West Jordan City Corporation
Public Works Department

Sanitary Sewer Model
&
Capital Facilities Plan

March 2003

J-U-B ENGINEERS, Inc.

J-U-B ENGINEERS, INC.
Engineers • Surveyors • Planners
466 North 900 West
Kaysville, Utah 84037
801/547-0393
Fax: 801/547-0397
www.jub.com

March 28, 2003

Mr. Roger Payne
Utility Manager, West Jordan City
8000 South Redwood Road
West Jordan, Utah 84088

RE: West Jordan City Sanitary Sewer Model and Capital Facilities Plan

Dear Roger:

We are pleased to submit to you the West Jordan City Sanitary Sewer Model and Capital Facilities Plan. This plan delineates several capital improvements that will likely be required during the next five to seven years in order to accommodate growth within the City. This plan also delineates long-range projects that may be necessary before build out. We have described these improvements in greater detail in the report.

Over a year ago, when we proposed on this project, we emphasized a collaborative approach to this work. It has been a pleasure to take this approach in creating the model and capital facilities plan. During this project we have had the opportunity to work several of the City staff. We have enjoyed all of these interactions. We are especially thankful to David Murphy, for his valuable contributions to this project. Dave provided much of the detailed information to make this project a success. We are also thankful to Drew Stevenson, for his coordination of survey information. Drew was responsive to our questions on survey data, and consistently followed up on our requests for detailed information from the field. This has indeed been a *collaborative* approach!

We have appreciated very much your own valuable input and direction during the creation of the model and capital facilities plan. We believe you will find this plan to be a valuable asset as the City of West Jordan grows in the coming years.

Sincerely,

J-U-B ENGINEERS, INC.

Paul E. Burnham, P.E.
Project Manager

West Jordan City Corporation

Table of Contents

EXECUTIVE SUMMARY

EXISTING SYSTEM SUMMARY

FUTURE SYSTEM SUMMARY

FUTURE RELIEF IMPROVEMENTS and CAPITAL IMPROVEMENT PLAN

1 - INTRODUCTION

2 - EXISTING SYSTEM EVALUATION

2-1 Introduction

2-2 Key Assumptions

2-3 Existing System Model Development

2-4 Calibration

2-5 Existing System Model Analysis

2-6 Conclusion of Existing System Evaluation

3 – CAPITAL FACILITIES PLAN & RELIEF ALTERNATIVES

3-1 Introduction

3-2 Key Assumptions

3-3 Master Plan Development

3-4 Master Plan Results and Relief Alternatives

3-5 Conclusion of Capital Facilities Plan and Relief Alternatives

4 – CAPACITY, MANAGEMENT, OPERATION, AND MAINTENANCE EVALUATION

4-1 What is the C.M.O.M. Program?

4-2 Capacity Assurance

4-3 Management

4-4 Operation & Maintenance

4-5 Recommendations

4-6 Conclusion of CMOM Evaluation

5 – CONCLUSIONS & RECOMMENDATIONS

Appendix A

Calibration

Flow Data

Appendix B

GIS Data

FIGURES

Figure ES-1 Existing Deficiency Projects (Red) Future Expansion Projects (Green)
Figure 2-1 Existing System Pipe Sizes
Figure 2-2 Existing System Calibrated to 2002 Population No Rain Event
Figure 2-3 Service Areas
Figure 2-4 Existing System with Rain Event
Figure 2-5 Existing System with 2010 Population with Rain Event
Figure 2-6 Existing System with 2030 Population with Rain Event
Figure 2-7 Future Improvements System with 2030 Population with Rain Event
Figure 2-8 Future Improvements System with 2030 Population with Rain Event, 90th S. Alternative
Figure 5-1 Future System Pipe Sizes
Figure A-1 Land Use Areas with G_ID Numbers (Refer to Appendix B)
Figure A-2 Land Use Areas within Service Areas

TABLES

Table E-1 Current and Projected Populations
Table E-2 Capital Facilities Costs
Table E-3 Extension Facilities Costs
Table 2-3 Diurnal Curves
Table 3-2 Design Slope Parameters
Table 3-4 Capital Facilities Cost Breakdown
Table 3-5 Extension Facilities Cost Breakdown

EXECUTIVE SUMMARY

A master plan is an essential element in the development of any community experiencing significant commercial or residential growth. With a master plan, a community has a tool to steer infrastructure improvements. This sanitary sewer master plan provides direction for future growth, and provides a plan for the construction of sewer improvements to serve the residents of West Jordan City.

West Jordan City (City) is currently experiencing a relatively high growth rate. The City retained J-U-B ENGINEERS, Inc. (J-U-B) to develop a sanitary sewer master plan that evaluates the capacity of the existing collection system and proposes collection system improvements to accommodate projected growth.

The goals of the master plan are listed below:

- Complete flow monitoring in key trunk lines to obtain baseline flows.
- Evaluate existing lines for current level of service and available capacity.
- Evaluate existing lines for reserve capacity at 2010 (capital facilities plan) and 2030 (build out) conditions, using the most recent projected populations from the analysis zones.
- Determine build out sizes and locations of new lines.
- Estimate approximate timeline for phasing relief alternatives and related capital improvement costs.

Computer models were used to evaluate the existing and future collection systems. The computer model includes lines that are considered to be trunk lines. These trunk lines are typically the larger lines running east and west, but also include some of the larger lines running north and south. The modeled trunk lines also include some eight-inch lines that carry flow from relatively large service areas. Refer to Section 2-1 for a detailed discussion on modeled lines. The model utilizes Global Positioning System (G.P.S.) survey data and flow line elevations collected by the City; two-foot contour information; record drawings; flow monitoring data collected by City and J-U-B personnel; and site observation. The existing system model was calibrated by correlating the metered flows with existing land use conditions and the current
population (2002).

EXISTING SYSTEM SUMMARY

In general, the results of the existing system evaluation indicate that most of the system is currently functioning well. However, a few sections of lines have reached or are approaching capacity. The area requiring improvements are highlighted in red on Figure ES-1 following this Executive Summary. The numbers on Figure ES-1 correspond to the projects listed on the same figure and in Table E-2.

Infiltration (ground water) and inflow (surface storm water) appear to be low to moderate across most of the system. However, infiltration appears be higher along 1300 West and Redwood Road. This area was given higher rates of infiltration during calibration of the existing system. Also, the CRS Infiltration Study, completed in 1992, indicates that these areas have a relatively high volume of infiltration. These volumes are discussed in KEY ASSUMPTIONS. Although the City may not eliminate all infiltration, the City should still be able to eliminate some infiltration through various methods of pipe rehabilitation.

Inflow (surface storm water) appears to be low to moderate across most of the system. During the monitoring period, the flow meters registered one significant storm event. This event contributed a relatively small amount of inflow to the system. This event and inflow volumes associated with it are discussed in KEY ASSUMPTIONS.

FUTURE SYSTEM SUMMARY

Build out lines are divided into two categories: those lines that will need to be constructed to serve currently undeveloped areas toward the west side (future lines), and those lines that will need to be constructed to relieve existing lines (relief lines). Build out lines were located to take advantage of existing system capacity. They were also located in proposed roads or section lines where rights-of-way and easements may more easily be acquired. Figure 5-1 shows proposed locations and sizes of future lines to serve the undeveloped areas.

The system has been modeled to simulate projected growth at specific times in the future. These projections occur at 2010 (capital facilities plan) and 2030 (assumed build out). The 2030 population for the area served by West Jordan sanitary sewers is 169,104 people, as projected in the traffic analysis zones. The table below shows the populations used throughout this sanitary sewer master plan. The traffic zone numbers are directly from the previous traffic study, while the sanitary sewer master plan numbers are from populating the land use areas within the sewer service areas.

Table E-1 Current and Projected Populations

	TRAFFIC ANALYSIS ZONES	SANITARY SEWER MASTER PLAN
2002 POPULATION	75,054	75,156
2010 POPULATION	104,211	104,255
2030 POPULATION	169,104	169,225

The existing system was subjected to future flows to determine which existing lines may need to be relieved. The 2030 system model identified the lines that will not

have the capacity to convey build out flows (bottlenecks). Once the bottlenecks were identified, then relief measures were developed by re-routing flows through existing diversions, increasing existing line sizes, or adding parallel lines. There are isolated areas where existing lines are at capacity or even slightly under capacity at 2030. The flows in these lines are close enough to capacity that they do not necessarily warrant replacement. However, significant increases to current land use densities could create too much flow for these lines. Also, extremely high impact uses, such as those found at Fairchild Semiconductor, OSI, or Dannon could also create capacity deficiencies in current lines. Typical residential, commercial, and industrial flows have been assumed throughout the City, and are discussed in KEY ASSUMPTIONS. Current land use densities do not create problems with the isolated areas that will be at or very near capacity in 2030.

FUTURE RELIEF IMPROVEMENTS and CAPITAL IMPROVEMENT PLAN

To accommodate future growth, relief improvements need to be constructed in portions of the existing system. Figure ES-1 shows the relief lines (highlighted in red) to be constructed to accommodate growth before 2010. Figure ES-1 also shows the extension lines to the west (highlighted in green), which will likely be required before 2030. The following is a list of the relief alternatives and estimated project costs for the recommended relief lines and the future extensions shown in Figure ES-1. A description of improvements and detailed probable costs is shown as the end of Section 3-4. The costs listed below are from the costs in Section 3-4.

Table E-2 Capital Facilities Costs

1.	7800 SOUTH RECONSTRUCTION	$ 1,102,000
2.	7000 SOUTH, REDWOOD ROAD TO 2200 WEST	$ 361,716
3.	7800 SOUTH, GRIZZLY WAY TO AIRPORT ROAD	$ 828,240
4.	9000 SOUTH RELIEF TO OLD BINGHAM HWY	$ 938,040
5.	OLD BINGHAM HWY, EAST OF BAGLEY PARK	$ 663,420
6.	1300 WEST, 8050 SOUTH TO 8420 SOUTH	$ 348,336
7.	GRIZZLY WAY, 7800 SOUTH TO 8200 SOUTH	$ 1,070,052
	TOTAL CAPITAL FACILITIES 2010	$ 5,311,804

Table E-3 Extension Facilities Costs

8.	AIRPORT CROSSING	$ 659,520
9.	7000 SOUTH EXTENSION	$ 2,144,040
10.	7400 SOUTH EXTENSION	$ 1,307,280
11.	8600 SOUTH/U-111 EXTENSION	$ 2,349,600
12.	NEW BINGHAM HWY EXTENSION	$ 2,636,760
13.	OLD BINGHAM HWY EXTENSION	$ 954,960
	TOTAL EXTENSION FACILITIES	$ 10,052,160

1 - INTRODUCTION

The West Jordan City sanitary sewer system currently serves areas that are experiencing rapid residential and commercial growth. As a result, West Jordan City needs to evaluate and improve sanitary sewer infrastructure to adequately accommodate this growth.

The City has chosen to take a proactive approach to handle the issues of evaluating sewer capacity in its existing system and planning for future growth in areas not yet served. As part of this proactive approach, the City retained J-U-B ENGINEERS, Inc. to study the existing system capacities and to propose the alignment and sizes of future trunk lines.

This report is divided into the following tasks:

- Evaluate the existing system (2002) to determine current capacity.
- Evaluate the build out system (2030) to size future lines and to determine status of existing sewers at build out conditions.
- Evaluate the Capital Improvement Plan system (2010) to delineate the improvements that may be necessary in the next 5 to 7 years, as part of an overall Capital Facilities Plan.
- Evaluate the current resources the City has for managing, maintaining, and operating the sanitary sewer system, for the purpose of making recommendations on how the City may meet the Environmental Protection Agency's Capacity, Management, Operation, and Maintenance (CMOM) Program requirements.

A central component of these tasks is the use of computer modeling software to simulate current and future sanitary sewer system capacity. The software and planning parameters (see KEY ASSUMPTIONS) used for this study are discussed in greater detail in the following sections.

By implementing the recommendations outlined in this master plan, West Jordan City will be better able to provide direction for future growth, and to provide adequate sanitary sewer service to the residents of the City. Future conditions have been created based on assumptions from the analysis zones (development patterns) and the draft future land use map (densities). Land use and other conditions may change and ultimately affect the master plan. The analysis and recommendations contained herein should be updated as necessary. This is especially true of the relatively undeveloped area on the west side of the City. This document should be used as a guide in providing for growth. The City should conduct an analysis during the detailed design of any sanitary sewer facilities to verify that growth is occurring according to the assumptions in this report.

2 - EXISTING SYSTEM EVALUATION

2-1 Introduction

The current system evaluation assesses the existing hydraulic conditions of the modeled trunk lines. Sanitary sewer lines were selected for modeling based on size and the amount of area they served. These modeled lines would be considered trunk lines since they carry flows from several smaller contributing lines. Smaller lines, or lines serving smaller areas were not modeled since the probability of those lines having sufficient capacity is very high. For example, an 8" line at minimum grade has sufficient capacity to serve 600 to 900 residential units, depending on the pipe location within the system. An 8" line serving less than 600 to 900 residential units will always have sufficient capacity, and may not need to be modeled. This does not completely rule out the need to model smaller lines, as was the case in West Jordan. A few sections of 8" line were modeled and even monitored for existing flows because these 8" sections served large areas. The existing lines that are evaluated in this report include the lines listed below and are shown on Figure 2-1.

- 7000 South
- 7300 South and 3200 West
- 7800 South
- 9000 South
- Sugar Factory Road
- Old Bingham Highway (West)
- Old Bingham Highway (East)
- New Bingham Highway
- Wheatcrest Drive (5290 West) and Grizzly Way (5100 West)
- Grizzly Way (5100 West)
- Airport Road (4500 West) and 7000 South
- 4800 West
- 4000 West
- Jordan Landing Area
- 2700 West
- 2700 West and 8600 South
- Redwood Road
- 1300 West and 8050 South

A computer model was developed to simulate the existing system using Pizer's Hydra® Version 6.1 sewer modeling software. Hydra® was chosen as the modeling software for this project for several reasons:

- A previous partial model was created with this software. Hydra® was selected in order to run and analyze the previous model.
- Hydra® software interfaces well with G.I.S. (Geographic Information Systems). Other modeling software uses G.I.S. information, but does not interface as well with the G.I.S. database. West Jordan City currently has land use and zoning information stored in a G.I.S. database. J-U-B Engineers used this existing information to create land use map for the model.
- The sanitary system map was drawn in AutoCAD. Hydra® is able to search for information in a Microsoft Access database, which has been created directly from the AutoCAD system map.
- The cost of Hydra® software is competitive with other modeling software. West Jordan City desired to purchase a copy of the modeling software, and Hydra® appeared to have all of the necessary functions that the City needed. As noted above, Hydra® interfaces well with AutoCAD, G.I.S. software, and Microsoft Access and Excel, all of which West Jordan is currently using.

Hydra® uses data from three sources:

The **first source** of information is from direct input into the Hydra® software. This includes flow line and manhole rim elevations, groundwater infiltration and storm water inflow volumes, and daily use patterns for residential and commercial contributors. The manhole rim and flow line elevations came from data collected by West Jordan staff, and were provided to J-U-B Engineers in the form of spreadsheet files. The spreadsheet files were imported to an AutoCAD drawing, where the individual manholes appear as points with rim elevation, flow line elevation, and northing and easting coordinates.

The **second source** of information comes from Microsoft Excel spreadsheets containing the data that generates sanitary sewer flows. This data includes land use densities, household densities, gallons per person per day (residential), gallons per acre per day (commercial and industrial) and the percent of developed land in each land use area.

(A further explanation of land use areas and service areas is appropriate at this point: Service areas define the regions that are served by a single line or that are injected in the model at a single point. Because service areas may contain more than one land use area, and because the land use areas are the mechanisms of populating the model, Hydra® uses information from individual land use areas rather than entire service areas. This allows the model to be built and examined on the basis of the percentage of current development against the total build out development within smaller, more definitive areas. Figure A-2, in Appendix B, shows the breakdown of land use areas within service areas.)

A spreadsheet was created for each scenario reviewed in this report, i.e., existing system with existing flows, existing system with 2010 and 2030 flows, and 2030

improved system with 2030 flows. These spreadsheets were then imported into a Microsoft Access database file, where Hydra® reads the information to run the model. These spreadsheets are found in Appendix B.

The **third source** of information comes from AutoCAD. The service area boundaries, the land use area boundaries, and the pipe geometry are drawn in AutoCAD. This information is linked to a Microsoft Access database file that Hydra® uses to develop the geometry of the system.

Once the model is built from the preceding information, the model is then calibrated to represent existing flow conditions. To aid in calibration of the model, West Jordan City crews and J-U-B personnel installed flow monitoring equipment in strategic locations. The South Valley Water Reclamation Facility also provided monitor information that was used for calibration.

These monitors were installed in August 2002, a period corresponding to seasonal high ground water. The monitor sites are identified in Figure 2-2. The monitoring results were graphed and are included in Appendix A. The size and shape of these graphs were used to calibrate the model. Further discussion of the hydrographs and model calibration is included in the following sections.

2-2 Key Assumptions

A computer model of a sewer system is based on assumptions that characterize the area and system components. The key assumptions used in the Existing System Model are as follows:

- Current and future land use densities were determined from the West Jordan Draft Land Use Map. The build out population was derived from the traffic analysis zones, provided by the City.

- For the current and future system analysis, the lines that belong to the Kearns Improvement District and the Taylorsville Bennion Improvement District have been omitted from this model. The population of the area served by these districts was included while calibrating to the current total population, but was not included in the flow calculations for West Jordan City sanitary sewer lines.

- Infiltration consists of groundwater that enters into the sewer system through open joint pipes, cracks in pipes, faulty service connections, leaky manhole joints and poor seals at the connections between pipes and manholes. The West Jordan Sanitary sewer system was divided into two categories of existing infiltration based on flow monitoring data and based on the previous infiltration study completed in 1992:

Low – 0 GPAD (gallons per acre per day)
Medium – 412 GPAD

The lines where low infiltration is applied tend to be the newer lines in the upper reaches of the system, or lines where the monitors showed low infiltration. The areas of medium infiltration tend to be older lines in 1300 West and Redwood Road.

- Inflow is surface storm water that enters into the sewer system through manhole covers and direct connections such as roof drains, foundation drains, and storm sewer connections which have not been identified and disconnected from the sanitary sewer. The storm event in August 2002 showed that on average the system receives 70 gallons per acre per day. The return period of this storm is unknown. This value does not correspond to a particular rainfall event, such as a 50 or 100-year rain event. This is due to the fact that the larger sources of inflow should be eliminated so that the sewer system does not act as a storm drain system.

- Each dwelling unit houses an average of 3.3 people, based on the traffic analysis zones. These zones use 3.24 to 3.30 people per household. In some of the very high density areas, we have assumed a lower people per household number, creating a citywide average between 3.24 and 3.30.

- The average wastewater flow per person per day was estimated to be 85 gallons per person per day for typical residential units. These values are based on flow monitoring results at West Jordan flow meters and at South Valley Water Reclamation Facility (SVWRF) meters, and typical domestic water use patterns in this region. The current model flows calibrated to within 5% on nearly all the meters, using 85 gallons per person per day. Six of the eight meter locations calibrated to between 1% and 5%. SVWRF #4 (7800 South) calibrated to within 7%. JUB #4 (Jordan Landing) calibrated to 15%, i.e., modeled flows were 15% higher than actual flows. This larger discrepancy may have occurred for various reasons – the current number of commercial contributors may be lower than calculated, the commercial contributors may be using less water than assumed, or the residential household densities may be lower in this area than those assumed for the rest of West Jordan City. This later scenario is likely. In any case, the departure between metered and modeled flows creates an additional factor of safety of 1.15 in the Jordan Landing area. This factor of safety is in addition to the factor of safety that is commonly applied through depth over diameter (DOD) values. For example, the 10” pipe in Jordan Landing has a 2030 modeled DOD value between 0.65 and 1.0, but may have a lower 2030 actual DOD value 15% less than those indicated in the model (0.55 and 0.85).

- Commercial, industrial, and mixed-use areas contribute approximately 800 gallons per acre per day (GPAD). The commercial and industrial areas that contribute to the 90th South trunk were given GPAD values of 850. Figure 2-3 shows the areas that drain to each of the four main sewer trunks within West Jordan City. This average flow was applied to areas where no other information was available. Where information was available on individual consumption, we used those numbers in the current model calibration. Those individual contributors included Fairchild Semiconductor, Dannon, OSI, Jordan Valley Hospital, Rivendell, National Guard, Sysco, and many of the very high density residential developments.

2-3 Existing System Model Development

The modeling software used for this model was Pizer's Hydra® Version 6.1, which interfaces with AutoCAD and ArcView GIS software. The model input consists of three layers: the system layer, the service area layer, and the land use layer.

System

The system layer contains a geometrical map of the sewer system and a database that holds information about the sewer system, such as pipe length, pipe diameter, infiltration, rim elevation, invert (flow line) elevation, and diversion location and geometry. All of this information is contained in the City's copy of the Hydra® model. The rim and invert elevations were collected with a G.P.S. rover unit and a measuring rod, by West Jordan City personnel. The sizes of the lines were taken from record drawings, existing West Jordan City sanitary sewer base maps, and were field verified as needed.

Area topography was taken from 2-foot contour information provided by West Jordan City.

Service Areas

Flow is routed into the system through the service area layer. The service areas were determined based on the current layout of the sewer system and area topography. All of the flow contributed by a service area is injected into the sewer line or the manhole indicated in the service area database. This database contains information imported from the Excel spreadsheets shown in the Appendix B. Because the service area layer injects all of the flows from a specific service area at a particular point, the tabulated model results indicates zero flow for some lines. These lines appear on the west side of the City. This should not be interpreted to mean there is no flow in the actual lines upstream of the injection points.

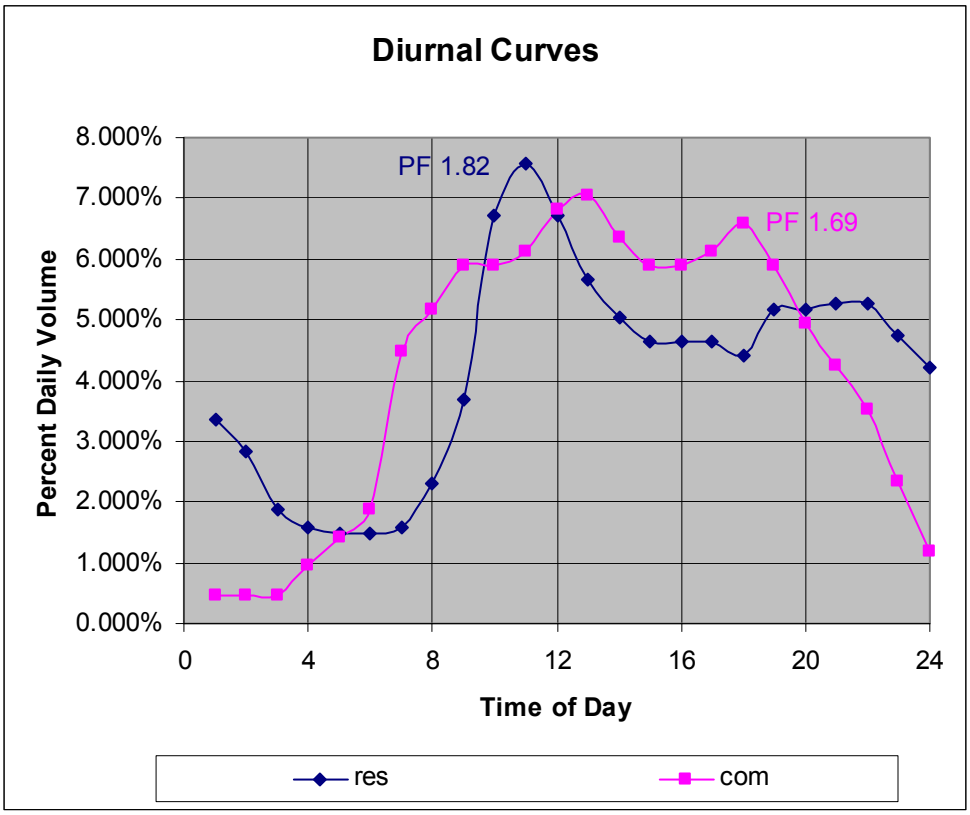
Land Use Areas

The land use layer generates the flows. It contains the flow generating information such as population, contribution per capita, commercial and

industrial contribution, and daily use patterns (diurnal curves). Inflow and infiltration are attributed to specific lines in the system layer. The land use information is derived from the West Jordan City Draft Land use Map. These land use divisions are shown on Figure A-1 and Figure A-2, in Appendix B.

Sewer flows vary differently throughout the day with each land use type. The shapes that are formed as a result of graphing land use flows verses the time of day are known as diurnal hydrographs or diurnal curves. The diurnal curves shown in Table 2-3 below were derived from flow monitoring at the locations shown on Figure 2-2. These diurnal curves are consistent with empirical data from the monitoring information (Appendix A and Figure 2-2), and were inserted into the land use layer in this model.

Table 2-3 Diurnal Curves



The unit diurnal curve allows the Hydra® software to quantify the flow throughout the day for the various types of land use. For example, residential diurnal curves tend to have two peaks throughout the day, 1) mid-morning, and 2) later in the evening. These peaks are due to similar lifestyles. Most people wake up and begin to use water by taking showers and preparing breakfast in preparation for work, school, or church at approximately the same time. As these morning flows are combined, the first and highest peak is formed. The second and lower peak occurs

in the evening when most people come home and prepare dinner. The second peak is lower, broader, and less pronounced because people tend to prepare dinner and use water at more varied times throughout the evening. The curves in Table 2-3 represent weekend flows. The commercial/industrial curve has similar trends to the residential curve, but differs significantly in the sharpness of the peak flows; the commercial curve remains as broad peaks throughout the working hours of the day. The commercial and industrial entities also tend to generate relatively small mid-morning or evening flows, compared to the higher residential flows at these same times.

The modeled sewer lines convey flow from all types of land use and, therefore, represent a combination of the above-described diurnal curves. As seen in the actual flow monitoring graphs in Appendix A, the residential flows tend to dominate the shape for the areas monitored. The information from monitor JUB #3 (in Appendix A and Figure 2-2) is a good representation of an isolated residential area.

The peaking factors designated with a PF, and ranging from 1.69 to 1.82 on the above graph, are ratios of peak hourly flow divided by average daily flow. The metered and modeled peaking factors are consistent with typical peaking factors for cities with similar populations (See Linsley, Franzini, Freyberg, Tchobanoglous. *Water-Resources Engineering*, fourth edition, p. 663).

2-4 Calibration

The existing system model was calibrated to simulate measured existing flow conditions. These conditions were determined by measuring flows at eight trunk line locations during August 2002. Flow monitoring locations are shown on Figure 2-2, and the results can be found in Appendix A. West Jordan City used the Marsh-McBirney Flo-Dar System to monitor flows in selected lines. This equipment provided continuous 24-hour monitoring over a period of two weeks at each site. The monitors were installed for two weeks in order to pick up two weekends. Weekend peak flows tend to be higher than weekday peak flows.

It should be noted that weekend flow monitoring does not correspond with school enrollment numbers. Therefore, the model was run without flows from schools. All other types of contributors (residential, commercial, industrial, mixed-use) have been included in the total model flows. As seen in Appendix A, West Jordan sanitary sewer lines generally have higher weekend flows than weekday flows. Therefore, the model was calibrated to the weekend flows.

The time of day that the peak flows occur varies depending on location in the system. The lines in the western reaches of the system tend to have earlier peak flows than the lines closer to the outfalls below 1300 West. This is due to the time it takes for flows to travel down the system, with flows from several upper system lines combining into one lower line. Also, the peak flows tend to occur at different

times from a weekday to a weekend. For example, at Site JUB #3, weekday peak flows tend to occur around 8:00 a.m. to 9:00 a.m., whereas weekend peak flows tend to occur around 11:00 a.m. to 12:00 p.m. During the week, many people prepare for work and school early in the morning, while weekends are structured around religious services and leisurely activities.

Calibration involved superimposing the graphs of the monitored flow over the model-generated diurnal curves. Then the model parameters (contribution per capita, contribution per acre of commercial and industrial areas, infiltration) were adjusted to match field conditions. During the calibration process, the land use parameters of the model were adjusted globally, which fine-tuned the model to simulate the measured flows. For instance, the residential diurnal curve was modified globally so that all of the land use areas with residential flows would take the same shape. As a result, the model curve took a shape that more closely reflected field conditions. In some cases, where commercial volumes for individual users were available, the contribution per acre was modified on an individual basis. These commercial users included Fairchild Semiconductor, Dannon, OSI, Jordan Valley Hospital, Rivendell, National Guard, and Sysco. Appendix A contains comparison charts for each flow-monitoring site showing modeled flows verses actual field measured flows. As seen in the graphs, the model calibrated closely with the monitoring sites.

The flow monitoring information was also used to determine the location and volume of infiltration occurring in the system. The system was divided into the two categories of infiltration mentioned previously in Key Assumptions. A detailed study of groundwater infiltration is beyond the scope of this report; the results from flow monitoring were generally consistent with the locations and volumes indicated in the 1992 infiltration study.

2-5 Existing System Model Analysis

Once the model was calibrated, it was adjusted to account for inflow in the system from precipitation. The inflow was added to the entire system in the amounts described in Key Assumptions.

This adjustment developed the existing system model. The existing system model simulates flows on a weekend, during seasonal high groundwater periods, with a rainfall event. We recommend that the City periodically monitor sanitary sewer flows to identify the possible sources of inflow, and then implement a plan to eliminate the identified sources.

Figure 2-4 shows the modeled sewer lines under current conditions, with a rain event. Figure 2-5 shows the current system at 2010 populations, with a rain event. Figure 2-6 shows the current system at 2030 populations, with a rain event.

From the model, and from field observations, the lines listed below are at capacity or do not have sufficient capacity at this time.

- 7800 South, 1300 West to 3600 West
- 7000 South, 1300 West to 2200 West

Other lines in the system will be near or at capacity before 2010. These are listed below.

- Grizzly Way (5100 West), 7800 South to 8100 South
- 7800 South, Grizzly Way (5100 West) to Airport Road
- Old Bingham Highway 5600 West, East of Bagley Park Road
- 1300 West, 8050 South to 8420 South (Slip Line Project)
- 9000 South Relief Extension to Old Bingham Highway (Future Extension)

The last line listed above (9000 South Relief) is not an existing line. This line should be constructed to relieve the 4000 West line if extremely large flows are generated from the Bagley Industrial Park, or other areas that would contribute to the 4000 West line. The 9000 South Relief could extend to 4800 West to relive the 4800 West Line and the 4000 West lines if land use densities change drastically to the west (Bagley Industrial Park, Old Bingham Highway area). The model does not indicate that any of the 9000 South Relief Line is necessary. However, as mentioned previously, if land use densities increased dramatically or if extremely large wastewater contributors developed in the Bagley Park area, this relief line would allow some of these flows to be diverted to 9000 South instead of up 4800 and 4000 West. Figure 2-7 shows the condition of the lines if the extension is taken only to Old Bingham Highway. Figure 2-8 shows the condition of the lines if the extension is taken to 4800 West. The existing lines in 9000 South, to the east of Old Bingham Highway, will have sufficient capacity at build out to carry approximately 70% of all flows from the Bagley Park area. Figure 2-3 shows the area that could be diverted to 4800 West, 4000 West, or 9000 South. Figures 2-4, 2-5, 2-6 show depth of flow over diameter for the existing model, 2010 model, and 2030 model, respectively. The depth of flow over diameter of pipe (DOD) is a typical measure of how a sewer is accommodating existing flows. Figure ES-1 shows the lines that will need to be improved before 2010 (in red), as well as the lines that will be constructed with the western expansion (in green).

2-6 Conclusion of Existing System Evaluation

Results of the existing system evaluation indicate that the most of the lines have capacity to handle the existing flows with a moderate rainfall event and they have some reserve capacity for growth.

Figure 2-4 shows the ratio of depth of flow over the diameter of the pipe (DOD) for the existing lines. The ratio of depth of flow over diameter of pipe is a typical

indicator of sewer pipe capacity. A full pipe would have a DOD value of 1.0, and would have no reserve capacity. While a pipe flowing half full would have a DOD value of 0.5, and would have some reserve capacity.

As shown in Figure 2-4, a few sections of lines have a DOD value of greater than 0.5. Larger lines are able to handle more flows than are smaller lines, at equivalent DOD values, i.e., the larger lines have more reserve capacity per increment of DOD value. Typically, trunk lines from 18" to 30" are designed for an allowable DOD value of 0.75. Smaller lines may require a DOD value as low as 0.50, while larger trunk lines (36" and larger) may have an allowable DOD of 0.80 and greater. Table 3-2 shows allowable DOD design values for all line sizes within the West Jordan City system.

With the exception of a few isolated segments, all trunk lines have a current DOD value of less than 0.65. This indicates a well functioning system, with sufficient capacity for current flows. The lines that currently require relief are shown in Figure 2-4. The lines that will require relief prior to 2010 (capital facilities model) or 2030 (build out model) are shown in Figure ES-1, highlighted in red and green, respectively.

The City has scheduled to complete the 7800 South Reconstruction Project (1300 West to 3600 West) during the 2003/2004 fiscal year. Once this project is complete, it is recommended that the City complete the 7000 South project as soon as possible. The 7800 South and Grizzly Way projects do not need to be completed immediately. However, these projects should be completed while construction is still occurring in this area, or while any road reconstruction may be occurring in the area. Other areas to review are the isolated lines where a reverse grade may exist. These were listed previously in FUTURE RELIEF IMPROVEMENTS and CAPITAL IMPROVEMENT PLAN.

In order to increase the reserve capacity for sanitary flows, it is recommended that the City identify sources of infiltration within the trunk lines in high ground water areas, particularly in the lines along 1300 West and Redwood Road. It is also recommended that the City identify sources of inflow, such as low-lying manholes and storm and roof drain connections, through smoke testing or video taping with a remote sewer camera.

The City should also begin to budget and plan for the proposed relief lines for the Capital Facilities plan, and to take advantage of concurrent road replacement or repair projects.

This section has addressed the current system, and current necessary improvements. The next section will address the build out system, and which projects may need to be completed in the next 5 to 7 years (2010 Capital Facilities Plan).

3 – CAPITAL FACILITIES PLAN & RELIEF ALTERNATIVES

3-1 Introduction

The master-planning portion of the study involves creating a conceptual layout of the future sewer trunk system to serve (currently) undeveloped portions of West Jordan City. The master plan study area covers approximately 32 square miles.

A master plan model was utilized as a tool for sizing future trunk lines (lines that will be extended to the western portion of the City), and for sizing relief lines (lines that will be constructed to relieve or replace existing lines). The results of the master plan model identify conceptual alignments and required line sizes to accommodate future conditions within the City boundary.

3-2 Key Assumptions

The following is a list of key assumptions and flow parameters used in the master plan, many of which are consistent with the development of the existing model described in the previous section:

- The inflow rates, in gallons per acre per day (GDAD), have been applied to the 2010 and 2030 models to reflect medium inflow throughout the entire system. The **inflow** (surface storm water) volumes were assumed to be as follows:

  Low – 0 GPAD
  Medium – 70 GPAD (this volume was assumed over the entire system)

  The **infiltration** (groundwater) rates were assumed to be as follows:

  Low – 0 GPAD
  Medium – 412 GPAD (assumed at along 1300 West and Redwood Road)

  The infiltration rates used in the 2010 and 2030 models are the same as the current model, but have been removed from the area along 1300 West, discussed previously. This assumes that improvements will be made to the line in 1300 West. Infiltration improvements (slip lining and similar improvements) in other areas along 1300 West and Redwood Road will likely occur before 2010 and 2030. The model should be updated to reflect those improvements, when those improvements are completed.

- Currently undeveloped areas were assumed to ultimately develop as shown in Figure A-1 and in Appendix B (Refer to Figure A-1 and Appendix B for Land Use Identification Number (G_ID) location).

- All land areas were assumed to be at build out or fully developed conditions in 2030. The traffic analysis zones show all but a few areas as being 100 percent built out. For the purpose of creating a built out sanitary sewer model, the City is shown as 100 percent built out in 2030.

- Each dwelling unit houses an average of 3.3 people, based on the traffic analysis zones, calibrated to the current population.

- The average weekend sanitary flow per person was estimated at 85 gallons per capita per day (GPCD) for future development areas, which is consistent with monitoring data used in the existing model.

- Future commercial and industrial areas were assumed to contribute an average weekend flow of 800 gallons per acre per day. This flow value is based on the assumption that most new businesses will be retail establishments, restaurants, and light industrial contributors, and will be open evenings and weekends.

- Master plan trunk lines will be limited by the following sizing parameters in Table 3-2:

Table 3-2 Design Slope Parameters

D diam (in)	d/D Maximum Allowed depth/diam	Minimum Pipe Slope [1]
8	0.50	0.40%
10	0.55	0.28%
12	0.60	0.22%
15	0.65	0.15%
18	0.75	0.12%
21	0.75	0.10%
24	0.75	0.10%
27	0.75	0.10%
30	0.75	0.10%
36	0.80	0.10%

[1] Ten State Standards allows for pipe slopes less than 0.10% (S=0.0010). However, practical construction tolerances do not warrant lesser slopes.

3-3 Master Plan Development

System

The master plan system was laid out to take advantage of the natural slope of the land and low-lying areas. The final decision on sewer service to these areas will be determined by West Jordan City policy and land development activity. For the purpose of the master plan, the entire area of West Jordan City was assumed to be

served at build out conditions, with the exception of defined open space areas and areas served by the Kearns Improvement District.

The routes of the master plan lines may be slightly altered without affecting service depths or reducing pipe capacities. A "meander" factor is built into the system layout, which permits line length to be increased between modeled manholes, while maintaining design slopes. This factor is applied to the future expansion lines by adding additional drop in the model manholes, which are spaced at intervals of approximately 660 feet. (Capital cost estimates are based on manhole spacing of 350 feet.) Model manholes have a drop of 0.6 feet, which provides additional drop if a future line diverges from locations in the model. These manhole drops were not applied to the relief lines, as these lines will likely follow the slopes of the existing pipes.

Large deviations from the master plan may affect line capacity and serviceability of some areas. The effects of changing the master plan should be thoroughly studied before allowing significant deviations.

For relatively flat areas of the City (lines running north and south), minimum design slopes listed above were used for sizing the master plan lines. However, in most areas of the City the existing grade is greater than the minimum required pipe slopes. In these areas, the master plan lines were modeled to maintain a minimum depth of 10 feet below the surface. The lines run deeper in some areas, namely, as the 8600 South line turns onto U-111, and where the 7000 South line runs through some of the hills and knolls to the west. In these areas, the lines may be as deep at eighteen feet for short sections, depending on how the future roads are graded.

Service Areas

The service areas were delineated based on natural and land use boundaries. The service areas divide the study area into parcels that drain naturally to the trunk lines.

One aspect of the modeling software is that the service area layer injects all of the flows generated within that service area into the system at a particular point. This is not an exact representation of how flows are injected into the system. In an actual system, the flows are generated by individual households or commercial entities and routed through 8" collector lines that eventually tie into a trunk line at various points. As a result of this software constraint, design pipes serving large service areas may be prematurely upsized when a smaller interceptor may have the capacity to serve the upper reaches of the service area. As flows are added downstream, the line must be upsized in accordance with the master plan model as needed to allow for additional flow. It is recommended that this shortfall in the software be considered during the detail design of trunk lines.

Land Use Areas
The land use areas of the existing system were made 100 percent active, i.e., the current undeveloped areas were assumed to be completely developed. Other parameters, such as the diurnal curves, remained the same as in the existing system. The numbers shown in land use areas correspond to the Land Use Identification number (G_ID) in the Land Use Database in Appendix B, and on Figure A-1.

3-4 Master Plan Results and Relief Alternatives

There are three isolated areas in the system where the flow line depth information appears to be incorrect, or where there actually may be a reverse grade in the line. These are listed below:

2700 West 7900 South - This 15" line appears to contain a flat section for 160'. At build out conditions, this line produces a d/D of approximately 1.0. We recommend further investigation into the geometry of this line.

4000 West 8600 South - This 12" line appears to contain a reverse grade for 23'. At build out conditions, this line produces a d/D of approximately 1.0. We recommend further investigation into the geometry of this line.

4800 West 8340 South - This 15" line appears to contain a reverse grade for 31'. At build out conditions, this line is surcharged and creates a substantial backwater in the first upstream pipe (from geometry information provided by the City, and used in the model). We recommend further investigation into the geometry of this line.

These lines should be reviewed further to determine if the grades are indeed reversed, or if the flow line elevation simply needs to be correctly measured.

The master plan model indicates several existing lines will not have capacity at build-out conditions without the implementation of relief lines. As illustrated in Figure 2-6, the majority of the lines that are projected to need relief are located on the west side of the City.

The methodology used in developing the 2010 relief lines consisted of applying the projected population for 2010 to the existing system. Figure 2-5 shows the capacity of the system at 2010. Generally, where relief lines are proposed, they have been sized to *replace* the existing lines, rather than run parallel to existing lines. The exception to this general trend is 7000 South, where a new 15" line is currently scheduled to run parallel to the existing 12" line. The lines that will need relief within a 5 to 7 year period (2010) are described below and are highlighted in red in Figure ES-1. The descriptions below are of the capital facilities that may be required in these locations.

7800 South, 1300 West to 3600 West – This reconstruction project is currently scheduled for completion in the 2003/2004 fiscal year. The majority of the existing line in this reconstruction project is 12" pipe. This will be replaced with a 15" pipe. For modeling purposes this line was shown as 15" in the current and future models. The costs associated with this project are taken from the City's 7-Year Implementation Plan. The total estimated cost is $1,102,000.

7000 South, Redwood Road West to 2200 West – The 12" line is currently surcharged from 1800 West to 1300 West. A design was completed in 1997 to construct a relief line in this area. The proposed relief line connects to the existing 15" line at 1800 West. This proposed line continues to 2200 West, where it will receive nearly all flows from above 2200 West. The new 15" relief line will have the capacity to carry nearly all flows above 2200 West, and should be constructed with a diversion at 2200 West to divert flows from both lines above 2200 West. Once this line is constructed, the lines that are currently surcharged between Redwood Road and 1300 West will have sufficient capacity. The proposed line has been included in the 2010 and 2030 models. The total estimated cost is $362,000.

7800 South, Grizzly Way (5100 West) to Airport Road – This 15" line currently has sufficient capacity, and will have sufficient capacity at 2010. However, it will be severely surcharged at build out. This line, or combined lines, will need to have the capacity of a 21" line at current grades. While this line will have sufficient capacity at 2010, proposed road construction in this area warrants this project to be completed before 2010, concurrent with the road expansion. The total estimated cost is $828,000.

9000 South Relief Extension to Old Bingham Highway and 4800 West – The lines that this extension would relieve appear to have sufficient capacity at 2010 and 2030. However, if land use densities or water uses increased dramatically in the southwest portion of the City, creating much larger flows that expected, this line would have capacity to relieve the Old Bingham Highway line and the 4000 West Line. This line extension could be constructed at any time before 2030. Any road construction or road rehabilitation in this area would warrant completing this project before 2010. The total estimated cost is $938,000.

Old Bingham Highway, East of Bagley Park Road - This 12" line currently has sufficient capacity, and will have sufficient capacity at 2010. This line will be slightly surcharged at build out. The amount of surcharging will be low. The 12" line will need to be replaced with a 15" line. This line could be improved at any time before 2030. Any road construction or road reconstruction in this area would warrant completing this project before 2010. The total estimated cost is $664,000.

1300 West, 8050 South to 8420 South - This 10" line will be nearly surcharged at build out. The amount of surcharging will be low. This line could be improved at any time before 2030. High groundwater infiltration in this line has decreased this line's capacity to carry sanitary sewer flows. Although the line has sufficient capacity at 2030, the City should consider slip lining 6520' of this line to eliminate infiltration. This would reduce overall flows in this line, and flows at the South Valley Water Reclamation Facility. This line appears to have the most infiltration in this area. Other areas along 1300 West and along Redwood Road are also candidates for slip lining projects. A groundwater report was completed in 1992, and could be used for a guide in determining which lines need to be improved. The total estimated cost for slip lining and reconnecting existing services along the 1300 West section is $349,000.

Grizzly Way (5100 West), 7800 South to 8200 South - These 10" and 12" lines currently have sufficient capacity, but will not have sufficient capacity at 2010. These lines will need to be replaced with 15" and 18" lines. From a capacity standpoint, these lines could be improved closer to 2010. However, these lines should be improved with any road construction that may occur in this area before 2010. The total estimated cost is $1,070,000.

Table 3-4 Capital Facilities Cost Breakdown

	7800 SOUTH, 1700 WEST TO 2700 WEST	Unit	Qty	Unit Cost	Amount
1a.	CURRENTLY PROPOSED RECONSTRUCTION PROJECT				
	TOTAL				**$ 517,000**

	7800 SOUTH, 1300 WEST TO 1700 WEST	Unit	Qty	Unit Cost	Amount
1b.	CURRENTLY PROPOSED RECONSTRUCTION PROJECT				
	TOTAL				**$ 260,000**

	7800 SOUTH, 2700 WEST TO 3600 WEST	Unit	Qty	Unit Cost	Amount
1c.	CURRENTLY PROPOSED RECONSTRUCTION PROJECT				
	TOTAL				**$ 325,000**

	7000 SOUTH, REDWOOD ROAD TO 2200 WEST	Unit	Qty	Unit Cost	Amount
2.	15" PVC	LF	1990	$ 137.00	$ 272,630.00
	60" DIA. MANHOLE	EA	6	$ 4,800.00	$ 28,800.00
	ENGINEERING & CONTIGENCIES (20%)				$ 60,286.00
	TOTAL				**$ 361,716**

3.

7800 SOUTH, GRIZZLY WAY TO AIRPORT ROAD	Unit	Qty	Unit Cost	Amount
21" PVC	LF	4300	$ 146.00	$ 627,800.00
60" DIA. MANHOLE	EA	13	$ 4,800.00	$ 62,400.00
ENGINEERING & CONTIGENCIES (20%)				$ 138,040.00
TOTAL				**$ 828,240**

4.

9000 SOUTH RELIEF TO OLD BINGHAM HWY	Unit	Qty	Unit Cost	Amount
12" PVC	LF	5300	$ 133.00	$ 704,900.00
60" DIA. MANHOLE	EA	16	$ 4,800.00	$ 76,800.00
ENGINEERING & CONTIGENCIES (20%)				$ 156,340.00
TOTAL				**$ 938,040**

5.

OLD BINGHAM HWY, EAST OF BAGLEY PARK	Unit	Qty	Unit Cost	Amount
15" PVC	LF	3650	$ 137.00	$ 500,050.00
60" DIA. MANHOLE	EA	11	$ 4,800.00	$ 52,800.00
ENGINEERING & CONTIGENCIES (20%)				$ 110,570.00
TOTAL				**$ 663,420**

6.

1300 WEST, 8050 SOUTH TO 8420 SOUTH	Unit	Qty	Unit Cost	Amount
10" PVC SLIP LINE	LF	6520	$ 39.00	$ 254,280.00
60" DIA. MANHOLE REHABILITATION	EA	18	$ 2,000.00	$ 36,000.00
ENGINEERING & CONTIGENCIES (20%)				$ 58,056.00
TOTAL				**$ 348,336**

7.

GRIZZLY WAY, 7800 SOUTH TO 8200 SOUTH	Unit	Qty	Unit Cost	Amount
18" PVC	LF	2280	$ 142.00	$ 323,760.00
15" PVC	LF	3550	$ 137.00	$ 486,350.00
60" DIA. MANHOLE	EA	17	$ 4,800.00	$ 81,600.00
ENGINEERING & CONTIGENCIES (20%)				$ 178,342.00
TOTAL				**$ 1,070,052**

TOTAL CAPITAL FACILITIES 2010 $ 5,311,804

The previous descriptions were for relief lines that will need to be built within the existing system. The descriptions below are for future lines that will need to be constructed in the western portion of the City. These future lines will need to be constructed as development generates flows in currently undeveloped areas. The schedule for these future lines may be dependant on City policy regarding utility cost-sharing, as well as on developmental pressures in these areas.

Airport Crossing – This 8” line will serve the area at the north end of the airport. This line was not modeled, but will likely be an 8” line. The downstream line that this proposed line connects to is also an 8” line. The total estimated cost is $660,000.

7000 South Extension – This 12” and 10” line will mostly serve a small area on the south side of 7000 South. This project is divided into two phases, 9a and 9b, as shown on Figure ES-1. As growth occurs in the western reaches of 7000 South, the City will need to evaluate when to construct various portions of these phases. The total estimated cost for both phases is $2,144,000.

7400 South Extension – This 12” and 10” line will serve an area west of 5600 West. As growth occurs in this area, the City will need to review the specific location of this line, and the specific point at which the line transitions from 12” to 10”. The total estimated cost is $1,307,000.

8600 South/U-111 Extension – This line will be 15”, 12” and 10”, and will mostly serve the area to the south of 8600 South and to the west of U-111. This project is divided into two phases, 11a and 11b, as shown on Figure ES-1. The total estimated cost for both phases is $2,350,000.

New Bingham Highway Extension – This 15” and 12” line will extend along the New Bingham Highway just past U-111. The 10” line will branch at 9000 South, as shown on Figure ES-1. The area has sufficient slope to allow this line to take various routes, depending on the configuration of proposed roadway alignments. The current alignment, along the New Bingham Highway, 9400 South, and U-111, reflects one possible route for this line. This project has been divided into two phases to anticipate gradual growth in the south west area of the City. The total estimated cost for both phases is $2,637,000.

Old Bingham Highway Extension – This 10” line will extend past Bagley Industrial Park, to the City limits, and will cross the railroad. The total estimated cost is $955,000.

Table 3-5 Extension Facilities Cost Breakdown

8.

AIRPORT CROSSING	Unit	Qty	Unit Cost	Amount
8" PVC	LF	4000	$ 123.00	$ 492,000.00
60" DIA. MANHOLE	EA	12	$ 4,800.00	$ 57,600.00
ENGINEERING & CONTIGENCIES (20%)				$ 109,920.00
TOTAL				**$ 659,520**

9a.

7000 SOUTH EXTENSION	Unit	Qty	Unit Cost	Amount
12" PVC	LF	6100	$ 133.00	$ 811,300.00
60" DIA. MANHOLE	EA	18	$ 4,800.00	$ 86,400.00
ENGINEERING & CONTIGENCIES (20%)				$ 179,540.00
TOTAL				**$ 1,077,240**

9b.

7000 SOUTH EXTENSION	Unit	Qty	Unit Cost	Amount
12" PVC	LF	3200	$ 133.00	$ 425,600.00
10" PVC	LF	2900	$ 130.00	$ 377,000.00
60" DIA. MANHOLE	EA	18	$ 4,800.00	$ 86,400.00
ENGINEERING & CONTIGENCIES (20%)				$ 177,800.00
TOTAL				**$ 1,066,800**

10.

7400 SOUTH EXTENSION	Unit	Qty	Unit Cost	Amount
12" PVC	LF	2640	$ 133.00	$ 351,120.00
10" PVC	LF	5280	$ 130.00	$ 686,400.00
60" DIA. MANHOLE	EA	23	$ 4,800.00	$ 110,400.00
ENGINEERING & CONTIGENCIES (20%)				$ 159,360.00
TOTAL				**$ 1,307,280**

11a.

8600 SOUTH/U-111 EXTENSION	Unit	Qty	Unit Cost	Amount
15" PVC	LF	6240	$ 137.00	$ 854,880.00
60" DIA. MANHOLE	EA	18	$ 4,800.00	$ 86,400.00
ENGINEERING & CONTIGENCIES (20%)				$ 188,256.00
TOTAL				**$ 1,129,536**

11b.

8600 SOUTH/U-111 EXTENSION	Unit	Qty	Unit Cost	Amount
15" PVC	LF	2100	$ 137.00	$ 287,700.00
12" PVC	LF	3440	$ 133.00	$ 457,520.00
10" PVC	LF	1350	$ 130.00	$ 175,500.00
60" DIA. MANHOLE	EA	20	$ 4,800.00	$ 96,000.00
ENGINEERING & CONTIGENCIES (20%)				$ 203,344.00
TOTAL				**$ 1,220,064**

12a.

NEW BINGHAM HWY EXTENSION	Unit	Qty	Unit Cost	Amount
15" PVC	LF	7200	$ 137.00	$ 986,400.00
10" PVC	LF	2100	$ 130.00	$ 273,000.00
60" DIA. MANHOLE	EA	27	$ 4,800.00	$ 129,600.00
ENGINEERING & CONTIGENCIES (20%)				$ 277,800.00
TOTAL				**$ 1,666,800**

12b.

NEW BINGHAM HWY EXTENSION	Unit	Qty	Unit Cost	Amount
12" PVC	LF	5500	$ 133.00	$ 731,500.00
60" DIA. MANHOLE	EA	16	$ 4,800.00	$ 76,800.00
ENGINEERING & CONTIGENCIES (20%)				$ 161,660.00
TOTAL				**$ 969,960**

13.

OLD BINGHAM HWY EXTENSION	Unit	Qty	Unit Cost	Amount
10" PVC	LF	5300	$ 130.00	$ 689,000.00
60" DIA. MANHOLE	EA	16	$ 4,800.00	$ 76,800.00
RAILROAD CROSSING (BORE & JACK CASING)	LS	1	$ 30,000.00	$ 30,000.00
ENGINEERING & CONTIGENCIES (20%)				$ 159,160.00
TOTAL				**$ 954,960**

TOTAL EXTENSION FACILITIES $ 10,052,160

3-5 Conclusion of Capital Facilities Plan and Relief Alternatives

For the City to serve the entire area encompassed by the current boundaries, several improvements will be required in the way of relief measures and future lines to convey future flows. This master plan will provide West Jordan City with a planning tool to guide development of the sewer collection system throughout the City. Some of the relief and future projects may not be necessary until after 2010, from a capacity standpoint. However, the City may want to install relief and future lines concurrent with road construction or road reconstruction.

The three areas, discussed at the beginning of Section 3-4, should be investigated to determine if there are any reverse grade problems, or if the flow line measurements simply need to be revised and modified in the model.

The City is currently following an infiltration reduction program, and will want to continue with this program past the existing contract time. Continuing to rehabilitate these lines (where infiltration is occurring) will increase the capacity of the existing system to convey sanitary flow. This may not necessarily delay or eliminate the need for relief lines. However, this would decrease the volume of flows going to the South Valley Water Reclamation Facility.

4 – CAPACITY ASSURANCE, MANAGEMENT, OPERATION AND MAINTENANCE EVALUATION

4-1 What is the Capacity Assurance, Management, Operation and Maintenance Program (CMOM)?

The CMOM Program, managed by the Environmental Protection Agency (EPA), establishes minimum requirements for managing, operating, and maintaining any part of a sanitary sewer system.

At the heart of the CMOM program is the Environmental Protection Agency's proposed Sanitary Sewer Overflow (SSO) Rule, which will require municipalities, service districts, and other entities to apply for a permit to operate any part of a sanitary sewer system. The provisions of this rule are contained in the proposed Capacity Assurance, Management, Operation, and Maintenance Program (CMOM or C.M.O.M.). The EPA estimates that the SSO Rule may be published in the Federal Register in the Spring of 2004. This rule will establish minimum requirements that system operators will need to meet.

The EPA classifies West Jordan's sanitary sewer collection system as a satellite system, i.e., West Jordan does not operate its own treatment plant, but conveys effluent through a City-operated system to a wastewater treatment facility. The EPA considers West Jordan to be a satellite system of the South Valley Water Reclamation Facility (SVWRF). Other satellite systems contribute to the treatment loads at SVWRF, including South Valley Sewer District, Salt Lake City Suburban Sanitary District #2, Sandy Suburban Improvement District, and Midvale City.

The South Valley Water Reclamation Facility holds a Utah Pollutant Discharge Elimination System (UPDES) permit to discharge treated wastewater to the waters of the State. This permit is issued by the Water Quality Board of the State of Utah. The permits issued under the proposed SSO Rule may be issued as Utah Pollutant Discharge Elimination System (UPDES) permits, or as National Pollutant Discharge Elimination System (NPDES) permits directly through the EPA. Under the proposed CMOM requirements, West Jordan City may be required to obtain a discharge permit on the State (UPDES) or National (NPDES) level.

These requirements, summarized below, may not be enforced until 2004, or later. However, the Environmental Protection Agency has indicated its desire to provide guidance and direction to those systems that are indeed attempting to meet all proposed C.M.O.M. requirements.

As a condition of obtaining a permit to operate a system, West Jordan City will likely need to:

1. Properly manage, operate and maintain, at all times, the parts of collection system that the permittee owns or over which it has operational control;

2. Provide adequate capacity to convey base flows and peak flows;

3. Take all feasible steps to stop, and mitigate the impact of, sanitary sewer overflows;

4. Provide notification to parties with a reasonable potential for exposure to pollutants associated with the overflow event; and

5. Develop a written summary of their CMOM program, and make the program and required program audits available to the public upon request.

Currently West Jordan City appears to be meeting conditions 1-4. Condition 5 will require that the City create a written summary of the CMOM program. In meeting with the Sewer Superintendent, it became clear that West Jordan City has already started to keep a record of maintenance and operational procedures and activities. As part of item 5 above, a written summary of the CMOM program may include the following items:

1. Goals of the CMOM program;

2. The organization responsible for implementing the CMOM program, and the chain of communication for reporting SSOs to the [EPA] authority;

3. Legal authorities for implementing the CMOM program;

4. Measures and activities the permittee intends to implement as part of its CMOM program;

5. Design and performance requirements and/or standards

6. How the permittee would monitor implementation of the CMOM program and, where appropriate, measure the performance or effectiveness of specific program elements; and

7. How the permittee would communicate with interested stakeholders about the implementation and performance of the CMOM program.

These requirements are taken directly from the existing draft of the SSO Rule. As this rule approaches adoption, West Jordan City will need to review these items, and determine the City's adherence to this proposed rule.

The following sections, 4-2, 4-3, and 4-4, provide a description of the four areas of the CMOM program: Capacity Assurance, Management, Operations and Maintenance.

4-2 Capacity Assurance

West Jordan City retained J-U-B Engineers, Inc. to create a model of the existing sanitary sewer collection system, and to expand the model to study the future system capacity at 2010 and 2030. Except for a few isolated areas, the West Jordan sanitary sewer system is functioning well, and has adequate capacity for current flows. Much of the system has sufficient capacity for large amounts of commercial and residential growth. However, some existing lines only have capacity for limited growth, and will need to be improved ahead of this growth. This report provides information regarding all areas of varying capacity:

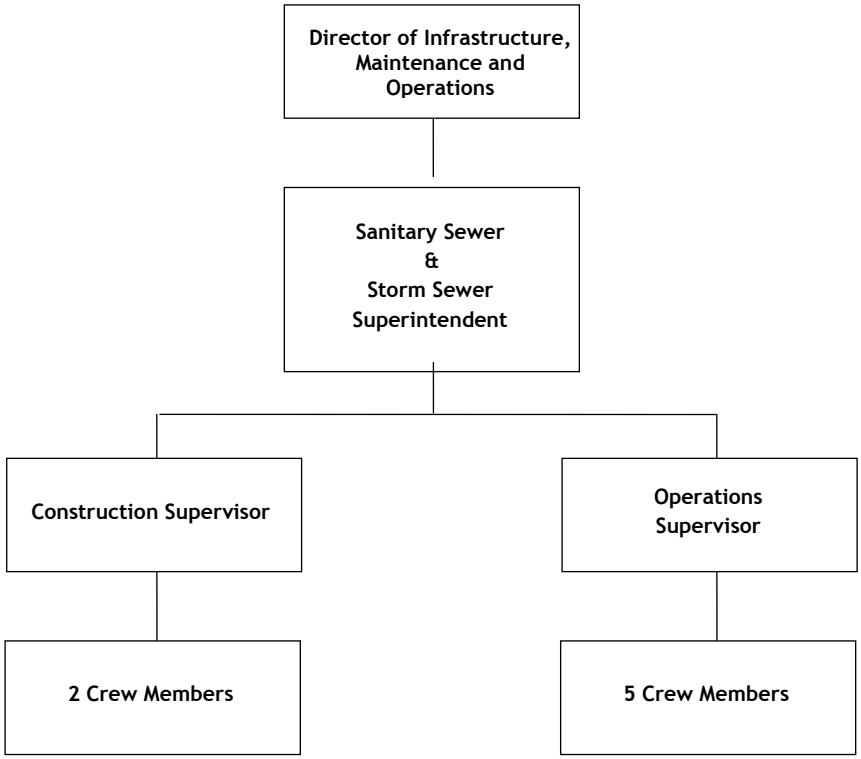
- Isolated areas of the system that need immediate attention
- Existing lines that will need to be improved concurrent with projected growth
- Future lines that will be required to handle growth in currently undeveloped areas to the west

All of these areas, and associated cost estimates, are listed in Section 3-4 of this report. The results of the existing and future models are discussed in detail in sections 1, 2, 3, and 5 of this report.

4-3 Management

Personnel

The collection system within West Jordan City limits is managed by the Sanitary Sewer and Storm Sewer Superintendent. A small portion of the City is provided with sanitary sewer service from the Kearns Improvement District and the Taylorsville Bennion Improvement District. The sewer system superintendent in West Jordan has the dual tasks of overseeing both the sanitary and storm sewers. The superintendent, in turn, has two supervisors: the construction supervisor and the operations supervisor. The primary responsibilities of each supervisor are listed below.



- Respond to Blue Stakes calls
- Respond to customer service issues
- Perform repairs to pipes and manholes
- Verify accuracy of existing system maps
- New construction inspection

- Clean and jet lines
- TV and camera lines
- Review line and manhole conditions
- Respond to customer service issues

Equipment and Tools

The City currently has a list of all equipment and tools, including vehicles, used for sanitary sewer operations. These resources are stored at the Infrastructure Maintenance Operations complex.

Sewer Ordinance

The South Valley Water Reclamation Facility (SVWRF) has adopted sewer regulations that cover the area of West Jordan. These regulations include a pretreatment program which prohibits the discharge of certain substances to system, including grease, oil, toxic pollutants, and other substances. The SVWRF also has specific regulations regarding the requirements for grease interceptors and grease traps.

Engineering

West Jordan City currently has a detailed map of all sanitary sewer lines and manholes. City staff are consistently updating the map to reflect new development and revisions to the existing maps and records. This map is available electronically in AutoCAD, and is also printed and bound for field crews and others to have on hand.

Design
West Jordan City has current construction standards for sanitary sewer projects. The new developments are evaluated for impact to the sanitary sewer system, and the Hydra® model is used to determine current capacity in the affected lines.

Construction
New construction is inspected by West Jordan City. The inspection is coordinated through the Engineering Construction Manager. New construction is pressure tested and pipes are televised and recorded on video tape. After the system has been functioning for at least 12 months, the total bond on the sanitary sewer improvements is released.

Management Information Systems
The crews in charge of operating and maintaining the sanitary sewer system create reports for any work performed on the system. These reports include necessary information regarding location, nature of work, condition of existing facilities, probable causes of malfunction, duration of work, and any follow-up work done after the initial work. Reports are generated for the following areas and are archived electronically and as a hard copy:

- Sewer Line and Manhole New Construction
- Sewer Line and Manhole Maintenance
- Sewer Line and Manhole Repair
- Sewer Backup Remediation

West Jordan utilizes various computer programs to manage the sanitary sewer system. These include the following programs:

- Pizer Hydra® Modeling Software
- Microsoft Excel
- Microsoft Word
- Microsoft Access Database
- AutoCAD Drafting and Mapping Software
- Marsh-McBirney Flo-Ware Monitoring Software
- Cartagraph Infrastructure Management Software

Complaints and Public Relations
Public complaints are handled by the Construction Supervisor or the Operations Supervisor. These supervisors may have crew members respond to public complaints. The most common complaints are from residents who cannot locate service lateral cleanouts. Although West Jordan City does not have jurisdiction over the service laterals (these are the responsibility of the individual property owner), the construction or operations crews often assist residents in locating cleanouts. The City crews assist residents in locating service lines and cleanouts in an effort to create better public relations. The other complaint received by the City relates to

sanitary sewer odor. These complaints are received infrequently, perhaps 1 or 2 times per year.
West Jordan City notifies the public regarding sanitary sewer projects several days in advance of the beginning of construction. Where work must be done on short notice, City crews notify the public as soon as possible about work in an area.

Emergency Maintenance and Contingency Plans
The City does have an emergency maintenance plan in place, and has personnel trained to respond to various emergencies. One person is on call 24 hours a day, seven days a week. West Jordan maintains the necessary parts to make most repairs to the sanitary sewer system. These parts are stored at the Infrastructure Maintenance Operations complex. The City completes an annual inventory on all emergency parts. Two large suppliers of pipe and parts are located within a few minutes of the operations complex.

4-4 Operation and Maintenance

Maintenance Scheduling
The City currently follows a schedule for maintaining the sanitary sewer system. The items on the schedule are prioritized based on formal reports from the Operations and Construction Crews and from video recordings of lines and manholes.

Sewer Cleaning
The Public Works Department has two vacuum trucks used for cleaning sanitary sewer and storm drain lines. Each of these trucks is operated by two crew members. The City began a systematic approach to cleaning sanitary sewer lines in 1998. Since then, over 330 miles of sewer line have been cleaned. The City of West Jordan contains approximately 360 miles of sanitary sewer pipe. In the past five years the cleaning crews have cleaned much of the system. In the EPA's proposed CMOM/SSO Rule the Urban Institute reported that the average cleaning times for systems throughout the United States varies between seven to twelve years. This indicates that West Jordan is doing slightly better than average on cleaning the sanitary sewer system. However, the Urban Institute found that average systems of similar size (to West Jordan) experience roughly 160 sewer backups per year. That West Jordan experienced a single backup in 2001, and only one again in 2002, is an indication of the general good condition of the system, and the good maintenance that crews have performed on this system.

4-5 Recommendations and Summary

Equipment
The equipment currently used for sanitary sewer maintenance is also used for storm drain maintenance. The City may consider obtaining additional equipment devoted solely to storm drain maintenance. The crews that clean storm and sanitary sewer lines are covering the sanitary sewer system approximately every five years. One of the most effective ways of discovering obstructions or breaks in lines or manholes is

through cleaning the system. If an area is not cleaned for over five years, that area has a greater probability of having problems that could lead to a sanitary sewer overflow or a backup. As the sanitary sewer system ages, it will be more critical to clean and observe lines and manholes in order to catch these obstructions or breaks early.

Personnel

The Manual on Uniform Traffic Control Devices (MUTCD), which the Utah Department of Transportation (UDOT) has adopted, recommends that one person be responsible for assuring that all crew members are protected from vehicle traffic in and around the work zone (See MUTCD Section 5G and 6D). This recommendation applies to the vacuum trucks and the TV truck, which frequently stop in lanes of traffic to perform routine work. The National Institute for Occupational Safety and Health (NIOSH) document Building Safer Highway Work Zones also recommends that one person in a work crew is given the responsibility to monitor traffic conditions in and around the work area (See NIOSH Publication 2001-128, Injury Prevention Measures).

As growth occurs in West Jordan City, the City will need to review current personnel needs. Additions to the sanitary sewer system will require more attention to system cleaning and maintenance. Sanitary sewer crews currently respond to maintenance issues on the storm drain system. As the sanitary sewer system grows, these crews may need to devote all of their time to that system, with additional crews being assigned to storm drain maintenance.

Flow Monitoring

The City currently owns five portable flow meters. As this initial study and report is implemented, West Jordan City should continue to monitor sanitary sewer lines. This monitoring can indicate areas of excessive infiltration in the system, and can be used to further calibrate the system as the model changes with growth.

4-6 Conclusion of CMOM Evaluation

West Jordan City appears to be well on the way to meeting proposed CMOM requirements. As the CMOM requirements are put into effect in 2004 or later, the City will want to look at three areas to meet these requirements:

1. Review the proposed requirements for a written summary of the CMOM program. The SSO Rule is still being reviewed by the EPA. However, the requirements for a written summary will likely be the seven items listed in Section 4-1.

2. Formalize an ongoing review of the City's existing resources (personnel, equipment, software) on a basis that will allow the City to stay ahead of growth.

3. As the NPDES Storm Drain Phase II regulations are implemented, the City will want to assure that sufficient resources are being dedicated to both the storm drain system and the sanitary sewer system. As discussed previously, the storm drain and sanitary sewer systems currently share personnel and equipment resources.

5 – CONCLUSIONS & RECOMMENDATIONS

The following conclusions and recommendations are based on the foregoing analysis:

Conclusions

- The existing system has adequate capacity in most lines. However, portions of the system are at or nearing capacity. These areas are delineated in Section 2-5 and are shown in Figure 2-4.

- Infiltration and Inflow appear to be low to moderate for *most* of the system. However, in some portions of the system (1300 West and Redwood Road) infiltration appears to be high. Refer to the first recommendation below.

- Several relief improvements to existing trunk lines will be required. These improvements are shown in Section 3-4, at the end of the Executive Summary, and in Figure ES-1 (highlighted in red). Figure 5-1 shows all of the future improvements (heavy lines), as well as future required line sizes.

Recommendations

- Continue to implement an infiltration elimination program in areas that appear to have relatively high levels of groundwater, as delineated in the 1992 report.

- Maintain and protect future alignment corridors from future utilities that may impact construction of the future trunks, and coordinate road construction with future and relief projects.

- Flow monitoring of critical lines described above should be done on an annual basis. In addition, proposed development should be added to the existing system model to help determine the flow conditions of existing lines.

- The west side of the City, in largely undeveloped areas, will need to be analyzed throughout the next planning period as land uses may change and development occurs. In most areas of the City the modeled densities are taken directly from municipal land use maps. In the case of the possible residential development that may be constructed at Jordan Landing, a higher density was used, in anticipation of a land use change in this area. The model should be updated frequently to reflect such changes, or potential changes, to the land use plan. Line sizing may be consequently affected by any changes in the planning densities. However, small changes to the land use map may not require size changes to build out lines.

- The current model of the sanitary sewer collection system encompasses lines that were anticipated to have capacity concerns. These are the major trunk lines throughout the City, and represent approximately 48 miles of the collection system. As discussed in Section 2-1, the modeled lines were selected based on the assumption that lines serving larger areas may have capacity issues, and lines serving relatively small areas would always have sufficient capacity. As development occurs to the west, the City will want to review the modeled system, and determine if other lines need to be included in the model. Proposed lines to the west have been modeled in the future system model. As these are built, they should be surveyed and included in the current model.

- Lines that do not need to be modeled may need to be surveyed for maintenance records. These would include smaller lines in subdivisions. The survey and flow line information from these lines and manholes will allow the City to track maintenance on the entire system.

In summary, we recommend that West Jordan City continue to take a proactive approach to sewer monitoring and modeling. Land use may change as undeveloped areas begin to fill in; these changes should be examined often to determine the accuracy of the current model. The model should be updated to reflect any changes to the land use within the City, and should also be updated to reflect residential and commercial growth in the individual service areas. By keeping the model current, West Jordan City will have a useful tool to create and maintain the capital facilities necessary for a well-functioning system.

West Jordan City Corporation
Public Works Department

Sanitary Sewer Model & Capital Facilities Plan

Appendix A

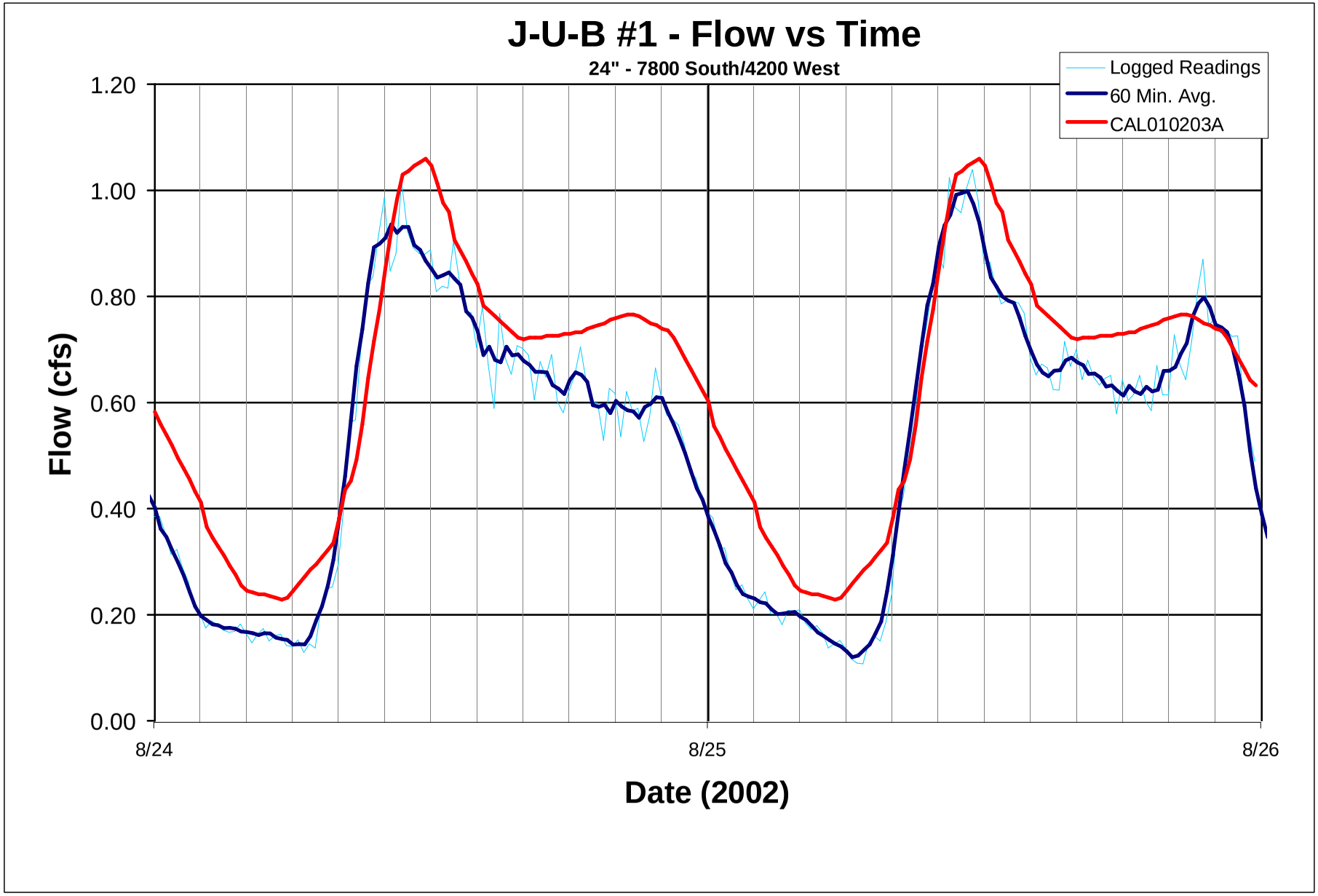
March 2003
J-U-B Engineers, Inc.

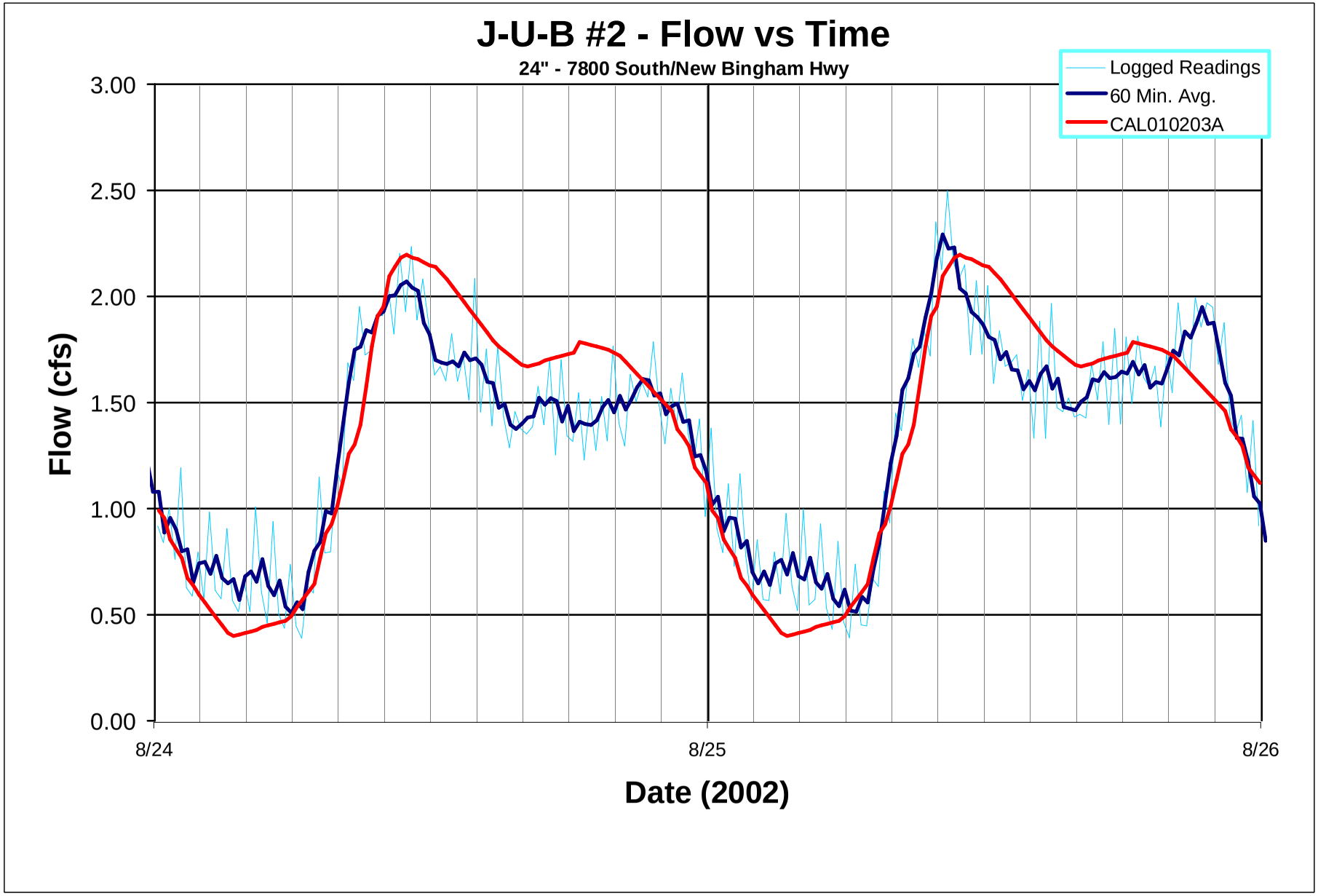
FLOW MONITOR RESULTS

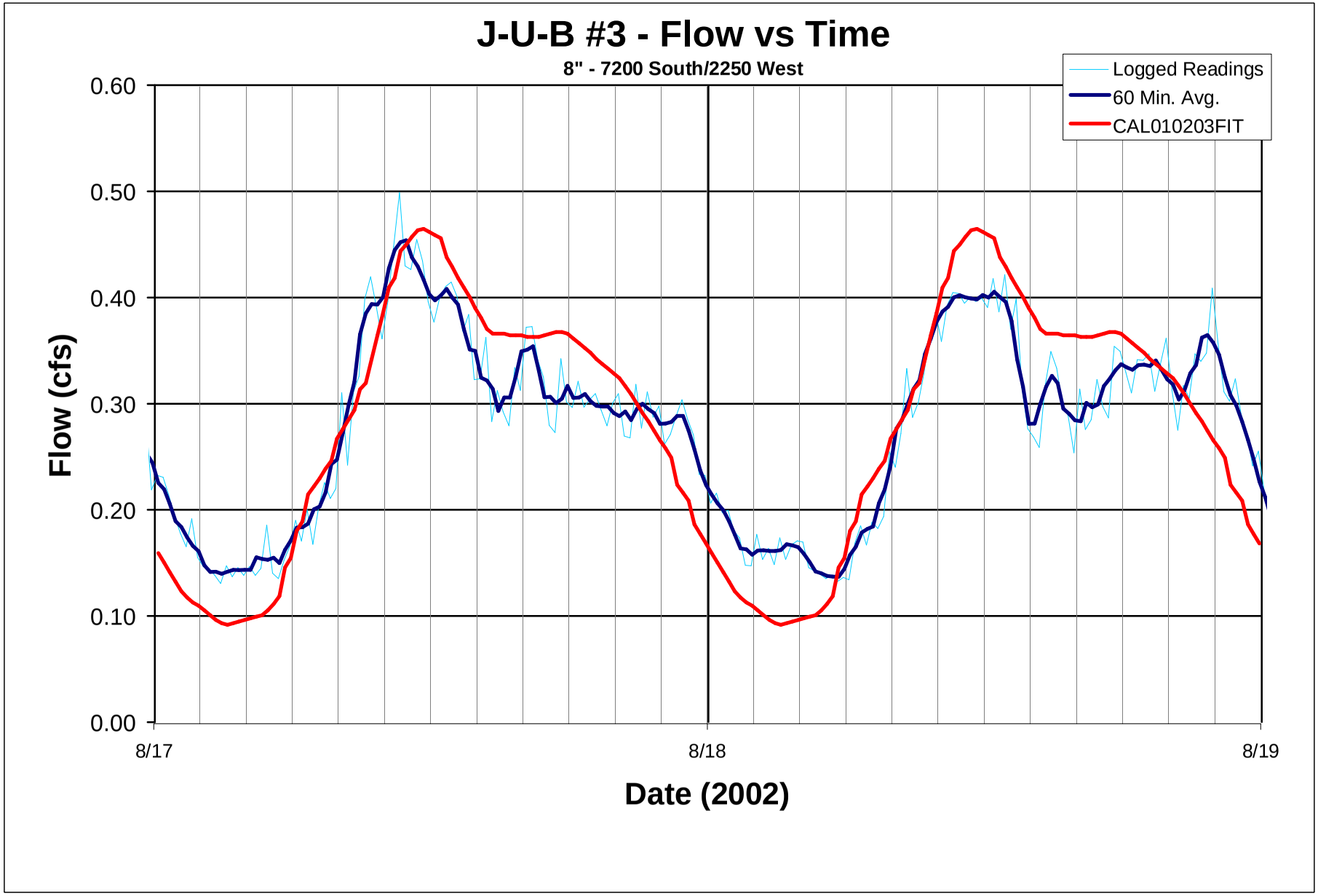
Model Calibration and Diurnal Curves

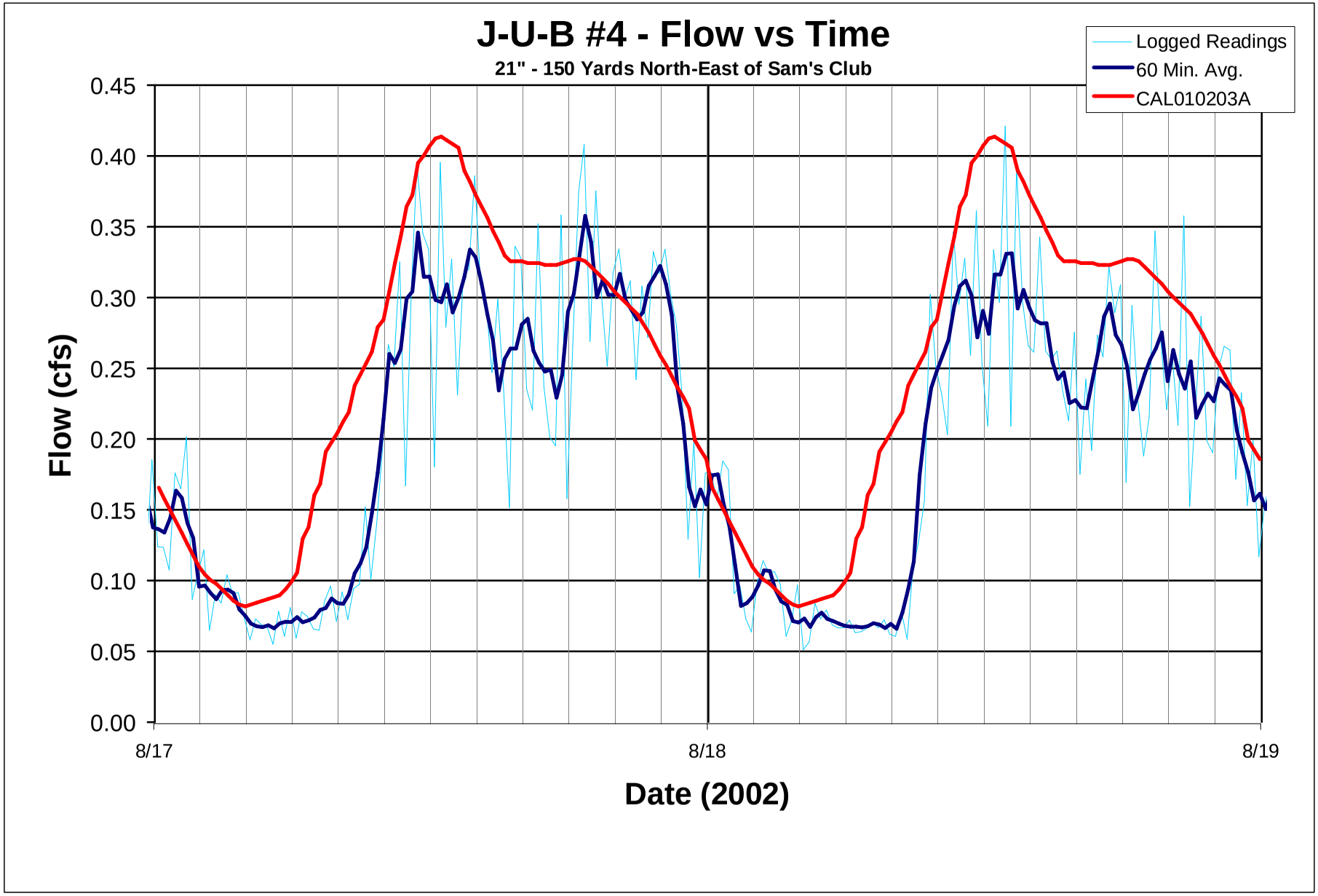
MODEL LOCATIONS

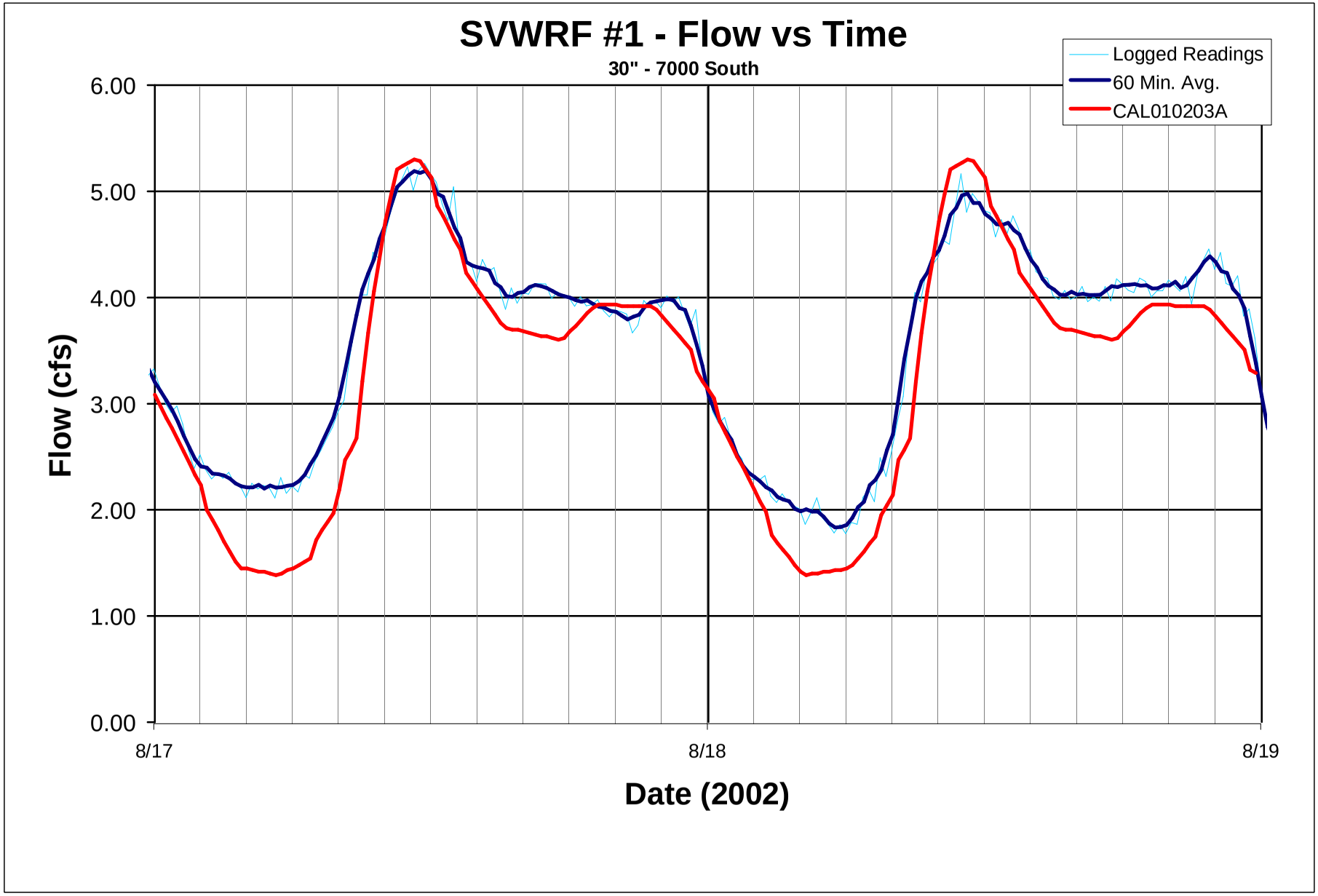
J-U-B #1	7800 South/4200 West
J-U-B #2	7800 South/New Bingham Hwy
J-U-B #3	7200 South/2250 West
J-U-B #4	150 Yards North-East of Sam's Club
SVWRF #1	7000 South
SVWRF #2	8000 South
SVWRF #3	9000 South
SVWRF #4	7800 South

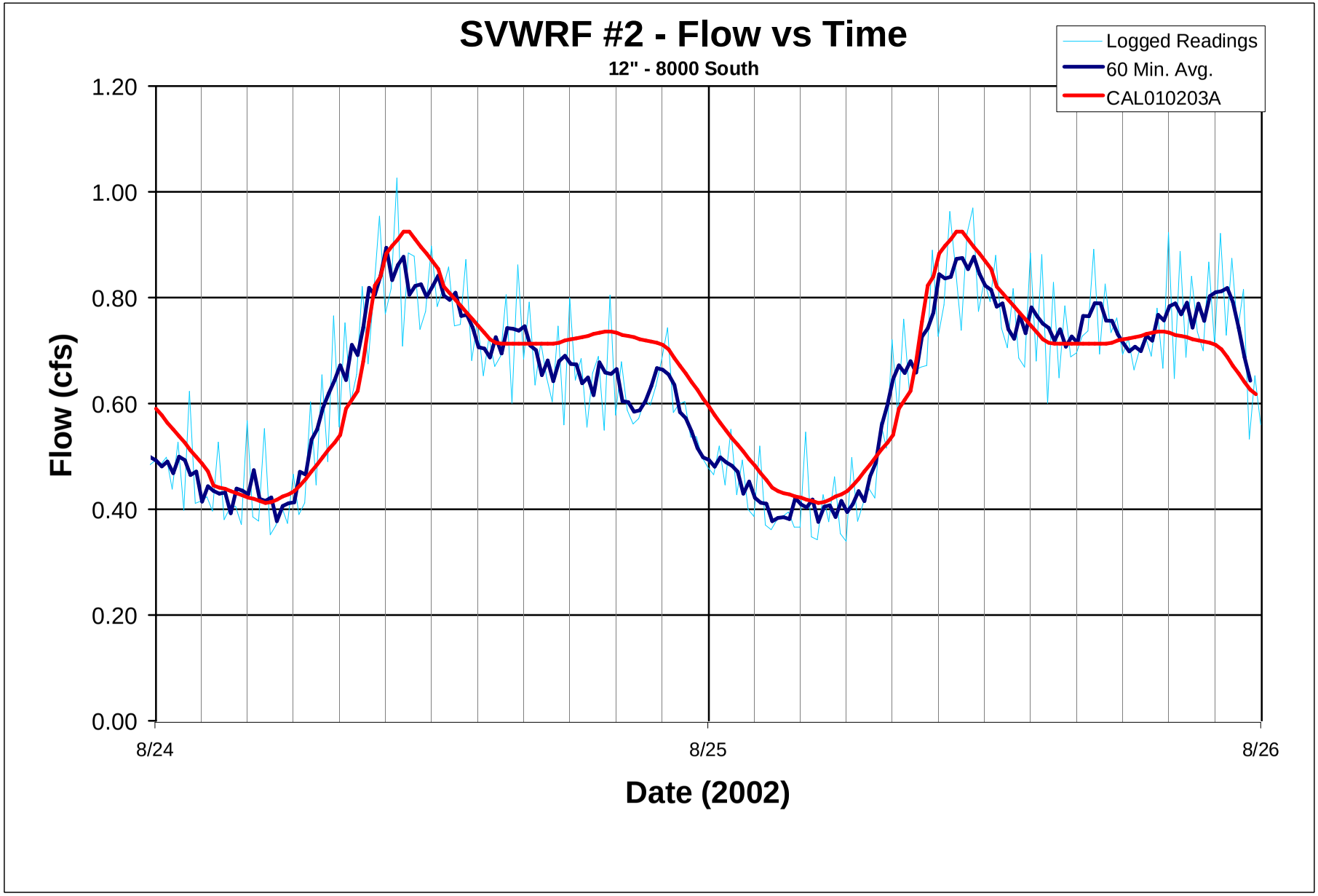

J-U-B #1 - Flow vs Time
24" - 7800 South/4200 West
Logged Readings
60 Min. Avg.
CAL010203A
Flow (cfs)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
8/24
8/25
8/26
Date (2002)

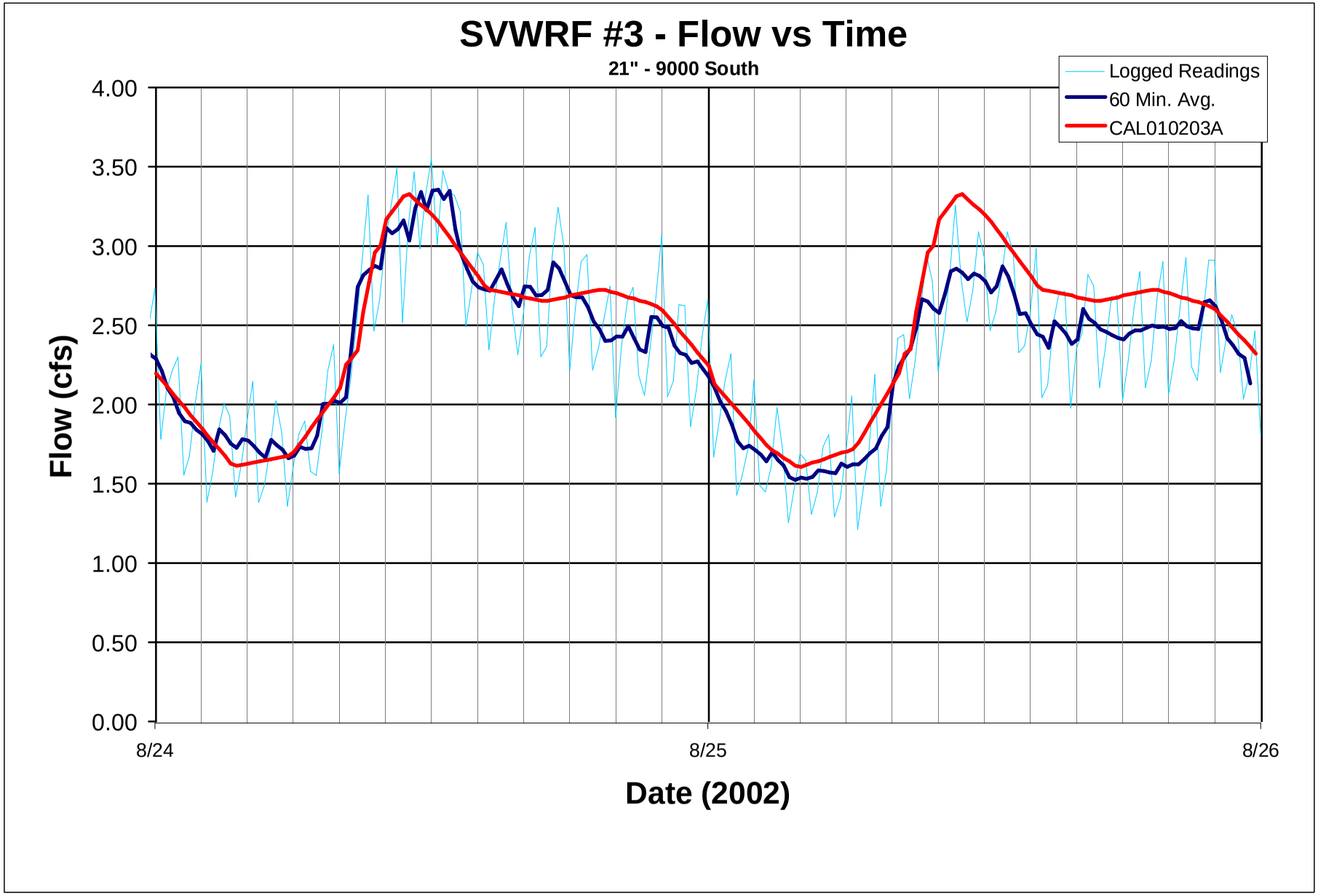

J-U-B #2 - Flow vs Time
24" - 7800 South/New Bingham Hwy
Logged Readings
60 Min. Avg.
CAL010203A
Flow (cfs)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
8/24
8/25
8/26
Date (2002)

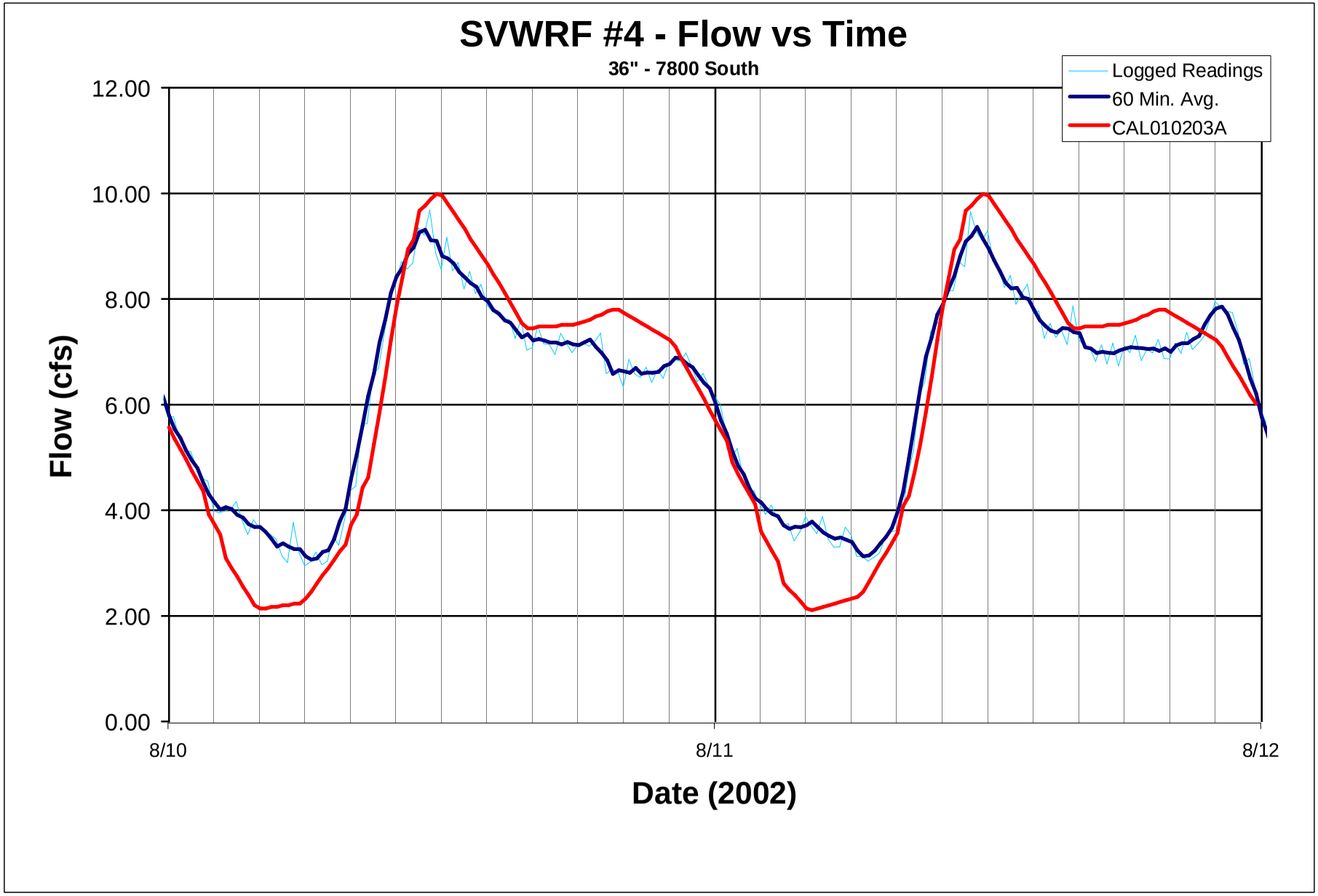

J-U-B #3 - Flow vs Time
8" - 7200 South/2250 West
Logged Readings
60 Min. Avg.
CAL010203FIT
Flow (cfs)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
8/17
8/18
8/19
Date (2002)


J-U-B #4 - Flow vs Time
21" - 150 Yards North-East of Sam's Club
Logged Readings
60 Min. Avg.
CAL010203A
Flow (cfs)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
8/17
8/18
8/19
Date (2002)


SVWRF #1 - Flow vs Time
30" - 7000 South
Logged Readings
60 Min. Avg.
CAL010203A
Flow (cfs)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
8/17
8/18
8/19
Date (2002)


SVWRF #2 - Flow vs Time
12" - 8000 South
Logged Readings
60 Min. Avg.
CAL010203A
Flow (cfs)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
8/24
8/25
8/26
Date (2002)


SVWRF #3 - Flow vs Time
21" - 9000 South
Logged Readings
60 Min. Avg.
CAL010203A
Flow (cfs)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
8/24
8/25
8/26
Date (2002)

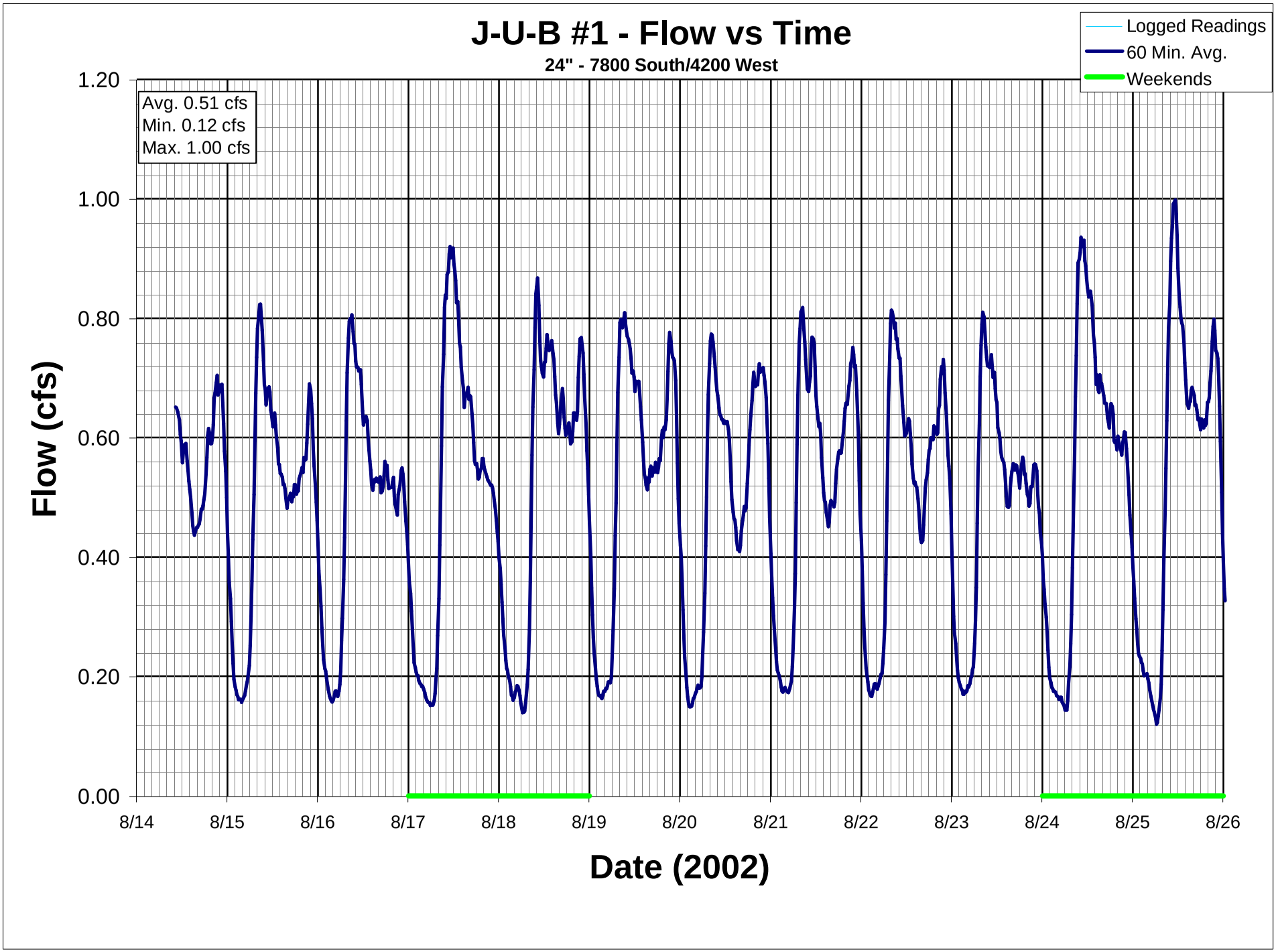

SVWRF #4 - Flow vs Time
36" - 7800 South
Logged Readings
60 Min. Avg.
CAL010203A
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Flow (cfs)
8/10
8/11
8/12
Date (2002)

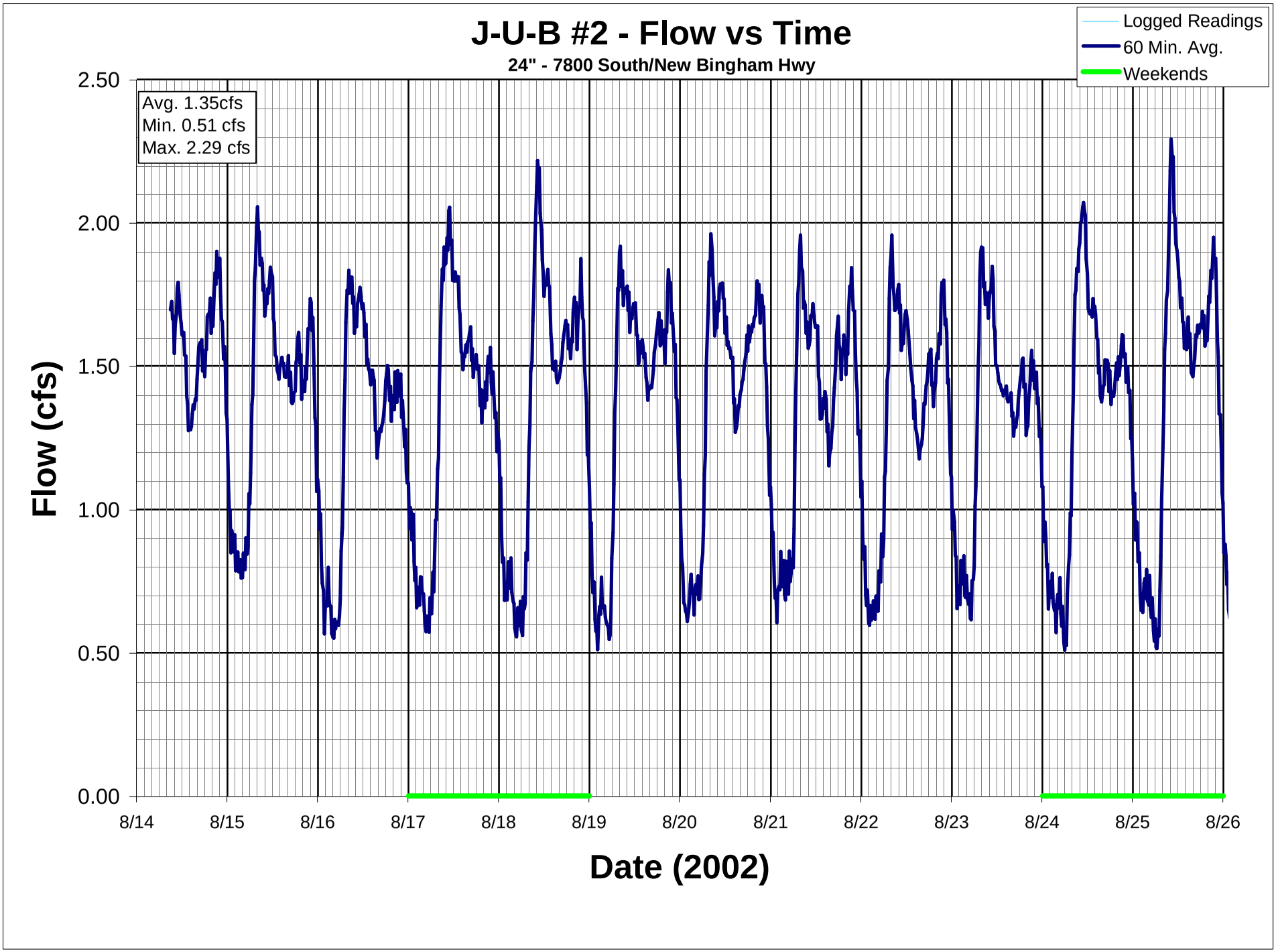
FLOW MONITOR RESULTS

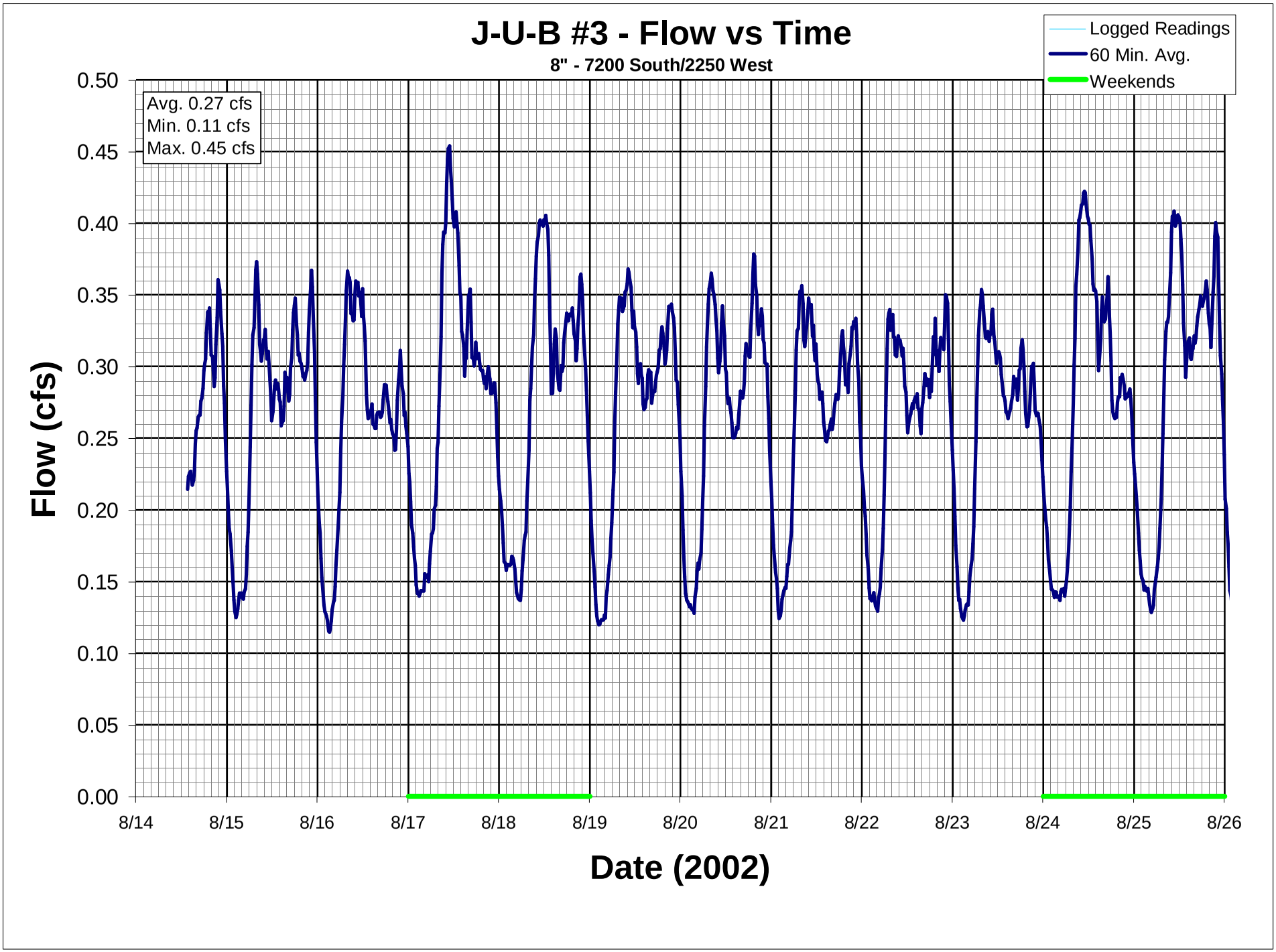
Monitor Periods

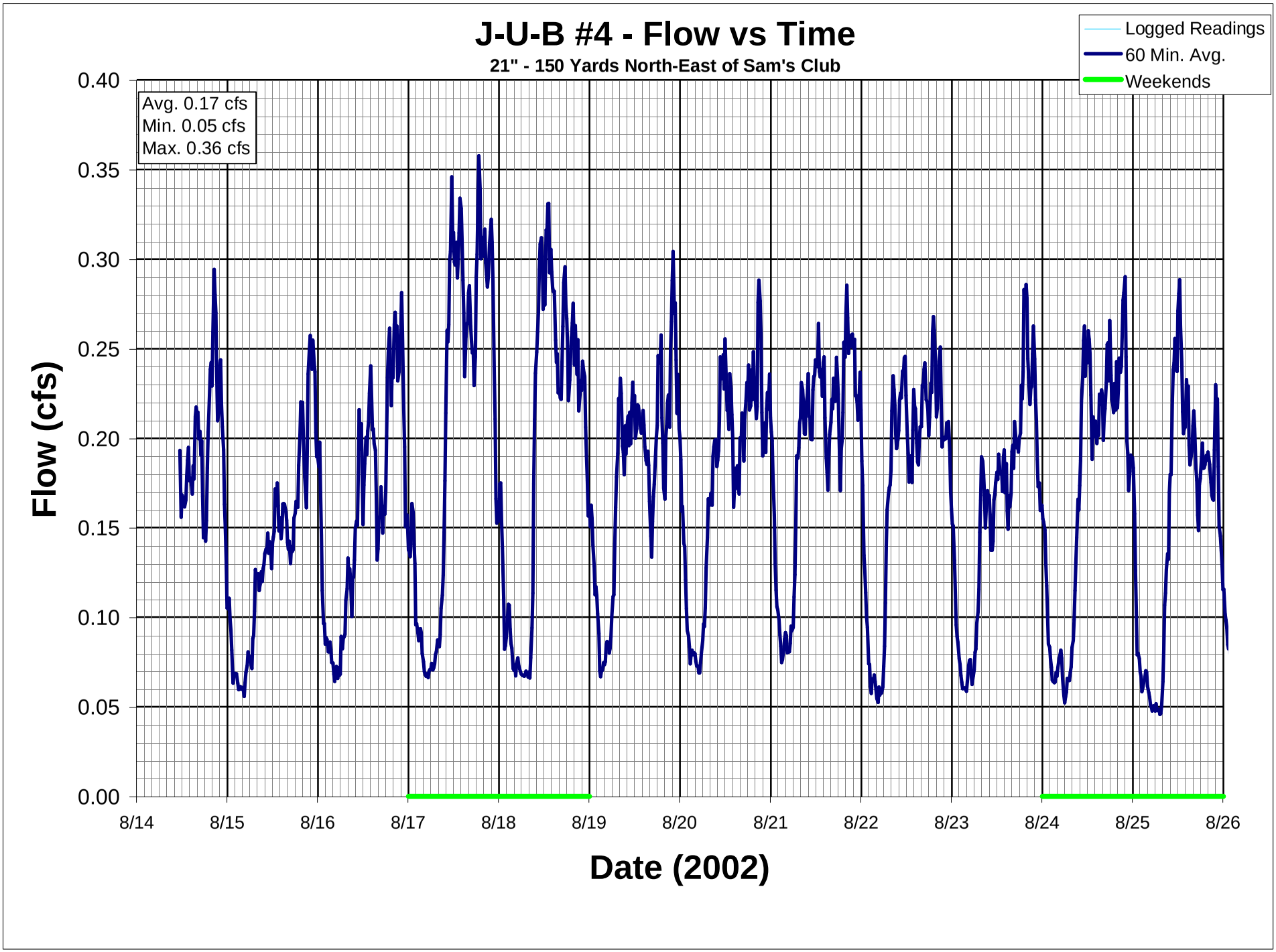
MODEL LOCATIONS

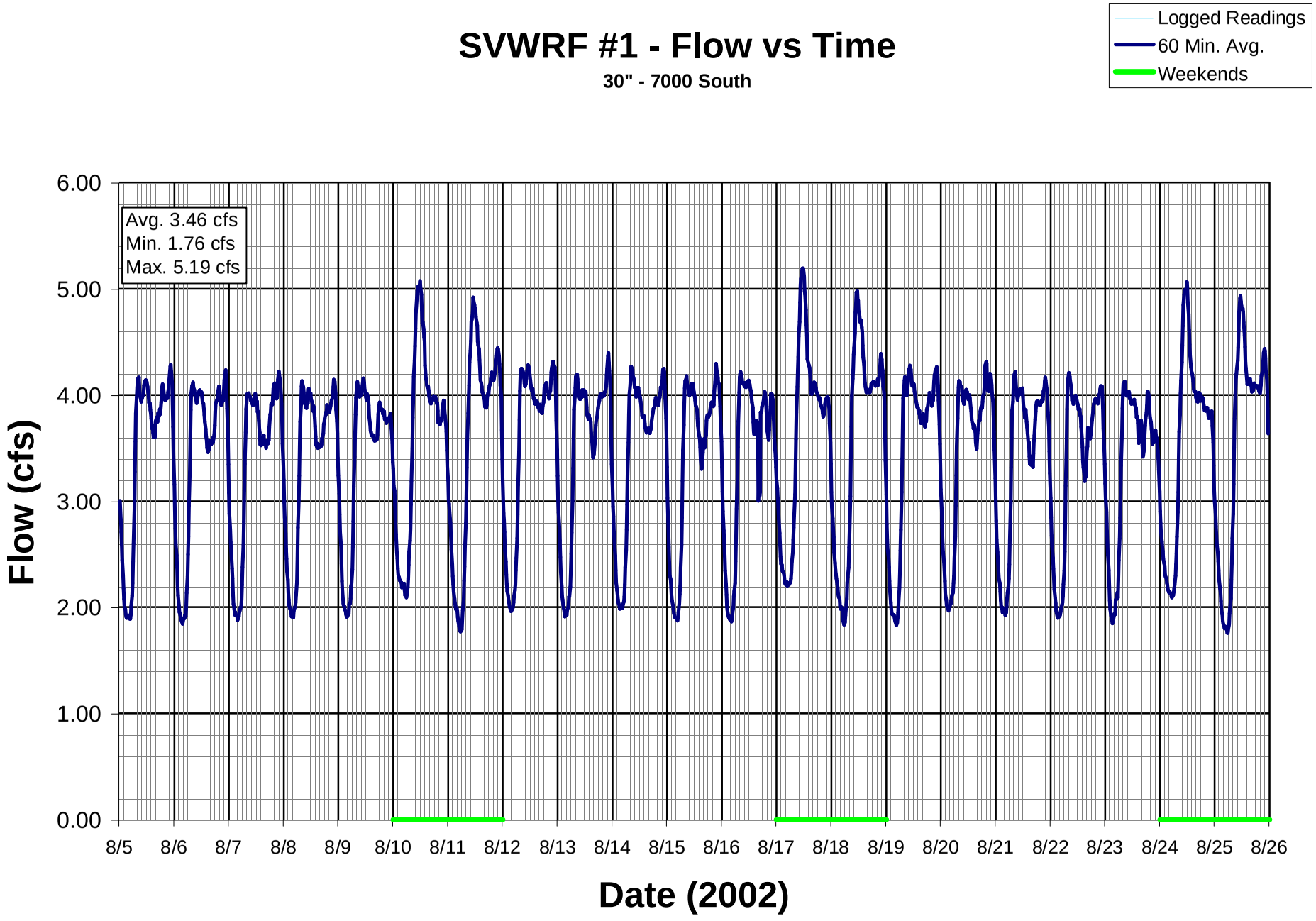
J-U-B #1	7800 South/4200 West
J-U-B #2	7800 South/New Bingham Hwy
J-U-B #3	7200 South/2250 West
J-U-B #4	150 Yards North-East of Sam's Club
SVWRF #1	7000 South
SVWRF #2	8000 South
SVWRF #3	9000 South
SVWRF #4	7800 South

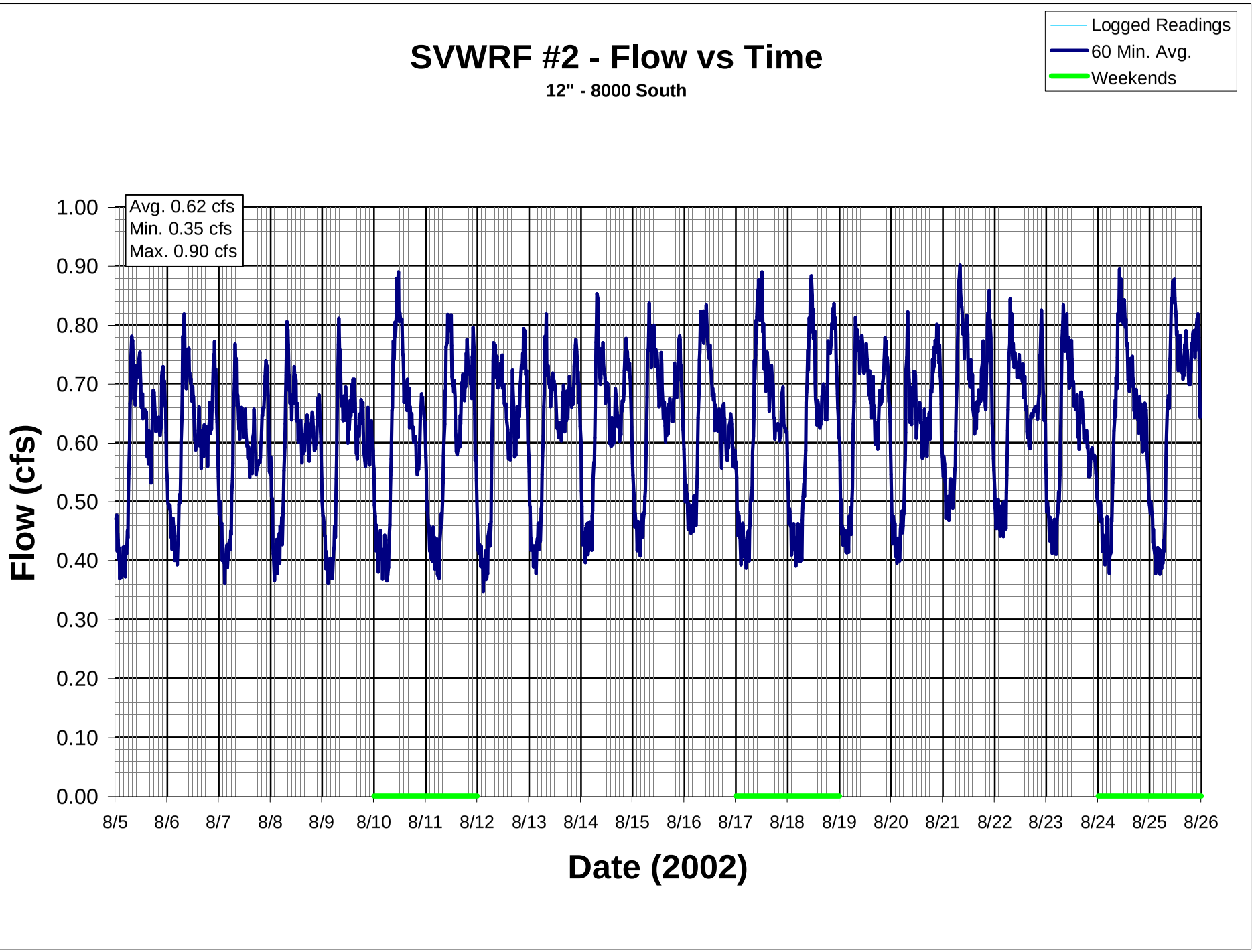

J-U-B #1 - Flow vs Time
24" - 7800 South/4200 West
Logged Readings
60 Min. Avg.
Weekends
Avg. 0.51 cfs
Min. 0.12 cfs
Max. 1.00 cfs
Flow (cfs)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25
8/26
Date (2002)

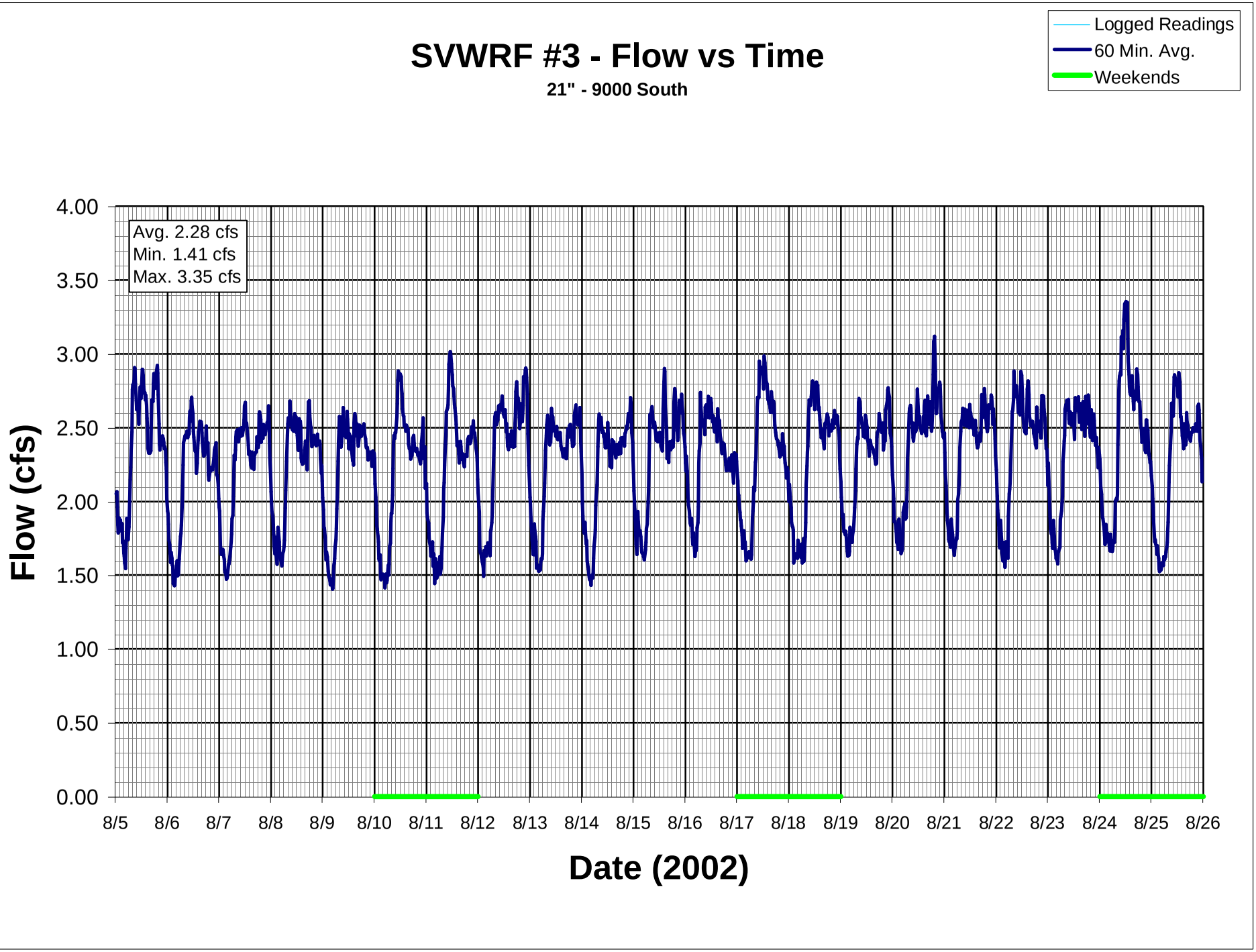

J-U-B #2 - Flow vs Time
24" - 7800 South/New Bingham Hwy
Logged Readings
60 Min. Avg.
Weekends
Avg. 1.35cfs
Min. 0.51 cfs
Max. 2.29 cfs
Flow (cfs)
2.50
2.00
1.50
1.00
0.50
0.00
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25
8/26
Date (2002)

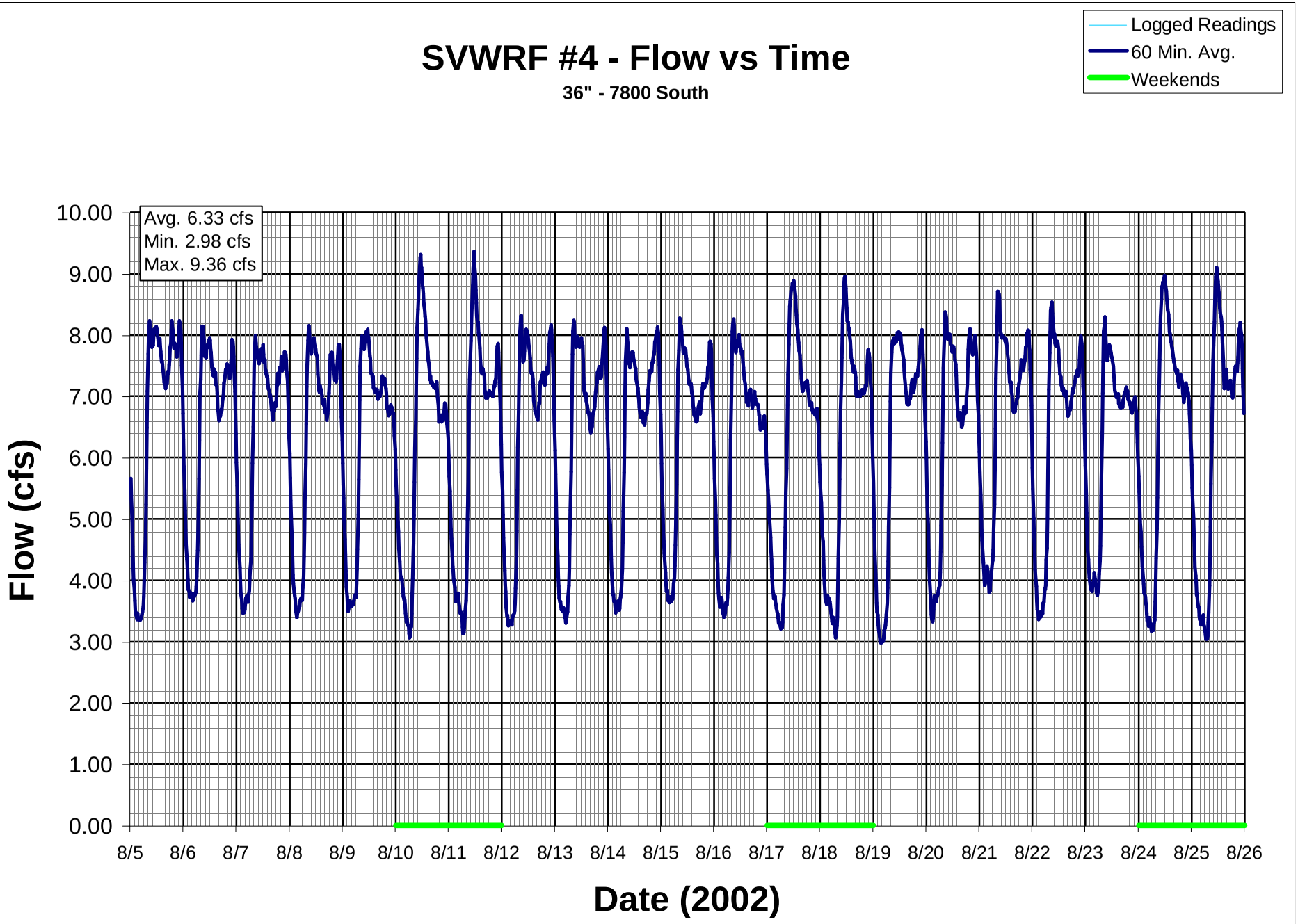

J-U-B #3 - Flow vs Time
8" - 7200 South/2250 West
Logged Readings
60 Min. Avg.
Weekends
Avg. 0.27 cfs
Min. 0.11 cfs
Max. 0.45 cfs
Flow (cfs)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25
8/26
Date (2002)


J-U-B #4 - Flow vs Time
21" - 150 Yards North-East of Sam's Club
Logged Readings
60 Min. Avg.
Weekends
Avg. 0.17 cfs
Min. 0.05 cfs
Max. 0.36 cfs
Flow (cfs)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25
8/26
Date (2002)


SVWRF #1 - Flow vs Time
30" - 7000 South
Logged Readings
60 Min. Avg.
Weekends
Avg. 3.46 cfs
Min. 1.76 cfs
Max. 5.19 cfs
Flow (cfs)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25
8/26
Date (2002)


SVWRF #2 - Flow vs Time
12" - 8000 South
Logged Readings
60 Min. Avg.
Weekends
Avg. 0.62 cfs
Min. 0.35 cfs
Max. 0.90 cfs
Flow (cfs)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25
8/26
Date (2002)


SVWRF #3 - Flow vs Time
21" - 9000 South
Logged Readings
60 Min. Avg.
Weekends
Avg. 2.28 cfs
Min. 1.41 cfs
Max. 3.35 cfs
Flow (cfs)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25
8/26
Date (2002)


SVWRF #4 - Flow vs Time
36" - 7800 South
Logged Readings
60 Min. Avg.
Weekends
Avg. 6.33 cfs
Min. 2.98 cfs
Max. 9.36 cfs
Flow (cfs)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
8/5
8/6
8/7
8/8
8/9
8/10
8/11
8/12
8/13
8/14
8/15
8/16
8/17
8/18
8/19
8/20
8/21
8/22
8/23
8/24
8/25
8/26
Date (2002)

West Jordan City Corporation
Public Works Department

Sanitary Sewer Model & Capital Facilities Plan

Appendix B

March 2003
J-U-B Engineers, Inc.

APPENDIX B

Existing System Land Use Database (2002)

FIELD NAME DESCRIPTIONS

FIELD	DESCRIPTION
G_ID	Land Use Identification Number number assigned by Hydra
R_LU_AREA	Total Land Use Area (acres)
R_DENSITY	Residential Density (dwelling units per acre)
R_BO_UNITS	Total Undeveloped residential area (acres)
R_CURRENT_UNITS	Total number of residential active connections
R_PPDU	Number of people per dwelling unit
RES_POP	Total ultimate population in land use
RES_ACTIVE (%)	Percent of the total pop. contributing flow. Used to adjust ultimate pop. to existing pop.
ACTIVE_POP	Population at Model Year
RES_CPC	Flow contribution (gallons per person per day)
C_IMP_AREA (AC)	Total developed Commercial Area (acres)
C_GPAD	Commercial contribution (gallons per acre per day)
COM_VOL	Total ultimate commercial flow (gallons)
COM_ACTIVE (%)	Percent of the total ultimate flow injected. Used to adjust ultimate flow to existing flow

G_ID	R_LU_AREA (ACRES)	R_DENSITY	R_BO_ UNITS	R_CURRENT _UNITS	R_PPDU	RES_POP	RES_ ACTIVE(%)	ACTIVE POP	RES_CPC	C_IMP_AREA (AC)	C_GPAD	COM_VOL	COM_ ACTIVE (%)
1	29.50	18.5	547	453	2.80	1531	83	1268	85	0.00	800	0	0
2	48.55	2.0	99	72	3.30	326	73	238	85	0.00	800	0	0
3	38.53	2.5	94	26	3.30	312	28	86	85	0.00	800	0	0
4	6.86	18.5	127	45	2.80	356	35	126	85	0.00	800	0	0
5	39.36	20.0	787	190	2.80	2204	24	532	85	0.00	800	0	0
6	7.57	2.5	19	2	3.30	62	11	7	85	0.00	800	0	0
7	0.00	0.0	0	0	3.30	1	100	1	85	8.75	850	14825	50
8	0.00	0.0	0	0	3.30	1	100	1	85	3.07	850	2612	100
9	20.17	7.1	143	143	3.30	472	100	472	85	0.00	800	0	0
10	10.05	5.9	59	0	3.30	195	0	0	85	0.00	800	0	0
11	0.00	0.0	0	0	3.30	1	100	1	85	1.21	850	2061	50
12	19.47	18.5	360	338	2.80	1009	94	946	85	0.00	800	0	0
13	0.00	0.0	0	0	3.30	1	100	1	85	45.60	850	48451	80
14	0.00	0.0	0	0	3.30	1	100	1	85	1.97	850	8374	20
15	55.97	3.7	204	172	3.30	674	84	568	85	0.00	800	0	0
16	0.00	0.0	0	0	3.30	1	100	1	85	2.88	850	2450	100
17	41.56	3.1	130	130	3.30	429	100	429	85	0.00	800	0	0
18	3.02	12.0	36	1	3.30	119	3	3	85	0.00	800	0	0
19	0.00	0.0	0	0	3.30	1	100	1	85	10.02	0	0	100
20	110.07	2.5	275	77	3.30	908	28	254	85	0.00	800	0	0
21	0.00	0.0	0	0	3.30	1	100	1	85	7.90	800	43989	14
22	0.00	0.0	0	0	3.30	1	100	1	85	1.83	800	1465	100
23	0.00	0.0	0	0	3.30	1	100	1	85	3.50	800	48276	6
24	18.77	2.5	47	42	3.30	155	90	139	85	0.00	800	0	0
25	22.62	5.9	133	132	3.30	440	99	436	85	0.00	800	0	0
26	31.53	4.6	146	146	3.30	482	100	482	85	0.00	800	0	0
27	1.53	12.0	18	1	3.30	61	5	3	85	0.00	800	0	0
28	0.00	0.0	0	0	3.30	1	100	1	85	2.48	0	0	100
29	3.51	8.0	28	0	3.30	93	0	0	85	0.00	800	0	0
30	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	827	0
31	13.28	5.9	79	62	3.30	260	79	205	85	0.00	800	0	0
32	7.38	4.7	35	0	3.30	115	0	0	85	0.00	800	0	0
33	28.59	2.8	80	34	3.30	264	42	112	85	0.00	800	0	0
34	0.00	0.0	0	0	3.30	1	100	1	85	4.36	800	5366	65
35	7.87	2.0	16	7	3.30	52	44	23	85	0.00	800	0	0
36	21.74	5.4	118	118	3.30	389	100	389	85	0.00	800	0	0
37	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	2102	0
38	9.48	12.0	114	114	3.30	375	100	376	85	0.00	800	0	0
39	0.00	0.0	0	0	3.30	1	100	1	85	10.68	0	0	100
40	26.20	3.0	78	78	3.30	257	100	257	85	0.00	800	0	0
41	3.99	12.0	48	48	3.30	158	100	158	85	0.00	800	0	0
42	7.30	10.3	75	75	3.30	248	100	248	85	0.00	800	0	0
43	0.00	0.0	0	0	3.30	1	100	1	85	2.00	800	4341	37
44	50.27	3.9	195	195	3.30	644	100	644	85	0.00	800	0	0
45	0.00	0.0	0	0	3.30	1	100	1	85	16.46	800	13171	100
46	20.14	21.9	440	440	2.80	1232	100	1232	85	0.00	800	0	0
47	0.00	0.0	0	0	3.30	1	100	1	85	7.03	800	5625	100
48	9.75	12.0	117	4	3.50	409	3	14	85	0.00	800	0	0
49	32.60	3.3	108	108	3.30	356	100	356	85	0.00	800	0	0
50	13.98	4.9	69	63	3.30	226	92	208	85	0.00	800	0	0
51	2.36	12.0	28	2	3.30	94	7	7	85	0.00	800	0	0
52	0.00	0.0	0	0	3.30	1	100	1	85	0.00	500	3916	0
53	183.41	3.1	576	576	3.30	1901	100	1901	85	0.00	800	0	0
54	0.00	0.0	0	0	3.30	1	100	1	85	9.60	0	0	100
55	110.09	2.2	242	218	3.30	799	90	719	85	0.00	800	0	0
56	0.00	0.0	0	0	3.30	1	100	1	85	1.00	800	8148	10
57	0.00	0.0	0	0	3.30	1	100	1	85	49.76	800	44632	89
58	27.96	2.6	73	59	3.30	240	81	195	85	0.00	800	0	0
59	76.66	2.6	199	184	3.30	658	92	607	85	0.00	800	0	0
60	160.16	1.9	304	291	3.30	1004	96	960	85	0.00	800	0	0
61	20.39	12.0	245	96	3.30	807	39	317	85	0.00	800	0	0
62	0.00	0.0	0	0	3.30	1	100	1	85	0.00	0	0	0
63	69.88	2.8	196	179	3.30	646	91	591	85	0.00	800	0	0
64	41.41	3.2	134	134	3.30	442	100	442	85	0.00	800	0	0
65	0.00	0.0	0	0	3.30	1	100	1	85	38.86	800	31087	100
66	11.19	6.1	68	68	3.30	224	100	224	85	0.00	800	0	0
67	56.99	3.2	183	183	3.30	604	100	604	85	0.00	800	0	0
68	3.66	2.8	10	3	3.30	34	29	10	85	0.00	800	0	0
69	0.00	0.0	0	0	3.30	1	100	1	85	6.82	800	5454	100
70	10.72	15.4	165	160	3.30	545	97	528	85	0.00	800	0	0
71	0.00	0.0	0	0	3.30	1	100	1	85	6.62	400	2649	100
72	0.00	0.0	0	0	3.30	1	100	1	85	32.44	0	0	100
73	119.95	3.1	367	367	3.30	1211	100	1211	85	0.00	800	0	0
74	0.00	0.0	0	0	3.30	1	100	1	85	4.62	800	3698	100
75	4.58	1.7	8	8	3.30	26	100	26	85	0.00	800	0	0
76	0.00	0.0	0	0	3.30	1	100	1	85	2.70	800	2159	100
77	32.60	3.8	124	124	3.30	409	100	409	85	0.00	800	0	0
78	0.00	0.0	0	0	3.30	1	100	1	85	8.03	800	6427	100

G_ID	R_LU_AREA (ACRES)	R_DENSITY	R_BO_ UNITS	R_CURRENT _UNITS	R_PPDU	RES_POP	RES_ ACTIVE(%)	ACTIVE POP	RES_CPC	C_IMP_AREA (AC)	C_GPAD	COM_VOL	COM_ ACTIVE (%)
79	0.00	0.0	0	0	3.30	1	100	1	85	15.79	800	12631	100
80	0.00	0.0	0	0	3.30	1	100	1	85	92.18	800	73744	100
81	27.54	5.7	158	158	3.30	522	100	521	85	0.00	800	0	0
82	0.00	0.0	0	0	3.30	1	100	1	85	2.31	800	3083	60
83	17.29	4.7	82	82	3.30	271	100	271	85	0.00	800	0	0
84	0.00	0.0	0	0	3.30	1	100	1	85	35.00	800	28001	100
85	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	5648	0
86	25.01	3.1	78	78	3.30	257	100	257	85	0.00	800	0	0
87	85.76	2.8	242	215	3.30	798	89	710	85	0.00	800	0	0
88	0.00	0.0	0	0	3.30	1	100	1	85	1.50	800	2801	43
89	0.00	0.0	0	0	3.30	1	100	1	85	0.50	800	1795	22
90	70.67	2.5	177	167	3.30	583	95	551	85	0.00	800	0	0
91	18.33	6.3	115	64	3.30	381	55	211	85	0.00	800	0	0
92	6.85	3.6	25	25	3.30	83	100	83	85	0.00	800	0	0
93	17.32	7.4	128	128	3.30	422	100	422	85	0.00	800	0	0
94	11.58	12.0	139	10	3.30	459	7	33	85	0.00	800	0	0
95	0.00	0.0	0	0	3.30	1	100	1	85	46.39	850	43810	90
96	4.94	2.4	12	1	3.30	40	8	3	85	0.00	800	0	0
97	18.55	12.0	223	0	3.30	735	0	0	85	0.00	800	0	0
98	0.00	0.0	0	0	3.30	1	100	1	85	19.64	850	16692	100
99	4.99	25.2	126	126	3.30	415	100	416	85	0.00	800	0	0
100	52.45	2.0	105	51	3.30	346	49	168	85	0.00	800	0	0
101	0.00	0.0	0	0	3.30	1	100	1	85	8.50	850	8419	86
102	26.39	1.2	32	23	3.30	105	73	76	85	0.00	800	0	0
103	0.00	0.0	0	0	3.30	1	100	1	85	2.18	850	1856	100
104	0.00	0.0	0	0	3.30	1	100	1	85	27.46	800	21970	100
105	11.45	12.0	137	0	3.30	454	0	0	85	0.00	800	0	0
106	34.97	2.7	93	60	3.30	306	65	198	85	0.00	800	0	0
107	9.25	12.0	111	1	3.30	366	1	3	85	0.00	800	0	0
108	16.37	1.4	23	23	3.30	76	100	76	85	0.00	800	0	0
109	10.79	1.4	15	15	3.30	50	100	50	85	0.00	800	0	0
110	19.70	12.0	236	0	3.30	780	0	0	85	0.00	800	0	0
111	0.00	0.0	0	0	3.30	1	100	1	85	3.10	850	9844	27
112	85.19	1.9	162	162	3.30	534	100	535	85	0.00	800	0	0
113	7.81	1.5	12	12	3.30	40	100	40	85	0.00	800	0	0
114	26.22	1.5	38	38	3.30	125	100	125	85	0.00	800	0	0
115	39.77	1.6	63	63	3.30	207	100	208	85	0.00	800	0	0
116	0.00	0.0	0	0	3.30	1	100	1	85	7.65	850	6504	100
117	72.31	3.2	228	228	3.30	752	100	752	85	0.00	800	0	0
118	0.00	0.0	0	0	3.30	1	100	1	85	0.00	400	3453	0
119	31.52	2.3	74	45	3.30	243	61	149	85	0.00	800	0	0
120	65.47	2.5	164	117	3.30	540	71	386	85	0.00	800	0	0
121	0.00	0.0	0	0	3.30	1	100	1	85	6.48	850	5507	100
122	0.00	0.0	0	0	3.30	1	100	1	85	3.01	800	2409	100
123	9.56	6.0	57	57	3.30	189	99	188	85	0.00	800	0	0
124	0.00	0.0	0	0	3.30	1	100	1	85	3.50	800	2799	100
125	60.82	2.5	152	45	3.30	502	30	149	85	0.00	800	0	0
126	97.55	2.5	244	70	3.30	805	29	231	85	0.00	800	0	0
127	28.73	2.7	78	75	3.30	256	97	248	85	0.00	800	0	0
128	7.93	12.5	99	60	3.30	327	61	198	85	0.00	800	0	0
129	4.63	12.0	56	0	3.30	183	0	0	85	0.00	800	0	0
130	0.00	0.0	0	0	3.30	1	100	1	85	19.00	800	30956	49
131	15.46	1.7	26	26	3.30	86	100	86	85	0.00	800	0	0
132	0.00	0.0	0	0	3.30	1	100	1	85	1.77	800	1415	100
133	8.74	3.3	29	29	3.30	96	100	96	85	0.00	800	0	0
134	2.90	6.0	17	6	3.30	57	35	20	85	0.00	800	0	0
135	16.80	12.0	202	70	3.30	665	35	231	85	0.00	800	0	0
136	103.01	3.4	350	203	3.30	1156	58	670	85	0.00	800	0	0
137	0.00	0.0	0	0	3.30	1	100	1	85	1.00	800	3655	22
138	5.40	18.0	97	0	3.30	321	0	0	85	0.00	800	0	0
139	0.00	0.0	0	0	3.30	1	100	1	85	22.00	800	24846	71
140	4.38	12.0	53	53	3.30	173	100	173	85	0.00	800	0	0
141	0.00	0.0	0	0	3.30	1	100	1	85	1.11	800	886	100
142	20.08	1.0	20	13	3.30	66	65	43	85	0.00	800	0	0
143	0.00	0.0	0	0	3.30	1	100	1	85	0.85	800	677	100
144	15.90	2.5	40	35	3.30	131	88	116	85	0.00	800	0	0
145	37.33	5.4	202	192	3.30	665	95	634	85	0.00	800	0	0
146	0.00	0.0	0	0	3.30	1	100	1	85	15.28	0	0	100
147	26.18	6.9	180	180	3.30	594	100	594	85	0.00	800	0	0
148	36.74	2.3	86	43	3.30	282	50	142	85	0.00	800	0	0
149	24.58	4.6	113	113	3.30	373	100	373	85	0.00	800	0	0
150	97.13	2.2	214	203	3.30	705	95	670	85	0.00	800	0	0
151	27.88	0.6	15	15	3.30	51	98	50	85	0.00	800	0	0
152	10.67	18.0	192	42	3.30	634	22	139	85	0.00	800	0	0
153	0.00	0.0	0	0	3.30	1	100	1	85	3.25	800	5246	50
154	0.00	0.0	0	0	3.30	1	100	1	85	62.89	9304	585112	100
155	0.00	0.0	0	0	3.30	1	100	1	85	20.00	800	22361	72
156	34.50	6.1	211	211	3.30	696	100	696	85	0.00	800	0	0

G_ID	R_LU_AREA (ACRES)	R_DENSITY	R_BO_ UNITS	R_CURRENT _UNITS	R_PPDU	RES_POP	RES_ ACTIVE(%)	ACTIVE POP	RES_CPC	C_IMP_AREA (AC)	C_GPAD	COM_VOL	COM_ ACTIVE (%)
157	187.88	2.7	498	419	3.30	1643	84	1383	85	0.00	800	0	0
158	0.00	0.0	0	0	3.30	1	100	1	85	72.06	0	0	100
159	61.60	4.8	296	281	3.30	976	95	927	85	0.00	800	0	0
160	0.00	0.0	0	0	3.30	1	100	1	85	3.79	800	3032	100
161	0.00	0.0	0	0	3.30	1	100	1	85	35.00	800	44774	63
162	20.61	2.5	51	51	3.30	168	100	168	85	0.00	800	0	0
163	0.00	0.0	0	0	3.30	1	100	1	85	5.00	800	5655	71
164	5.96	7.6	45	45	3.30	149	100	149	85	0.00	800	0	0
165	0.00	0.0	0	0	3.30	1	100	1	85	13.38	400	5354	100
166	0.00	0.0	0	0	3.30	1	100	1	85	2.03	800	1620	100
167	124.73	3.1	386	386	3.30	1273	100	1274	85	0.00	800	0	0
168	120.53	2.6	307	308	3.30	1014	100	1016	85	0.00	800	0	0
169	73.35	1.5	110	110	3.30	363	100	363	85	0.00	800	0	0
170	52.25	2.2	115	112	3.30	379	97	370	85	0.00	800	0	0
171	0.00	0.0	0	0	3.30	1	100	1	85	10.38	0	0	100
172	112.12	2.3	258	258	3.30	851	100	851	85	0.00	800	0	0
173	0.00	0.0	0	0	3.30	1	100	1	85	10.44	0	0	100
174	30.35	1.8	54	54	3.30	178	100	178	85	0.00	800	0	0
175	71.63	1.4	100	96	3.30	331	96	317	85	0.00	800	0	0
176	143.03	1.9	266	266	3.30	878	100	878	85	0.00	800	0	0
177	14.12	0.8	11	9	3.30	37	80	30	85	0.00	800	0	0
178	0.00	0.0	0	0	3.30	1	100	1	85	50.00	850	72898	58
179	24.57	6.5	160	0	3.30	527	0	0	85	0.00	800	0	0
180	95.30	2.4	231	231	3.30	761	100	762	85	0.00	800	0	0
181	20.81	6.5	135	0	3.30	446	0	0	85	0.00	800	0	0
182	0.00	0.0	0	0	3.30	1	100	1	85	0.00	850	2129	0
183	0.00	0.0	0	0	3.30	1	100	1	85	11.00	850	13688	68
184	0.00	0.0	0	0	3.30	1	100	1	85	30.00	2090	102973	61
185	6.39	12.0	77	0	3.30	253	0	0	85	0.00	800	0	0
186	0.00	0.0	0	0	3.30	1	100	1	85	12.00	800	14967	64
187	0.00	0.0	0	0	3.30	1	100	1	85	8.50	800	16538	41
188	53.27	3.0	160	160	3.30	527	100	528	85	0.00	800	0	0
189	0.00	0.0	0	0	3.30	1	100	1	85	24.00	800	32310	59
190	56.38	3.6	200	200	3.30	660	100	660	85	0.00	800	0	0
191	0.00	0.0	0	0	3.30	1	100	1	85	12.00	800	23865	40
192	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	2173	0
193	9.73	6.1	59	59	3.30	195	100	195	85	0.00	800	0	0
194	33.69	4.2	143	143	3.30	471	100	472	85	0.00	800	0	0
195	0.00	0.0	0	0	3.30	1	100	1	85	2.02	800	1613	100
196	0.00	0.0	0	0	3.30	1	100	1	85	13.50	800	12691	85
197	0.00	0.0	0	0	3.30	1	100	1	85	0.00	0	0	0
198	44.71	5.4	239	239	3.30	789	100	789	85	0.00	800	0	0
199	117.49	1.1	130	128	3.30	430	98	422	85	0.00	800	0	0
200	50.82	2.8	143	143	3.30	471	100	472	85	0.00	800	0	0
201	11.85	3.0	36	36	3.30	119	100	119	85	0.00	800	0	0
202	21.86	16.5	360	360	2.50	899	100	900	85	0.00	800	0	0
203	20.75	3.9	80	80	3.30	264	100	264	85	0.00	800	0	0
204	0.00	0.0	0	0	3.30	1	100	1	85	0.00	0	0	0
205	38.33	4.4	167	167	3.30	551	100	551	85	0.00	800	0	0
206	2.97	2.5	7	4	3.30	24	54	13	85	0.00	800	0	0
207	17.83	1.6	29	29	3.30	96	100	96	85	0.00	800	0	0
208	62.89	2.5	157	157	3.30	519	100	518	85	0.00	800	0	0
209	0.00	0.0	0	0	3.30	1	100	1	85	11.92	800	9535	100
210	28.67	18.0	516	0	3.30	1703	0	0	85	0.00	800	0	0
211	0.00	0.0	0	0	3.30	1	100	1	85	40.00	800	63647	50
212	0.00	0.0	0	0	3.30	1	100	1	85	16.00	800	15967	80
213	51.32	2.2	111	111	3.30	366	100	366	85	0.00	800	0	0
214	103.08	3.4	350	350	3.30	1157	100	1155	85	0.00	800	0	0
215	108.64	4.0	429	429	3.30	1416	100	1416	85	0.00	800	0	0
216	3.36	5.7	19	19	3.30	63	100	63	85	0.00	800	0	0
217	63.35	3.7	234	235	3.30	773	100	776	85	0.00	800	0	0
218	0.00	0.0	0	0	3.30	1	100	1	85	19.60	800	19603	80
219	8.16	12.0	98	98	3.30	323	100	323	85	0.00	800	0	0
220	13.58	1.6	22	22	3.30	73	100	73	85	0.00	800	0	0
221	78.71	2.5	196	196	3.30	647	100	647	85	0.00	800	0	0
222	99.63	2.7	268	268	3.30	884	100	884	85	0.00	800	0	0
223	0.00	0.0	0	0	3.30	1	100	1	85	0.00	0	0	0
224	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	19558	0
225	0.00	0.0	0	0	3.30	1	100	1	85	14.80	800	73078	16
226	12.18	1.5	18	18	3.30	60	100	59	85	0.00	800	0	0
227	2.68	4.5	12	0	3.30	40	0	0	85	0.00	800	0	0
228	15.23	7.0	106	106	3.30	350	100	350	85	0.00	800	0	0
229	82.70	2.3	190	170	3.30	628	89	561	85	0.00	800	0	0
230	162.81	2.5	402	112	3.30	1327	28	370	85	0.00	800	0	0
231	10.66	3.0	32	0	3.30	106	0	0	85	0.00	800	0	0
232	0.00	0.0	0	0	3.30	1	100	1	85	61.09	1230	75146	100
233	0.00	0.0	0	0	3.30	1	100	1	85	204.16	800	163328	100
234	0.00	0.0	0	0	3.30	1	100	1	85	0.00	700	106846	0

G_ID	R_LU_AREA (ACRES)	R_DENSITY	R_BO_ UNITS	R_CURRENT _UNITS	R_PPDU	RES_POP	RES_ ACTIVE(%)	ACTIVE POP	RES_CPC	C_IMP_AREA (AC)	C_GPAD	COM_VOL	COM_ ACTIVE (%)
235	0.00	0.0	0	0	3.30	1	100	1	85	417.00	800	677977	49
236	0.00	0.0	0	0	3.30	1	100	1	85	73.45	400	29380	100
237	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	7240	0
238	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	14464	0
239	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	85178	0
240	17.91	12.0	215	0	3.30	709	0	0	85	0.00	800	0	0
241	19.25	3.1	60	0	3.30	197	0	0	85	0.00	800	0	0
242	0.00	0.0	0	0	3.30	1	100	1	85	0.00	0	0	0
243	60.19	2.8	171	171	3.30	564	100	564	85	0.00	800	0	0
244	0.00	0.0	0	0	3.30	1	100	1	85	16.85	0	0	100
245	33.92	2.5	83	83	3.30	274	100	274	85	0.00	800	0	0
246	92.50	3.0	276	276	3.30	910	100	911	85	0.00	800	0	0
247	139.27	2.7	377	378	3.30	1245	100	1247	85	0.00	800	0	0
248	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	10823	0
249	183.44	2.5	462	418	3.30	1525	90	1379	85	0.00	800	0	0
250	0.00	0.0	0	0	3.30	1	100	1	85	43.00	800	53788	64
251	0.00	0.0	0	0	3.30	1	100	1	85	82.00	800	78466	84
252	0.00	0.0	0	0	3.30	1	100	1	85	36.00	800	43947	66
253	95.35	2.7	253	253	3.30	834	100	835	85	0.00	800	0	0
254	25.78	3.0	76	76	3.30	251	100	251	85	0.00	800	0	0
255	0.00	0.0	0	0	3.30	1	100	1	85	10.29	800	8232	100
256	0.00	0.0	0	0	3.30	1	100	1	85	4.80	800	5635	68
257	0.00	0.0	0	0	3.30	1	100	1	85	1.75	200	350	100
258	0.00	0.0	0	0	3.30	1	100	1	85	3.00	800	57181	4
259	25.96	12.0	312	0	3.30	1028	0	0	85	0.00	800	0	0
260	54.50	12.0	654	430	2.00	1308	66	860	85	0.00	800	0	0
261	0.00	0.0	0	0	3.30	1	100	1	85	34.00	800	304762	9
262	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	202459	0
263	0.00	0.0	0	0	3.30	1	100	1	85	3.70	800	28720	10
264	0.00	0.0	0	0	3.30	1	100	1	85	20.00	400	16311	49
265	0.00	0.0	0	0	3.30	1	100	1	85	16.00	400	18720	34
266	63.60	1.9	118	98	3.30	388	83	323	85	0.00	800	0	0
267	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	6036	0
268	76.30	1.9	147	81	3.30	486	55	267	85	0.00	800	0	0
269	0.00	0.0	0	0	3.30	1	100	1	85	3.07	0	0	100
270	21.85	2.2	47	47	3.10	146	100	146	85	0.00	800	0	0
271	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	16351	0
272	17.96	2.5	45	0	3.10	139	0	0	85	0.00	800	0	0
273	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	12707	0
274	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	7773	0
275	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	10461	0
276	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	18430	0
277	30.65	7.2	219	177	3.10	679	81	549	85	0.00	800	0	0
278	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	3568	0
279	23.49	5.3	123	123	3.10	382	100	381	85	0.00	800	0	0
280	0.00	0.0	0	0	3.30	1	100	1	85	1.96	800	1567	100
281	84.09	2.9	241	241	3.10	748	100	747	85	0.00	800	0	0
282	101.61	2.8	286	272	3.10	885	95	843	85	0.00	800	0	0
283	21.99	2.0	44	41	3.10	136	93	127	85	0.00	800	0	0
284	27.56	2.7	73	73	3.10	226	100	226	85	0.00	800	0	0
285	89.59	1.8	157	145	3.10	486	92	450	85	0.00	800	0	0
286	0.00	0.0	0	0	3.30	1	100	1	85	10.53	0	0	100
287	11.66	1.5	17	17	3.10	53	100	53	85	0.00	800	0	0
288	119.82	3.1	365	290	3.10	1133	79	899	85	0.00	800	0	0
289	0.00	0.0	0	0	3.30	1	100	1	85	9.70	0	0	100
290	58.79	3.0	176	0	3.10	547	0	0	85	0.00	800	0	0
291	32.25	6.5	210	0	3.10	650	0	0	85	0.00	800	0	0
292	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	14179	0
293	67.63	2.5	169	169	3.30	558	100	558	85	0.00	800	0	0
294	34.54	2.5	87	87	3.30	287	100	287	85	0.00	800	0	0
295	28.90	2.5	72	72	3.30	237	100	238	85	0.00	800	0	0
296	0.00	0.0	0	0	3.30	1	100	1	85	21.26	0	0	100
297	0.00	0.0	0	0	3.30	1	100	1	85	57.17	0	0	100
298	14.08	12.0	169	0	3.30	557	0	0	85	0.00	800	0	0
299	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	49676	0
300	0.00	0.0	0	0	3.30	1	100	1	85	13.12	2510	32938	100
301	0.00	0.0	0	0	3.30	1	100	1	85	5.14	0	0	100
302	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	5290	0
303	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	2816	0
304	45.66	3.8	172	0	3.30	568	0	0	85	0.00	800	0	0
305	10.97	4.0	44	0	3.30	145	0	0	85	0.00	800	0	0
306	9.50	4.0	38	0	3.30	125	0	0	85	0.00	800	0	0
307	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	43167	0
308	214.17	3.8	803	0	3.30	2650	0	0	85	0.00	800	0	0
309	32.20	12.0	386	0	3.30	1275	0	0	85	0.00	800	0	0
310	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	4667	0
311	62.50	6.5	406	0	3.30	1341	0	0	85	0.00	800	0	0
312	221.03	3.0	663	0	3.30	2188	0	0	85	0.00	800	0	0

G_ID	R_LU_AREA (ACRES)	R_DENSITY	R_BO_ UNITS	R_CURRENT _UNITS	R_PPDU	RES_POP	RES_ ACTIVE(%)	ACTIVE POP	RES_CPC	C_IMP_AREA (AC)	C_GPAD	COM_VOL	COM_ ACTIVE (%)
313	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	5443	0
314	21.37	6.5	139	0	3.30	458	0	0	85	0.00	800	0	0
315	67.19	12.0	806	0	3.30	2661	0	0	85	0.00	800	0	0
316	10.90	10.0	109	5	3.30	360	5	17	85	0.00	800	0	0
317	1.83	1.1	2	2	3.30	7	100	7	85	0.00	800	0	0
318	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	7412	0
319	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	94811	0
320	39.28	2.1	82	0	3.10	256	0	0	85	0.00	800	0	0
321	26.16	12.0	314	0	3.10	973	0	0	85	0.00	800	0	0
322	63.26	3.0	190	0	3.10	588	0	0	85	0.00	800	0	0
323	16.00	1.0	16	7	3.30	53	44	23	85	0.00	800	0	0
324	0.00	0.0	0	0	3.30	1	100	1	85	56.00	800	55313	81
325	20.2	2.3	46	3	3.30	153	6	10	85	0.00	800	0	0
326	17.1	4.9	84	84	3.30	277	100	277	85	0.00	800	0	0
327	0.0	0.0	0	0	3.30	1	100	1	85	1.50	800	2326	52
328	0.0	0.0	0	0	3.30	1	100	1	85	109.88	40	4395	100
329	0.0	0.0	0	0	3.30	1	100	1	85	6.00	800	18657	26
330	237.79	3.5	832	0	3.30	2746	0	0	85	0.00	800	0	0
331	48.61	6.5	316	0	3.30	1043	0	0	85	0.00	800	0	0
332	37.55	6.5	244	0	3.30	805	0	0	85	0.00	800	0	0
333	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	11237	0
334	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	13835	0
335	43.05	6.5	280	0	3.30	924	0	0	85	0.00	800	0	0
336	136.53	3.5	478	0	3.30	1577	0	0	85	0.00	800	0	0
337	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	15919	0
338	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	11404	0
339	49.50	6.5	322	0	3.30	1062	0	0	85	0.00	800	0	0
340	133.40	3.5	467	0	3.30	1541	0	0	85	0.00	800	0	0
341	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	8310	0
342	204.68	3.5	716	0	3.30	2364	0	0	85	0.00	800	0	0
343	298.25	3.5	1044	0	3.30	3445	0	0	85	0.00	800	0	0
344	354.70	3.5	1241	0	3.30	4097	0	0	85	0.00	800	0	0
345	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	11221	0
346	23.01	6.5	150	0	3.30	494	0	0	85	0.00	800	0	0
347	65.85	3.5	230	0	3.30	761	0	0	85	0.00	800	0	0
348	31.62	6.5	206	0	3.30	678	0	0	85	0.00	800	0	0
349	18.78	6.5	122	0	3.30	403	0	0	85	0.00	800	0	0
350	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	21775	0
351	188.32	3.5	659	0	3.30	2175	0	0	85	0.00	800	0	0
352	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	17428	0
353	140.00	3.5	490	0	3.30	1617	0	0	85	0.00	800	0	0
354	112.41	3.5	393	0	3.30	1298	0	0	85	0.00	800	0	0
355	49.38	6.5	321	0	3.30	1059	0	0	85	0.00	800	0	0
356	68.82	3.5	241	0	3.30	795	0	0	85	0.00	800	0	0
357	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	19967	0
358	38.43	6.5	250	0	3.30	824	0	0	85	0.00	800	0	0
359	192.41	3.5	673	0	3.30	2222	0	0	85	0.00	800	0	0
360	257.61	3.5	902	0	3.30	2975	0	0	85	0.00	800	0	0
361	273.08	3.5	956	0	3.30	3154	0	0	85	0.00	800	0	0
362	49.21	6.5	320	0	3.30	1056	0	0	85	0.00	800	0	0
363	102.47	3.5	359	0	3.30	1184	0	0	85	0.00	800	0	0
364	101.24	6.5	658	0	3.30	2172	0	0	85	0.00	800	0	0
365	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	37246	0
366	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	93249	0
367	90.60	3.5	317	0	3.30	1046	0	0	85	0.00	800	0	0
368	269.09	3.5	942	0	3.30	3108	0	0	85	0.00	800	0	0
369	404.14	3.5	1414	0	3.30	4668	0	0	85	0.00	800	0	0
370	265.28	3.5	928	0	3.30	3064	0	0	85	0.00	800	0	0
371	228.88	3.5	801	0	3.30	2644	0	0	85	0.00	800	0	0
372	40.62	3.5	142	0	3.30	469	0	0	85	0.00	800	0	0
373	21.87	3.5	77	0	3.30	253	0	0	85	0.00	800	0	0
374	7.37	6.5	48	0	3.30	158	0	0	85	0.00	800	0	0
375	45.78	3.5	160	0	3.30	529	0	0	85	0.00	800	0	0
376	0.00	0.0	0	0	3.30	1	100	1	85	0.00	800	71300	0
377	90.16	3.5	316	0	3.30	1041	0	0	85	0.00	800	0	0
378	27.60	12.0	331	0	3.30	1093	0	0	85	0.00	800	0	0

APPENDIX B

Ultimate System Land Use Database (2030)

FIELD NAME DESCRIPTIONS

FIELD	DESCRIPTION
G_ID	Land Use Identification Number number assigned by Hydra
R_LU_AREA	Total Land Use Area (acres)
R_DENSITY	Residential Density (dwelling units per acre)
R_BO_UNITS	Total Undeveloped residential area (acres)
R_CURRENT_UNITS	Total number of residential active connections
R_PPDU	Number of people per dwelling unit
RES_POP	Total ultimate population in land use
RES_ACTIVE (%)	Percent of the total pop. contributing flow. Used to adjust ultimate pop. to existing pop.
ACTIVE_POP	Population at Model Year
RES_CPC	Flow contribution (gallons per person per day)
C_IMP_AREA (AC)	Total developed Commercial Area (acres)
C_GPAD	Commercial contribution (gallons per acre per day)
COM_VOL	Total ultimate commercial flow (gallons)
COM_ACTIVE (%)	Percent of the total ultimate flow injected. Used to adjust ultimate flow to existing flow

G_ID	R_LU_AREA (ACRES)	R_DENSITY	R_BO_ UNITS	R_CURRENT _UNITS	R_PPDU	RES_POP	RES_ ACTIVE(%)	ACTIVE POP	RES_CPC	C_IMP_AREA (AC)	C_GPAD	COM_VOL	COM_ ACTIVE(%)
1	29.50	18.5	547	547	2.80	1531	100	1531	85	0.00	800	0	0
2	48.55	2.0	99	99	3.30	326	100	326	85	0.00	800	0	0
3	38.53	2.5	94	94	3.30	312	100	312	85	0.00	800	0	0
4	6.86	18.5	127	127	2.80	356	100	356	85	0.00	800	0	0
5	39.36	20.0	787	787	2.80	2204	100	2204	85	0.00	800	0	0
6	7.57	2.5	19	19	3.30	62	100	62	85	0.00	800	0	0
7	0.00	0.0	0	0	3.30	1	100	1	85	17.44	850	14825	100
8	0.00	0.0	0	0	3.30	1	100	1	85	3.07	850	2612	100
9	20.17	7.1	143	143	3.30	472	100	472	85	0.00	800	0	0
10	10.05	5.9	59	59	3.30	195	100	195	85	0.00	800	0	0
11	0.00	0.0	0	0	3.30	1	100	1	85	2.42	850	2061	100
12	19.47	18.5	360	360	2.80	1009	100	1009	85	0.00	800	0	0
13	0.00	0.0	0	0	3.30	1	100	1	85	57.00	850	48451	100
14	0.00	0.0	0	0	3.30	1	100	1	85	9.85	850	8374	100
15	55.97	3.7	204	204	3.30	674	100	674	85	0.00	800	0	0
16	0.00	0.0	0	0	3.30	1	100	1	85	2.88	850	2450	100
17	41.56	3.1	130	130	3.30	429	100	429	85	0.00	800	0	0
18	3.02	12.0	36	36	3.30	119	100	119	85	0.00	800	0	0
19	0.00	0.0	0	0	3.30	1	100	1	85	10.02	0	0	100
20	110.07	2.5	275	275	3.30	908	100	908	85	0.00	800	0	0
21	0.00	0.0	0	0	3.30	1	100	1	85	54.99	800	43989	100
22	0.00	0.0	0	0	3.30	1	100	1	85	1.83	800	1465	100
23	0.00	0.0	0	0	3.30	1	100	1	85	60.34	800	48276	100
24	18.77	2.5	47	47	3.30	155	100	155	85	0.00	800	0	0
25	22.62	5.9	133	133	3.30	440	100	440	85	0.00	800	0	0
26	31.53	4.6	146	146	3.30	482	100	482	85	0.00	800	0	0
27	1.53	12.0	18	18	3.30	61	100	61	85	0.00	800	0	0
28	0.00	0.0	0	0	3.30	1	100	1	85	2.48	0	0	100
29	3.51	8.0	28	28	3.30	93	100	93	85	0.00	800	0	0
30	0.00	0.0	0	0	3.30	1	100	1	85	1.03	800	827	100
31	13.28	5.9	79	79	3.30	260	100	260	85	0.00	800	0	0
32	7.38	4.7	35	35	3.30	115	100	115	85	0.00	800	0	0
33	28.59	2.8	80	80	3.30	264	100	264	85	0.00	800	0	0
34	0.00	0.0	0	0	3.30	1	100	1	85	6.71	800	5366	100
35	7.87	2.0	16	16	3.30	52	100	52	85	0.00	800	0	0
36	21.74	5.4	118	118	3.30	389	100	389	85	0.00	800	0	0
37	0.00	0.0	0	0	3.30	1	100	1	85	2.63	800	2102	100
38	9.48	12.0	114	114	3.30	375	100	375	85	0.00	800	0	0
39	0.00	0.0	0	0	3.30	1	100	1	85	10.68	0	0	100
40	26.20	3.0	78	78	3.30	257	100	257	85	0.00	800	0	0
41	3.99	12.0	48	48	3.30	158	100	158	85	0.00	800	0	0
42	7.30	10.3	75	75	3.30	248	100	248	85	0.00	800	0	0
43	0.00	0.0	0	0	3.30	1	100	1	85	5.43	800	4341	100
44	50.27	3.9	195	195	3.30	644	100	644	85	0.00	800	0	0
45	0.00	0.0	0	0	3.30	1	100	1	85	16.46	800	13171	100
46	20.14	21.9	440	440	2.80	1232	100	1232	85	0.00	800	0	0
47	0.00	0.0	0	0	3.30	1	100	1	85	7.03	800	5625	100
48	9.75	12.0	117	117	3.50	409	100	409	85	0.00	800	0	0
49	32.60	3.3	108	108	3.30	356	100	356	85	0.00	800	0	0
50	13.98	4.9	69	69	3.30	226	100	226	85	0.00	800	0	0
51	2.36	12.0	28	28	3.30	94	100	94	85	0.00	800	0	0
52	0.00	0.0	0	0	3.30	1	100	1	85	7.83	500	3916	100
53	183.41	3.1	576	576	3.30	1901	100	1901	85	0.00	800	0	0
54	0.00	0.0	0	0	3.30	1	100	1	85	9.60	0	0	100
55	110.09	2.2	242	242	3.30	799	100	799	85	0.00	800	0	0
56	0.00	0.0	0	0	3.30	1	100	1	85	10.18	800	8148	100
57	0.00	0.0	0	0	3.30	1	100	1	85	55.79	800	44632	100
58	27.96	2.6	73	73	3.30	240	100	240	85	0.00	800	0	0
59	76.66	2.6	199	199	3.30	658	100	658	85	0.00	800	0	0
60	160.16	1.9	304	304	3.30	1004	100	1004	85	0.00	800	0	0
61	20.39	12.0	245	245	3.30	807	100	807	85	0.00	800	0	0
62	0.00	0.0	0	0	3.30	1	100	1	85	0.45	0	0	100
63	69.88	2.8	196	196	3.30	646	100	646	85	0.00	800	0	0
64	41.41	3.2	134	134	3.30	442	100	442	85	0.00	800	0	0
65	0.00	0.0	0	0	3.30	1	100	1	85	38.86	800	31087	100
66	11.19	6.1	68	68	3.30	224	100	224	85	0.00	800	0	0
67	56.99	3.2	183	183	3.30	604	100	604	85	0.00	800	0	0
68	3.66	2.8	10	10	3.30	34	100	34	85	0.00	800	0	0
69	0.00	0.0	0	0	3.30	1	100	1	85	6.82	800	5454	100
70	10.72	15.4	165	165	3.30	545	100	545	85	0.00	800	0	0
71	0.00	0.0	0	0	3.30	1	100	1	85	6.62	400	2649	100
72	0.00	0.0	0	0	3.30	1	100	1	85	32.44	0	0	100
73	119.95	3.1	367	367	3.30	1211	100	1211	85	0.00	800	0	0
74	0.00	0.0	0	0	3.30	1	100	1	85	4.62	800	3698	100
75	4.58	1.7	8	8	3.30	26	100	26	85	0.00	800	0	0
76	0.00	0.0	0	0	3.30	1	100	1	85	2.70	800	2159	100

G_ID	R_LU_AREA (ACRES)	R_DENSITY	R_BO_ UNITS	R_CURRENT _UNITS	R_PPDU	RES_POP	RES_ ACTIVE(%)	ACTIVE POP	RES_CPC	C_IMP_AREA (AC)	C_GPAD	COM_VOL	COM_ ACTIVE(%)
77	32.60	3.8	124	124	3.30	409	100	409	85	0.00	800	0	0
78	0.00	0.0	0	0	3.30	1	100	1	85	8.03	800	6427	100
79	0.00	0.0	0	0	3.30	1	100	1	85	15.79	800	12631	100
80	0.00	0.0	0	0	3.30	1	100	1	85	92.18	800	73744	100
81	27.54	5.7	158	158	3.30	522	100	522	85	0.00	800	0	0
82	0.00	0.0	0	0	3.30	1	100	1	85	3.85	800	3083	100
83	17.29	4.7	82	82	3.30	271	100	271	85	0.00	800	0	0
84	0.00	0.0	0	0	3.30	1	100	1	85	35.00	800	28001	100
85	0.00	0.0	0	0	3.30	1	100	1	85	7.06	800	5648	100
86	25.01	3.1	78	78	3.30	257	100	257	85	0.00	800	0	0
87	85.76	2.8	242	242	3.30	798	100	798	85	0.00	800	0	0
88	0.00	0.0	0	0	3.30	1	100	1	85	3.50	800	2801	100
89	0.00	0.0	0	0	3.30	1	100	1	85	2.24	800	1795	100
90	70.67	2.5	177	177	3.30	583	100	583	85	0.00	800	0	0
91	18.33	6.3	115	115	3.30	381	100	381	85	0.00	800	0	0
92	6.85	3.6	25	25	3.30	83	100	83	85	0.00	800	0	0
93	17.32	7.4	128	128	3.30	422	100	422	85	0.00	800	0	0
94	11.58	12.0	139	139	3.30	459	100	459	85	0.00	800	0	0
95	0.00	0.0	0	0	3.30	1	100	1	85	51.54	850	43810	100
96	4.94	2.4	12	12	3.30	40	100	40	85	0.00	800	0	0
97	18.55	12.0	223	223	3.30	735	100	735	85	0.00	800	0	0
98	0.00	0.0	0	0	3.30	1	100	1	85	19.64	850	16692	100
99	4.99	25.2	126	126	3.30	415	100	415	85	0.00	800	0	0
100	52.45	2.0	105	105	3.30	346	100	346	85	0.00	800	0	0
101	0.00	0.0	0	0	3.30	1	100	1	85	9.90	850	8419	100
102	26.39	1.2	32	32	3.30	105	100	105	85	0.00	800	0	0
103	0.00	0.0	0	0	3.30	1	100	1	85	2.18	850	1856	100
104	0.00	0.0	0	0	3.30	1	100	1	85	27.46	800	21970	100
105	11.45	12.0	137	137	3.30	454	100	454	85	0.00	800	0	0
106	34.97	2.7	93	93	3.30	306	100	306	85	0.00	800	0	0
107	9.25	12.0	111	111	3.30	366	100	366	85	0.00	800	0	0
108	16.37	1.4	23	23	3.30	76	100	76	85	0.00	800	0	0
109	10.79	1.4	15	15	3.30	50	100	50	85	0.00	800	0	0
110	19.70	12.0	236	236	3.30	780	100	780	85	0.00	800	0	0
111	0.00	0.0	0	0	3.30	1	100	1	85	11.58	850	9844	100
112	85.19	1.9	162	162	3.30	534	100	534	85	0.00	800	0	0
113	7.81	1.5	12	12	3.30	40	100	40	85	0.00	800	0	0
114	26.22	1.5	38	38	3.30	125	100	125	85	0.00	800	0	0
115	39.77	1.6	63	63	3.30	207	100	207	85	0.00	800	0	0
116	0.00	0.0	0	0	3.30	1	100	1	85	7.65	850	6504	100
117	72.31	3.2	228	228	3.30	752	100	752	85	0.00	800	0	0
118	0.00	0.0	0	0	3.30	1	100	1	85	8.63	400	3453	100
119	31.52	2.3	74	74	3.30	243	100	243	85	0.00	800	0	0
120	65.47	2.5	164	164	3.30	540	100	540	85	0.00	800	0	0
121	0.00	0.0	0	0	3.30	1	100	1	85	6.48	850	5507	100
122	0.00	0.0	0	0	3.30	1	100	1	85	3.01	800	2409	100
123	9.56	6.0	57	57	3.30	189	100	189	85	0.00	800	0	0
124	0.00	0.0	0	0	3.30	1	100	1	85	3.50	800	2799	100
125	60.82	2.5	152	152	3.30	502	100	502	85	0.00	800	0	0
126	97.55	2.5	244	244	3.30	805	100	805	85	0.00	800	0	0
127	28.73	2.7	78	78	3.30	256	100	256	85	0.00	800	0	0
128	7.93	12.5	99	99	3.30	327	100	327	85	0.00	800	0	0
129	4.63	12.0	56	56	3.30	183	100	183	85	0.00	800	0	0
130	0.00	0.0	0	0	3.30	1	100	1	85	38.69	800	30956	100
131	15.46	1.7	26	26	3.30	86	100	86	85	0.00	800	0	0
132	0.00	0.0	0	0	3.30	1	100	1	85	1.77	800	1415	100
133	8.74	3.3	29	29	3.30	96	100	96	85	0.00	800	0	0
134	2.90	6.0	17	17	3.30	57	100	57	85	0.00	800	0	0
135	16.80	12.0	202	202	3.30	665	100	665	85	0.00	800	0	0
136	103.01	3.4	350	350	3.30	1156	100	1156	85	0.00	800	0	0
137	0.00	0.0	0	0	3.30	1	100	1	85	4.57	800	3655	100
138	5.40	18.0	97	97	3.30	321	100	321	85	0.00	800	0	0
139	0.00	0.0	0	0	3.30	1	100	1	85	31.06	800	24846	100
140	4.38	12.0	53	53	3.30	173	100	173	85	0.00	800	0	0
141	0.00	0.0	0	0	3.30	1	100	1	85	1.11	800	886	100
142	20.08	1.0	20	20	3.30	66	100	66	85	0.00	800	0	0
143	0.00	0.0	0	0	3.30	1	100	1	85	0.85	800	677	100
144	15.90	2.5	40	40	3.30	131	100	131	85	0.00	800	0	0
145	37.33	5.4	202	202	3.30	665	100	665	85	0.00	800	0	0
146	0.00	0.0	0	0	3.30	1	100	1	85	15.28	0	0	100
147	26.18	6.9	180	180	3.30	594	100	594	85	0.00	800	0	0
148	36.74	2.3	86	86	3.30	282	100	282	85	0.00	800	0	0
149	24.58	4.6	113	113	3.30	373	100	373	85	0.00	800	0	0
150	97.13	2.2	214	214	3.30	705	100	705	85	0.00	800	0	0
151	27.88	0.6	15	15	3.30	51	100	51	85	0.00	800	0	0
152	10.67	18.0	192	192	3.30	634	100	634	85	0.00	800	0	0

G_ID	R_LU_AREA (ACRES)	R_DENSITY	R_BO_ UNITS	R_CURRENT _UNITS	R_PPDU	RES_POP	RES_ ACTIVE(%)	ACTIVE POP	RES_CPC	C_IMP_AREA (AC)	C_GPAD	COM_VOL	COM_ ACTIVE(%)
153	0.00	0.0	0	0	3.30	1	100	1	85	6.56	800	5246	100
154	0.00	0.0	0	0	3.30	1	100	1	85	62.89	9704	610267	100
155	0.00	0.0	0	0	3.30	1	100	1	85	27.95	800	22361	100
156	34.50	6.1	211	211	3.30	696	100	696	85	0.00	800	0	0
157	187.88	2.7	498	498	3.30	1643	100	1643	85	0.00	800	0	0
158	0.00	0.0	0	0	3.30	1	100	1	85	72.06	0	0	100
159	61.60	4.8	296	296	3.30	976	100	976	85	0.00	800	0	0
160	0.00	0.0	0	0	3.30	1	100	1	85	3.79	800	3032	100
161	0.00	0.0	0	0	3.30	1	100	1	85	55.97	800	44774	100
162	20.61	2.5	51	51	3.30	168	100	168	85	0.00	800	0	0
163	0.00	0.0	0	0	3.30	1	100	1	85	7.07	800	5655	100
164	5.96	7.6	45	45	3.30	149	100	149	85	0.00	800	0	0
165	0.00	0.0	0	0	3.30	1	100	1	85	13.38	400	5354	100
166	0.00	0.0	0	0	3.30	1	100	1	85	2.03	800	1620	100
167	124.73	3.1	386	386	3.30	1273	100	1273	85	0.00	800	0	0
168	120.53	2.6	307	307	3.30	1014	100	1014	85	0.00	800	0	0
169	73.35	1.5	110	110	3.30	363	100	363	85	0.00	800	0	0
170	52.25	2.2	115	115	3.30	379	100	379	85	0.00	800	0	0
171	0.00	0.0	0	0	3.30	1	100	1	85	10.38	0	0	100
172	112.12	2.3	258	258	3.30	851	100	851	85	0.00	800	0	0
173	0.00	0.0	0	0	3.30	1	100	1	85	10.44	0	0	100
174	30.35	1.8	54	54	3.30	178	100	178	85	0.00	800	0	0
175	71.63	1.4	100	100	3.30	331	100	331	85	0.00	800	0	0
176	143.03	1.9	266	266	3.30	878	100	878	85	0.00	800	0	0
177	14.12	0.8	11	11	3.30	37	100	37	85	0.00	800	0	0
178	0.00	0.0	0	0	3.30	1	100	1	85	85.76	850	72898	100
179	24.57	6.5	160	160	3.30	527	100	527	85	0.00	800	0	0
180	95.30	2.4	231	231	3.30	761	100	761	85	0.00	800	0	0
181	20.81	6.5	135	135	3.30	446	100	446	85	0.00	800	0	0
182	0.00	0.0	0	0	3.30	1	100	1	85	2.50	850	2129	100
183	0.00	0.0	0	0	3.30	1	100	1	85	16.10	850	13688	100
184	0.00	0.0	0	0	3.30	1	100	1	85	49.27	2090	102973	100
185	6.39	12.0	77	77	3.30	253	100	253	85	0.00	800	0	0
186	0.00	0.0	0	0	3.30	1	100	1	85	18.71	800	14967	100
187	0.00	0.0	0	0	3.30	1	100	1	85	20.67	800	16538	100
188	53.27	3.0	160	160	3.30	527	100	527	85	0.00	800	0	0
189	0.00	0.0	0	0	3.30	1	100	1	85	40.39	800	32310	100
190	56.38	3.6	200	200	3.30	660	100	660	85	0.00	800	0	0
191	0.00	0.0	0	0	3.30	1	100	1	85	29.83	800	23865	100
192	0.00	0.0	0	0	3.30	1	100	1	85	2.72	800	2173	100
193	9.73	6.1	59	59	3.30	195	100	195	85	0.00	800	0	0
194	33.69	4.2	143	143	3.30	471	100	471	85	0.00	800	0	0
195	0.00	0.0	0	0	3.30	1	100	1	85	2.02	800	1613	100
196	0.00	0.0	0	0	3.30	1	100	1	85	15.86	800	12691	100
197	0.00	0.0	0	0	3.30	1	100	1	85	13.74	0	0	100
198	44.71	5.4	239	239	3.30	789	100	789	85	0.00	800	0	0
199	117.49	1.1	130	130	3.30	430	100	430	85	0.00	800	0	0
200	50.82	2.8	143	143	3.30	471	100	471	85	0.00	800	0	0
201	11.85	3.0	36	36	3.30	119	100	119	85	0.00	800	0	0
202	21.86	16.5	360	360	2.50	899	100	899	85	0.00	800	0	0
203	20.75	3.9	80	80	3.30	264	100	264	85	0.00	800	0	0
204	0.00	0.0	0	0	3.30	1	100	1	85	9.03	0	0	100
205	38.33	4.4	167	167	3.30	551	100	551	85	0.00	800	0	0
206	2.97	2.5	7	7	3.30	24	100	24	85	0.00	800	0	0
207	17.83	1.6	29	29	3.30	96	100	96	85	0.00	800	0	0
208	62.89	2.5	157	157	3.30	519	100	519	85	0.00	800	0	0
209	0.00	0.0	0	0	3.30	1	100	1	85	11.92	800	9535	100
210	28.67	18.0	516	516	3.30	1703	100	1703	85	0.00	800	0	0
211	0.00	0.0	0	0	3.30	1	100	1	85	79.56	800	63647	100
212	0.00	0.0	0	0	3.30	1	100	1	85	19.96	800	15967	100
213	51.32	2.2	111	111	3.30	366	100	366	85	0.00	800	0	0
214	103.08	3.4	350	350	3.30	1157	100	1157	85	0.00	800	0	0
215	108.64	4.0	429	429	3.30	1416	100	1416	85	0.00	800	0	0
216	3.36	5.7	19	19	3.30	63	100	63	85	0.00	800	0	0
217	63.35	3.7	234	234	3.30	773	100	773	85	0.00	800	0	0
218	0.00	0.0	0	0	3.30	1	100	1	85	24.50	800	19603	100
219	8.16	12.0	98	98	3.30	323	100	323	85	0.00	800	0	0
220	13.58	1.6	22	22	3.30	73	100	73	85	0.00	800	0	0
221	78.71	2.5	196	196	3.30	647	100	647	85	0.00	800	0	0
222	99.63	2.7	268	268	3.30	884	100	884	85	0.00	800	0	0
223	0.00	0.0	0	0	3.30	1	100	1	85	13.54	0	0	100
224	0.00	0.0	0	0	3.30	1	100	1	85	24.45	800	19558	100
225	0.00	0.0	0	0	3.30	1	100	1	85	91.35	800	73078	100
226	12.18	1.5	18	18	3.30	60	100	60	85	0.00	800	0	0
227	2.68	4.5	12	12	3.30	40	100	40	85	0.00	800	0	0
228	15.23	7.0	106	106	3.30	350	100	350	85	0.00	800	0	0

G_ID	R_LU_AREA (ACRES)	R_DENSITY	R_BO_ UNITS	R_CURRENT _UNITS	R_PPDU	RES_POP	RES_ ACTIVE(%)	ACTIVE POP	RES_CPC	C_IMP_AREA (AC)	C_GPAD	COM_VOL	COM_ ACTIVE(%)
229	82.70	2.3	190	190	3.30	628	100	628	85	0.00	800	0	0
230	162.81	2.5	402	402	3.30	1327	100	1327	85	0.00	800	0	0
231	10.66	3.0	32	32	3.30	106	100	106	85	0.00	800	0	0
232	0.00	0.0	0	0	3.30	1	100	1	85	61.09	1820	111192	100
233	0.00	0.0	0	0	3.30	1	100	1	85	204.16	800	163328	100
234	0.00	0.0	0	0	3.30	1	100	1	85	152.64	700	106846	100
235	0.00	0.0	0	0	3.30	1	100	1	85	847.47	800	677977	100
236	0.00	0.0	0	0	3.30	1	100	1	85	73.45	400	29380	100
237	0.00	0.0	0	0	3.30	1	100	1	85	9.05	800	7240	100
238	0.00	0.0	0	0	3.30	1	100	1	85	18.08	800	14464	100
239	0.00	0.0	0	0	3.30	1	100	1	85	106.47	800	85178	100
240	17.91	12.0	215	215	3.30	709	100	709	85	0.00	800	0	0
241	19.25	3.1	60	60	3.30	197	100	197	85	0.00	800	0	0
242	0.00	0.0	0	0	3.30	1	100	1	85	11.39	0	0	100
243	60.19	2.8	171	171	3.30	564	100	564	85	0.00	800	0	0
244	0.00	0.0	0	0	3.30	1	100	1	85	16.85	0	0	100
245	33.92	2.5	83	83	3.30	274	100	274	85	0.00	800	0	0
246	92.50	3.0	276	276	3.30	910	100	910	85	0.00	800	0	0
247	139.27	2.7	377	377	3.30	1245	100	1245	85	0.00	800	0	0
248	0.00	0.0	0	0	3.30	1	100	1	85	13.53	800	10823	100
249	183.44	2.5	462	462	3.30	1525	100	1525	85	0.00	800	0	0
250	0.00	0.0	0	0	3.30	1	100	1	85	67.24	800	53788	100
251	0.00	0.0	0	0	3.30	1	100	1	85	98.08	800	78466	100
252	0.00	0.0	0	0	3.30	1	100	1	85	54.93	800	43947	100
253	95.35	2.7	253	253	3.30	834	100	834	85	0.00	800	0	0
254	25.78	3.0	76	76	3.30	251	100	251	85	0.00	800	0	0
255	0.00	0.0	0	0	3.30	1	100	1	85	10.29	800	8232	100
256	0.00	0.0	0	0	3.30	1	100	1	85	7.04	800	5635	100
257	0.00	0.0	0	0	3.30	1	100	1	85	1.75	200	350	100
258	0.00	0.0	0	0	3.30	1	100	1	85	71.48	800	57181	100
259	25.96	12.0	312	312	3.30	1028	100	1028	85	0.00	800	0	0
260	54.50	12.0	654	654	2.00	1308	100	1308	85	0.00	800	0	0
261	0.00	0.0	0	0	3.30	1	100	1	85	380.95	800	304762	9
262	0.00	0.0	0	0	3.30	1	100	1	85	253.07	800	202459	0
263	0.00	0.0	0	0	3.30	1	100	1	85	35.90	800	28720	100
264	0.00	0.0	0	0	3.30	1	100	1	85	40.78	400	16311	100
265	0.00	0.0	0	0	3.30	1	100	1	85	46.80	400	18720	100
266	63.60	1.9	118	118	3.30	388	100	388	85	0.00	800	0	0
267	0.00	0.0	0	0	3.30	1	100	1	85	7.55	800	6036	100
268	76.30	1.9	147	147	3.30	486	100	486	85	0.00	800	0	0
269	0.00	0.0	0	0	3.30	1	100	1	85	3.07	0	0	100
270	21.85	2.2	47	47	3.10	146	100	146	85	0.00	800	0	0
271	0.00	0.0	0	0	3.30	1	100	1	85	20.44	800	16351	100
272	17.96	2.5	45	45	3.10	139	100	139	85	0.00	800	0	0
273	0.00	0.0	0	0	3.30	1	100	1	85	15.88	800	12707	100
274	0.00	0.0	0	0	3.30	1	100	1	85	9.72	800	7773	100
275	0.00	0.0	0	0	3.30	1	100	1	85	13.08	800	10461	100
276	0.00	0.0	0	0	3.30	1	100	1	85	23.04	800	18430	100
277	30.65	7.2	219	219	3.10	679	100	679	85	0.00	800	0	0
278	0.00	0.0	0	0	3.30	1	100	1	85	4.46	800	3568	100
279	23.49	5.3	123	123	3.10	382	100	382	85	0.00	800	0	0
280	0.00	0.0	0	0	3.30	1	100	1	85	1.96	800	1567	100
281	84.09	2.9	241	241	3.10	748	100	748	85	0.00	800	0	0
282	101.61	2.8	286	286	3.10	885	100	885	85	0.00	800	0	0
283	21.99	2.0	44	44	3.10	136	100	136	85	0.00	800	0	0
284	27.56	2.7	73	73	3.10	226	100	226	85	0.00	800	0	0
285	89.59	1.8	157	157	3.10	486	100	486	85	0.00	800	0	0
286	0.00	0.0	0	0	3.30	1	100	1	85	10.53	0	0	100
287	11.66	1.5	17	17	3.10	53	100	53	85	0.00	800	0	0
288	119.82	3.1	365	365	3.10	1133	100	1133	85	0.00	800	0	0
289	0.00	0.0	0	0	3.30	1	100	1	85	9.70	0	0	100
290	58.79	3.0	176	176	3.10	547	100	547	85	0.00	800	0	0
291	32.25	6.5	210	210	3.10	650	100	650	85	0.00	800	0	0
292	0.00	0.0	0	0	3.30	1	100	1	85	17.72	800	14179	100
293	67.63	2.5	169	169	3.30	558	100	558	85	0.00	800	0	0
294	34.54	2.5	87	87	3.30	287	100	287	85	0.00	800	0	0
295	28.90	2.5	72	72	3.30	237	100	237	85	0.00	800	0	0
296	0.00	0.0	0	0	3.30	1	100	1	85	21.26	0	0	100
297	0.00	0.0	0	0	3.30	1	100	1	85	57.17	0	0	100
298	14.08	12.0	169	169	3.30	557	100	557	85	0.00	800	0	0
299	0.00	0.0	0	0	3.30	1	100	1	85	62.09	800	49676	100
300	0.00	0.0	0	0	3.30	1	100	1	85	13.12	2510	32938	100
301	0.00	0.0	0	0	3.30	1	100	1	85	5.14	0	0	100
302	0.00	0.0	0	0	3.30	1	100	1	85	6.61	800	5290	100
303	0.00	0.0	0	0	3.30	1	100	1	85	3.52	800	2816	100
304	45.66	3.8	172	172	3.30	568	100	568	85	0.00	800	0	0

G_ID	R_LU_AREA (ACRES)	R_DENSITY	R_BO_ UNITS	R_CURRENT _UNITS	R_PPDU	RES_POP	RES_ ACTIVE(%)	ACTIVE POP	RES_CPC	C_IMP_AREA (AC)	C_GPAD	COM_VOL	COM_ ACTIVE(%)
305	10.97	4.0	44	44	3.30	145	100	145	85	0.00	800	0	0
306	9.50	4.0	38	38	3.30	125	100	125	85	0.00	800	0	0
307	0.00	0.0	0	0	3.30	1	100	1	85	53.96	800	43167	100
308	214.17	3.8	803	803	3.30	2650	100	2650	85	0.00	800	0	0
309	32.20	12.0	386	386	3.30	1275	100	1275	85	0.00	800	0	0
310	0.00	0.0	0	0	3.30	1	100	1	85	5.83	800	4667	100
311	62.50	6.5	406	406	3.30	1341	100	1341	85	0.00	800	0	0
312	221.03	3.0	663	663	3.30	2188	100	2188	85	0.00	800	0	0
313	0.00	0.0	0	0	3.30	1	100	1	85	6.80	800	5443	100
314	21.37	6.5	139	139	3.30	458	100	458	85	0.00	800	0	0
315	67.19	12.0	806	806	3.30	2661	100	2661	85	0.00	800	0	0
316	10.90	10.0	109	109	3.30	360	100	360	85	0.00	800	0	0
317	1.83	1.1	2	2	3.30	7	100	7	85	0.00	800	0	0
318	0.00	0.0	0	0	3.30	1	100	1	85	9.27	800	7412	100
319	0.00	0.0	0	0	3.30	1	100	1	85	118.51	800	94811	100
320	39.28	2.1	82	82	3.10	256	100	256	85	0.00	800	0	0
321	26.16	12.0	314	314	3.10	973	100	973	85	0.00	800	0	0
322	63.26	3.0	190	190	3.10	588	100	588	85	0.00	800	0	0
323	16.00	1.0	16	16	3.30	53	100	53	85	0.00	800	0	0
324	0.00	0.0	0	0	3.30	1	100	1	85	69.14	800	55313	100
325	20.16	2.3	46	46	3.30	153	100	153	85	0.00	800	0	0
326	17.10	4.9	84	84	3.30	277	100	277	85	0.00	800	0	0
327	0.00	0.0	0	0	3.30	1	100	1	85	2.91	800	2326	100
328	0.00	0.0	0	0	3.30	1	100	1	85	109.88	40	4395	100
329	0.00	0.0	0	0	3.30	1	100	1	85	23.32	800	18657	100
330	237.79	3.5	832	832	3.30	2746	100	2746	85	0.00	800	0	0
331	48.61	6.5	316	316	3.30	1043	100	1043	85	0.00	800	0	0
332	37.55	6.5	244	244	3.30	805	100	805	85	0.00	800	0	0
333	0.00	0.0	0	0	3.30	1	100	1	85	14.05	800	11237	100
334	0.00	0.0	0	0	3.30	1	100	1	85	17.29	800	13835	100
335	43.05	6.5	280	280	3.30	924	100	924	85	0.00	800	0	0
336	136.53	3.5	478	478	3.30	1577	100	1577	85	0.00	800	0	0
337	0.00	0.0	0	0	3.30	1	100	1	85	19.90	800	15919	100
338	0.00	0.0	0	0	3.30	1	100	1	85	14.26	800	11404	100
339	49.50	6.5	322	322	3.30	1062	100	1062	85	0.00	800	0	0
340	133.40	3.5	467	467	3.30	1541	100	1541	85	0.00	800	0	0
341	0.00	0.0	0	0	3.30	1	100	1	85	10.39	800	8310	100
342	204.68	3.5	716	716	3.30	2364	100	2364	85	0.00	800	0	0
343	298.25	3.5	1044	1044	3.30	3445	100	3445	85	0.00	800	0	0
344	354.70	3.5	1241	1241	3.30	4097	100	4097	85	0.00	800	0	0
345	0.00	0.0	0	0	3.30	1	100	1	85	14.03	800	11221	100
346	23.01	6.5	150	150	3.30	494	100	494	85	0.00	800	0	0
347	65.85	3.5	230	230	3.30	761	100	761	85	0.00	800	0	0
348	31.62	6.5	206	206	3.30	678	100	678	85	0.00	800	0	0
349	18.78	6.5	122	122	3.30	403	100	403	85	0.00	800	0	0
350	0.00	0.0	0	0	3.30	1	100	1	85	27.22	800	21775	100
351	188.32	3.5	659	659	3.30	2175	100	2175	85	0.00	800	0	0
352	0.00	0.0	0	0	3.30	1	100	1	85	21.79	800	17428	100
353	140.00	3.5	490	490	3.30	1617	100	1617	85	0.00	800	0	0
354	112.41	3.5	393	393	3.30	1298	100	1298	85	0.00	800	0	0
355	49.38	6.5	321	321	3.30	1059	100	1059	85	0.00	800	0	0
356	68.82	3.5	241	241	3.30	795	100	795	85	0.00	800	0	0
357	0.00	0.0	0	0	3.30	1	100	1	85	24.96	800	19967	100
358	38.43	6.5	250	250	3.30	824	100	824	85	0.00	800	0	0
359	192.41	3.5	673	673	3.30	2222	100	2222	85	0.00	800	0	0
360	257.61	3.5	902	902	3.30	2975	100	2975	85	0.00	800	0	0
361	273.08	3.5	956	956	3.30	3154	100	3154	85	0.00	800	0	0
362	49.21	6.5	320	320	3.30	1056	100	1056	85	0.00	800	0	0
363	102.47	3.5	359	359	3.30	1184	100	1184	85	0.00	800	0	0
364	101.24	6.5	658	658	3.30	2172	100	2172	85	0.00	800	0	0
365	0.00	0.0	0	0	3.30	1	100	1	85	46.56	800	37246	100
366	0.00	0.0	0	0	3.30	1	100	1	85	116.56	800	93249	100
367	90.60	3.5	317	317	3.30	1046	100	1046	85	0.00	800	0	0
368	269.09	3.5	942	942	3.30	3108	100	3108	85	0.00	800	0	0
369	404.14	3.5	1414	1414	3.30	4668	100	4668	85	0.00	800	0	0
370	265.28	3.5	928	928	3.30	3064	100	3064	85	0.00	800	0	0
371	228.88	3.5	801	801	3.30	2644	100	2644	85	0.00	800	0	0
372	40.62	3.5	142	142	3.30	469	100	469	85	0.00	800	0	0
373	21.87	3.5	77	77	3.30	253	100	253	85	0.00	800	0	0
374	7.37	6.5	48	48	3.30	158	100	158	85	0.00	800	0	0
375	45.78	3.5	160	160	3.30	529	100	529	85	0.00	800	0	0
376	0.00	0.0	0	0	3.30	1	100	1	85	89.12	800	71300	100
377	90.16	3.5	316	316	3.30	1041	100	1041	85	0.00	800	0	0
378	27.60	12.0	331	331	3.30	1093	100	1093	85	0.00	800	0	0