yes
FORD VALLEY[8]	#1	ALLISCHALMR	20	500 @ 75'	443.9				SOUTH KNOXVILLE/KNOB	
	#2	ALLISCHALMR	20	500 @ 75'	473.9					
	Combined Pump Capacity		1,2		582.9	443.9	1288			no

0001423

Pump Station Capacity Spreadsheet

PUMP STATION	PUMP	MODEL	H/P	Design Capacity[1]	Revised Capacity (gpm)[2]	CAP Capacity (gpm)[3]	Peak WWF to PS (gpm)[4]	ADWF to PS (gpm)[5]	BASIN	Meets CAP Criteria[6]
FORKS OF THE RIVER[10]	#1	INGERSOL RAND	75	1050 @ 174'	1011.4				SWANPOND CREEK	
	#2	INGERSOL RAND	75	1050 @ 174'	990.8					
	#3	INGERSOL RAND	75	1050 @ 174'	990.8					
	Combined Pump Capacity		1, 2		1135.2					
	Combined Pump Capacity		1, 3		1155.9					
	Combined Pump Capacity		2, 3		1135.2					
	Combined Pump Capacity		1, 2, 3		1217.6	1135.2	2139	535		no
GINNBROOKE	#1	YEOMANS	15	350 @ 76'					SOUTH KNOXVILLE/KNOB	
	#2	YEOMANS	15	350 @ 76'						
	Combined Pump Capacity		1, 2	560		350	39.2	9.8		yes
HANOVER	#1	ALLISCHALMR	7.5	150 @ 42'					SOUTH KNOXVILLE/KNOB	
	#2	ALLISCHALMR	7.5	150 @ 42'						
	Combined Pump Capacity		1, 2	240		150	72	18		yes
HARRISON KEEPE[7]	#1	GORMAN RUPP	25	325 @ 76'					FOURTH CREEK	
	#2	GORMAN RUPP	25	325 @ 76'						
	Combined Pump Capacity		1, 2	520		325				
HOLSTON HILLS	#1	ALLISCHALMR	30	600 @ 120'					LOVES CREEK	
	#2	ALLISCHALMR	40	850 @ 127'						
	#3	ALLISCHALMR	75	1600 @ 127'						
	#4	ALLISCHALMR	75	1600 @ 127'						
	Combined Pump Capacity			2790		2135	568.3	142.1		yes

Pump Station Capacity Spreadsheet

PUMP STATION	PUMP	MODEL	H/P	Design Capacity[1]	Revised Capacity (gpm)[2]	CAP Capacity (gpm)[3]	Peak WWF to PS (gpm)[4]	ADWF to PS (gpm)[5]	BASIN	Meets CAP Criteria[6]
ISLAND HOME[7]	#1	FLYGT	5	50 @ 112'					SOUTH KNOXVILLE/KNOB	
	#2	FLYGT	5	50 @ 112'						
	Combined Pump Capacity			80		50	16.7	4.2		yes
JOHN SEVIER	#1	AURORA	20	450 @ 27'					LOVES CREEK	
	#2	AURORA	20	450 @ 27'						
	Combined Pump Capacity		1, 2	720		450	697.5	174.4		no
JONES STREET[8]	#1	FAIRBANKS	20	3200 @ 12'	3114.3				SOUTH KNOXVILLE/KNOB	
	#2	FAIRBANKS	20	3200 @ 12'	3148.4					
	#3	FAIRBANKS	20	3200 @ 12'	3166.5					
	Combined Pump Capacity		1,2		5605.7					
	Combined Pump Capacity		1,2,3		7252.9					
	Combined Pump Capacity		1, 3		5652.72	5605.7	4448			yes
KOHL'S[5]	#1	FLYGT	5	125 @ 42'					FIRST CREEK	
	#2	FLYGT	5	125 @ 42'						
	Combined Pump Capacity		1, 2	200		125				
LYONS CREEK	#1	CORNELL	25	400 @ 100'					EASTBRIDGE	
	#2	CORNELL	25	400 @ 100'						
	Combined Pump Capacity		1, 2	640		400	309	77		yes
LYONS VIEW	#1	WEMCO	20	125 @ 98'					FOURTH CREEK	
	#2	WEMCO	20	125 @ 98'						
	Combined Pump Capacity		1, 2	200		125	82	21		yes

Pump Station Capacity Spreadsheet

PUMP STATION	PUMP	MODEL	H/P	Design Capacity[1]	Revised Capacity (gpm)[2]	CAP Capacity (gpm)[3]	Peak WWF to PS (gpm)[4]	ADWF to PS (gpm)[5]	BASIN	Meets CAP Criteria[6]
MALONEYVILLE	#1	GORMAN RUPP	20	325 @ 99'					EASTBRIDGE	
	#2	GORMAN RUPP	20	325 @ 99'						
	Combined Pump Capacity		1,2		330	290	167	42		yes
MASCOT	#1	GORMAN RUPP	3	80 @ 31'					EASTBRIDGE	
	#2	GORMAN RUPP	3	80 @ 31'						
	Combined Pump Capacity		1,2	128		80	27	7		yes
McNUTT[8]	#1	ALLISCHALMR	25	380 @ 100'	345.3				SOUTH KNOXVILLE/KNOB	
	#2	ALLISCHALMR	25	380 @ 100'	345.3					
	Combined Pump Capacity				405.7	345.3	192			yes
MEADOW OAKS	#1	ALLISCHALMR	20	160 @ 100'					SOUTH KNOXVILLE/KNOB	
	#2	ALLISCHALMR	20	160 @ 100'						
	Combined Pump Capacity		1,2	256		160				
MILLERTOWN[5]	#1	GORMAN RUPP	10	80 @ 62'					LOVES CREEK	
	#2	GORMAN RUPP	10	80 @ 62'						
	Combined Pump Capacity		1,2	128		80				
NATIONAL DRIVE[7]	#1	FLYGT	5	341 @ 22'					SWANPOND CREEK	
	#2	FLYGT	5	341 @ 22'						
	Combined Pump Capacity		1,2	545.6		341				
NEUBERT SPRINGS[8]	#1	FAIRBANKS	100	1850 @ 140'	1521				SOUTH KNOXVILLE/KNOB	
	#2	FAIRBANKS	100	1850 @ 140'	1535					
	#3	FAIRBANKS	100	1850 @ 140'	1265					
	Combined Pump Capacity		1,2		3060					
	Combined Pump Capacity		1,2,3		3524					
	Combined Pump Capacity		1,3		2228	2228	2993			no

Pump Station Capacity Spreadsheet

PUMP STATION	PUMP	MODEL	H/P	Design Capacity[1]	Revised Capacity (gpm)[2]	CAP Capacity (gpm)[3]	Peak WWF to PS (gpm)[4]	ADWF to PS (gpm)[5]	BASIN	Meets CAP Criteria[6]
PELHAM	#1	GORMAN RUPP	7.5	200 @ 53'					LOVES CREEK	
	#2	GORMAN RUPP	7.5	200 @ 53'						
	Combined Pump Capacity		1,2	320		200	26.5	6.6		yes
PILLEAUX	#1	WEMCO	15	170 @ 65'					SECOND CREEK	
	#2	WEMCO	15	170 @ 65'						
	Combined Pump Capacity		1,2	272		170	81	20		yes
POWER PARK	#1	YEOMANS	15	250 @ 85'					SOUTH KNOXVILLE/KNOB	
	#2	YEOMANS	15	250 @ 85'						
	Combined Pump Capacity		1,2	400		250	516.2			no
QUEENSBURY	#1	FLYGT	10	115 @ 67'					FOURTH CREEK	
	#2	FLYGT	10	115 @ 67'						
	Combined Pump Capacity		1,2	184		115	58	15		yes
RAILROAD[7]	#1	WEMCO	20	400 @ 62'					SWANPOND CREEK	
	#2	WEMCO	20	400 @ 62'						
	Combined Pump Capacity		1,2	640		400				
RIVERS RUN[7]	#1	GORMAN RUPP	15	200 @ 68'					SWANPOND CREEK	
	#2	GORMAN RUPP	15	200 @ 68'						
	Combined Pump Capacity		1,2	320		200				
ROLLING RIDGE[7]	#1	FAIRBANKS	25	125 @ 145'					THIRD CREEK	
	#2	FAIRBANKS	25	125 @ 145'						
	Combined Pump Capacity		1,2	200		125				

0001427

Pump Station Capacity Spreadsheet

PUMP STATION	PUMP	MODEL	H/P	Design Capacity[1]	Revised Capacity (gpm)[2]	CAP Capacity (gpm)[3]	Peak WWF to PS (gpm)[4]	ADWF to PS (gpm)[5]	BASIN	Meets CAP Criteria[6]
RUGGLES FERRY	#1	FAIRBANKS	20	350 @ 43'					LOVES CREEK	
	#2	FAIRBANKS	20	350 @ 43'						
	Combined Pump Capacity		1,2	560		350	654	164		no
SCHAAD ROAD[7]	#1	KSB	30	300 @ 140'					THIRD CREEK	
	#2	KSB	30	300 @ 140'						
	Combined Pump Capacity		1,2	480		300				
SCOTTISH PIKE	#1	ALLISCHALMR	7.5	100 @ 45'					SOUTH KNOXVILLE/KNOB	
	#2	ALLISCHALMR	7.5	100 @ 45'						
	Combined Pump Capacity		1,2	160		100	90	23		yes
SEARAY[7]	#1	PACIFIC	7.5	100					SWANPOND CREEK	
	#2	PACIFIC	7.5	100						
	Combined Pump Capacity		1,2	160		100				
SHIPETOWN	#1	GORMAN RUPP	30	320 @ 105'					EASTBRIDGE	
	#2	GORMAN RUPP	30	320 @ 105'						
	Combined Pump Capacity		1,2		590	440	438	110		yes
SMITHLAND[7]	#1	FAIRBANKS	5	120 @ 27'					SWANPOND CREEK	
	#2	FAIRBANKS	5	120 @ 27'						
	Combined Pump Capacity		1,2	192		120				
SOUTHSIDE	#1	WEMCO	20	60 @ 80'					SOUTH KNOXVILLE/KNOB	
	#2	WEMCO	20	60 @ 80'						
	Combined Pump Capacity		1,2	96		60	132.6	33.1		no

0001428

Pump Station Capacity Spreadsheet

PUMP STATION	PUMP	MODEL	H/P	Design Capacity[1]	Revised Capacity (gpm)[2]	CAP Capacity (gpm)[3]	Peak WWF to PS (gpm)[4]	ADWF to PS (gpm)[5]	BASIN	Meets CAP Criteria[6]
TEN MILE[8]	#1	WORTHINGTON	150	2200 @ 160'	1227 @ 157'				FOURTH CREEK	
	#2	WORTHINGTON	150	2200 @ 160'	1647 @ 162'					
	#3	YEOMANS	200	3300 @ 187'	2115 @ 162'					
	#4	YEOMANS	200	3300 @ 187'	2841 @ 162'					
	Combined Pump Capacity		1,2	2760.4	2760 @ 157'					
	Combined Pump Capacity		2,3	3712.8	3713 @ 162'					
	Combined Pump Capacity		3,4	4520	4520 @ 166'	3713	4520			no
THREE POINTS	#1	GORMAN RUPP	40	250 @ 161'					EASTBRIDGE	
	#2	GORMAN RUPP	40	250 @ 161						
	Combined Pump Capacity		1,2	400		250	66	16.5		yes
VESTAL	#1	HYDRA GRIND	5	45 @ 30'					SOUTH KNOXVILLE/KNOB	
	#2	HYDRA GRIND	5	45 @ 30'						
	Combined Pump Capacity		1,2	72		45	19	5		yes
WALKER SPRINGS[8]	#1	CORNELL	100	1650 @ 180'	2069				FOURTH CREEK	
	#2	CORNELL	100	1650 @ 180'	2083					
	#3	CORNELL	100	1650 @ 180'	2069					
	Combined Pump Capacity		1,2		2682					
	Combined Pump Capacity		2,3		2669					
	Combined Pump Capacity		1,3		2655					
	Combined Pump Capacity		1, 2, 3		2913					
	Combined Pump Capacity				2913	2655	3972			no
WAYLAND ROAD	#1	GORMAN RUPP	50	325 @ 95'					SWANPOND CREEK	
	#2	GORMAN RUPP	50	325 @ 95'						
	Combined Pump Capacity		1,2	520		325	401	100		no

Pump Station Capacity Spreadsheet

PUMP STATION	PUMP	MODEL	H/P	Design Capacity[1]	Revised Capacity (gpm)[2]	CAP Capacity (gpm)[3]	Peak WWF to PS (gpm)[4]	ADWF to PS (gpm)[5]	BASIN	Meets CAP Criteria[6]
WOODSON[8]	#1	CORNELL	60	800 @ 187'	811.7				SOUTH KNOXVILLE/KNOB	
	#2	CORNELL	60	800 @ 187'	811.7					
	Combined Pump Capacity		1,2		973.3	811.7	1005			no
WYNGATE	#1	GORMAN RUPP	10	180 @ 70'					FIRST CREEK	
	#2	GORMAN RUPP	10	180 @ 70'						
	Combined Pump Capacity		1,2	288		180	18.3	4.6		yes

1 Design capacity is the capacity of pump station when first installed as provided by KUB. The following assumptions were used to estimate combined capacity: the combined capacity of a two-pump station is 80% of the capacity of both pumps, the combined capacity of a three-pump station is 70% of the capacity of all three pumps, and the combined capacity of a four-pump station is 60% of the capacity of both pumps.

2 Revised capacity is the capacity determined from drawdown test information.

3 The CAP capacity is the capacity with the largest unit out of service. This is also commonly referred to as the firm capacity.

4 Peak WWF was determined for modeled pump stations as the peak hour flow for a 2-year 24-hour storm event. For non-modeled pump stations, peak flow was estimated to be four times the ADWF.

5 The ADWF from the subbasins flowing to a pump station was calculated from tables in the Phase 1 CAP/ER and/or the most recent flow monitoring data for each subbasin.

6 A blank indicates that the flows to the pump station are still being determined and therefore a conclusion cannot be made.

7 Average dry weather flow data was not available for this pump station. Flows are being determined.

8 Modeled pump station.

9 ADWF estimated from 2003 Draft Wastewater Collection System Facilities Master Plan Table 2-3.

10 Average dry weather flow is an estimate from March 2005 SCADA data. Further investigation is warranted before this pump station is deemed undersized.

Appendix C: Average Dry Weather Flow Estimates for Building Permit Applications

Type of Facility or Use	Design Dry Weather Flow Rate (Avg.) **
Single Family Residence	167 gpd
Two Family Residence	334 gpd
Apartment to a single family unit (up to 400 sq. ft.)	100 gpd
Motels with kitchenettes, apartments, townhouses, mobile homes, trailers, co-ops, etc. up to 600 sq. ft. of gross floor area	100 gpd/unit
Motels with kitchenettes, apartments, townhouses, mobile homes, trailers, co-ops, etc. up to 601 – 1200 sq. ft. of gross floor area	138 gpd/unit
Motels with kitchenettes, apartments, townhouses, mobile homes, trailers, co-ops, etc. greater than 1200 sq. ft. of gross floor area	175 gpd/unit
Motel unit less than 400 sq. ft.	100 gpd/unit *
Motel unit greater than 400 sq. ft.	150 gpd/unit *
Hospital (without laundry)	150 gpd/bed *
Hospital	300 gpd/bed *
University housing, rooming house, institutions	75 gpd/capita *
Cafeteria (integral to an office or industrial building)	2.50 gpd/capita *
Non-Medical Office space	0.06 gpd/sf gr. Floor area *
General Industrial Space	0.04 gpd/sf gr. Floor area *
Medical Arts (doctor, dentist, urgent care)	0.10 gpd/sf gr. Floor area *
Auditorium/Theater	5 gpd/seat *
Bowling alley, tennis court	100 gpd/crt – alley + food *
Nursing Home	150 gpd/bed *
Church	1.50 gpd/capita *
Restaurant (16 seat minimum or any size with dishwasher)	30 gpd/seat *
Restaurant (fast food)	20 gpd/seat *
Wet Store - Food processing	0.15 gpd/sf gr. Floor area *
Wet Store no food (barber shop, beauty salon, etc.)	0.10 gpd/sf gr. Floor area *
Dry Store (no process water discharge)	0.03 gpd/sf gr. Floor area *
Catering Hall	7.50 gpd/capita *
Market	0.05 gpd/sf gr. Floor area *
Bar, Tavern, Disco	15 gpd/occupant + food *
Bath House	5 gpd/occ + 5 gpd/shower *
Swimming Pool	20 gpd/capita *
Service Stations	300 gpd/double hose pump *
Shopping Centers	0.02 gpd/sf gr. Sales area *
Warehouse	0.02 gpd/sf gr. Area *
Laundry	425 gpd/laundry machine *
Schools, nursery and elementary	10 gpd/student *
Schools, high and middle	20 gpd/student *
Summer Camps	160 gpd/bed *
Spa, Country Club	0.30 gpd sf gr. Floor area *
Industrial Facility, Large Research Facility	"Determined by Authority of Water Utilities Director"
Others (car wash, etc.)	"Determined by Authority of Water Utilities Director"

*Source: City of Ann Arbor, Michigan and currently used to meet TDEC requirements.

Appendix D
Protocol for Pre-/Post-Rehabilitation Monitoring

The purpose of pre- and post-rehabilitation flow monitoring is to verify that the anticipated reductions in RDI/I associated with a rehabilitation project are being achieved. Initially, the reduction in peak wet weather flow will be based on an estimated reduction to an R-value of two percent. This is based on several studies and experience showing a fully rehabilitated system will not remove all I/I but should not let in more than two percent of rainfall that fell over the study area. The I/I model discussed in the Phase 1 CAP/ER is used to calculate the estimated peak flow from a 2-year, 24-hour storm event based on current R-values, as well as the estimated peak flow based on an R-value of 2 percent.

The procedure used to provide the pre- and post-rehabilitation flow monitoring analysis is briefly described below.

- Pre- and post-rehabilitation flow monitoring is conducted in the rehabilitated basin and a control basin.
- RDI/I flows are computed from all monitored areas by conducting the same analysis on the pre- and post-flow monitoring data.
- A linear regression analysis is then performed to compare the pre- and post-rehabilitation monitoring results.
- The reduction in both peak flow and volume of flow is determined. These reductions will be used to corroborate the estimated reductions in comprehensive rehabilitation areas.