Indiana Utility Regulatory Commission

Utility Center Water System
Allen County, Indiana

WATER SYSTEM OPERATIONS AUDIT

PHASES 1 & 2

OCTOBER 12, 2012 & NOVEMBER 30, 2012

Prepared by:

CRAWFORD, MURPHY & TILLY, INC.
8790 Purdue Road
Indianapolis, Indiana 46268

RICHARD T. BERNARD
REGISTERED
No.
PE10911065
STATE OF
INDIANA
PROFESSIONAL ENGINEER

SIGNATURE

11/30/2012
DATE

CMT

TABLE OF CONTENTS

EXHIBITS

Phase 2

EXHIBITS

PREFACE

This report presents the results of an independent audit that investigated the recent water pressure and service issues in the Aqua Indiana, Inc. Utility Center Water System for the Indiana Utility Regulatory Commission (IURC). This audit and report were developed in two stages. The first stage, Phase 1 investigation and report, was completed prior to the second stage, the Phase 2 investigation and report. The Phase 1 Report, as issued by the IURC, is included in this Final Report as originally submitted, and without major revisions. There are some isolated corrections to the Phase 1 Report that have been included and are noted as such (refer to pages 2, 11A, 12 & 13). This final report includes both the Phase 1 and Phase 2 reports.

It should be noted that references in the Phase 1 Report to IDEM 327 IAC 8 requirements are based upon CMT's analysis and are a conservative application, employed for this audit, as a means of motivating and quantifying the need for reserve capacity. References to IDEM requirements should not be interpreted to indicate that IDEM has reviewed and concurred specifically with CMT's calculations of production capacity.

It should be noted that for this audit the definition of "rated capacity" in 327 IAC 8-3.3-1(3) is interpreted to include the total pump head at each well pump during normal operating conditions. Pump capacities based on discharge rates developed under well test procedures that do not duplicate actual operating conditions are not included in this audit.

EXECUTIVE SUMMARY

An independent audit investigated the recent water pressure and service issues in the Aqua Indiana, Inc. Utility Center Water System for the Indiana Utility Regulatory Commission. For this report, the new Well #11 was investigated as an in-kind replacement for the current Ft. Wayne connection, current water consumption levels and system capacity were analyzed to verify that the purchase of water from the Fort Wayne water system is no longer required, and the necessity of continuing with the Ft. Wayne connection was determined.

The practices of Aqua Indiana, Inc. relating to the recent water pressure and service issues were investigated and compared to current industry standards and practices.

During the investigation it was noted that the Utility Center Water System did not achieve its listed production capacity during the recent period of water pressure and service issues. A comprehensive evaluation of the Utility Center Water System facilities should be undertaken to determine the cause of this shortfall. For the purposes of this report, the causes of this shortfall will be assumed to have no effect on the reported capacity of Well #11 and its resulting increase in total system capacity.

The conclusions of the Phase 1 audit are as summarized follows:

1. The current Fort Wayne connection is not providing industry-standard fire protection for the isolated area that it supplies.
2. The addition of Well #11 along with seasonally declining water use should allow for the purchase of water from the Fort Wayne connection, which comes at substantially higher cost than self-produced water, to be discontinued for the current time.
3. When customer water usage increases, the purchase of water from Fort Wayne must resume until the limitations on water production and rated capacities at the Utility Center facilities are addressed.
4. The three existing connections to the Fort Wayne water system are required to supplement the pumping capacity of the wells by adding purchased water capacity and maintain the IDEM requirement[(a)] for reserve capacity.

(a) Refer to Preface for clarification regarding the application of IDEM requirements to this report.

Phase 2

The conclusions reached in the Phase 2 audit include:

1. The recent period of water supply and service issues occurred when several factors that are typical of peak water usage periods combined to increase the system water demand and decrease water production. High temperatures and dry conditions increased customer usage and water loss due to water main breaks. Wells were out of service for repairs and replaced with lower-capacity back-up wells. Prolonged pumping at higher rates may have led to a decrease in water production from the aquifer. None of these factors were unprecedented but their combined effect pushed the Utility Center system beyond its water production capacity.
2. Aqua's procedures during the recent water pressure and service issues followed industry practices but their planning prior to those events did not. The Utility Center system relies on the combined capacity of all wells to meet peak customer demand. Water industry standards highlight the need for reserve capacity. When water demand increases or production decreases unexpectedly, the reserve capacity is available to supply customers and avoid water pressure and service issues such as those experienced by the Utility Center water system in 2012.
3. Until adequate reserve capacity is added from additional wells or other source, connection to the Fort Wayne water system should be included in the Utility Center water master plan. The benefit to water production realized by the addition of Well #11 is limited by the capacity of the treatment plant that it supplies. Connection to the Fort Wayne water system is necessary to supplement the inadequate reserve pumping capacity in the Utility Center water system.
4. Planning is needed for the next period of high customer demand when the purchase of water from Fort Wayne resumes. Improvements are needed to avoid compromising the fire flow available to Utility Center customers. Treatment plant improvements can achieve compatible water quality such that there will be no need to isolate an area to be served by Fort Wayne and no sacrifice of fire protection to that isolated area. Improved connection to Fort Wayne and water mains serving the isolated customers could be developed such that the needed fire flow to the isolated area is provided from the Fort Wayne connection alone.
5. Pursuing water conservation ordinances at the city and county level is recommended to support water master planning and mitigate rate increases that would be needed for additional peak production capacity.
6. The Water Master Plan adequately addressed the growth in customer base, water production, and water storage needs when it was developed. Reserve capacity to meet peak system water demand in accordance with industry standards was not addressed. The current water master plan should be revised to include growth in customers and water production that reflect current growth rates and needs for reserve water supply capacity from additional wells and the connection to the Fort Wayne water system.

WATER SYSTEM OPERATIONS AUDIT

PHASE 1

Report Submitted October 12, 2012

Corrections made to the Phase 1 Report after its release by the IURC are noted.

1.0 Purpose of Audit and Report

A. This audit has been conducted as an independent investigation for the Indiana Utility Regulatory Commission (IURC). This audit was conducted to investigate recent water pressure and service issues in the Aqua Indiana Inc. (Aqua) Utility Center Water System (UCWS) service area.

B. The focus of the report is to address the following topics as developed by the IURC.

Phase 1

1. Verify that Aqua's Well #11 will be an in-kind replacement for the current Ft. Wayne connection.
2. Verify whether current water consumption levels and system capacity are such that the purchase of water from the Fort Wayne water system is no longer required .
3. Verify whether it is necessary to continue with the Ft. Wayne connection at this time using a cost benefit and sufficiency of service analysis.

Phase 2

4. Assuming proposed Well #11 goes on line, what role if any should a connection to Ft. Wayne have in Aqua's master plan?
5. Does the current master plan need to be supported by conservation ordinances at the city/or county level?
6. Review and analyze the existing water system master plan to ensure that adequacy of supply and pressure for the next 10 years is properly addressed.
7. Review and analyze Aqua's procedures addressing recent water pressure and service issues to determine whether they are compatible with current industry standards.

C. The method of the investigation is to compare Aqua’s records and practices, as reported by Aqua and evaluated by CMT, regarding the recent water pressure and service issues with the following:

1. Industry standards and recommendations developed by the American Water Works Association (AWWA),
2. Recommended Standards for Water Works, a Report of the Water Supply Committee of the Great Lakes—Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (10 States Standards).
3. Current industry practice,
4. Article 8, Public Water Supply, of Title 327 of the Indiana Administrative Code (327 IAC 8), and
5. Requirements of the Indiana Department of Environmental Management (IDEM).

2.0 General Description of the Utility Center Water System

2.01 Indiana Department of Environmental Management (IDEM) Information:

IDEM Water System Name:	AQUA INDIANA – ABOITE
Water System Number:	IN5202014
Address:	1111 W Hamilton Rd S
	Fort Wayne IN 46814
Population Served:	24,890
Service Connections:	10,371(1)

Components of this system are depicted schematically in Exhibit A and B and are summarized as follows:

2.02 Source:

A. There are eleven wells that supply water to one of the three water treatment plants.

1. Wells #1, #2, #3, and #4 are located in a single well field and supply water to the Aboite Water Treatment Plant. Due to their lower head capacity, Wells #1 and #2 are available for operation only when Wells #3 and #4 are not operating.
2. Wells #5, #6, and #7 are located in a single well field and supply water to the Covington Water Treatment Plant. Due to its lower head capacity, Well #7 is available for operation only when Wells #5 and #6 are not operating.
3. Wells #8, #9, and #10 are located in a single well field and supply water to the Chestnut Water Treatment Plant. Well #11, which is located next to the Chestnut Water Treatment Plant, was drilled in 2001, and a submersible pump was installed in August 2012.

B. The available information for these wells is summarized in Exhibit C.

2.03 Supply:

A. There are three water treatment plants that supply water to the UCWS as follows.

1. The Chestnut Hills Water Treatment Plant is located in the northwest portion of the system and is located on Illinois Road (State Road 14).
2. The Covington Water Treatment Plant is located in the western portion of the system and is located south of Covington Road.
3. The Aboite Water Treatment Plant is located in the central portion of the system on Turf Lane.

(1) The 10,371 customer count is the number of residential service connections taken from the IDEM Drinking Water Watch website. After release of the Phase 1 Report, Aqua has indicated that as of November 7, the total customer count is 12,560.

B. Each water treatment plant treats water with the following similar processes and equipment:

1. Iron removal is accomplished with the addition of chlorine for oxidation and manganese-greensand pressure filtration.
2. Softening is accomplished by ion exchange in pressure vessels.
3. Disinfection is by addition of chlorine gas to provide a free chlorine, disinfectant residual.

C. There are three interconnects to the Fort Wayne water system that are in place for purchased water capacity. The Fort Wayne connection, that is currently in use, is found on Montclair Drive as shown in Exhibit A. The second interconnect is found on Covington Road at Getz Road, and the third interconnect is found on West Jefferson Boulevard (US 24) at South Bend Drive. All three interconnects are normally closed.

2.04 Storage:

A. The UCWS has three elevated storage tanks with a total storage volume of 3.0 million gallons.

1. Aboite Elevated Tank is a 500,000 gallon legged tank located on Bronco Drive and is near the Aboite Water Treatment Plant.
   a. Capacity: 500,000 gallons
   b. Elevation of top capacity line: 971 feet
2. Covington Elevated Tank is a 1,500,000 gallon composite tank located south of Covington Road near the Covington Water Treatment Plant.
   a. Capacity: 1,500,000 gallons
   b. Elevation of top capacity line: 972 feet.
3. Lafayette Meadows Elevated Tank is a 1,000,000 gallon composite tank located on Huntington Road at the south end of the system.
   a. Capacity: 1,000,000 gallons
   b. Elevation of top capacity line: 971 feet.

2.05 Distribution:

A. The UCWS distribution system provides water to customers as a single pressure zone system as shown in Exhibit A.

B. To address the recent pressure and service issues, an area of approximately 1,300 customers was isolated from the UCWS distribution system to form a second, isolated service area (ISA), shown in Exhibit B, to be served by water supplied from the Fort Wayne water system.

1. The ISA was created by closing seven valves along the southern limit of the area. These valves are on five 8-inch, one 10-inch, and one 12-inch diameter water mains.

2. The ISA is supplied entirely by water from the Fort Wayne water system through an interconnect located on Montclair Drive at the northeast edge of the UCWS.
3. This current Fort Wayne connection (FWC) is reported by Aqua staff to include a six-inch turbine meter with check valve and isolation valves.
4. Creation of the ISA was necessary because the disinfectant residual in the Fort Wayne water system is not compatible with the disinfectant residual in the UCWS. If water supplied by the UCWS were to mix with water supplied through the FWC, the incompatible disinfectants would combine to form an ineffective disinfectant residual and could result in unsafe drinking water that would not meet IDEM requirements.

2.06 **Customers:**

A. Exhibit D presents the history of customer counts by class for 2004 through August 2012.

B. Exhibit E presents the history of metered water sold by class for 2004 through August 2012.

C. Exhibit F presents the monthly metered water sold and customer counts by class for 2011 through August 2012.

D. From the data in Exhibits D, E and F, the average daily usage for residential customers is assumed to be 190 gallons per day for this audit. Note that the average daily usage per residential customer during the months of June and July 2012 was 327 gallons per day.

2.07 **System Capacity:**

A. Current system capacities were provided by Aqua for this audit and are summarized as follows:

1.	Aboite Plant treatment capacity	1,728,000 gallons per day
2.	Covington Plant treatment capacity	2,000,000 gallons per day
3.	Chestnut Hills Plant treatment capacity	4,000,000 gallons per day
4.	Total Plant treatment capacity	7,728,000 gallons per day
5.	Aboite Wellfield total capacity	1,490,400 gallons per day
6.	Covington Wellfield total capacity	1,056,960 gallons per day
7.	Chestnut Hills Wellfield total capacity	3,912,480 gallons per day

Note that the Chestnut Hills well capacity as listed does not include Well #11.

8.	Total Pumping Capacity	6,459,840 gallons per day
9.	Firm Pumping Capacity	4,377,600 gallons per day

Note that firm capacity is calculated with the largest capacity pump out of service and includes only Wells #3, #4, #5, #6, #8 and #9. The total capacities listed above include only Wells #3, #4, #5, #6, #8, #9 and #10.

10. Two Year Average Peak 5,637,000 gallons per day

B. Two Year Average Peak, as defined by 327 IAC 8-1-3(12), is the arithmetic average of the highest five daily pumpages as reported over the previous two years. This was reported in the current calculations of system capacity, provided by Aqua for this audit, and confirmed by the audit from pumping records also provided by Aqua. [(a)]Water System Daily Capacity is determined according to 327 IAC 8-3.3-3 as the lesser of the capacity as determined by the current IDEM sanitary survey or the sum of all of the rated daily capacities of production wells less the largest capacity well. Based on the well capacity and plant production furnished by Aqua, the Water System Daily Capacity, Two Year Average Peak, and ratio of peak to capacity are as follows:

1.	Water System Daily Capacity (WSDC)	4,377,600 gallons per day
2.	Two Year Average Peak (TYAP)	5,637,000 gallons per day
3.	Ratio of TYAP to WSDC	129%
4.	IDEM requirement	90%

C. The Two Year Average Peak daily water demand exceeds 90-percent of the Water System Daily Capacity, as defined in 327 IAC 8-3.3-3, when this capacity is calculated on the basis of well pump capacity alone. In accordance with 327 IAC 8-3.3-3, purchased water capacity can be included in the calculation of Water System Daily Capacity. The capacity provided by the three connections to the Fort Wayne water system could provide that needed additional capacity. The 2001 Water Master Plan listed the combined capacity of the three connections to the Fort Wayne water system as being set by contract with the City of Fort Wayne at 2,000,000 gallons per day. Assuming that this contract remains in effect, the total UCWS capacity can be calculated to include purchased water as follows:

1.	Water System Daily Capacity (WSDC)	4,377,600 gallons per day
2.	Purchased water capacity	2,000,000 gallons per day
3.	Total Water System Daily Capacity (TWSDC)	6,377,600 gallons per day
4.	Two Year Average Peak (TYAP)	5,637,000 gallons per day
5.	Ratio of TYAP to TWSDC	88%
6.	IDEM requirement	90%

2.08 Recent Water Pressure and Service Issues:

A. The water pressure and service issues can be summarized as the failure of water production to meet customer demand in the UCWS during June 2012. Presumably,

(a) Refer to Preface for clarification regarding the application of IDEM requirements to this report.

the high demand can be attributed to drought conditions that resulted in increased irrigation throughout the UCWS.

B. It should be noted that, during this recent period of water pressure and service, daily well production did not exceed the historical maximum daily pumpages as presented in Exhibit I.

C. An analysis of the UCWS water storage tanks during June 2012 is presented in Exhibit G.

1. This analysis indicates that over a ten-day period the storage volume dropped substantially. Standard practice in the water industry is to fill system storage on a daily basis. As shown in Exhibit G, the total volume of water in storage declined during the period June 6 through 15. This cumulative storage deficit can be related to a daily average shortfall in water production.
   a. 6/6 – 6/15/2012 cumulative storage deficit 2,050,000 gallons
   b. Number of days 10 days
   c. Equivalent daily shortfall in water production 205,000 gallons per day.
2. According to UCWS records, the pumping capacity of the system is 6,459,840 gallons per day which is more than 1,150,000 gallons per day greater than the average actual plant production during the period of the production shortfall described above 5,308,400 gallons per day.
   a. Rated pumping capacity 6,459,840 gallons per day
   b. Average plant production 6/6-6/15/2012 5,308,400 gallons per day
   c. Excess rated capacity 1,151,440 gallons per day

D. Investigating the recent water pressure and service issues has led to the question of why, during this June 6 through June 15 period of the 2012 drought, the UCWS wells could not meet their rated and previously demonstrated capacity.

1. This is not a question regarding the validity of reported capacities and water production but a question as to what might have limited the capacity.
2. There is no indication that there has been any failure of Aqua's practices to meet industry standards regarding the recording and reporting of water pumpages and productions. On the contrary, it is the comprehensive records kept by Aqua that have allowed the identification of the capacity shortfall.
3. This issue of capacity shortfall should be resolved before the audit questions regarding Well #11 can be answered completely.

E. One possible explanation for the water production shortfall is stress on the aquifer.

1. Exhibit I presents well production information that is pertinent to stress on the aquifer during the drought. Total well production was tallied for periods of consecutive pumping during each year from 2003 to 2012. The total well pumpage for all periods of one, five, ten, thirty, sixty, and ninety consecutive days occurring in each year were calculated. The exhibit presents the maximum of these periods for each year.

   a. What can be seen from the exhibit is that the drought of 2012 did not result in the highest one-day, five-day, ten-day, or even 30-day pumpage.
   b. The drought of 2012 did set maximums for sixty-day and ninety-day well pumpage.
   c. It is these extended periods of maximum well pumpage that stress the aquifer capacity.
   d. Water levels at the wells during the drought period were not measured. Without this information, this discussion of drought stress on the aquifer and how it might relate to a loss of well production is only speculative.
2. Although the UCWS capacity shortfall might be explained by drought stress on the aquifer, there is not sufficient information to draw this conclusion.
   a. Additional engineering investigation into why the UCWS wells did not provide their rated capacity during the drought period is recommended.
   b. Monitoring of the static and pumping water levels at all of the UCWS wells could provide valuable information on the conditions in the aquifer.

3.0 Verify that Aqua's Well #11 will be an in-kind replacement for the current Fort Wayne connection.

3.01 Definition of In-Kind Replacement:

A. The question of in-kind replacement in this audit is one of capacities. Utility Center Water System (UCWS) records of system capacity, pumpage, and production, provided by Aqua, were reviewed and analyzed. Providing an answer to the question of whether Well #11 is an in-kind replacement for the Current Fort Wayne Connection (FWC) depends on the answer to the question of why the reported water production of the UCWS fell significantly short of its reported capacity during the recent period of water pressure and service issues. Without understanding what led to the limitation on water production during the time in question, the actual contribution of Well #11 to the UCWS can't be determined. The following discussion of in-kind replacement and conclusions presented below are based on the assumption that the stated capacity of Well #11 will result in an equivalent increase in the water production capacity of the UCWS.

B. A strict interpretation of in-kind replacement would not allow a comparison of Well #11 with the current Fort Wayne connection. For the purposes of this audit, in-kind replacement will be defined as delivering an equivalent level of adequacy, safety, and reliability in the supply of drinking water to the customers in the UCWS. This will include the supply of water for fire protection.

3.02 Comparison of Well #11 with Current Fort Wayne Connection:

A. Reliability of Service:

1. The FWC is a single point of connection at the east end of the isolated service area (ISA), described in Section 2.05, at an 8-inch water main.
2. Well #11 is connected to the ISA through the UCWS supply and distribution network which has seven points of connection along the southern border of the ISA.

B. Capacity for fire flow:

The best methods for comparison of fire flow capacity would be field testing and hydraulic modeling of the water system. There is a reasonable concern regarding the inability of the FWC to maintain sufficient service pressure throughout the ISA during a fire flow test which precluded such testing for this audit. Aqua has reported that calibration of Aqua's hydraulic model of the UCWS to field conditions has not been completed. The following discussion of capacity is intended to provide a comparison, in general, of the fire flow capacities provided by Well #11 and the FWC.

1. The AWWA rates a 6-inch, Type II, turbine meter at 1,400 gallons per minute maximum flow.

a. In a fire flow situation, it could be expected that the velocity of flow through the meter could exceed twenty feet per second and supply 1,900 gallons per minute.
b. The water pressure drop at the FWC during fire flow would be excessive and result in low pressures throughout the ISA and, perhaps, the need for a boil order after a fire event.

2. Standard practice in the water industry is to design the fire flow capacity of a water main at a maximum flow velocity of five feet per second.
   a. At a maximum velocity of five feet per second, the five 8-inch connections from the UCWS to the ISA could deliver up to 750 gallons per minute each.
   b. At a maximum velocity of five feet per second, the single 10-inch connection from the UCWS to the ISA could deliver up to 1,200 gallons per minute.
   c. At a maximum velocity of five feet per second, the single 12-inch connection from the UCWS to the ISA could deliver up to 1,800 gallons per minute.
3. Well #11 alone doesn't provide equivalent fire flow capacity to the FWC but, when the ISA is supplied by water from Well #11, the area is receiving water from the entire UCWS supply and distribution network. Under typical conditions, the fire flow capacity of the entire UCWS exceeds the fire flow capacity of the FWC.

C. Fire protection at the Whispering Meadows Elementary School:
1. Water from the FWC must travel 1.9 miles along a single path of 8-inch, 10-inch, and 12-inch diameter water main.
2. Water from Well #11 has multiple shorter paths of travel to reach the school.

D. Adequacy of Supply (non-fire flow):
1. Customer usage within the ISA can be calculated as follows:
   a. The current, 2011, UCWS average daily water production is 3,056,000.
   b. The current two year average peak daily water production is 5,637,000.
   c. Then the ratio of peak to average day is:

      5,637,000 gpd ÷ 3,056,000 gpd = 1.84

   d. As presented in Section 2.05, the current UCWS average daily water usage per average residential-class customer is 190 gallons per day. Based on the audit count of customers in the ISA, the average daily residential-class water usage in this area can be calculated as

      1,302 customers x 190 gpcpd = 247,000 gallons per day

   e. Based on the UCWS ratio of peak to average day, the peak customer usage in the ISA can be calculated as:

      247,000 gallons per day x 1.84 = 454,000 gallons per day

2. The ISA also includes Whispering Meadows Elementary School.
    a. Average usage for this customer in 2011 can be taken as 1,890 gallons per day which is the average daily usage for the public-class customers.
    b. At the peak to average day ratio calculated above, the peak daily usage can be calculated as:

       1,890 gallons per day x 1.84 = 3,480 gallons per day

    c. It should be noted that this calculation is over-predicting the peak usage since peak days typically occur during the months when school is not in session.
3. Then the total average day demand is 248,900 gallons per day
4. And the total peak day demand is 457,500 gallons per day
5. The AWWA rating for a Type II, turbine meter is 920 gallons per minute continuous flow. At this rating, the FWC meter has adequate capacity for average and peak day customer demands. This connection has been supplying an adequate supply of water, not considering fire flow, since it was opened in June 2012.
6. Well #11 is rated at 350 gallons per minute which is equivalent to 504,000 gallons per day and also has adequate capacity to supply the average and peak daily domestic usage demands, as calculated above.

E. Safety of Supply:

1. Water Quality: Based on 2011 Water Quality Reports for the UCWS and the Fort Wayne water system, water from the FWC and UCWS meet IDEM requirements for water quality.
2. Water Pressure:
    a. As discussed above regarding fire flow provided by the FWC, the connection would require high velocities in the single water main connection to supply fire flow. High flow velocities develop high pressure losses and it is expected that a fire flow event, whether a hydrant flow test or actual fire event, would result in service pressure in portions of the ISA falling below the minimum IDEM requirement for safety of the water system. A request that Aqua perform a flow test on a fire hydrant in the ISA for this audit was withdrawn when the potential for low pressures and resulting boil order due to the test was considered.
    b. Fire hydrant flow test data, supplied by Aqua for the audit, indicate adequate fire flows and pressure in the ISA when the area is not isolated from the UCWS.

3.03 Conclusions:

A. Based on a strict definition of “in-kind replacement” Aqua’s Well #11 is not an in-kind replacement for the current Fort Wayne connection.

1. Well #11 has a capacity of 350 gallons per minute and the FWC has a normal capacity of 920 gallons per minute which may be as high as 1,900 gpm during fire flow.
2. Well #11 potentially adds capacity to the UCWS supply but could be limited by UCWS treatment capacity in what it can deliver to customers. The FWC can deliver its full capacity to the water system.
3. The FWC can supply water only to an isolated area of UCWS customers, those customers must rely on the single source for their water supply. Well #11 supplies water to the entire UCWS and the customers served by Well #11 are supplied by multiple connections to multiple sources of water.

B. Although there is no question that the Fort Wayne water system has excellent capacity to supply the ISA, the single point of connection does not provide an adequate level of reliability, fire flow capacity, and service pressure during fire flow. Well #11 cannot supply fire flow to the ISA by itself. The well is connected to the area as a part of the UCWS supply, treatment, and distribution network which has better fire flow capacity than the FWC.

C. It should be noted that Well #11 adds pumping capacity to the Chestnut Hills water treatment plant. If this added capacity is to be realized by the UCWS, the reported capacity of the Chestnut Hills plant must be addressed.

1. At its reported capacity of 350 gallons per minute, Well #11 adds 504,000 gallons per day to the total capacity of the Chestnut Hills wellfield. As presented in Section 2.07, the reported capacity of the wellfield is 3,912,480 gallons per day and the reported treatment capacity of the plant is 4,000,000 gallons per day.
2. During the recent period of water pressure and supply issues, the UCWS was unable to meet customer demand with all wells at the well field operating. If the full capacity of Well #11 is to be added to the system, the plant capacity should be equal to or greater than the wellfield capacity. This plant capacity can be calculated as follows:

a.	Wellfield capacity without Well #11	3,912,480 gallons per day
b.	Well #11 capacity	504,000 gallons per day
c.	Required plant capacity	4,416,480 gallons per day
d.	Current plant capacity	4,000,000 gallons per day

3. How best to achieve this increase in plant capacity is beyond the scope of this audit and report.

D. As presented in Exhibit G and discussed in Section 2.08, the shortfall in water production from June 6 through 15, 2012 was 205,000 gallons per day. Well #11 can add more than twice this shortfall amount to the UCWS pumping capacity. If the treatment capacity of the Chestnut Hills plant is increased, this increase in pumping capacity from Well #11 can result in an increase in water supplied to UCWS customers.

This analysis was developed following the release of the Phase 1 Report

3.04 Hydraulic Modeling of Fire Flow in the ISA

After completion of the Phase 1 investigation, a copy of the UCWS steady-state hydraulic model was provided to CMT. Scenarios were created within the hydraulic model to determine the approximate static pressure and available fire flow to junction nodes within the ISA as shown in Exhibit J with supply from the UCWS and FWC.

A. It is CMT’s understanding that Aqua has not completed calibration of the UCWS steady-state hydraulic model and is currently reviewing the model for accuracy in terms of pipes, pipe diameters, initial settings, demands, etc. CMT has not calibrated or reviewed the model. Assumptions were made for the UCWS tank levels and hydraulic gradeline for the FWC. The results from the modified hydraulic model may not match actual field conditions; however, the results from UCWS and FWC supply can be compared to one another to determine the relative difference in fire flow capacity.

B. The first scenario created was for average day demand conditions with water supply from the UCWS. A summary of the model results is shown in Exhibit K.

1. The minimum available fire flow to junction nodes within the ISA is 515 gpm.
2. The maximum available fire flow to junction nodes is 1,892 gpm.
3. The average available fire flow to junction nodes is 1,165 gpm.

C. The second scenario created was for average day demand conditions with water supply from the FWC. A summary of the model results is shown in Exhibit K.

1. The minimum available fire flow to junction nodes within the ISA is 181 gpm.
2. The maximum available fire flow to junction nodes is 732 gpm.
3. The average available fire flow to junction nodes is 309 gpm.

D. As shown in Exhibit K, available fire flow from the FWC is significantly lower than available fire flow from the UCWS.

4.0 Verify whether current water consumption levels and system capacity are such that the purchase of water from the Fort Wayne water system is no longer required.

4.01 Description of Current Water Consumption Levels:

A. Exhibit H presents the monthly water production for the Utility Center Water System (UCWS). The 2012 data in this exhibit includes the water purchased from the Fort Wayne water system.

B. During July, August and September 2012, average daily water delivered to the system has fallen below June 2012 levels.

1. Average daily production for July decreased ~~10.4~~9.7%[a] from June.
2. Average daily production for August decreased ~~29.8~~29.3%[a] from June.
3. Average daily production for ~~July~~September[a] decreased ~~24.5~~23.9%[a] from June.
4. Average daily production for July through September 23 decreased 21.3% from June.

C. During July, August and September 2012, average daily water delivered to the system has fallen below 2011 levels for the same period.

1. Average daily production for July decreased 5.4% in 2012 from 2011.
2. Average daily production for August decreased 21.2% in 2012 from 2011.
3. Average daily production for ~~July~~September[a] increased ~~10.4~~20.0%[a] in 2012 from 2011.
4. Average daily production for July through September 23 decreased 8.0% in 2012 from 2011.

4.02 Description of System Capacity:

A. As discussed in Section 2.07, adequate system capacity, according to the Indiana Department of Environmental Management (IDEM) and 327 IAC 8-3.3-3, requires the capacity to purchase water from the Fort Wayne water system. It is not required to purchase that water on an on-going basis but the three Fort Wayne connections provide the required reserve system capacity that is not provided by the UCWS well pumps.

B. As discussed in Section 2.08, the UCWS was not able to produce water at its rated capacity during the period of water pressure and service issues.

4.03 Conclusions:

A. Unless well pumping capacity, in addition to Well #11, is added to the system, the Fort Wayne connections are required to provide UCWS with the reserve capacity needed to meet the regulated Water System Daily Capacity.

(a) *corrected after release of Phase 1 report*

B. Based on system information, customer demand in the UCWS (including the ISA) has fallen to within the capacity of the UCWS water supply as reported during June 2012. If customer demands follow the normal annual pattern for UCWS, this trend should continue until the peak demand season returns. Until such a time as the peak daily demands exceed the UCWS pumping capacity, the purchase of water from the Fort Wayne water system is no longer required.

C. As discussed in Section 2.08, there are significant questions regarding the difference between reported capacity and the quantity of water supplied during the period of recent water pressure and service issues. Although the July, August, and September 2012 water production and purchase information indicates that UCWS system capacity with Well #11 is adequate for current demands, a conclusive answer to the current need for the FWC can't be given without a physical investigation of the aquifer, wells, well pumps, treatment equipment, piping, valves, and instrumentation. The reported capacity of the UCWS was adequate for the recent period of water pressure and supply issues but, in reality, it proved to not be adequate.

D. It is not uncommon for the actual performance of pumping and treatment equipment to fall below the original rated capacity over time. The concern is that the maximum daily pumpage from wells was ~~40~~14[1] percent lower during the recent period of water pressure and service issues than in the previous five years. Prudent engineering judgement, where the health and safety of the public is concerned, is to recommend a physical evaluation of the UCWS facilities to determine the cause, or causes, of the capacity shortfall or, if no cause can be determined, to verify the water production capacity of the facilities.

(1) After release of the Phase 1 Report a typographical error was discovered and corrected. As shown in Exhibit I, the maximum daily pumpage from wells was 6.104 MG and 6.100 MG in 2007 and 2008, respectively. The maximum daily pumpage from wells during June 2012 was reported for this audit as 5.276 MG which is 86 percent of the 2007 and 2008 values.

5.0 Verify whether it is necessary to continue with the Fort Wayne connection at this time using a cost benefit and sufficiency of service analysis.

5.01 Cost of Water Delivered at Fort Wayne Connection:

A. Based on the schedule of rates and charges for the Utility Center Water System (UCWS) by the Fort Wayne water system, the charges for water supplied at the Current Fort Wayne Connection (FWC) are:

1. Monthly Demand Charge $7,217.44
2. Rate per hundred cubic feet (hcf) on metered usage $0.9686
3. Monthly Meter Charge $665.69

B. As calculated in Section 3.02, the average daily customer demand in the isolated service area (ISA), described in Section 2.05, is 248,900 gallons. This is equivalent to 90,848,500 gallons per year and 7,570,700 gallons for an average month. The average monthly charge is then calculated as:

Usage: 7,570,700 gallons x 0.001337 hcf/gallon = 10,122 hcf

10,122 hcf x $0.9686/hcf = $9,804.17

$7,217.44 + $9,804.17 + $665.69 = $17,687.30

2. The total cost per hundred cubic feet (hcf) for an average month for water supplied at the FWC can then be calculated as:

$17,687.30 ÷ 10,122 hcf = $1.75/hcf

5.02 Cost of Water Delivered by UCWS:

A. The equivalent cost for delivering water from the UCWS to the ISA can be calculated as the sum of pumping power costs and chemical costs for water treatment since all other costs would remain essentially unchanged whether water to the ISA is delivered through the UCWS or FWC. These costs were furnished by Aqua as:

1. Water pumped YTD through 8/31/2012 845,090,948 gallons 112,972,603 hcf
2. Power Costs YTD through 8/31/2012 $174,913
3. Chemical Costs YTD through 8/31/2012 $158,729
4. Power Costs per 100 cubic feet of water pumped $0.1548
5. Chemical Costs per 100 cubic feet of water pumped $0.1405

6. Then the total cost of water delivered by the UCWS is given as $0.2953 per hundred cubic feet.

5.03 Sufficiency of Service:

A. For this audit, sufficiency of service is taken to mean sufficient for all normal operating conditions. For the UCWS this would mean sufficient to meet average customer demands, peak customer demands, and fire flow demands.

B. As discussed in Section 2.07, the combination of well pump capacity and purchased water capacity is required to meet the water system daily capacity required by the Indiana Department of Environmental Management (IDEM) and 327 IAC 8.

C. As discussed in Section 2.05, above, the water delivered at the FWC should not be mixed with the UCWS water. This requires that the area of the UCWS that receives Fort Wayne water is isolated from the UCWS and provided with water from a single connection. As discussed in Sections 3.02 and 3.03, above, the single point of supply provided by the FWC is not anticipated to provide sufficient fire flow and pressure during fire flow events.

D. As discussed in Section 3.03, the rated capacity of the Chestnut Hills water treatment plant limits the total capacity of the Chestnut Hills wellfield and the benefit to the UCWS provided by Well #11.

E. As discussed in Section 2, issues related to the capacity shortfall that occurred during the recent period of water pressure and service issues need to be resolved before a determination of sufficiency of service can be made.

5.04 Conclusions:

A. Water purchased from the Fort Wayne water system costs substantially more than water produced by UCWS. Isolation of a part of the UCWS to allow water supply from the FWC results in insufficient fire flow and pressure service to the isolated area. This cost and limited benefit associated with the supply of water from the FWC makes the FWC best suited to use as a back-up water supply to be used when the UCWS production falls short of system demand.

B. Although it appears on paper that Well #11 can produce sufficient water to have met the water production shortfall observed during June 2012, the unanswered question about the cause of this shortfall and the limitation on the rated capacity of the Chestnut Hills water treatment plant prevent a recommendation regarding the sufficiency of Well #11.

WATER SYSTEM OPERATIONS AUDIT

PHASE 2

Report Submitted November 28, 2012

6.0 Assuming proposed Well #11 goes on line, what role if any should a connection to Ft. Wayne have in Aqua's master plan?

6.01 Introduction:

This question of the role of the Fort Wayne connections in the UCWS master plan is complex. To provide a basis for the answer the following issues must be addressed:

A. Calculation and discussion of the UCWS firm capacity for water production.
   1. IDEM's rated capacity for UCWS.
   2. Calculation of UCWS capacity based on current reported well capacities.
   3. Discussion of the limitation on the contribution of Well #11 to UCWS capacity.

B. Calculation of peak day pumpage and need for supplemental capacity.

C. Discussion of the challenges to using the Fort Wayne connections.
   1. Need for isolating area served by Fort Wayne water.
   2. Options for compatible water quality.
   3. Issues related to diversion of Great Lakes water.

6.02 UCWS water production capacity:

A. IDEM completed a sanitary survey of the UCWS facilities on October 9, 2012.
   1. This survey lists the production capacity at 6.8 million gallons per day. If the UCWS wells were able to pump water at this capacity during June 2012, the system would have experienced an excess in water supply capacity and there would have been no water pressure and service issues due to a shortfall in capacity.
   2. This capacity is higher than what is calculated in this audit. This may be due to the individual well capacities listed in the survey which are higher than the capacities reported by Aqua for this audit. These IDEM-listed capacities appear to be the rated capacities of the well pumps at the time of installation. Aqua reported that the 2011 capacities, used for the audit, are based on the most recent pump test or actual production pumping rates. Changes in total pump head due to changes at the treatment plant or in aquifer levels as well as normal pump wear could be responsible for the difference between the IDEM-listed capacities and the capacities presented in this audit.
   3. The well capacity available at each well is dependent on a number of factors including the influence of other wells in operation. As noted previously, the well capacities reported by Aqua are based on recent pump tests or actual production pumping rates. For this audit, it is unknown what the influencing conditions were at the time each well was tested. Therefore additional well production testing and analysis should be conducted to determine the actual pumping rates that can be expected from each well while other wells are in operation.

B. For this audit, calculation of the UCWS water production capacity will be based on the capacities reported for the audit. The production capacity of the system can be calculated as the sum of the production capacities of the three plants. The production capacity at each plant is the lesser of the treatment capacity and the well pumping capacity. The well pumping capacity at each plant is the sum of the individual well capacities reported at each plant. Wells that are reported as suitable for back-up service only will not be included in the totals. Although these three wells may be capable of producing water while the wells they back up are also in operation, those pumping rates are not known for this audit and the potential contribution of these wells to the UCWS production capacity will be excluded. In accordance with 327 IAC 8-3.3-3, firm capacity is calculated with the largest capacity well out of service for the system. These capacities are calculated as follows:

1. Well #1 (256 gpm) operates only when Well #3 or #4 is out of service.
2. Well #2 (308 gpm) operates only when Well #3 or #4 is out of service.
3. Well #3 585 gpm 842,400 gallons per day
4. Well #4 450 gpm 648,000 gallons per day
5. Aboite Plant Well Capacity 1,490,400 gallons per day
6. Aboite Plant Treatment Capacity 1,728,000 gallons per day
7. Aboite Plant Production Capacity 1,490,400 gallons per day
8. Well #5 383 gpm 551,520 gallons per day
9. Well #6 351 gpm 505,440 gallons per day
10. Well #7 (251 gpm) operates only when Well #5 or #6 is out of service.
11. Covington Plant Well Capacity 1,056,960 gallons per day
12. Covington Plant Treatment Capacity 2,000,000 gallons per day
13. Covington Plant Production Capacity 1,056,960 gallons per day
14. Well #8 323 gpm 465,120 gallons per day
15. Well #9 948 gpm 1,365,120 gallons per day
16. Well #10 1,446 gpm 2,082,240 gallons per day
17. Well # 11 350 gpm 504,000 gallons per day
18. Chestnut Hills Plant Well Capacity 4,416,480 gallons per day
19. Chestnut Hills Plant Treatment Capacity 4,000,000 gallons per day
20. Chestnut Hills Plant - Total Production Capacity with all wells 4,000,000 gallons per day
21. Chestnut Hills Plant - Firm Production Capacity with Well #11 and without Well #10 (327 IAC 8-3.3-3) 2,334,240 gallons per day
22. Total UCWS Production Capacity (all wells) 6,547,360 gallons per day
23. <u>Firm UCWS Production Capacity</u> (w/o Well #10) 4,881,600 gallons per day

It should be noted that this firm production capacity is calculated with the best information available for this audit which has resulted in a firm capacity that is based on four wells out of service and not one as required by 327 IAC 8-3.3-3.

C. An examination of the well and production capacities reveals a limitation on the contribution of Well #11 to the full production capacity of the system. Without Well #11, the Chestnut Hills well capacity is 3,912,480 gallons per day. Adding Well #11 increases the well pumping capacity to 4,416,480 gallons per day but the treatment capacity at the plant limits the production to 4,000,000 gallons per day. Thus the contribution of Well #11 is limited to 87,520 gallons per day and the total UCWS production capacity is increased from 6,459,840 gallons per day, reported for 2011, to the 6,547,360 gallons per day calculated above. This limitation does not affect the firm capacity since the Well #10 capacity is removed from the Chestnut Hills capacity for the calculation.

6.03 <u>Peak Day Pumpage and Supplemental Capacity:</u>

A. The current Two Year Average Peak is reported to be 5,637,000 gallons per day.

This is the average of the highest five peak demand in 2010 and 2011days as follows:

1. August 18, 2011 5,869,000 gallons per day
2. July 21, 2011 5,706,000 gallons per day
3. August 3, 2011 5,625,000 gallons per day
4. July 20, 2011 5,514,000 gallons per day
5. July 29, 2011 5,469,000 gallons per day
6. Average 5,637,000 gallons per day

B. As developed in 327 IAC 8-3-4.2, a water system should maintain capacity such that 90-percent of the water system firm capacity can provide the two-year average peak day production. It should be noted that this is not an absolute requirement for all water systems but it is the requirement to allow a water system to be free from restrictions on expansion to serve additional customers. Because the UCWS is a growth area, this is a reasonable application of the rule in 327 IAC 8-3-4.2 for this audit. Then the current required water system firm capacity is 6,263,300 gallons per day which provides the current two-year average peak day at 90-percent as follows:

6,263,300 gallons per day x 90% = 5,637,000 gallons per day

Therefore the additional capacity needed to meet the target system capacity can be calculated as the difference of the required firm capacity and the current firm capacity as follows:

6,263,300 gallons per day – 4,881,600 gallons per day = 1,381,700 gallons per day

Based on these calculations, supplemental capacity of at least 1,381,700 gallons per day is needed to meet the current required water system daily capacity. As noted previously, additional well production testing and analysis is recommended. The calculation of needed supplemental capacity should be re-evaluated when additional well production data is available.

6.04 Fort Wayne Connections:

There are three connections between the UCWS and the Fort Wayne water system as described in Section 2.03.C and shown in Exhibit A. As discussed in Section 2.07.C, these connections have been designated with capacity to provide 2 million gallons per day of purchased water capacity to supplement the well pumping capacity in the UCWS. The role for these Fort Wayne connections in the water master plan and the future of the UCWS depends upon a few issues as follows:

A. The disinfectants used in the UCWS and Fort Wayne water systems are not compatible. When mixed, the disinfectant residuals will, in effect, neutralize each other and leave the water with inadequate protection from microbial growth. To assist with the understanding of this issue, a detailed explanation regarding the disinfectant incompatibility is as follows:

1. Water systems are required to maintain a minimum concentration of disinfectant in the water throughout the distribution system. This is known as the disinfectant residual.
2. There are two types of disinfectant residual in question here.
   a. According to the 2011 Fort Wayne Water Quality Report, the water system carries an average disinfectant residual of 1.5 mg/L chloramine.
   b. According to the UCWS 2011 Water Quality Report, the UCWS carries an average disinfectant residual of 0.88 mg/L free chlorine.
3. When mixed with Fort Wayne water, the free chlorine residual in the UCWS will oxidize the chloramine residual in the Fort Wayne water. Depending upon the ratio of the mixture, this oxidation will exhaust the free chlorine and convert the chloramine to a lower concentration of a less effective disinfectant or eliminate it entirely. This could leave the water with inadequate protection from microbial contaminants.

B. As discussed previously in Phase 1 of this audit, this incompatibility is why Aqua requires that the waters be kept separate. This separation is accomplished by isolating a portion of the UCWS to receive only water supplied from the Fort Wayne System. With the connection as implemented in June 2012, the isolated area is supplied water by a single 6-inch meter and the capacity for fire flow is inadequate in the isolated area (refer to Section 3.02 for discussion).

C. The requirement for separation also requires that valves in the UCWS distribution system be closed to isolate the area and that the remaining UCWS water in the area be flushed out with the water from Fort Wayne. This makes initiating the flow of water from the Fort Wayne connections time consuming and limited to times when UCWS staff can be available for the necessary field operations.

D. These incompatible waters can be made compatible by changing the disinfectant residual. Two options are as follows:

1. The Fort Wayne water could be converted to free chlorine by feeding sufficient chlorine at the connection to eliminate the chloramine residual and leave a free chlorine residual.
2. The UCWS water treatment could be supplemented by feeding ammonia at the plants to convert the free chlorine to a chloramine residual in the UCWS.

E. The potential for the formation of disinfection by-products in the Fort Wayne water makes the option of converting the water to compatible free chlorine disinfection a poor choice. The 2011 Fort Wayne Water Quality Report indicates 47 micrograms per liter as the maximum level detected for the regulated total trihalomethanes (TTHM) and 45 micrograms per liter as the maximum level detected for the sum of the five regulated haloacetic acids (HAA5) in the water. These levels of disinfection byproduct are at 75 percent and 59 percent, respectively, of the regulated maximum contaminant level and would most likely increase above their regulated maximum level if the water were converted to a free chlorine residual. Free chlorine disinfection can result in unacceptable levels of disinfection byproducts where the formation potential exists. The presence of these byproducts in the Fort Wayne water when no free chlorine disinfection is used indicates significant byproduct formation potential.

F. Converting the UCWS disinfection to be compatible with Fort Wayne water could be a viable option for avoiding the compromise of needed fire flow to UCWS customers receiving Fort Wayne water. This option consists of adding a small quantity of ammonia to the UCWS water before it leaves the treatment plant. The ammonia would react with the chlorine, currently being added to the water, to form chloramines as used in Fort Wayne. This ammonia addition is in addition to the current treatment and disinfection and would not modify those existing processes.

1. The forms of ammonia available for water treatment are anhydrous ammonia gas, ammonium hydroxide solution, and ammonium sulfate which is available as a dry granules or solution. Because of the safety issues associated with anhydrous ammonia gas and ammonium hydroxide, ammonium sulfate, either dry or solution, is the recommended product for smaller facilities such as the UCWS plants.
2. The additional chemical costs associated with feeding ammonium sulfate are anticipated to be less than $0.02 per hundred cubic feet of treated water.
3. Capital costs for the treatment plant improvements could be less than $50,000 per plant but additional engineering design should be conducted to determine the actual cost of improvements.
4. Internal corrosion of water pipes can be associated with chloramine disinfection. UCWS can review their Lead and Copper Rule compliance monitoring with IDEM to determine if any changes in monitoring are warranted.

G. Another issue related to the use of the Fort Wayne connections is the issue of diversion of water from the Great Lakes watershed. The source of the Fort Wayne water supply is within the Maumee Watershed which is within the Great Lakes watershed. The UCWS is outside the Great Lakes watershed. For this audit, the Indiana Department of Natural Resources (IDNR) was contacted regarding the diversion of water from the Great Lakes Watershed. A baseline value had been assigned by IDNR for diversion of water by the Fort Wayne water system for compliance with the Great Lakes-St. Lawrence River Basin Water Resources Compact (Indiana Code 14-25-15). Based on this value, the supply of water by Fort Wayne to the UCWS complies with IC 14-25-15.

6.05 Conclusions:

A. Recommending a role for a connection to the Fort Wayne water system in Aqua's Water Master Plan is complicated:

1. Until additional well pumping and treatment capacity is added to the UCWS, the Fort Wayne connections are needed to meet reserve capacity requirements. If water demand, as experienced this past summer, returns the connections could be needed to meet that customer demand. Well #11 does not replace directly the capacity provided by the current Fort Wayne connection.
2. The current water master plan does not adequately address needs for additional water supply capacity.
3. The Fort Wayne connection, as implemented in June 2012, does not provide adequate fire flow to the area isolated for service. The fire flow capacity, normally provided to this area, has been sacrificed in order to use the Fort Wayne water to offset a water production shortfall in the UCWS.

B. Until another water supply alternative is made available for the short term, the connection to Fort Wayne water should be included in the water master plan.

1. It has been demonstrated this past summer that the UCWS needs the supplemental capacity.
2. The addition of Well #11 does not meet the need for water supply firm capacity in accordance with the application of 327 IAC 8 for this audit.
3. Future supply of water from the Fort Wayne connection should not result in compromising the fire flow to customers receiving Fort Wayne water. There are options for avoiding this compromise. Treatment improvements can be constructed at the UCWS plants to make the UCWS water compatible with the Fort Wayne water.
4. Alternately, if the compatibility of the water is not improved, the fire flow throughout the isolated service area could be improved. This could be accomplished by a combination of the following:
   a. Improvements to the Fort Wayne connection(s).
   b. Improvements to water mains in the isolated area.
   c. Additional Fort Wayne connections.
   d. Selection of an alternate area of the UCWS to isolate for supply with Fort Wayne water.

C. For the long term, development of additional well capacity could replace the capacity supplied by the Fort Wayne connection. If the well capacity needed to meet the water system daily capacity in accordance with 327 IAC 8 can't be provided, then the connection to Fort Wayne could be included in the master plan but should also include:

1. Planning for supply of Fort Wayne water to UCWS customers without compromising the needed fire flow.
2. Planning to include the higher cost of purchased water from Fort Wayne.

7.0 Does the current master plan need to be supported by conservation ordinances at the city/or county level?

7.01 UCWS Conservation Measures

The water conservation measures in the current rules and regulations for the UCWS were put into effect in June 2012. The following is a brief analysis of their effectiveness during the recent period of water pressure and service issues.

A. In the week prior to June 15, 2012, the average water production was 5.4 million gallons per day but the volume of water in storage had dropped from 1.6 million gallons on the 8th to 0.6 million gallons at noon on the 15th.

B. On June 15, 2012, Aqua issued a request for customers to water their lawns every other day in an effort to reduce demand by ten percent.

C. During the week after the request, plant production remained at about 5.3 million gallons per day and the water in storage had increased to 1.3 million gallons.

D. During this first week, the decrease in average plant production is a total of 0.7 million gallons and the increase in storage was 0.7 million gallons. The increase in stored water and decrease in plant production are together equal to an average of 0.2 million gallons per day or about 3.8 percent of the 5.3 million gallon average plant production per day over the period.

E. The second week after the request for conservation began with the addition of water from Fort Wayne to the system. The total water delivered to the system, plant production plus water purchased from Fort Wayne, was an average of 5.6 million gallons per day during this second week. If it is assumed that the water in storage increased from 1.6 million gallons to the maximum of 3.0 million gallons, the customer demand was an average of 5.4 million gallons per day.
   1. This is up from 5.3 million gallons per day in the previous week.
   2. During the week before the request for conservation, average plant production was 5.4 million gallons per day.

F. Beginning in the third week after the request for conservation, significant rainfall began to occur. The precipitation can be assumed to have resulted in a decrease in irrigation and total customer demand. The effect of the rain is sufficient to prevent further analysis of the effect of the request for conservation alone on customer usage.

G. In summary, the first week after the request for water conservation saw less than 4 percent decline in water usage. Water usage returned to pre-request levels during the second week after the request.

7.02 Indianapolis Conservation Measures

The City of Indianapolis and Marion County have included provisions for supporting and enforcing the water conservation policies of Citizens Water, the private utility that provides water supply to Indianapolis and Marion County. These provisions include voluntary water conservation, mandatory water conservation, civil penalties for violations of mandatory water conservation requirements, and enforcement of mandatory water conservation requirements by City Department of Code Enforcement.

A. With the support by the City/County government of the water conservation policies of the utility, Citizens Water, the water conservation measures implemented by Citizens Water in 2012 were effective in Marion County:

1. 06/29 Citizens Water issues request for voluntary water conservation.
2. 07/13 Mandatory conservation implemented.
3. 07/14 10% decline in water usage for first day of mandatory conservation.
4. 09/05 Mandatory water conservation lifted.
5. 09/14 Voluntary water conservation lifted.

B. Without the support of local ordinances for enforcement of water conservation, the water conservation measures implemented by Citizens Water during 2012 were not effective in Boone County until local government took action to implement enforcement.

1. 06/22 Citizens Water issues request for voluntary water conservation.
2. 06/29 Citizens Water issues mandatory water conservation in Zionsville.
3. 07/19 Due to ineffectiveness of Citizens Water measures, Town of Zionsville issues Emergency Executive Order to implement mandatory conservation with civil penalties for violations.
4. 09/05 Mandatory water conservation lifted.
5. 09/14 Voluntary water conservation lifted.

7.03 Conclusions:

A. Based on the limited evidence available, the current master plan should be supported by conservation ordinances at the city and county level. Without civil penalties being set and enforced by local government, the water conservation rules set by a private utility are not likely to be effective at reducing water use.

B. Without the support of city and county ordinances for mandatory water conservation, the UCWS master plan will need to include provisions for developing additional peak day supply and distribution capacity.

1. This additional capacity would be in excess of the level provided by most water systems but would be needed to accommodate higher peak day demand associated with no effective conservation measures.
2. The additional capacity will require higher water rates to cover the cost of additional wells and plant capacity to meet peak demand.

C. Support by local government of a private utility's conservation measures is not unprecedented and it is in the best interests of the citizens who would be subject to higher water rates without that support.

8.0 Review and analyze the existing water system master plan to ensure that adequacy of supply and pressure for the next 10 years is properly addressed.

8.01 Introduction

The Water Master Plan was evaluated regarding adequacy of supply and pressure for the next ten years, 2012 through 2021, by evaluating the following specific issues:

A. Growth in customer base and water usage.

B. Water system supply and pressure capacity, including:

1. Well pumping capacity.
2. Water treatment capacity.
3. Water storage capacity to meet peak hour and fire flow requirements.

8.02 The Current Water Master Plan:

A. A water master plan was developed for Utility Center, Inc. for the Aboite (UCWS) and North End Water System by Tetra Tech, Inc. This plan, entitled *Water Master Plan 2004-2006*, was filed with the Indiana Utility Regulatory Commission (IURC) on November 18, 2003 and was approved by the Commission's August 31, 2005 Order in Cause No. 41187. The IURC has no other master plans submitted by Aqua, Indiana. Thus, the portions of this water master plan that pertain to the UCWS Aboite system will be reviewed and evaluated as part of this audit. A copy of this plan is shown in Exhibit L.

B. The *Water Master Plan 2004-2006* contains a summary of the existing water systems, land use and population projections, proposed water system improvements, a water system management summary, and a master plan implementation schedule.

8.03 Growth in customer base and water usage:

A. Water Master Plan 2004-2006:

1. The population and water usage projections developed in the Water Master Plan 2004-2006 serve as the basis of the water master plan in order to identify well, treatment, and storage improvements needed for future growth. The plan does not follow a simple population growth model. Population projections were based on potential for development, housing development density, and population per housing unit. The calculations were carried out for each square mile section of the UCWS area and tabulated in a spreadsheet, included as Appendix B in the Water Master Plan 2004-2006.
2. This master plan does not state explicitly the base year. For the purposes of this audit it will be assumed that the base year is 2002. This assumption is based on the Water Master Plan 2004-2006 being an update of the previous water master plan that was completed in 2001.

3. As shown in Chapter 2, Page 3 of Exhibit L, the existing population for the Aboite Water System (assumed to be in 2002) was 32,315 people. The calculated future population (assumed to be in 2021) was 50,090 people.
4. As shown in Table 2-3, Page 4 in Exhibit L, the Current (2002) Average Day Demand and Peak Day Demand were 2.70 MGD and 5.698 MGD, respectively. The future Average Day Demand and Peak Day Demand (assumed to be in 2021) were 4.25 MGD and 8.92 MGD, respectively.

B. Independent Evaluation

1. As a method of checking the growth in customer base, presented in the Water Master Plan 2004-2006, census data was reviewed and analyzed. The census data and population projections for Aboite Township, Fort Wayne, and Allen County are shown in Exhibit N. The cumulative annual growth rates (CAGR) for the population in Aboite Township are substantially higher than the rate for Allen County as a whole and Fort Wayne. The CAGR for Fort Wayne includes growth due to numerous annexations in the past and is not representative of true population growth for the UCWS area. The 2000 to 2010 CAGR, 2.35 percent, is most representative of the rate that would apply to the Water Master Plan.
2. Exhibit M summarizes the growth in population, average day demand, and peak day demand projected in the Water Master Plan 2004-2006. Intermediate values for the study period were interpolated based on the apparent 20-year CAGR in the plan. Also presented in Exhibit M are actual data reported by UCWS for average day demand and peak day demand for 2002 through 2011.
3. Exhibit M also presents the average day and maximum day demands that were projected from the 2011 reported values through 2021 based on the 2000 to 2010 CAGR for Aboite Township population of 2.35 percent.
4. The difference between the 2021 Average Day Demand projected by the Water Master Plan, 4.250 MGD, and the value projected from the 2011 actual Average Day Demand, 3.050 MGD, at 2.35 percent CAGR for this audit to 2021, 3.847 MGD, is 0.403 MGD. This difference is predominantly due to the difference, 0.348 MGD, between the 2011 value for Average Day Demand, 3.398 MGD, interpolated from the Master Plan and the actual 2011 Average Day Demand, 3.050 MGD. This is to say that the difference between the master plan projection and the audit check is that the audit projection included the drop in actual production data from 2008 to 2011 whereas the master plan, which was developed before that drop occurred, does not.

C. Conclusion

1. As shown in Exhibits M and O, the actual average day and peak day demands fell near and slightly above the values projected by the Water Master Plan for 2003 through 2008.
   a. Average day and peak day demands declined from 2008 through 2011.
   b. The average day and peak day demands projected for 2012 through 2021 based on the township population growth rate fall below the values projected

by the Water Master Plan by an amount approximately equal to the 2008 to 2011 decline in demands.

2. Aboite Township experienced rapid population increases from 1980 to 2000 as the area changed from rural to suburban. Since the quantity of undeveloped land is decreasing, these higher growth rates are not expected to recur. The Water Master Plan has adequately projected the growth in customer base and water usage.

8.04 Well Capacity

A. Water Master Plan 2004-2006

1. The plan noted that the current water system supply (in 2003) exceeded the projected 20 year planning period Average Day Demand and that the development of potential water supplies should remain a high priority but was not a requirement.
2. The plan also stated that increased water usage would not be realized for ten years or more and that there was adequate time to develop additional water supplies.

B. Independent Evaluation

1. 10-States Standards and 327 IAC 8-3.3-3 require that the UCWS have well pumping capacity to provide the peak daily water production with the largest well out of service. This capacity with the largest unit out of service is called the “firm” capacity in the water industry. 327 IAC 8-1-3(12) defines a “Two-year Average Peak” as the arithmetical average of the five greatest reported daily pumpages over the previous two years. 327 IAC 8-3-4.2 requires that a water system meet the two-year average peak daily pumpage with 90 percent of the water system pumping capacity to avoid a prohibition on the connection of additional water main extensions to the system. Because the UCWS is a growth area, it is a reasonable application of the rule in 327 IAC 8-3-4.2 for this audit to require well pumping capacity such that 90 percent of that capacity will meet the two year average peak daily pumpage.
2. The following calculations demonstrate how the UCWS capacities, Water Master Plan projections, and 2011 reported data compare to these capacity criteria in 327 IAC 8.
   a. Table 3-4 of the Water Master Plan 2004-2006, Exhibit L, presents the well capacities that were current at the time of writing. The sum of these capacities without Well #10, the largest, without Well #7 which is noted in Table 3-7 as a “back-up” well only, and Well #11, a future well, is 5.314 MGD, the firm capacity. Table 2-4 of the Water Master Plan 2004-2006 presents the peak demand day, current at the time of writing, as 6.3 MGD. Applying the 90-percent criterion, the well capacity deficit can be calculated as follows:

6.6 MGD peak day ÷ 90% = 7.0 MGD target capacity

7.0 MGD target capacity – 5.314 MGD well capacity = 1.686 MGD deficit

b. As shown in Exhibit M, the current 2011 Peak Day Demand was 5.637 MGD and the well pumping capacity for 2011, calculated in Section 2.04, was 4.378 MGD . Then the required well pumping capacity can be calculated as follows:

5.637 MGD peak day ÷ 90% = 6.263 MGD target capacity

6.263 MGD target capacity – 4.378 MGD = 1.886 MGD deficit

c. As developed above, the firm well capacity at the time of writing the Water Master Plan 2004-2006 was 5.314 MGD. Table 2-4 of the Water Master Plan 2004-2006 presents the 20-year peak demand day as 8.92 MGD. Applying the 90-percent criterion, the well capacity deficit can be calculated as follows:

8.92 MGD peak day ÷ 90% = 9.91 MGD target capacity

9.91 MGD target capacity – 5.314 MGD well capacity = 4.596 MGD deficit

d. The difference between the capacity required by 327 IAC 8 and the actual well capacity reported for this audit was calculated for 2002 through 2012 and is presented in Exhibit P.

C. Conclusion

1. The *Water Master Plan 2004-2006* does not adequately address well capacity for the next ten years.

   a. The statement in the master plan that the water system supply exceeds the 20-year average daily demand is correct but incomplete in that the water system supply should meet or exceed the peak daily demand not merely the average demand.

   b. The firm well pumping capacity for 2002, presented in Table 3-7 of the Water Master Plan 2004-2006, was 6.033 million gallons per day. This information is misleading because the 6.033 million gallons per day included 0.72 million gallons per day from Well #11 which was not yet installed.

   c. Since 2002, the capacity of Wells #1 and #2 are such that they were not included in the Aqua's calculation of water production at normal operating conditions further reducing the current well capacity from the capacity presented in the water master plan.

   d. Well pumping capacity was not adequate at the time of writing the Water Master Plan 2004-2006, it is not adequate currently, and the Water Master Plan does not adequately address the need for additional well capacity to meet the future daily pumping capacity requirements projected in the Master Plan.

8.05 Treatment Capacity

A. Water Master Plan 2004-2006

1. The plan noted that both the Covington and Chestnut Hills water treatment plants could have their capacities expanded when needed to meet the water system's future flow demands.

B. Independent Evaluation

1. As shown in Exhibit M, the 2021 Peak Day Demand projected by the Water Master Plan is 8.92 MGD. The sum of the UCWS water treatment plant capacities is reported to be 7.728 MGD. The difference between the required capacity and the rated treatment plant capacity can be calculated as follows:

8.92 MGD - 7.728 MGD = 1.192 MGD deficit

C. Conclusion

1. The *Water Master Plan 2004-2006* does not adequately address treatment capacity for the next ten years, 2012 through 2021 because the rated plant capacity is 1,192,000 gallons per day below the projected capacity.

8.06 Storage Capacity

This capacity is needed in the water system to meet peak hourly demands that routinely occur in the system and can exceed the pumping capacity which is designed to meet the peak daily customer demand rate. Storage tanks are also needed to provide capacity for fire flow.

A. Water Master Plan 2004-2006

1. The plan noted that additional water storage capacity would be required in the UCWS in order to meet the 20 year planning period peak daily flow demands. It was recommended that two new 1.5 million gallon elevated storage tanks be constructed in the UCWS or a single 2.0 million gallon elevated storage tank be constructed.

B. Independent Evaluation

1. Since 2003, a new 1.0 million gallon elevated storage tank (Lafayette Meadows Elevated Tank) was constructed.
2. 10-States Standards, Section 7.01, states that storage facilities should have sufficient capacity to meet domestic demands and fire flow demands.
3. The current, 2011, average daily water production is 3,050,000 gallons. The current water storage capacity is 3,000,000 gallons.
4. The Water Master Plan 2004-2006 sets the 20-year future average daily water production at 4,250,000 gallons and identifies the need for additional water storage capacity.

C. Conclusion

1. The *Water Master Plan 2004-2006* has adequately addressed water storage requirements with recommended improvements to increase storage capacity by 2,000,000 to 3,000,000 gallons. UCWS has constructed one tank providing 1,000,000 gallons of this capacity. The remaining recommended improvements to add 1,000,000 to 2,000,000 gallons in water storage capacity will meet the UCWS needs for water storage capacity over the next ten years.
2. It should be noted that while the planning for additional storage was addressed adequately in the master plan, the UCWS currently has 3.0 million gallons in storage capacity which is just below the current average day production of 3.05 million gallons.

8.07 Summary Conclusions:

A. While the *Water Master Plan 2004-2006* has adequately addressed the issues of growth in customer base, growth in water usage, and need for additional water storage capacity, the growth projections in the plan are based on data that is at least ten years old. The master plan could benefit from growth projections based on more current information.

B. The *Water Master Plan 2004-2006* has not adequately addressed the issues of:

1. Well capacity for the next ten years (2012-2021). The plan does not address the need for reserve capacity in accordance with 327 IAC 8-3.3-3. The system capacity does not meet this required reserve capacity at the current time or throughout the planning period (2002-2021).
2. Treatment capacity for the next ten years (2012-2021). Currently, the UCWS has adequate treatment capacity. Although the current treatment capacity is below the water production capacity projected in the Water Master Plan 2004-2006, water treatment improvements will not be needed until the actual increase in water demand reaches the levels projected in the plan.

9.0 Review and analyze Aqua's procedures addressing recent water pressure and service issues to determine whether they are compatible with current industry standards.

9.01 Introduction

Drinking water systems must plan for the supply of adequate, safe, and reliable water to their customers over time. Water system facilities must be maintained to ensure that the supply of safe water is not interrupted. The facilities must be operated properly and efficiently to provide adequate supply without compromising the safety and reliability of the water quality and flow. When problems arise, the water system must respond adequately to the threat so that the adequate, safe, and reliable supply of water to the customers is not interrupted or is returned promptly.

9.02 Approach

Analysis of the information provided by Aqua for this audit forms the basis of addressing this question regarding Aqua's procedures.

A. Records of well pumpage, water production, and water tower levels were provided for review.

B. A summary of water main breaks and estimated water losses during May through July 2012 was provided for review. A chronology of events during the recent period of water pressure and service issues was provided for review.

C. Records of customer calls and Aqua's handling of those calls were not available for review.

D. Operator's logs that would identify the times that pumps, chemical feeders, and other equipment are started and stopped were not available for review.

9.03 Planning:

A. The UCWS has a Water Master Plan. Based on the water system map, as built plans of treatment plant improvements, and other records provided for this audit, all of the improvements outlined in the water master plan have been completed, except for the following:

1. One water main extension was not completed. It appears to have been associated with a development that did not occur.
2. Only part of the water storage improvements have been completed.

B. For this audit, Aqua has provided records that were developed as part of their annual capital planning for the UCWS. As discussed in Section 8, above, the UCWS planning addresses growth in the number of customers, customer demand, and water storage but the planning does not address water supply capacity in accordance with 327 IAC 8 and industry standards.

C. As has been discussed throughout this report, the UCWS does not have adequate reserve pumping capacity to meet peak customer demand or planning in place to meet that need for reserve capacity.

1. 327 IAC 8 requires that a water system have pumping capacity such that 90 percent of the pumping capacity without the largest unit in service be adequate to supply the two-year average peak daily production.
2. Exhibit P summarizes the well capacities and peak production reported for the most recent ten years. Exhibit P also presents the calculation of the reserve capacity required by 327 IAC 8 in the column "90% of Rated Well Capacity Less Two Year Average Peak". The numbers in this column indicate that the reserve capacity has remained below what it should have been during the ten year period presented in the exhibit. Adequate reserve capacity could have prevented the recent period of water pressure and service issues.

9.04 <u>Maintenance and Operation of UCWS facilities:</u>

A. A narrative of events provided by Aqua indicated that a valve at the Fort Wayne connection failed to operate when UCWS attempted to open the connection.

1. UCWS had crews, equipment, and spare parts available to promptly repair the valve.
2. AWWA recommends and many public water supplies have a program of routinely exercising and maintaining valves in the system. A valve maintenance program can reduce but not eliminate problems with valves in a water system.

9.05 <u>Responding to the threat to the safe and reliable supply of water:</u>

A. In the recent period of water supply and service issues, the UCWS experienced an extended period when customer water usage exceeded the system's daily water production and their best efforts fell short of providing safe and adequate supply of water to their customers. Analysis of the information provided for the period leading up to and during the period of water supply and pressure issues indicates the following:

1. Aqua was one of the first public water supplies in Indiana to issue a request for water conservation during June 2012.
2. During the period, system demand, which includes both customer demand and water loss due to leaks and breaks, did not exceed the capacity of UCWS facilities as rated by Aqua and IDEM. Demand did not exceed levels that had been met by UCWS facilities in previous years.
3. The capacity shortfall occurred over a period of five days before Aqua issued a request for water conservation on June 7. After June 3, the system was not able to refill the elevated storage tanks. After June 6, the volume of water in storage was consistently dropping each day.

4. When the capacity shortfall became evident, Aqua engaged the supply from Fort Wayne and isolated a portion of the water system to be served by Fort Wayne water and preserve the safe disinfection quality of the water to UCWS customers.
5. While the low pressure complaints from customers increased as the water levels were dropping in the storage tanks, there were no significant periods of water outages.
6. A recent IDEM sanitary survey indicated no instances where the UCWS facilities are not in accordance with Indiana public water supply regulations.

9.06 Water Main Breaks

A. Aqua reported the occurrence of three significant water main breaks during the recent period of water pressure and service issues. Their report included estimates of the rate of water loss for these breaks as follows:

1. On June 17 an 8-inch main break was discovered with estimated loss of 350 gpm.
2. On June 19 an 8-inch main break was discovered with estimated loss of 350 gpm.
3. On June 22 an 8-inch main break was discovered with estimated loss of 350 gpm.

B. The actual quantity of water lost by a water main break can be impossible to determine. Aqua has provided estimates of the rates of water loss but the time period during which the water loss occurred is unknown. Comments provided by Aqua on the breaks indicated that two of them had been leaking for several days.

C. Estimating water loss due to a water main break based on an estimated rate and duration of leakage is prone to substantial inaccuracy. Rather than neglect the contribution of these three breaks to the UCWS demand for water production during the recent period of water pressure and service issues can be characterized by estimating a minimum and maximum effect from the information provided by Aqua as follows:

1. A quantity representative of the minimum water loss can be calculated by assuming that each break leaked at the estimated rate for a half a day before being repaired.

   3 x 350 gpm x 12 hours x 60 min/hour = 0.75 million gallons

2. A quantity representative of the maximum water loss can be calculated by assuming that each break leaked at the estimated rate for five days before being repaired.

   3 x 350 gpm x 5 days x 24 hrs/day x 60 min/hour = 7.5 million gallons

3. The average effect on water demand by the breaks can then be estimated as being within the range of water loss described as follows:
   a. More than 0.25 million gallons on each of three days, and
   b. Less than 0.75 million gallons per day average over a ten day period. (Based on the assumptions for maximum water loss the first break would have started five days prior to June 17 and the last break was repaired on June 22.)
4. It should be noted that, based on the assumptions for the maximum water loss, although the average water loss might be 0.75 million gallons per day, water loss on June 17 could have occurred from all three breaks generating a total water loss rate of 1.5 million gallons per day.
5. It should also be noted that the rate of water loss at a water main break is often not constant. Water loss at a break often starts slowly and continues for some time before the final higher loss rate is reached. The analysis above does not include this level of detail and is only meant to represent an approximation of the actual water loss.

D. The effect of the water loss attributed to these breaks on the water demand and water production was analyzed by tabulating the water demand for similar periods in previous years. Two exhibits present the analysis of water demands. Exhibit Q considers similar calendar periods in 2012 and previous years. Because water demands follow weather and other factors and do not follow the calendar alone, Exhibit R was developed to present the analysis for similar periods of peak demand in the previous years.

   Two periods are considered for each analysis for each year:

   1. A 28-day or June 3 through 30 period was selected as corresponding to the period in June 2012 when the UCWS was unable to refill the elevated storage tanks on a daily basis.
   2. A 10-day or June 6 through 15 period was selected as corresponding to the period in June 2012 when the daily decrease in storage volume was most acute. This is the period discussed in Section 2.08.

E. As presented in Exhibit Q, the total daily water demand for the periods June 3 through 30 and June 6 through 15 are substantially higher in 2012 than in the same calendar period in previous years. As presented in Exhibit R, this difference is not as significant when similar high demand periods are considered. The highest maximum daily demand was set in 2005. The 28-day and 10-day demands in 2012 are 2-percent and 6-percent higher than those in 2011, respectively.

F. Based on the analysis presented in Exhibits Q and R and the discussion above, the reported water main breaks and associated water loss had an effect on the total system demand but that effect was not extraordinary.

G. Water main breaks can be expected to occur every year. Peak customer demand can be expected to occur every year. When extended periods of below average rainfall occur, soil moisture can be depleted at depths where water mains are buried. Because soils shrink as they dry out, buried pipes can be subjected to abnormal conditions during periods of extended below-average precipitation and a higher incidence of water main breaks can be expected. Because the same weather conditions that increase lawn irrigation demand can also increase subsoil moisture loss, an increased incidence of water main breaks can be expected to accompany periods of extended high customer demand.

9.07 **<u>Wells Out Of Service:</u>**

A. Aqua reported equipment failures at two wells that left those wells out of service for repairs.

B. Well #5 was reported to be out of service for repairs for most of the period of water pressure and service issues. Well #7 was placed into service as a replacement for Well #5. Based on the well capacities reported for this audit and presented in Section 6.02, this replacement resulted in a decrease of 132 gallons per minute in the water production rate due to the lower capacity of Well #7. This decrease in production is 3 percent of the 2011 Total UCWS Production Capacity presented in Section 2.07.

C. Well #3 was reported to be out of service for repairs for less than a day. Well #1 was placed in service as a replacement. This resulted in a decrease of 329 gallons per minute in the water production rate. This decrease in production is 7 percent of the 2011 Total UCWS Production Capacity presented in Section 2.07. Based on pumping records, the estimated total decrease in water production due to Well #3 being replaced by Well #1 is approximately 247,000 gallons over the two day period that the well was out of service.

D. The effect of these wells being out of service can be calculated as follows:

1. As presented in Exhibit Q, the minimum volume of water in storage during the recent period of water pressure and service issues occurred on June 15 and was approximately 887,000 gallons. The decrease in storage volume during this period can be calculated as the storage capacity less the minimum volume:

   3,000,000 gallons - 887,000 gallons = 2,113,000 gallons

2. Pumping records indicate that the total decrease in water production on June 15 due to Well #3 being replaced by Well #1 was approximately 115,000 gallons.

3. Based on the decrease in pumping rates, listed in Section 6.02, the maximum decrease in water production over the period June 3 through 15 that could be attributed to Well #5 being replaced by Well #7 can be calculated as follows:

   132 gpm x 1,440 min/day x 13 days = 2,471,000 gallons

4. It should be noted that this decrease in production is based on the capacities reported for 2011. Since Well #5 was out of service during the entire period of water pressure and service issues, it is not known what the actual pumping rate would have been during this period when the other wells were experiencing decreased production rates.

5. Based on the best available information, the combined effect of Wells #5 and #3 being out of service is calculated to be 2,586,000 gallons which is 473,000 gallons in excess of the decrease in water storage volume calculated from water storage tank levels. The calculated effect of these wells being out of service is approximate but it is clear that these wells being out of service, without adequate back up capacity in reserve, played a major role in the capacity shortfall and the loss of water in storage that led to the recent water pressure and service issues.

9.08 Conclusions:

A. Overall, Aqua's procedures addressing the recent water pressure and service issues during the events were compatible with current industry standards. Their response to the water production shortfall, as indicated by the press release provided for this audit, could have been quicker but this slow response is common. Public water supplies are often slow to call for water conservation from their customers and even slower to request emergency supply from a neighboring system.

B. Where planning is concerned, Aqua's procedures leading up to the recent water pressure and service issues are not compatible with current industry standards for addressing water supply. Without the supplemental supply of water from the Fort Wayne water system, the UCWS does not have adequate reserve capacity to supply the peak water demand with the largest well out of service.

1. The inadequate reserve capacity was demonstrated when Well #3 was out of service for the entire period of water pressure and service issues. Even though it is not the largest capacity well, the decrease in pumping capacity associated with Well #3 being out of service without adequate back up capacity was still the major factor contributing to the water pressure and service issues. This demonstrates the need for adequate reserve capacity. It is not unusual for a water system to experience mechanical failures when equipment is operating at capacity for prolonged periods.
2. The water master plan that Aqua inherited with the purchase of the water system is fundamentally flawed. It effectively neglects the need for reserve capacity needed to meet customer demand as the drought of 2012 has proven.
3. The wells that were available as back up capacity when Wells #3 and #5 were out of service do not have sufficient capacity to adequately replace those wells. During June 2012, Well #1 provided 56 percent of Well #3's capacity and Well #7 provided 66 percent of Well #5's capacity. Based on the Total UCWS Production Capacity (reported as 6,459,840 gallons per day prior to Well #11) the decrease in production was 3 percent while Well #5 was out of service and 10 percent when both wells were out of service.

C. It should be noted that this report is not concluding that the UCWS is out of compliance with the Indiana Administrative Code for Public Water Systems, 327 IAC 8. Portions of the requirements of 327 IAC 8 and the 10-States Standards have been applied in this audit and report to develop and quantify, conservatively, the need for reserve capacity that was demonstrated by the recent water pressure and service issues.

D. Although the drought of 2012 may be considered an extraordinary event, the customer demand for water in the UCWS during the drought was not extraordinary. Lawn irrigation usage may have increased due to the drought and water loss from main breaks was a contributing factor but the overall total water demand was not extraordinary:

1. Actual daily quantities of water pumped by the wells did not exceed the capacities recorded by Aqua and reported for this audit.
2. Daily water production was not at record levels.
3. The maximum well pumpage for period of one, five, ten, and thirty consecutive days were below previous years (refer to Exhibit I).
4. The maximum well pumpage for a period of 60 consecutive days was 1.2 percent higher in 2012 than in 2007 (refer to Exhibit I).
5. The maximum well pumpage for a period of 90 consecutive days was 2.9 percent and 6.6 percent higher in 2012 than in 2007 and 2011, respectively (refer to Exhibit I).

E. The incidence of main breaks during the recent period of water pressure and service issues was a contributing factor to those issues. It is probable that a high incidence of water main breaks and associated water loss will occur during future drought conditions.

F. Aqua's procedures for addressing the recent water pressure and service issues, now that those issues have abated, should be to determine and address the cause of the capacity shortfall and to develop and execute a plan for adding reliable, water system capacity with sufficient reserve capacity in accordance with 327 IAC 8.

10.0 Summary, Conclusions and Recommendations

10.01 Summary of the recent water pressure and service issues:

A. The recent period of water pressure and service issues occurred when the daily water production of the UCWS wells could not meet the customer demand for water.

1. The total volume of water in elevated storage began dropping on June 3 and the tanks did not return to full until June 30.
2. The largest drop in storage occurred over ten days from June 6 to June 15. It should be noted that after the release of the Phase 1 Report, analysis of additional water tank level data indicated that the decrease in volume of water in storage began on June 3 but the period of June 6 through 15 is the period of the most acute decrease in volume of water in storage.
3. The average customer usage over the period did not rise to a record level.
4. The total well production decreased below levels achieved in previous years due, in part, to lower capacity wells being put in service as back up for wells that had equipment failures.
5. The daily shortfall was less than four percent of the system's 2011 peak daily production.
6. For 2011, Aqua rated the well pumping capacity at 6.46 million gallons per day but, during the June 6 through June 15 period, water production averaged 5.31 million gallons per day.

B. Production at each of the wells that remained in service was reported to be less than expected levels. Although Aqua monitors the UCWS wells and operation, the specific cause of the decreased production rate at each well is not apparent.

1. It is common for well pumping capacity to decrease over years of operation.
2. The UCWS routinely maintains and tests their wells.
3. The UCWS has monitored and tracked well capacity over the years.
4. The water system has a computer-based supervisory control and data acquisition (SCADA) system to monitor well supply, water treatment, and system pressures.
5. Based on the information furnished for this audit, the cause has not been determined for the decrease in daily water production at individual wells from previous years to the levels experienced during June 2012.

C. Additional effort is needed for well production testing and analysis to determine the actual pumping rates that can be expected from each well while all other wells are in operation and to determine a specific cause for why the UCWS wells could not supply water at their proven capacity.

1. Field inspection, evaluation, and testing of the UCWS wells, treatment plants, and instrumentation are needed to determine what caused the water production at individual wells to fall short of previous levels.

2. Routine monitoring of aquifer water levels by taking monthly measurements of pumping and non-pumping water levels in the UCWS wells could help identify aquifer stress as a cause of future shortfalls.
3. Additional well production testing and analysis should be conducted to determine the actual pumping rates that can be expected from each well while other wells are in operation.

10.02 Summary of the pumping capacity issues:

A. The UCWS faces two issues regarding pumping capacity.

1. The first issue is discussed above: the performance of individual well pumps fell short of previously recorded levels.
2. The second issue is one of reserve, total, and firm capacity.

B. In the water industry, the minimum *reserve capacity* can be defined as the difference between the *total capacity*, calculated with all units operating, and the *firm capacity*, calculated with all but the largest capacity unit operating.

1. In order to serve new customers with new water mains, public water supplies in Indiana are required to maintain *reserve capacity* such that 90 percent of the *firm capacity* will supply the peak customer demand.
2. UCWS records indicate that *total capacity* was targeted to supply the peak customer demand.
3. When the capacity shortfall occurred during June 2012, and the well pumps couldn't meet the system demand, there was no *reserve capacity* to call into service.

C. For the short term, the connections to the Fort Wayne water system can provide supplemental water supply capacity to offset the inadequate pumping capacity and will require modification of the UCWS treatment plants to achieve compatible disinfection with the Fort Wayne water.

10.03 Conclusions regarding the UCWS Water Master Plan:

A. The UCWS master plan adequately addressed the growth in customers and water usage. It should be noted that there was a drop in peak water usage from 2008 through 2010 that was not predicted in the Water Master Plan. This drop has resulted in the peak water usage, projected in the plan, being approximately 1.5 million gallons above the actual peak usage for 2010 and 2011.

B. The UCWS master plan adequately addressed the need for additional water mains. The identified improvements have been completed except for one due to the associated development not occurring.

C. The UCWS master plan adequately addressed the need for additional storage capacity. Part of the identified improvements has been completed.

D. The master plan does not adequately address well pumping capacity:

1. The master plan identified additional wells as a priority but not a requirement.
2. The actual UCWS well pumping capacity does not meet the requirements as developed for this audit from the Indiana Administrative Code for Public Water Supply (327 IAC 8) throughout the planning period in the Water Master Plan.

E. The master plan did not adequately address supplemental water supply capacity.

1. The supply of Fort Wayne water to the UCWS was identified in the master plan as not being an option due to the Great Lakes-St. Lawrence River Basin Water Resources Compact (IC 14-25-15).
2. As demonstrated this past summer, the supplemental water supply from Fort Wayne is needed until well pumping capacity is increased to meet the reserve capacity as developed for this audit based on 327 IAC 8 and 10-States Standards.
3. Baseline water withdrawals established by DNR for the Fort Wayne water system allow the continued use of supplemental water supply from Fort Wayne in compliance with the Great Lakes St. Lawrence River Basin Water Resources Compact.
4. The supply of Fort Wayne water to the UCWS should include measures to avoid the compromise of needed fire flow capacity to the UCWS customers receiving Fort Wayne water.
    a. The isolation of a portion of the UCWS customers to be supplied by Fort Wayne water could be eliminated by disinfection changes at the UCWS plants to produce water that is compatible with the Fort Wayne water.
    b. The fire flow capacity to an area isolated for supply by Fort Wayne could be maintained with improvements to the existing connections to Fort Wayne, improvements to the water mains serving the isolated customers, additional Fort Wayne connections, or selection of the area to be isolated.

F. The master plan does not address the need for additional treatment capacity.

1. The current UCWS treatment capacity is adequate with the exception of the limitation of the contribution of Well #11 to the total plant capacity as discussed in Section 6.02.C.
2. Additional capacity will be needed when the 20-year peak daily water production projected by the master plan is approached.

G. The master plan addresses the need for additional water storage.

1. Currently, the water storage volume is just below the nominal requirement for maintaining capacity equal to the average daily water production.
2. The capacity shortfall that caused the recent water pressure and service issues was a problem with water production capacity not water storage volume. The elevated tanks in the UCWS didn't maintain pressure adequately, not because they lacked capacity, because the wells couldn't meet customer demand and refill the tanks each day. Additional storage volume could have postponed but not prevented the water pressure and supply issues.

10.04 Conclusions regarding Well #11:

A. This well was added to address the capacity shortfall but the benefit from its capacity is limited.

1. The capacity shortfall occurred during a time when all of the well pumps at the Chestnut Hills water treatment plant were running.
2. When all of the pumps are running at the Chestnut Hills water treatment plant, the capacity of the treatment equipment limits the additional water that can be supplied by Well #11.

B. Well #11 does not satisfy the need for additional supply capacity. With Well #11, the current UCWS well supply capacity does not meet the firm capacity requirements of the Indiana Administrative Code for Public Water Supply and the 10-States Standards.

10.05 Conclusions regarding Water Conservation:

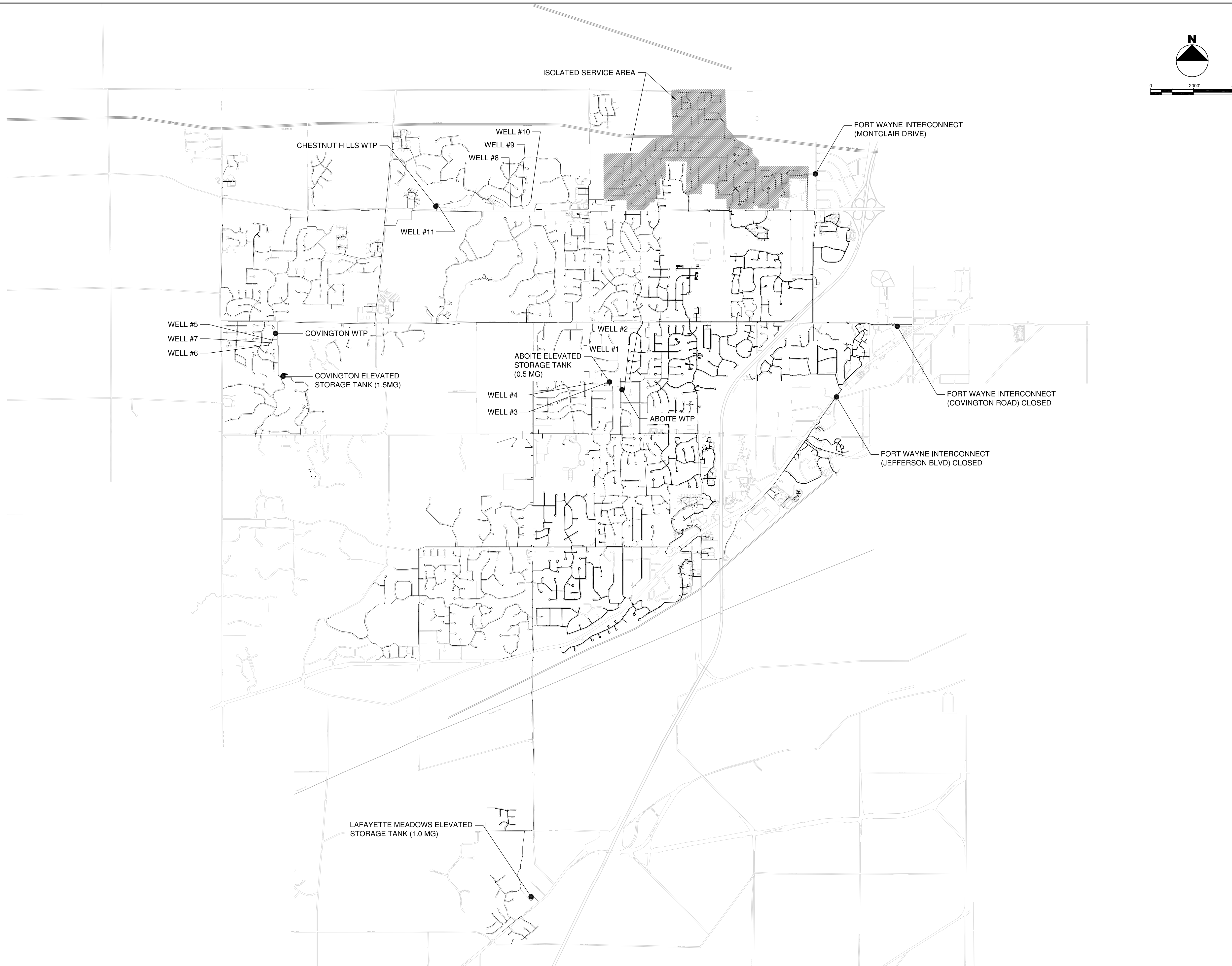
A. Without the support of local ordinances, calls for water conservation are often ineffective.

B. Without effective water conservation measures, the UCWS will need to develop greater water supply capacity to meet the potential for unprecedented peak usage.

C. Negotiations with the City of Fort Wayne and Allen County to develop adequate ordinances that support Aqua's water conservation measures would serve the best interests of the UCWS customers who would be subject to higher water rates without that local government support for conservation.

WATER SYSTEM OPERATIONS AUDIT

EXHIBITS



NOTE: BASE AUTOCAD DRAWING OF WATER SYSTEM AND LOCATION OF FACILITIES FOR THIS EXHIBIT WERE FURNISHED BY AQUA INDIANA, INC.

J:\Aqua-Indiana\12701-08\Draw\Sheets\
FILE: ABOITE – W&S_EXHIBIT_A.dwg
LAYOUT: Layout1
UPDATE BY: rbernard
SURVEY BOOK #
DATE: Mon 10/1/12 8:46am
XREF DWG:
ABOITE – W&S.dwg
Tb36x24.dwg

REVISIONS

NUMBER	BY	DATE

0 1 2

THIS BAR IS EQUAL TO 2" AT FULL SCALE (34X22).

AQUA INDIANA, INC.
UTILITY CENTER WATER SYSTEM
ALLEN COUNTY, INDIANA

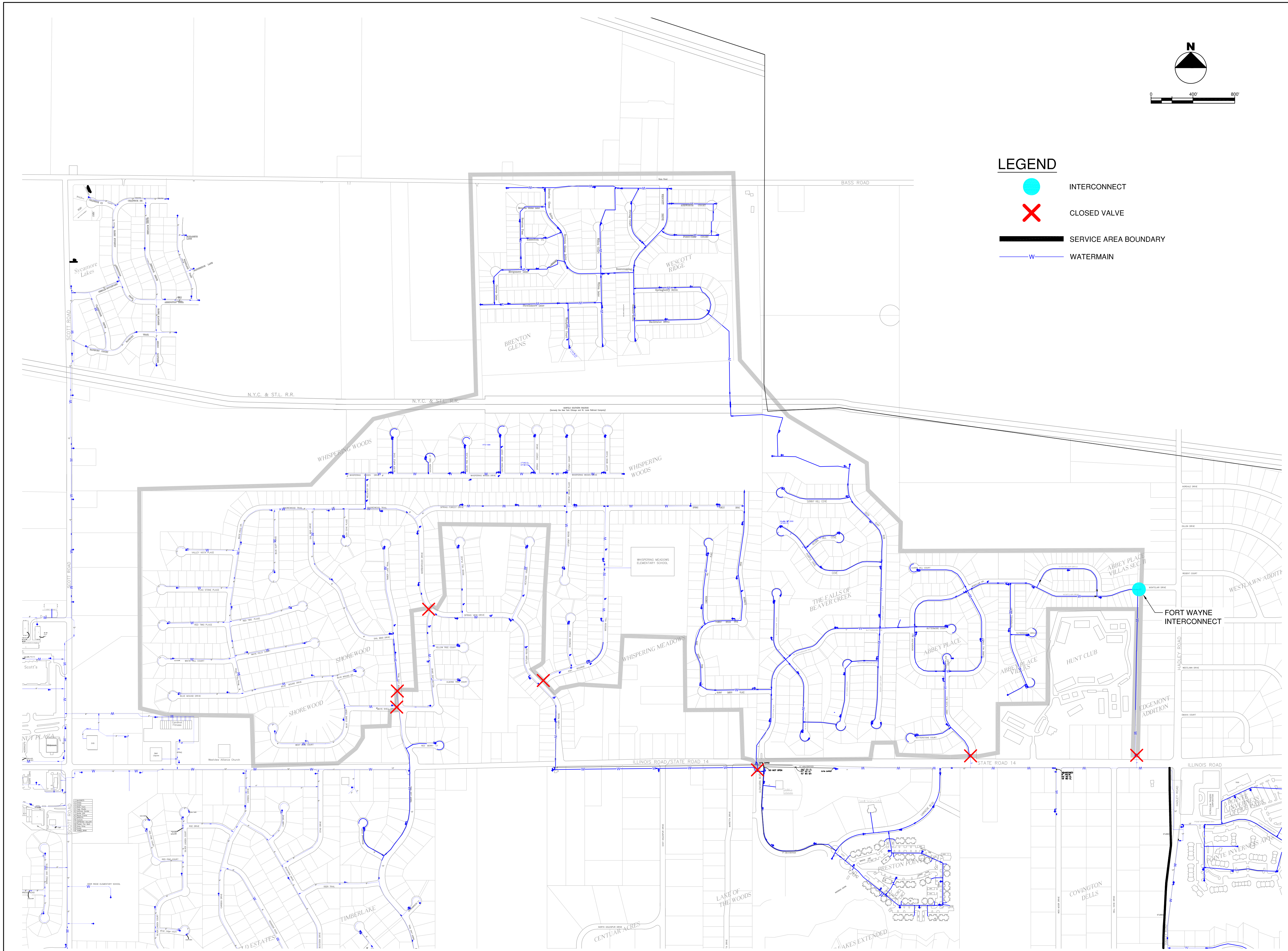
EXHIBIT A
MAP OF WATER SYSTEM FACILITIES

CMT
CRAWFORD, MURPHY & TILLY, INC.
CONSULTING ENGINEERS
License No. 184-00063

DESIGN BY:	KMB
DRAWN BY:	DJW
CHECKED BY:	
APPROVED BY:	
DATE:	OCTOBER 2012
JOB No:	12701-08

EXHIBIT A

SHEET OF SHEET



NOTE: BASE AUTOCAD DRAWING OF WATER SYSTEM AND LOCATION OF FACILITIES FOR THIS EXHIBIT WERE FURNISHED BY AQUA INDIANA, INC.

J:\Aqua-Indiana\12701-08\Draw\Sheets\
FILE: ABOITE – W&S_EXHIBIT_B.dwg
LAYOUT: Layout1
UPDATE BY: rbernard
SURVEY BOOK #
DATE: Mon 10/1/12 8:19am
XREF DWG:
ABOITE – W&S.dwg
Tb36x24.dwg

REVISIONS

NUMBER	BY	DATE

0 1 2
THIS BAR IS EQUAL TO 2" AT FULL SCALE (34X22).

AQUA INDIANA, INC.
UTILITY CENTER WATER SYSTEM
ALLEN COUNTY, INDIANA

EXHIBIT B
MAP OF ISOLATED SERVICE AREA

CMT
CRAWFORD, MURPHY & TILLY, INC.
CONSULTING ENGINEERS
License No. 184-00063

DESIGN BY:	KMB
DRAWN BY:	DJW
CHECKED BY:	
APPROVED BY:	
DATE:	OCTOBER 2012
JOB No:	12701-08

EXHIBIT B

SHEET OF SHEET

Exhibit C - Summary of Well Information

Information summarized from "Well & Pump Service Inspection Reports" and "Pump Installation Reports" furnished by Aqua Indiana, Inc.

Wells

Name	Water Treatment Plant	Column Pipe Size (inches)	Discharge Pipe Size (inches)	Depth (ft)	Top of Pump (ft.)	Pump Design Capacity (gpm)	Pump Design TDH (ft)	Date of Construction	Motor Size (HP)	Airline Length (ft)
Well #1	Aboite	6		247	120'-0"	400	291	1964	40	135
Well #2	Aboite	5	4	212	130'-0"	350	260	1966	30	150
Well #3	Aboite	8	8	225	140'-0"	800	349	1973	100	150
Well #4	Aboite	8	8	225	170'-0"	800	349	1977	100	170
Well #5	Covington	8	8	300	140'-0"	500	360	1986	75	143
Well #6	Covington	8	8	300	160'-0"	600	350	1987	75	160
Well #7	Covington	5	6	300	130'-0"	300	312	1988	40	150
Well #8	Chestnut Hills	6	6	360	185'-0"	500	340	1998	60	190
Well #9	Chestnut Hills	8	8	360	194'-0"	1,000	325	1998	100	200
Well #10	Chestnut Hills	8		360	121'-0"	1,400	300	2001	200	134
Well #11	Chestnut Hills	6	6	320	134'-0"	350	340	2012	40	150

Pump Test Data - 1

Name	Date	Pump Flow (gpm)	Static Level (ft)	Pumping Level (ft)	Discharge Pressure (psi)	Duration (hr)	Specific Capacity (gpm/ft)
Well #1	3/31/2003	349	95	106	81	1.0	31.7
Well #2	4/19/2001	350	99	131	55	1.0	10.9
Well #3	9/16/2008	800	108	145	68	1.5	21.6
Well #4	9/23/2008	510 [2]	124	151	130	1.0	18.9
Well #5	2/19/2007	317	91	143	128	1.0	6.1 [3]
Well #6	7/21/1997	412	90	146	119	1.0	7.4
Well #7	2/13/2001	310	83	110	95	0.5	11.5
Well #8	6/10/2008	503	62	146	65	NOT AVAILABLE	6.0
Well #9	7/3/2008	888	60	135	75	NOT AVAILABLE	11.8
Well #10	10/21/2008	872	66	80	116	NOT AVAILABLE	62.3
Well #11	8/7/2012	NOT AVAILABLE	60	NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE

Pump Test Data - 2[1]

Name	Date	Static Level (ft)	Pump Flow (gpm)	Pumping Level (ft)	Discharge Pressure (psi)	Specific Capacity (gpm/ft)
Well #1	2007	85	266	91	NOT AVAILABLE	44.3
Well #2	2000	102	364	120	NOT AVAILABLE	20.2
Well #3	2007	65	716	97	NOT AVAILABLE	22.4
Well #4	2006	110	650	141	62	21.0
Well #5	2010	74	500	128	NOT AVAILABLE	9.3
Well #6	2010	80	550	150	NOT AVAILABLE	7.9
Well #7	2010	74	299	102	NOT AVAILABLE	10.7
Well #8	2010	62	443	166	NOT AVAILABLE	4.3
Well #9	2008	54	927	137	NOT AVAILABLE	11.2

Pump Test Data - 3

Name	Date	Static Level (ft)	Pump Flow (gpm)	Pumping Level (ft)	Discharge Pressure (psi)	Specific Capacity (gpm/ft)	Operating Capacity (gpm)	Operating TDH (ft)	Projected Pump Design Capacity (gpm)	Projected Pump Design TDH (ft)
Well #1	9/26/2011	91	256	101	76	25.6	256	277	400	260
Well #2	9/26/2011	106	308	123	67	18.1	308	278	350	252
Well #3	9/27/2011	86	791	122	86	22.0	791	321	800	319
Well #4	9/26/2011	98	753	136	89	19.8	753	342	800	322
Well #5	9/27/2011	81	383	126	103	8.5	407	357	500	325
Well #6	9/27/2011	79	351	141	99	5.7	400	364	600	323
Well #7	9/27/2011	74	251	101	95	9.3	296	242	300	241
Well #8	9/28/2011	58	323	142	70	3.8	323	304	500	170
Well #9	9/28/2011	87	948	134	76	20.2	948	310	1,000	300
Well #10	9/28/2011	58	1,446	95	81	39.1	1,446	289	1,400	299

Notes:
1). Pump test data after last well cleaning.
2). Well #4 pumps air if the water level falls below 160'.
3). The 2/19/2007 pump installation report lists a specific capacity of 5.1.

Water System Operations Audit

Exhibit D - Customer Counts by Class

2003 - 2010 INFORMATION NOT AVAILABLE FOR PHASE 1 REPORT

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average	Jan - Aug Average
2003														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2004														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2005														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2006														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2007														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2008														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2009														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2010														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2011														
Residential	10,982	10,981	10,997	11,184	11,463	11,679	11,784	11,804	11,714	11,404	11,159	11,133	11,357	11,359
Commercial	238	237	237	247	254	262	263	263	258	250	244	245	250	250
Public	80	80	83	83	85	86	86	86	86	84	81	81	83	84
Total	11,300	11,298	11,317	11,514	11,802	12,027	12,133	12,153	12,058	11,738	11,484	11,459	11,690	11,693
2012														
Residential	11,120	11,126	11,194	11,456	11,834	12,010	12,045	12,087						11,609
Commercial	245	245	247	250	261	265	267	268						256
Public	81	81	84	85	86	86	85	85						84
Total	11,446	11,452	11,525	11,791	12,181	12,361	12,397	12,440						11,949

Note: The customer count and metered water sales data used to calculate the information presented in this exhibit were furnished by Aqua Indiana, Inc.

Water System Operations Audit

Exhibit E - Metered Water Sold by Class

2003 - 2010 INFORMATION NOT AVAILABLE FOR PHASE 1 REPORT

	Jan [gallons]	Feb [gallons]	Mar [gallons]	Apr [gallons]	May [gallons]	Jun [gallons]	Jul [gallons]	Aug [gallons]	Sep [gallons]	Oct [gallons]	Nov [gallons]	Dec [gallons]	Annual Total [gallons]	Jan - Aug Total [gallons]
2003														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2004														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2005														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2006														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2007														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2008														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2009														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2010														
Residential													0	0
Commercial													0	0
Public													0	0
Total													0	0
2011														
Residential	62,663,600	50,891,600	50,477,800	47,553,600	56,270,200	63,218,600	92,794,700	104,481,000	82,792,900	58,578,300	54,637,205	52,733,200	777,092,705	528,351,100
Commercial	4,687,800	4,843,900	4,242,600	4,359,100	4,674,100	5,542,700	6,174,100	8,822,300	8,807,600	6,395,900	4,888,200	4,621,700	68,060,000	43,346,600
Public	2,190,000	2,239,500	2,392,100	1,952,200	2,523,500	2,922,000	2,444,200	3,339,600	3,590,700	3,785,800	2,733,800	2,563,700	32,677,100	20,003,100
Total	69,541,400	57,975,000	57,112,500	53,864,900	63,467,800	71,683,300	101,413,000	116,642,900	95,191,200	68,760,000	62,259,205	59,918,600	877,829,805	591,700,800
2012														
Residential	59,355,900	48,578,400	50,488,800	52,257,000	61,490,200	117,609,000	122,339,600	88,850,800						600,969,700
Commercial	3,732,100	4,714,200	4,917,700	8,704,900	5,154,000	8,395,200	8,748,100	9,835,400						54,201,600
Public	2,581,200	2,910,400	3,464,900	3,475,900	3,867,800	3,350,300	2,843,100	3,201,600						25,695,200
Total	65,669,200	56,203,000	58,871,400	64,437,800	70,512,000	129,354,500	133,930,800	101,887,800						680,866,500

Note: The customer count and metered water sales data used to calculate the information presented in this exhibit were furnished by Aqua Indiana, Inc.

Water System Operations Audit

Exhibit F - Average Daily Metered Water Sold by Customer by Class

	Jan [gallons]	Feb [gallons]	Mar [gallons]	Apr [gallons]	May [gallons]	Jun [gallons]	Jul [gallons]	Aug [gallons]	Sep [gallons]	Oct [gallons]	Nov [gallons]	Dec [gallons]	Annual Total [gallons]	Jan - Aug Total [gallons]
2003														
Residential	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Commercial	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Public	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2004														
Residential	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Commercial	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Public	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2005														
Residential	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Commercial	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Public	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2006														
Residential	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Commercial	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Public	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2007														
Residential	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Commercial	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Public	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2008														
Residential	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Commercial	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Public	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2009														
Residential	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Commercial	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Public	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2010														
Residential	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Commercial	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Public	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2011														
Residential	184	166	148	142	158	180	254	286	236	166	163	153	187	191
Commercial	635	730	577	588	594	705	757	1,082	1,138	825	668	609	746	713
Public	883	1,000	930	784	958	1,133	917	1,253	1,392	1,454	1,125	1,021	1,073	984
Total	199	183	163	156	173	199	270	310	263	189	181	169	206	208
2012														
Residential	172	151	145	152	168	326	328	237	---	---	---	---	---	212
Commercial	491	664	642	1,161	637	1,056	1,057	1,184	---	---	---	---	---	868
Public	1,028	1,239	1,331	1,363	1,451	1,299	1,079	1,215	---	---	---	---	---	1,252
Total	185	169	165	182	187	349	348	264	---	---	---	---	---	234

2003 - 2010 INFORMATION NOT AVAILABLE FOR PHASE 1 REPORT

Note: The customer count and metered water sales data used to calculate the information presented in this exhibit were furnished by Aqua Indiana, Inc.

Water System Operations Audit

Exhibit G - Analysis of Elevated Water Storage June 6 through 21, 2012

	Beginning Tower Level [Elevation in Feet]			Level change for Day [Feet]			Volume Change for Day [Gallons]					Plant Production [gallons]
Date	Aboite	Covington	Lafayette	Aboite	Covington	Lafayette	Aboite	Covington	Lafayette	Total	Cummulative	
							0	0	-352,343	-352,343	-352,343	
6/6/12	970.7	970.6	958.7	-10.6	-8.8	0.0	-162,346	-379,260	0	-541,606	-893,949	5,005,000
6/7/12	960.2	961.8	958.7	-0.9	-0.1	0.0	-14,538	-2,940	0	-17,479	-911,428	4,906,000
6/8/12	959.2	961.7	958.7	-6.1	-5.0	0.0	-94,015	-214,620	0	-308,635	-1,220,063	6,075,000
6/9/12	953.1	956.7	958.7	0.8	0.1	0.0	11,631	5,880	0	17,511	-1,202,552	5,275,000
6/10/12	953.9	956.8	958.7	-5.5	-3.7	0.0	-84,323	-160,230	0	-244,553	-1,447,105	5,114,000
6/11/12	948.4	953.1	958.7	7.5	4.9	-3.7	115,823	208,740	-105,086	219,477	-1,227,628	5,227,000
6/12/12	955.9	958.0	955.0	1.9	1.8	0.2	28,592	76,440	7,006	112,038	-1,115,590	5,439,000
6/13/12	957.8	959.7	955.2	-5.6	-4.0	-0.2	-85,777	-173,460	-7,006	-266,243	-1,381,832	5,294,000
6/14/12	952.2	955.7	955.0	-4.0	-2.5	0.0	-61,546	-105,840	0	-167,386	-1,549,219	5,487,000
6/15/12	948.2	953.2	955.0	-4.7	-5.5	-6.6	-71,723	-236,670	-189,154	-497,547	-2,046,766	5,262,000
6/16/12	943.5	947.7	948.4	19.2	-3.2	0.0	294,646	-135,240	0	159,406	-1,887,360	5,242,000
6/17/12	962.7	944.5	948.4	4.2	0.1	2.5	64,454	5,880	70,057	140,391	-1,746,969	5,200,000
6/18/12	966.9	944.7	950.8	-10.7	-0.1	0.0	-165,254	-2,940	0	-168,194	-1,915,163	5,376,000
6/19/12	956.1	944.6	950.8	4.7	-0.1	0.0	71,723	-2,940	0	68,783	-1,846,380	5,245,000
6/20/12	960.8	944.5	950.8	0.0	0.0	0.0	0	0	0	0	-1,846,380	5,685,000
6/21/12	960.8	944.5	950.8	9.9	0.1	8.8	152,654	5,880	252,206	410,740	-1,435,640	5,174,000
6/22/12	970.7	944.7	959.6									
							Average Plant Production for 6/6/2012 through 6/15/2012					5,308,400

Note: The elevated water storage and water production data used to calculate the information presented in thei exhibit were furnished by Aqua Indiana, Inc

Exhibit H - Monthly Water Production

Total Water Plant Production by Month in Million Gallons

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	77.672	69.725	76.665	86.702	102.542	122.401	132.088	140.324	109.698	95.269	77.504	78.439	1,169.029
2006	47.978	NA	NA	NA	NA	NA	NA	NA	NA	NA	78.817	77.362	204.157
2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2008	80.185	70.163	78.497	85.897	100.662	94.692	118.788	144.271	122.390	102.267	84.456	86.423	1,168.691
2009	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2010	95.534	85.176	77.375	71.154	85.267	92.938	126.189	121.332	114.682	107.357	83.250	92.420	1,152.674
2011	88.223	65.658	74.274	71.763	85.902	97.587	152.749	143.527	98.221	93.312	70.913	76.601	1,118.730
2012	79.187	72.671	68.434	84.983	130.351	154.773	144.428	113.102	90.329	NA	NA	NA	938.258

Note: Sep 2012 data is through 23rd

Average Daily Water Plant Production by Month in Million Gallons

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	2.506	2.490	2.473	2.890	3.308	4.080	4.261	4.527	3.657	3.073	2.583	2.530	3.203
2006	1.548	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.627	2.496	0.559
2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2008	2.587	2.419	2.532	2.863	3.247	3.156	3.832	4.654	4.080	3.299	2.815	2.788	3.193
2009	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2010	3.082	3.042	2.496	2.372	2.751	3.098	4.071	3.914	3.823	3.463	2.775	2.981	3.158
2011	2.846	2.345	2.396	2.392	2.771	3.253	4.927	4.630	3.274	3.010	2.364	2.471	3.065
2012	2.554	2.506	2.208	2.833	4.205	5.159	4.659	3.648	3.927	NA	NA	NA	2.564

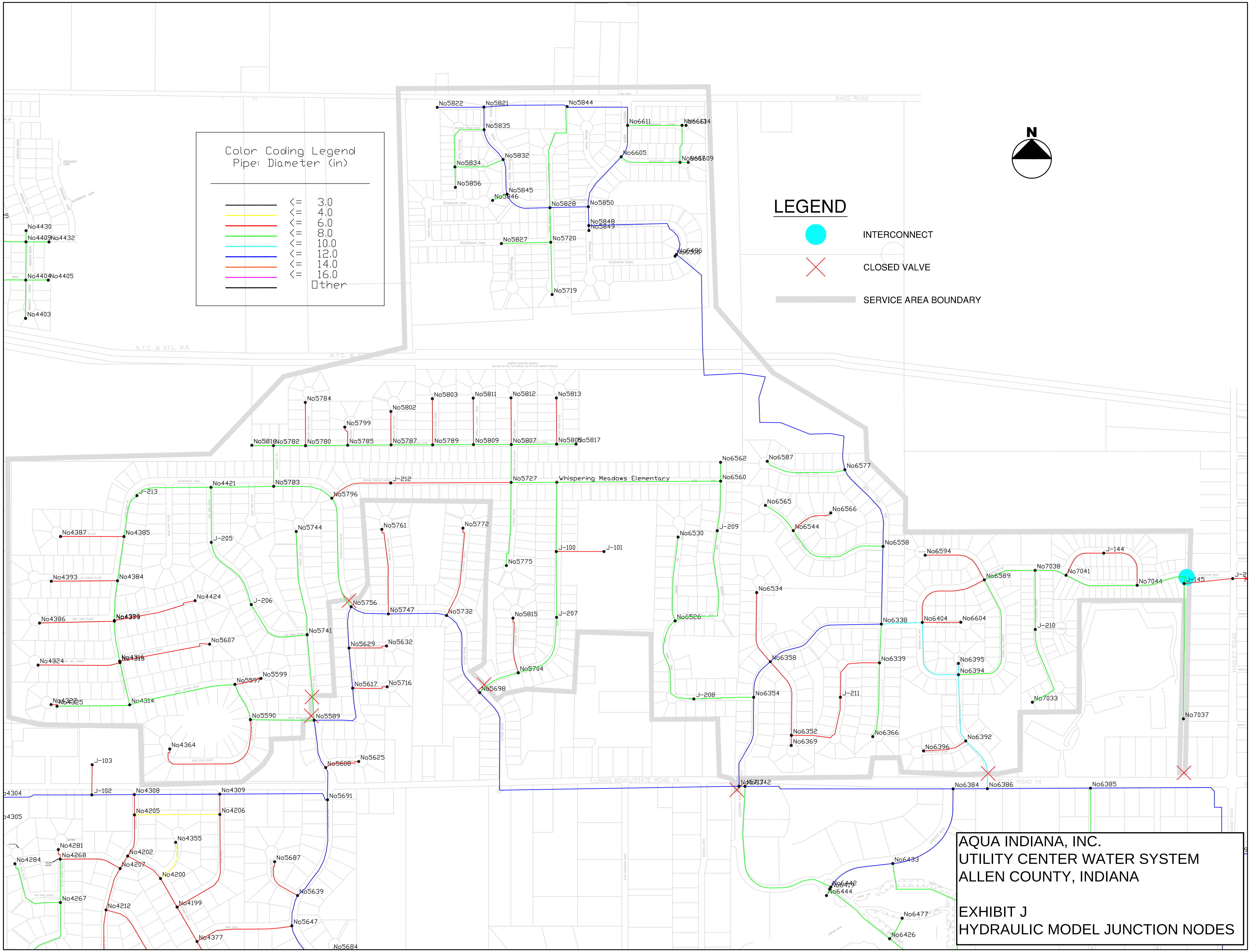
"NA" indicates data not available for Report

Note: September 2012 data is through 23rd
June 2012 total monthly and average daily production corrected after release of Phase 1 Report.
September 2012 average daily production corrected after release of Phase 1 Report.

Note: The water production data used to calculate the information presented in this exhibit was furnished by Aqua Indiana, Inc.

Exhibit I - Maximum Well Pumpage for Periods of Consecutive Days by Year

	2012 [MG]	2011 [MG]	2010 [MG]	2009 [MG]	2008 [MG]	2007 [MG]	2006 [MG]	2005 [MG]	2004 [MG]	2003 [MG]
1 Day	5.858	5.790	5.579	5.761	6.100	6.104	3.488	8.402	6.272	5.723
5 Days	27.981	28.637	23.409	24.872	28.470	29.065	15.273	28.612	24.248	22.981
10 Days	55.519	56.751	43.011	46.591	54.164	56.755	29.245	53.323	44.542	43.813
30 Days	160.876	166.330	118.568	127.715	149.647	164.520	85.142	143.347	120.138	110.278
60 Days	313.268	299.465	230.889	247.568	280.991	309.493	166.765	265.416	212.443	209.910
90 Days	441.591	414.290	339.007	352.553	389.632	429.229	169.103	394.936	313.587	309.960



Color Coding Legend
Pipe: Diameter (in)
<= 3.0
<= 4.0
<= 6.0
<= 8.0
<= 10.0
<= 12.0
<= 14.0
<= 16.0
Other
LEGEND
INTERCONNECT
CLOSED VALVE
SERVICE AREA BOUNDARY
N
Whispering Meadows Elementary
AQUA INDIANA, INC.
UTILITY CENTER WATER SYSTEM
ALLEN COUNTY, INDIANA
EXHIBIT J
HYDRAULIC MODEL JUNCTION NODES

Indiana Utility Regulatory Commission
Aqua Indiana, Inc. Utility Center Water System
- Allen County, Indiana
Water System Operations Audit

Exhibit K - Average Day Demand (3.1 MGD) Fire Flow Summary

Data summarized from a hydraulic model furnished by Aqua Indiana, Inc.

	"ISOLATED SERVICE AREA" Connected to UCWS[1]		"ISOLATED SERVICE AREA" Connected to Fort Wayne[2]	
Label	Static Pressure (psi)	Available Fire Flow (gpm)	Static Pressure (psi)	Available Fire Flow (gpm)
J-100	45	1,557	43	241
J-101	45	812	43	241
J-144	55	978	53	484
J-145	61	979	60	581
J-205	56	1,892	53	215
J-206	52	1,853	50	215
J-207	45	1,574	43	241
J-208	53	1,773	51	334
J-209	47	1,351	45	276
J-210	55	1,081	54	442
J-211	53	1,208	52	361
J-212	45	1,142	43	225
J-213	53	1,447	50	209
J-221	64	881	61	732
No4314	42	1,233	40	198
No4315	40	1,156	37	198
No4316	40	1,153	37	198
No4324	40	551	37	186
No4325	45	981	43	198
No4327	43	880	40	198
No4364	46	548	43	198
No4379	41	1,168	38	201
No4380	40	1,167	37	201
No4384	42	1,227	39	203
No4385	49	1,324	47	206
No4386	40	579	37	192
No4387	45	703	42	206
No4393	41	623	38	203
No4421	58	1,784	56	215
No4424	41	556	38	193
No5590	45	1,686	43	198
No5597	44	1,487	41	198
No5599	43	880	40	198

Exhibit K - Average Day Demand (3.1 MGD) Fire Flow Summary

Data summarized from a hydraulic model furnished by Aqua Indiana, Inc.

	"ISOLATED SERVICE AREA" Connected to UCWS[1]		"ISOLATED SERVICE AREA" Connected to Fort Wayne[2]	
Label	**Static Pressure (psi)**	**Available Fire Flow (gpm)**	**Static Pressure (psi)**	**Available Fire Flow (gpm)**
No5607	39	515	36	181
No5704	45	1,794	43	241
No5719	48	911	46	362
No5720	48	965	47	362
No5727	46	1,525	43	235
No5741	49	1,801	46	215
No5744	47	1,090	44	216
No5775	43	1,015	40	235
No5780	42	1,423	40	223
No5782	42	1,509	40	222
No5783	45	1,771	42	221
No5784	46	849	43	223
No5785	45	1,461	43	224
No5787	45	1,415	42	226
No5789	44	1,399	42	228
No5796	45	1,848	42	222
No5799	46	880	43	225
No5802	50	880	47	226
No5803	50	876	47	228
No5805	49	1,193	46	232
No5807	46	1,501	43	232
No5809	44	1,418	41	230
No5811	45	795	42	230
No5812	45	809	42	232
No5813	45	755	43	232
No5815	46	795	43	241
No5816	46	1,425	43	222
No5817	45	1,108	42	232
No5821	50	958	48	362
No5822	49	958	47	361
No5827	45	864	43	362
No5828	45	965	43	362
No5832	44	960	43	362

Exhibit K - Average Day Demand (3.1 MGD) Fire Flow Summary

Data summarized from a hydraulic model furnished by Aqua Indiana, Inc.

	"ISOLATED SERVICE AREA" Connected to UCWS[1]		"ISOLATED SERVICE AREA" Connected to Fort Wayne[2]	
Label	**Static Pressure (psi)**	**Available Fire Flow (gpm)**	**Static Pressure (psi)**	**Available Fire Flow (gpm)**
No5834	45	946	43	362
No5835	45	959	43	362
No5844	40	952	39	360
No5845	41	962	39	362
No5846	41	923	39	362
No5848	41	981	39	363
No5849	43	981	41	363
No5850	42	971	40	363
No5856	42	892	40	362
No6338	53	1,656	51	363
No6339	53	1,675	51	362
No6352	54	1,211	52	360
No6354	54	1,799	52	355
No6358	59	1,751	58	357
No6366	52	1,252	51	362
No6369	54	880	52	360
No6392	54	1,825	52	373
No6394	50	1,755	48	373
No6395	52	1,755	50	373
No6396	54	880	52	374
No6404	53	1,700	51	369
No6496	52	1,044	50	363
No6506	55	1,044	53	363
No6526	50	1,413	48	305
No6530	47	1,032	45	305
No6534	51	792	49	357
No6544	51	1,100	49	363
No6558	52	1,501	50	363
No6560	46	1,336	44	266
No6562	47	1,253	45	267
No6565	51	1,040	49	363
No6566	48	757	46	363
No6577	50	1,364	48	363

Exhibit K - Average Day Demand (3.1 MGD) Fire Flow Summary

Data summarized from a hydraulic model furnished by Aqua Indiana, Inc.

	"ISOLATED SERVICE AREA" Connected to UCWS[1]		"ISOLATED SERVICE AREA" Connected to Fort Wayne[2]	
Label	**Static Pressure (psi)**	**Available Fire Flow (gpm)**	**Static Pressure (psi)**	**Available Fire Flow (gpm)**
No6587	48	1,126	46	363
No6589	54	1,505	52	405
No6594	53	765	51	405
No6604	44	880	42	370
No6605	44	963	42	362
No6607	45	962	43	362
No6609	52	962	50	362
No6611	58	960	56	361
No6613	59	962	57	361
No6614	59	962	57	361
No7033	57	929	55	442
No7037	58	800	57	581
No7038	54	1,231	53	441
No7041	53	1,121	52	468
No7044	55	1,052	54	509
Whispering Meadows Elementary	46	1,684	43	241
Minimum		515		181
Maximum		1,892		732
Average		1,165		309

Notes:
1). Assumes normal water supply from UCWS and an average tank elevation of 966' at Aboite, Covington, and Lafeyette Elevated Storage Tanks with the service area as shown in Exhibit J.
2). Assumes water supply from the Fort Wayne connection as shown in Exhibit B. Assumes a hydraulic gradeline of 964' upstream of the 6" flowmeter.
3). Available fire flow was calcuated for junction nodes with a residual pressure of 20 psi.

Exhibit L

COPY

41187

WATER MASTER PLAN
2004 - 2006

For
Utility Center, Inc.
Allen County, Indiana
Water Production, Treatment, Storage
And Distribution Facilities

Submitted To

Indiana Utility Regulatory Commission

November 18, 2003

TETRA TECH, INC.
Tt Project No. 04034

800 Corporate Drive
Lexington, Kentucky 40503

UTILITY CENTER, INC.
WATER MASTER PLAN
UPDATE
November 18, 2003

TABLE OF CONTENTS

EXHIBITS

EXECUTIVE SUMMARY

As a component of the ***Plan for Achieving Service Excellence,*** the Utility Center, Inc. committed to the development of a Water Master Plan as a strategic plan for addressing the future needs of the Utility Center, Inc.'s (UCI) water system. This document is an updated report on the development of the Water Master Plan.

During the past four years, numerous improvements have been implemented in the operation, maintenance and management of the UCI's water systems. In the North End water service area, both raw water production and treatment capacity have been increased. The development of a second raw water production well and expansion of the Dupont water treatment plant provides an additional 1.4 million gallons per day of high quality water into the service area. Increased production capacity of the Lake River wells and expansion of the Lake River Water Treatment Facility provides an additional 1.5 MGD of finished water to the north service area. These increases in water production and treatment capacity have established an adequate water supply for long term needs. The construction and placement into operation of the 2 million gallon Perry Hill water storage tower increased the North End water system's ability and reliability to meet its customers water demands.

In the Aboite water system, a new Chestnut Hills Water Treatment Plant capable of treating 4.0 MGD was placed into service. Design of a new Aboite Water Treatment Plant is in the progress and should be constructed within the next two years. An additional Chestnut Hills water production well is available that can provide a total water a supply of 5 MGD; at such time additional water supplies are needed, the Chestnut Hills Water Treatment Plant will be expanded to 6 MGD.

While a typical Master Plan is a documentation of information and future plans, this Master Plan report is more of a summary of the work which has been completed, work activities which are in progress of being completed, and the water facilities needed to meet the projected 20 year water demand.

A Master Plan can not be a 20 year planning document cast in stone. It should be flexible enough to adapt to the changing conditions and assumptions upon which the plan was developed. Simultaneously, it should be a document used as map by which regular organizational evaluations can judge where, how and in what time frame the UCI water system is growing. Judgment of the efficacy of a Master Plan should not be based on how strictly it was implemented but rather on how the plan served as a reference milestone for future activities. This 2003 Update of the original Master Plan uses capital budget expectations to forecast projects during the next few years.

CHAPTER 1

INTRODUCTION

Introduction

The Utility Center, Inc. operates two water systems as a "public utility" regulated under the Indiana Utility Regulatory Commission (IURC). There are two (2) distinct water service areas both primarily in Allen County, Indiana. The North End water service area is located in Washington, St. Joseph, and Perry Townships of Allen County. The Aboite water service area is located in Aboite Township of Allen County and Jefferson Township of Whitley County. Due to the physical distance separation between the two water systems, the two water systems are operated independent of each other. It is not practical to interconnect the two water service areas.

During 1999, AquaSource, Inc. purchased the Utility Center, Inc (UCI). As a result of past operating and expansion practices and the lack of planning by the former owners, AquaSource took ownership of a water system which had been expanded without the direction of a strategic master plan.

As a result, the UCI's water systems grew through incremental expansion relying on a weak infrastructure system; water mains not sized for long term growth and expansion; and a dependency on long distance water distribution through smaller (6" and 8") water mains. Growth occurred until the water systems experienced operating failures. The operating failures were mainly due to the continued incremental expansion of the water systems' production treatment, storage and distribution systems. Prior to AquaSource's purchase of the Utility Center, Inc. (UCI), there was no reinvestment in the UCI's water infrastructure. As a result both water systems' infrastructures had low reliability and limited operational capabilities.

In 2003, the Utility Center was sold to Philadelphia Water Co. (PWC). PWC will continue to implement improvements to the system. These improvements will be based upon maintaining regulatory compliance and meeting future growth and development requirements.

Need For Study

As a result of water customers' complaints; a history of service delivery problems; water main distribution system failures; an inability to meet peak flow water demands; and associated regulatory enforcement actions; the IURC ordered Utility Center, Inc. to prepare a Water Master Plan. The Plan is to address the existing and anticipated needs of the water systems to meet future water service area demands. The purpose of this Water Master Plan is to develop a strategy for addressing existing water system problems and then to provide guidelines and direction for meeting future demands of the North End and Aboite water service areas.

In order for a Master Plan to be functional, it must be based on a factual and fundamental knowledge of the existing water system. This Master Plan documents existing water system facilities and facilities that are in the process of being constructed.

The Master Plan should be used as a strategic planning tool, not as a detailed plan. Many variables such as land use development and rezoning, highway infrastructure development and economic growth will ultimately determine where and when water infrastructure development will be required. Only through preliminary engineering and detailed engineering design studies will the most cost effective water system improvements be developed to respond to unknown future conditions and demands.

There is a balance between constructing water system improvements based on 20 year theoretical assumptions and responding to actual water system growth demands. To build water system infrastructure improvements in anticipation of actual water system growth demands may result in unwise capital infrastructure investment, while slow response to water system growth may result in an inability to meet actual demands. Most water system improvements can be planned, designed and constructed in a 12 to 18 month time frame. Therefore, it is recommended that this Master Plan be reviewed and updated every two (2) years to reconcile the Plan's theoretical water system demand projections and the service area's actual water system demands.

CHAPTER 2

LAND USE & POPULATION

Planning Area

The general boundaries of the original North End and Aboite Water Systems' existing service areas are shown in Exhibit 1. For the purpose this Master Plan, the 20 year planning area is shown in Exhibit 2. It is acknowledge that there are numerous existing water providers that may service localized areas within the planning area. However, over the 20 year period, the extension of water service into the planning area from the existing service areas can reasonably be expected. This activities will occur through land development, service area negotiations with adjoining water system purveyors as well as service area consolidations. Proposed new service area boundaries for the Aboite System are included in Exhibit 9 of this Plan Update. Until this proposal is approved, the original Master Plan concepts will be retained with the exception of two small areas within Area #1 and Area #3 of the CTA Expansion Proposal.

Land Use

The topography within the two planning areas varies from gently sloping to fairly flat, with the exception of the areas adjacent to creek beds which can be categorized as sloping and irregular.

Overall, the land use is predominantly residential, commercial business and institutional such as churches, schools and other non-business uses.

The most current Allen County land use plan is the 1970 Allen County Comprehensive Plan. For the Comprehensive Plan's planning period (approximately 1970 to 1990), it shows the service area as being mainly residential in nature and commercial businesses developed consistent with services and shopping required to support residential growth. In fact, the area's development has been fairly close to the 1970 Plan. While Allen County is currently updating its Comprehensive

Plan, the DRAFT Comprehensive Plan does not established specific future land use projections for the planning area.

Population

Generally, the population in Allen County has experienced stable growth with steady increases since the 1970's. An estimated 83% of the population resides in urban areas.

In Aboite Township, the population has nearly tripled since 1970. As report in the to US Census records, the 1990 population of Aboite Township was 18,490 which is almost a 50% increase from the 1980 population estimate. The 1990 Census for Aboite Township reported a total 6,941 housing units representing a person per household (pph) rate of 2.66 and a density of 555 persons per square mile, or 0.867 persons per acre. The estimated 1992 population was 18,746 as recorded in Flying the Colors, Indiana Facts, and has exceeded 20,000 based on estimates after the last census. The Allen County Department of Planning Services projected a 2.45% growth per year for the Aboite Township area.

As previously stated, the most current Allen County Comprehensive Plan does not project population beyond 1990. The Indiana University publishes population projections for Indiana Counties. Table 2-1 summarizes its February, 1999 Preliminary Population Projections for Allen County.

In order to develop a basis for population growth in the planning area, existing maps were reviewed and population projections were developed based on existing and projected 20 year population densities.

Based on the existing and planning areas land use and availability, the populations presented in Table 2-2 were developed.

Table 2-1
Allen County, Indiana
Population Projections

Date	Allen County Population	Percent Change	Aboite Township Population Projection
1990 (Census Data)	300,836		18,490
1997	312,091	3.7%	19,174
2000	321,245	2.9%	19730
2005	329,908	2.7%	20,263
2010	335,140	1.6%	20,587
2015	339,486	1.3%	20,854
2020	343,414	1.2%	21,105

Table 2-2
Water Service Populations

Water System	Existing Service Area Population	20 year Planning Area Population
North End	22,173	35,111
Aboite	32,315	50,090

The above population projections were calculated using a development density of 2.1 house per acre and a 3.1 persons per house unit. The spreadsheet calculations for the North End population projections are presented in Appendix A. The spreadsheet calculations for the Aboite water system are presented in Appendix B.

Water demand was developed by taking the population figures and applying an 85 gallon per day per capita (gpdc) usage rate. Peak day demand is 2.1 based on the historic operating data of the North End and Aboite water systems. The calculated versus existing water system demands are shown in Table 2-3.

Table 2-3
Current Service Area Water Demands

Existing Service Area	Existing Calculated Population	Calculated Average Daily Demand (MGD)	Actual Average Daily Demand (MGD)	Calculated Peak Day Demand (MGD)	Actual * Peak Day Demand (MGD)
North End Water System	22,173	1.98	2.15	4.16	4.534
Aboite Water System	32,316	2.74	2.70	5.75	5.698

* Five Peak Day Average - 2002

Table 2-3 demonstrates that the methodology used to develop future population projections and planning area water demands is reliable. Therefore, the 20 year planning area water demands based on projected population growth is shown in Table 2-4.

Table 2-4
20 Year Planning Area Water Demands

Planning Area	20 Year Calculated Population	Average Daily Demand (MGD)	Peak Day Demand (MGD)
North End Water System	35,111	3.00	6.30
Aboite Water System	50,090	4.25	8.92

As stated above, Allen County has not developed population projects since its 1970 Comprehensive Master Plan. The speed, type and intensity for growth and the resulting demand for increased water service in the area will depend on how Allen County controls or focuses land use.

The water demands documented above will be used for the purpose of discussions in this report.

CHAPTER 3

EXISTING WATERWORKS SYSTEMS

Introduction

The American Water Works Association (AWWA) has published several standards for the effective design, operation and management of water systems. Typically, water systems are designed and constructed to meet three (3) specific performance criteria: elevated storage volume equivalent to the average daily water volume usage; ability to meet the peak daily water demand with the largest production unit out of service; and the ability to meet the peak hourly water demand from a combination of water production and treatment facilities and available water storage volume. Due to the small size of the North End and Aboite water systems, determination of the peak hourly water demand is more of an academic calculation rather than actual measurement. Therefore, the two water systems will only be evaluated as to their ability to meet both the water storage requirements and the peak daily water demand requirements.

Description of Service Areas

The Utility Center, Inc operates two water systems. The existing water service boundaries of the Aboite Water Service Area and the North End Water Service Area are shown in Exhibit No. 1. Exhibit 2 shows proposed new service area boundaries. Exhibit 9 features the CTA Expansion Plan for the Aboite Systems; until this plan is approved, we will continue to utilize Exhibit 2 as our proposed service area. Exhibit 10 features the north annexation areas since the original Master Plan was developed.

North End Water Service Area

The North End water system has ten (10) water production wells, three (3) treatment facilities, two (2) elevated water storage tanks, one (1) water booster station, and water distribution piping water mains ranging from 6" to 16" in size. The North End water system schematic is depicted in Exhibit No. 5. The North End annexation areas are depicted in Exhibit 10. The geographic locations of the North End water system facilities are shown on Exhibit No. 6. The North End water system IDEM identification designation is PWSID No. 5202002.

The reported average daily water usage in 2002 was 2.152 MGD with a reported maximum daily water usage of 4.8 MGD and a five peak day average of 4.534 MGD.

Water Supply

There are three (3) raw water production well fields. Among the production well fields, there are a total of ten (10) raw water production wells supplying the North End water service area. Table 3-1 summaries the North End water service water production wells information.

Table 3-1

North End Water System Production Wells*

Well No.	Well Field	Capacity (gpm)	Depth (feet)	Diameter (inches)	Aquifer Type
1	Washington	410	149	12	Sand/Gravel
2	Washington	320	91	12	Sand/Gravel
3	Washington	280	62	12	Sand/Gravel
4	Washington	215	80	12	Sand/Gravel
1	Dupont	1,000	212	12	Sand/Gravel
2	Dupont	1,000	200	12	Sand/Gravel
1	Lake River	1,000	150	12	Sand/Gravel
2	Lake River	850	152	12	Sand/Gravel
3	Lake River	500	144	12	Sand/Gravel
4	Lake River	700	146	12	Sand/Gravel

* Subject to field verification

There is no known bacteriological or chemical contamination of the well fields or any individual wells. Overall, the water quality in the three well fields is excellent. The raw water does have elevated dissolved iron and manganese concentrations requiring treatment. Wellhead Protection program Phase I activities have been completed and have found no existing threat to the water supply.

Assuming the largest raw water production well out of service, the firm water production capacity of the North End water service area is 4,841 gallons per minute (gpm) or 6.97 MGD. There are no alternate water supplies interconnected to the North End water service area.

Based on the current usage records, the North End water system production facilities have adequate production capacity to meet current and the 20 year future projected average daily water flow demands.

Water Treatment

There are three (3) water treatment plants in the North End water service area: the Washington Water Treatment Plant (WTP); the Dupont Water Treatment Plant (WTP); and the Lake River Water Treatment Plant (WTP).

The Washington WTP has a rated treatment capacity of 1.2 million gallon per day (MGD). The Washington water treatment plant is a water softening and filtration treatment system. Raw water is pumped from raw water production wells numbers 1, 2, 3 and 4 directly into and through the pressure softening/iron removal filters. The water is disinfected by chlorination prior to entering the water distribution system.

The Washington WTP is older and requires reinvestment in the plant's physical infrastructure to maintain its operability. The plant has physical space constraints limiting its ability for upgrade and/or expansion within the existing plant building. The water plant does not have an alternate electrical supply in the event the primary commercial electrical supply is lost. Water treatment plant wastes are discharged to the sanitary sewer.

The Dupont Road Water Treatment Plant was upgraded during the year 2000 to a rated treatment capacity of 1.44 MGD. The plant uses the permanganate green sand pressure filter treatment system for removal of iron and manganese. Raw water is pumped from raw water production wells numbers 1 or 2 directly into and through the pressure iron removal filters. The water is disinfected by chlorination prior to entering the water distribution system. There is no alternate electrical supply in the event the primary commercial electrical supply is lost. Water plant waste is discharged to an on-site waste treatment facility, which has a direct discharge permit (NPDES permit No. IN0060127). The existing treatment facility can not be expanded without additional building construction.

The Lake River WTP has a rated capacity of 4.0 MGD. Four raw water production wells supply the plant. The plant uses the permanganate green sand pressure filter treatment system for removal of iron and manganese. Raw water is pumped from raw water production wells numbers 1, 2, 3 or 4 directly into and through the pressure iron removal filters. The water is disinfected by chlorination prior to entering the water distribution system. There is no alternate electrical supply in the event the primary commercial electrical supply is lost. The water plant has a waste flow equalization tank and discharges the waste to the sanitary sewer.

Table 3-2 summarizes the water treatment capacity.

Table 3-2

North End Water System
Water Treatment Capacity

Water Treatment Plant	Treatment Capacity (MGD)	Comments
Washington	1.2	Approaching the end of its useful life
Dupont	1.44	Full capacity of existing structure
Lake River	4.0	Full capacity of existing structure
Total Treatment Capacity	6.64	Future Average Daily Flow 3.0 MGD Future Peak Daily Flow 6.3 MGD

Water Storage

The North End water service area has two (2) elevated water storage tanks. The Dupont water storage tank is a pedisphere elevated storage tank with a storage capacity of 500,000 gallons. The Dupont water storage tank was inspected and painted in 2001. The Perry Hill water tank is a 2,000,000 gallon elevated water storage tank built and placed into service during the year 2000. Both water tanks have remote monitoring and reporting of actual water storage volumes as well as alarm monitoring systems to detect excess water usage and low water inventory.

Table 3-3 summaries the water storage system in the Aboite Water System.

Table 3-3

North End Water System
Water Storage Capacity

Water Tower	Storage Volume (gallons)	Comment
Perry Hill	2,000,000	Elevated, composite tank, steel bowl, concrete column placed into service in 2000
Dupont	500,000	Elevated, steel tank, painted in 2001, good condition
Total Storage Capacity	2,500,000	Current Average Daily Flow 2.15 MGD Future Average Daily Flow 3.0 MGD

Based on AWWA and industry standards, a water volume equal to the average daily water usage volume should be in elevated storage. Based on the 20-year future average daily flow estimate, the North End water service area needs additional water storage capacity. This need is further reaffirmed by the fact that there is no electrical power supply backup to maintain water pumping capacity of the production wells in the event of a commercial power failure.

Water Booster Station

There is a water booster station in the North End water distribution system. The purpose of the water booster station is to transfer water from the water distribution system into which the Lake River WTP discharges to the central and western portions of the North End water service area. This allows water produced at the Lake River WTP to be stored in the Dupont and Perry Hill water towers. The water booster station has a pressure-regulating valve, which allows water stored in the elevated towers to automatically flow back in the Lake River water distribution system in the event there is a high water demand in the area of the Lake River water treatment plant. The booster station is in marginal working condition. It does not have electrical backup; creates a pressure-regulating problem; and is not energy efficient. Based on water hydraulic modeling, the water booster station could be abandoned if larger water transmission mains would be constructed to supplement the existing water mains. However, the removal of the water booster station is an elective construction activity not required for the operation of the water distribution system. While the water booster station currently functions, its replacement with larger water transmission lines would reduce energy costs; increase system reliability by removing a mechanical device subject to mechanical and electrical system failure; and provide a more stable water pressure in the water distribution system.

Water Distribution System

The North End water distribution system has two pressure zones. A quasi-pressure zone is created in the eastern area by the water booster station described above. There is no water storage between the Lake River WTP and the water booster station. This creates inefficient pumping and pressure regulation. It also restricts the water systems ability to transfer water since water transfer is limited by the capacity of the water booster station. The pressure is regulated through the water booster described above. The water distribution system's operating pressure is created by the operating water levels in the Dupont and Perry Hill elevated water towers.

Localized areas in the North End water system have been identified as having low water pressure mainly associated with high water demand delivery. As discussed above, additional water storage capacity will be required to meet future peak day demands. The strategic locating of the new water tower and interconnecting water mains will be used to address and resolve the low pressure service areas during peak flow service days.

North End Water System Service

See Table 3-8 for a summary of the North End Water System to include peak demand days through 2002.

Aboite Water Service Area

The Aboite water system has eleven (11) production wells, three (3) treatment facilities, two (2) elevated water storage tanks, and a water distribution piping system with water mains ranging from 6" to 16" size. The Aboite water system schematic is depicted in Exhibit No. 3. The geographic locations of the Aboite Water System facilities are shown on Exhibit No. 4. The Aboite water system IDEM identification designation is PWSID No. 5202014.

The reported average daily water usage in 2002 was 2.70 MGD with a reported maximum daily water usage of 6.052 MGD, and a five peak day average of 5.698 MGD.

Water Supply

There are three (3) raw water production well fields. There are a total of eleven (11) raw water production wells supplying the Aboite water service area. Table 3-4 summaries the Aboite water system water production wells.

There is no known bacteriological or chemical contamination of the well fields or any individual wells. Overall, the water quality in the three well fields is excellent. The raw water does have elevated dissolved iron and manganese concentrations requiring treatment. Wellhead Protection program Phase I activities have been completed and have found no existing threat to the water supply. Being in a limestone aquifer structure, the water supply has an elevated hardness.

Several reports on the future development of well fields in the Aboite Water System have been conducted. These reports are noted in Appendix E. Based on the preliminary findings, groundwater supplies are available in the limestone aquifer, which can be developed as needed to meet future water demands.

Table 3-4

Aboite Water System
Production Wells

Well No.	Well Field	Capacity (gpm)	Depth (feet)	Diameter (inches)	Aquifer Type
1	Aboite	400	247	12	Limestone
2	Aboite	200	212	12	Limestone
3	Aboite	485	225	12	Limestone
4	Aboite	325	300	12	Limestone
5	Covington	420	300	12	Limestone
6	Covington	360	300	12	Limestone
7	Covington	350	300	12	Limestone
8	Chestnut Hills	500	300	14	Limestone
9	Chestnut Hills	1,000	300	12	Limestone
10	Chestnut Hills	1,500	300	12	Limestone
11*	Chestnut Hills	500	300	12	Limestone

* Proposed

Assuming the largest raw water production well out of service, the firm water production capacity of the Aboite water service area is 4,040 gallons per minute (gpm) or 6.03 MGD. See Table 3-7 for a Aboite Water System Summary. The Aboite water service area has met its current peak daily flow demands using the firm production capacity of the Aboite water system. The 20-year future peak day flow demand cannot be met using the firm production capacity of the Aboite water system. However, the future peak daily flows could be met if the alternate water supply described below was used to provide the balance of the water demand.

Alternate Water Supply

Due to restrictions on water transfer out of the Great Lakes Basin, the interconnections previously identified as alternate water supplies are no longer viable. Thus, new well field sites within the potential service area have become increasingly important to the future growth of the utility.

Four well studies have been recently completed which identify potential well field sites, i.e. See Appendix E, Documents 1, 2, 12 and 13. It is apparent from these studies that adequate water is available to meet long needs.

Area 1 of the Proposed CTA Expansion Plan for the Aboite System includes the potential for additional well sites. See Exhibit 9 for the location of Area 1.

Water Treatment

There are a total of three (3) water treatment plants in the Aboite water service area: the Aboite Water Treatment Plant (WTP), the Covington Road Water Treatment Plant (WTP), and the Chestnut Hills Water Treatment Plant (WTP). These plants have remote operation capability via SCADATA system.

The Aboite WTP has a rated treatment capacity of 2.33 million gallon per day (MGD). The Aboite water treatment plant is an iron/manganese removal plant coupled to an ion exchange water softening treatment process. Raw water is pumped from raw water production wells numbers 1, 2, 3 or 4 direct into and through the pressure iron removal filters. Chlorination is used both as a chemical oxidizer for the iron and for disinfection to maintain water quality. Polyphosphate is added to the finished water to sequester soluble iron and stabilize the water quality. Since the water is pumped from the wells directly to the water plant and through the treatment process pressure vessels, the wells create the pump pressure required to pump the treated water into the water distribution system and water storage tanks. Water treatment plant wastes are discharged to the sanitary sewer.

The Aboite WTP is older and will be replaced. The replacement of the Aboite WTP has been designed and a commitment to its construction has been made. The new Aboite WTP should be constructed and online within the next two years.

The Covington Road Water Treatment Plant has a rated treatment capacity of 2.0 MGD. Well number 5, 6 and 7 supply the Covington Road WTP. The Covington Road WTP uses potassium permanganate and greensand pressure filters to remove iron and manganese which may be present in the raw water. Chlorination is added to the water to protect water quality. Polyphosphate is added to the finished water to sequester soluble iron and stabilize the water quality.

The Covington Road WTP's existing treatment capacity of 2.0 MGD can be expanded to a treatment capacity of 4.0 MGD. It does not have an alternate electrical supply in the event the primary commercial electrical

supply is lost. Although the water plant has an on-site waste treatment facility and a direct discharge permit (NPDES permit No. IN0060348), it is currently discharging water plant wastes to the sanitary sewer.

The Chestnut Hills WTP has a treatment capacity of 4.0 MGD. The water plant uses potassium permanganate and greensand pressure filters to remove iron and manganese which may be present in the raw water. Chlorination is added to the water to protect water quality. Polyphosphate is added to the finished water to sequester soluble iron and stabilize the water quality. Table 3-5 summarizes the Aboite water system's water treatment plant production capacity. The plant has an alternate electrical supply in the event that power is lost; the well field complex does not have an alternate electrical supply.

The 20-year future peak day estimate can be met by the existing water plant treatment capacity.

Table 3-5

Aboite Water System
Water Treatment Capacity

Water Treatment Plant	Treatment Capacity (MGD)	Comments
Aboite	2.33	Replacement currently under design, construction anticipated by 12/05
Covington Road	2.0	Can be expanded to 4.0 MGD
Chestnut Hills	4.0	To be Expanded to 6.0 MGD
Total Treatment Capacity	8.33	Future ADF 4.25 MGD Future PDF 8.92 MGD Future Maximum Capacity 12 MGD

ADF = Average Daily Flow PDF = Peak Daily Flow

Water Storage

The Aboite water service area has two (2) elevated water storage tanks. The Aboite Meadows water storage tank is a multi-leg elevated storage tank with a storage capacity of 500,000 gallons. The Covington Road water storage tank is a 1,500,000 gallon fluted column elevated water storage tank. Both tanks were inspected and painted in 2001. Both water tanks have remote reporting of actual water storage volumes as well as alarm monitoring systems to detect excess water usage and low water inventory.

Table 3-6 summaries the water storage system in the Aboite Water System.

Table 3-6

Aboite Water System
Water Storage Capacity

Water Tower	Storage Volume (gallons)	Comment
Aboite Meadows	500,00	Elevated, multi-leg, steel tank painted in 2001, good condition
Covington Road	1,500,000	Elevated, fluted column, steel tank, good condition
Total Storage Capacity	2,000,000	Current Average Daily Flow 2.70 MGD Future Average Daily Flow 4.25 MGD

Based on AWWA and industry standards, a water storage volume equal to the average daily water usage volume should be in elevated storage. Based on the 20-year future average daily flow estimate, the Aboite water service area needs additional water storage capacity. This need is further reaffirmed by the fact that there is no electrical power supply backup to maintain water-pumping capacity of the production wells in the event of a commercial power failure.

Water Distribution System

The Aboite water distribution system has developed and expanded over a period of time. There are areas in the water distribution system that would benefit from water main looping. however, in general the water distribution pattern is acceptable for meeting current domestic water usage demands. There are no known water mains with excessive structural or water quality problems.

Aboite System Summary

See Table 3-7 for a summary of the Aboite Water System to include peak day demands through 2002.

Wells

Includes Data Thru 2002

		Present Capacity	
		Total Capacity	Firm Capacity
Aboite Wellfield	GPM	GPD	GPD
#1	400	576,000	576,000
#2	200	288,000	288,000
#3	485	698,400	698,400
#4	325	468,000	468,000
Sub-Total		2,030,400	2,030,400
Covington Wellfield	GPM	GPD	GPD
#5	420	604,800	604,800
#6	360	518,400	518,400
#7	350	504,000	504,000
Sub-Total		1,123,200	1,123,200*
Chestnut Hills Wellfield	GPM	GPD	GPD
#8	500	720,000	720,000
#9	1000	1,440,000	1,440,000
#10	1500	2,160,000	Out of Service
Proposed #11	500	720,000	720,000
Sub-Total		5,040,000	2,880,000
Fort Wayne City Connections		0	0
Pumping Capacity	4040	**8,193,600**	**6,033,600**

* Subtotal for Covington only includes #5 and #6.
Well #7 can only be operated in a "back-up" mode.

Plants

	Capacity
Aboite Water Plant	2,331,000
Covington Water Plant	2,000,000
Chestnut Water Plant	4,000,000
Fort Wayne City Connections	0
Total Water Plant Capacity	**8,331,000**

Storage

Aboite Elevated Tank MG	0.5
Covington Elevated Tank MG	1.5
Total MG	2.0
Average Day Demand MGD	2.70
Percent Capacity vs. Demand	74.07%

Highest Peak Demand Days - Last 2 Years

Date	Demand / MGD
22-Jul-02	6.052
09-Jul-02	5.731
16-Jul-02	5.679
11-Aug-01	5.649
12-Aug-02	5.377
Five Peak Day Average	**5.698**

Percentage Based On Five Peak Day Average

	Total Capacity	Firm Capacity
Well Capacity	69.54%	94.43%
Plant Capacity	68.39%	68.39%

Aboite Water System PWSID #5202014

TABLE 3-7

Wells

Includes Data Thru 2002

Washington Wellfield	GPM	Total Capac GPD	Firm Capacity GPD
#1	410	590,400	590,400
#2	320	460,800	460,800
#3	280	403,200	403,200
#4	215	309,600	309,600
Sub-Total		1,764,000	1,764,000
Lake River Wellfield	**GPM**	**GPD**	**GPD**
#1	1000	1,440,000	1,440,000
#2	850	1,224,000	1,224,000
#3	500	720,000	720,000
#4	700	1,008,000	1,008,000
Sub-Total		4,392,000	4,392,000
Dupont Wellfield	**GPM**	**GPD**	**GPD**
#1	1000	1,440,000	1,440,000
#2	1000	1,440,000	[illegible]
Sub-Total		2,880,000	1,440,000
Pumping Capacity		9,036,000	7,596,000

Plants

Washington Water Plant	1,200,000
Lake River Water Plant	4,000,000
Dupont Water Plant	1,440,000
Total Water Plant Capacity	6,640,000

Storage

Dupont Elevated Tank MG	0.5
Perry Hill Elevated Tank MG	2.0
Total MG	2.5
Average Day Demand MGD	2.15
Percent Capacity vs. Demand	116.17%

Highest Peak Demand Days - Last 2 Years

Date	
11-Jul-02	4.801
10-Jul-02	4.623
16-Jul-01	4.475
15-Jul-01	4.386
13-Aug-01	4.385
Five Peak Day Average	4.534

Percentage Based On Five Peak Day Average

	Total Capacity	Firm Capacity
Well Capacity	50.18%	59.69%
Plant Capacity	68.28%	68.28%

North End Water Supply PWSID #5202002

TABLE 3-8

CHAPTER 4

PROPOSED WATER SYSTEM IMPROVEMENTS

North End Water Service Area

The objective of the short term improvements to the North End water service area has been to increase service reliability and water quality. The objective of long term improvements is to insure water system with a water supply of adequate quantity and quality.

Water Supply

The North End water system has an adequate water supply to meet the current and 20 year planning period demands. However, as part of an ongoing strategic planning, the management of the UCI should actively participate in land use planning activities in Allen County and adjoining Whitley County to protect UCI's existing groundwater supplies and well fields, and to identify future groundwater well fields for future use. As important as developing new water supplies is the protection of the existing aquifer water supply. Therefore, the faithful implementation of the wellhead protection program is critical for the protection of existing water supplies.

Water Treatment

Normal maintenance and replacement of the water treatment facilities should be budgeted. As currently constructed, with the exception of the Washington WTP, existing water treatment facilities should have a 20 year life. The replacement of the Washington WTP will be needed sometime in the 20 year planning period due to its age. The need to increase or provide capability for expansion of a new Washington WTP should be evaluated at the time the replacement of the existing Washington WTP goes into detail engineering design.

Water Storage

In order to provide adequate water storage and water distribution system stability, a new elevated water storage tank should be constructed in the North End water system. Based on projected average daily and peak daily water usage rates, it is recommended that a 1.0 million gallon elevated storage tank be constructed. The estimated cost for this improvement is $2,232,500. A proposed location for the new water tank is shown on Exhibit 8. The construction of a new 1.0 million gallon water storage tank will increase the total water storage capacity from 2,500,000 gallons to 3,500,000 gallons of elevated water storage. This will exceed the projected 20 year average daily water usage.

The exact location of the water tank will be subject to many variables including land availability, maximization of existing water transmission mains, current land development projects and land costs. Detailed engineering design study will determine the best location to resolve the above competing requirements.

Water Distribution System

The replacement of the water booster station, while not required, would improve the water distribution pattern, reliability and stability of the North End water system. The exact alignment of the replacement water transmission main will be determined during preliminary and detail engineering studies. In addition, the implementation of a program to establish looping in the water distribution system will improve both water flow characteristics and water quality throughout the water system. Several projects have been submitted for budget consideration and those are identified in the Proposed Project section below.

It is recommended that as a matter of practice, every new proposed water expansion be modeled using the water distribution system's hydraulic model to determine the opportunities to reinforce the water distribution system through looping.

Proposed Projects – North End

Based upon growth, reliability, compliance and need, nine (9) projects have been identified as budgetary priority. These projects are shown on Exhibit 8 (Vicinity Locations) and are listed below.

Project	Description
1	State Road #3 Feeder Main (Wallen to Lima Valley)
2	Wallen Road Main Extension (State Road #3 to Broadmoor)
3	Washington Water Treatment Plant Replacement
4	Coldwater Road Main Extension (Perry Hill to Falcon Creek)
5	Carroll Road / State Road #3 Main Extension
6	Till/Wallen Interconnection
7	LaCabreah – Union Chapel Looping
8	North Water Storage
9	Dupont Well #3

The Utility Center also plans on continued system improvements other than these identified projects to include looping, new hydrants, additional isolation valves, etc.

It is anticipated that the majority of these projects will be completed in the next four (4) years.

Aboite Water Service Area

The Aboite water distribution system has the potential for significant increased water usage. However, the rate of increase and total increased volume is dependent on several variables mostly beyond the control of UCI. Therefore, water system planning should be ongoing as each new development and proposed water expansion is reviewed.

Water Supply

While the current Aboite water system supply exceeds the projected 20 year planning period average daily demand, the development of potential water supplies should remain a high priority. As discussed in Chapter 3 of this report, potential well field sites have been identified. An important activity is the protection of future groundwater well field sites through participation in land use activities and an aggressive enforcement of UCI's well field protection program.

Since increased water usage will not be realized for several years (10+ years). There will be adequate time to develop additional water supplies. Since Area 1 of the Proposed CTA Expansion Area is rapidly developing, well sites in this area may become a high priority.

Water Treatment

With the completion of construction of the Chestnut Hills WTP and the proposed new Aboite Meadows WTP, all three (3) of the Aboite water system treatment plants should have useful operating lives beyond the 20 year planning period. Both the Covington and Chestnut Hills water treatment plants can be expanded, if and when needed to meet the water system's future flow demands. The Aboite Meadows WTP has been included in the 2003/2006 capital budget request and will likely be placed into service in the next two years. In conjunction with this project, the Aboite Meadows well house will also be replaced.

Water Storage

Additional water storage capacity will be required in the Aboite water service area to meet the 20 year planning period peak daily flow demands. It is recommended that two new 1.5 million gallon elevated storage tanks be constructed in the Aboite water service area. A single larger tank option (2.0 million gallons) should also be considered if an appropriate site can be located. The estimated cost for the two tank improvement is $5,351,500. Proposed locations for the new water tanks are shown on Exhibit 7. The construction of two new 1.5 million gallon water storage tanks will increase the total water storage capacity from 2,000,000 gallons to 5,000,000 gallons of elevated water storage. This will exceed the projected 20 year average daily water usage. The construction of one 2 million gallon elevated storage tank would bring the system close to the 20 year ADF estimate. The estimated cost for this improvement is $2,400,000.

The exact location of the water tank(s) will be subject to many variables including land availability, maximization of existing water transmission mains, current land development projects and land costs. Detailed engineering design study will determine the best location to resolve the above competing requirements.

Water Distribution System

Service to Area 1 via a new Homestead Road Feeder Main will be required by mid 2004. It should also be recognized that the construction of the recommended elevated storage tank(s) will require the construction of associated water transmission mains to adequate supply water from the tanks. Several projects have been submitted for budget consideration those are identified in the Proposed Project section below. It is recommended that as a matter of practice, every new proposed water expansion be modeled using the water distribution system's hydraulic model to determine the opportunities to reinforce the water distribution system through looping.

Proposed Projects – Aboite Area

Based upon growth, reliability, compliance and need, several projects have been identified as budgetary priority. These projects are shown on Exhibit 7 (Vicinity Locations) and are listed below.

Project	Description
1	Aboite Meadows Water Treatment Plant
2	Aboite Meadows Well House Replacement
3	Aboite Elevated Water Storage
4	Homestead Road Feeder Main
5	State Road #4 Feeder Main (Replace Existing Hadley to Scott Main)
6	Scott/Bass Road Feeder Main
7	West Hamilton / Noyer Feeder Main
8	Noyer / County Line Feeder Main
9	County Line Feeder Main
10	County Line / County Road 500 E Feeder Main
11	Chestnut / Scott Feeder Main
12	Bass Road Feeder Main (Whispering Meadows – Wescott)

The Utility Center also plans on continued system improvements other than these identified projects to include looping, new hydrants, additional isolation valves, etc.

It is anticipated that the majority of these projects will be completed in the next 4 years.

System Reliability – North and Aboite Areas

To improve system reliability, emergency generator/transfer switch installations at the well sites and treatment plants will be considered on future projects.

CHAPTER 5

WATER SYSTEM MANAGEMENT

General

The long term successful operation of a water system depends on several functioning and interrelated components. The historic operation and past condition of the Utility Center, Inc.'s water system demonstrates that a system must be put into place to ensure that the management, operation and maintenance of the water system is an ongoing process.

As part of the Water Master Plan development activities, the following tools have been developed and implemented. These documents are listed in Appendix E - Report References.

Water Rules & Regulations

The Utility Center, Inc.'s Water Rules & Regulations have been revised to reflect current industry standards. As part of the Water Rules & Regulations revision work effort, water conservation program has been considered. The revised rules address protection of the raw water supply through an active ongoing wellhead protection plan. A defined cross-connection program has been incorporated into the rules to increase the protection of the water quality in the water distribution system.

Construction Standards

The Utility Center, Inc.'s existing Construction Standards have been reviewed and updated. The revised Construction Standards specify the quality of material and workmanship standards to ensure the highest quality water distribution system construction in the future. Criteria for minimizing the construction of "dead end" and non-looped water mains has been established. The Construction Standards establishes standards for documentation of construction both in performance testing and "As Built" record documentation.

Water System Operation & Maintenance Manual

As a component of its *Plan for Achieving Service Excellence*, a Water System Operation & Maintenance Manual has been developed to establish performance procedures to ensure an operating level consistent with industry standards for the maintenance of the water distribution system and its appurtenances. The implementation of a water system management has improved water quality and the water distribution system's reliability.

Water Treatment Plant Operation & Maintenance Manuals

In order to protect the investment at the water treatment plants, Operation & Maintenance manuals are being developed for each water treatment plant. These O&M manuals will establish performance procedures for operating the treatment facilities to increase their performance and reliability. In addition, the O&M manuals will set forth a regular maintenance program for each water treatment plant to protect the plant's infrastructure investment.

Review & Update of the Water Master Plan

In order to maintain a viable plan reflecting current and changed conditions, the Water Master Plan should be reviewed and revised every two (2) years. This will allow the Master Plan to be revised based on actual conditions that have occurred and reduces the reliance on long term projections for infrastructure investment and expansion.

CHAPTER 6

MASTER PLAN IMPLEMENTATION

Considerable resources and financial investment has been made in the UCI's North End and Aboite water systems. This investment has been made to stop the past deterioration of the water systems that had occurred prior to the previous AquaSource and recent Philadelphia Water Co. purchase of UCI. Now that the operating condition of the water systems has been stabilized, it is recommended that the improvements recommended herein be reviewed by the governing regulatory agency and authorized so that the water system improvements achieved in the past four years can continue.

The suggested time frames for the implementation of the recommendations presented in this report are presented in this Chapter. Because the current existing water systems can adequately meet the existing customer demands, the implementation schedule is extended over a three year period (2004-2006).

The following projects are included in the 2003/2006 budgetary request for the North Water System.

Project #	Description	Estimated Date of Completion
1	State Road #3 Feeder Main	12/04
2	Wallen Road Main Extension	6/05
3	Washington Water Treatment Plant Replacement	12/05
4	Coldwater Road Main Extension	6/06
5	Carroll Road / State Road #3 Main Extension	6/04
6	Till / Wallen Interconnection	6/05
7	LaCabreah – Union Chapel Looping	6/04
8	North Water Storage	12/05
9	Dupont Well #3	12/06

See Exhibit 8 for vicinity locations for these projects.

The following projects are included in the 2003/2006 budgetary request for the Aboite Water System.

Project #	Description	Estimated Date of Completion
1	Aboite Meadows Water Treatment Plant	12/04
2	Aboite Meadows Wall House Replacement	12/04
3	Aboite Elevated Water Storage	12/04
4	Homestead Road Feeder Main	6/04
5	State Road 14 Feeder Main	12/06
6	Scott / Bass Road Feeder Main	12/05
7	West Hamilton / Noyer Feeder Main	6/04
8	Noyer / County Line Feeder Main	12/05
9	County Line Feeder Main	12/05
10	County Line / County Road 500 E Feeder Main	12/05
11	Chestnut / Scott Feeder Main	6/04
12	Bass Road Feeder Main	12/04

See Exhibit 7 for vicinity locations for these projects.

Beyond the recommended construction activities presented in this report, the continued ongoing improvements that the UCI staff has incorporated into the daily management, operation and maintenance of the water systems must be maintained. It is this long term delivery of service quality that will ultimately determine the effectiveness of any master plan.

NORTHERN SECTOR WATER SYSTEM

ANNUAL POPULATION INCREASE= 3% PERCENT
DESIGN PERIOD= 20 YEARS

(1) 14% = Unaccounted for Water
(2) 75 gal/capita/day water usage
2.1 Houses per Acre

	Range/Township	SECTION	LENGTH	WIDTH	AREA sq ft.	AREA ACRES	CURRENT DEMAND: ESTIMATED CURRENT POP	CURRENT DEMAND: (1) (2) AVG DEMAND	20-YEAR PLANNING PERIOD: CURRENT % DEVELOPED	20-YEAR PLANNING PERIOD: CURRENT POP	20-YEAR PLANNING PERIOD: 20-YEAR POP	20-YEAR PLANNING PERIOD: DESIGN POP	20-YEAR PLANNING PERIOD: (1) (2) AVG DEMAND
(3)	R 12 E. Twp. 31 N	1	5,850	3,500	20,475,000	470	229	19,630	10%	229	414	414	35,440
(3)	R 12 E. Twp. 31 N	2	5,900	5,200	30,680,000	704	917	78,410	25%	917	1,656	1,656	141,610
(3)	R 12 E. Twp. 31 N	3	6,000	5,100	30,600,000	702	2,378	203,330	65%	2,378	4,295	3,659	312,810
(3)	R 12 E. Twp. 31 N	4	6,000	4,900	29,400,000	675	246	22,150	7%	246	444	444	38,000
(3)	R 12 E. Twp. 31 N	5	6,000	2,700	16,200,000	372	58	5,230	3%	58	105	105	8,960
(3)	R 12 E. Twp. 31 N	9	5,200	4,900	25,480,000	585	152	13,710	5%	152	275	275	23,530
(3)	R 12 E. Twp. 31 N	10	5,250	5,200	27,300,000	627	2,611	235,010	80%	2,611	4,716	3,264	279,070
(3)	R 12 E. Twp. 31 N	15	5,200	2,600	13,520,000	310	303	27,260	30%	303	547	547	46,810
(3)	R 12 E. Twp. 31 N	16	5,000	2,600	13,000,000	298	47	4,200	3%	47	84	84	7,210
(3)	R 12 E. Twp. 32 N	22	2,600	2,300	5,980,000	137	21	1,940	3%	21	39	39	3,320
(3)	R 12 E. Twp. 32 N	27	5,300	2,200	11,660,000	268	1,115	100,380	80%	1,115	2,014	1,394	119,200
(3)	R 12 E. Twp. 32 N	28	5,300	5,250	27,825,000	639	166	14,960	5%	166	300	300	25,690
(3)	R 12 E. Twp. 32 N	29	5,350	2,650	14,177,500	325	17	1,530	1%	17	31	31	2,620
(3)	R 12 E. Twp. 32 N	31	5,200	5,150	26,780,000	615	2,251	202,620	75%	2,251	4,066	3,002	256,650
(3)	R 12 E. Twp. 32 N	32	5,400	5,200	28,080,000	645	2,518	226,620	75%	2,518	4,546	3,367	287,050
(3)	R 12 E. Twp. 32 N	33	5,250	5,250	27,562,500	633	2,472	222,440	75%	2,472	4,464	3,296	281,760
(3)	R 12 E. Twp. 32 N	34	5,250	2,100	11,025,000	253	989	88,980	75%	989	1,786	1,318	112,710
(4)	R 13 E. Twp. 31 N	5	2,700	1,700	4,590,000	105	137	12,350	25%	137	248	248	21,190
(4)	R 13 E. Twp. 31 N	5	2,700	850	2,295,000	53	69	6,180	25%	69	124	124	10,600
(4)	R 13 E. Twp. 31 N	4	4,700	3,300	15,510,000	356	37	3,340	2%	37	67	67	5,730
(4)	R 13 E. Twp. 31 N	4	4,700	1,550	7,285,000	167	96	8,820	15%	96	177	177	15,140
(4)	R 13 E. Twp. 31 N	3	3,300	2,600	8,580,000	197	77	6,930	10%	77	139	139	11,890
(4)	R 13 E. Twp. 31 N	3	3,300	1,950	6,435,000	148	48	4,330	10%	48	87	87	7,430
(4)	R 13 E. Twp. 32 N	30	5,200	2,700	14,040,000	322	50	4,540	3%	50	91	91	7,760
(4)	R 13 E. Twp. 32 N	31	5,300	4,800	25,440,000	584	912	82,130	30%	912	1,648	1,648	140,910
(4)	R 13 E. Twp. 32 N	29	1,300	2,700	3,510,000	81	13	1,140	3%	13	23	23	1,950
(4)	R 13 E. Twp. 32 N	32	1,300	1,300	1,690,000	39	6	560	3%	6	11	11	940
(4)	R 13 E. Twp. 32 N	29	700	2,700	1,890,000	43	6	540	3%	6	11	11	920
(4)	R 12 E. Twp. 32 N	22	2,850	2,600	7,410,000	170	27	2,400	3%	27	48	48	4,110
(4)	R 12 E. Twp. 32 N	27	5,200	2,900	15,080,000	346	1,172	105,460	65%	1,172	2,117	1,803	154,160
(4)	R 12 E. Twp. 32 N	26	5,250	2,600	13,650,000	313	82	7,350	5%	82	147	147	12,610
(4)	R 12 E. Twp. 32 N	25	5,200	2,600	13,520,000	310	16	1,460	1%	16	29	29	2,500
(4)	R 12 E. Twp. 32 N	34	5,200	3,000	15,600,000	358	1,212	109,110	65%	1,212	2,190	1,865	159,470
(4)	R 12 E. Twp. 32 N	35	5,200	5,100	26,520,000	609	1,110	99,860	35%	1,110	2,004	2,004	171,380
(4)	R 12 E. Twp. 32 N	36	5,100	5,000	25,500,000	585	610	54,880	20%	610	1,101	1,101	94,160
	R 12 E. Twp. 31 N	5	6,000	2,500	15,000,000	344	18	1,540	1%	18	32	32	2,770
	R 11 E. Twp. 32 N	36	5,450	5,000	27,250,000	626	33	2,790	1%	33	59	59	5,040
	R 12 E. Twp. 32 N	21	5,300	5,250	27,825,000	639	67	5,690	2%	67	120	120	10,280
	R 12 E. Twp. 32 N	16	5,250	1,300	6,825,000	157	41	3,490	5%	41	74	74	6,310
	R 12 E. Twp. 32 N	22	5,100	2,600	13,260,000	304	79	6,760	5%	79	143	143	12,250
	R 12 E. Twp. 32 N	15	5,100	1,300	6,630,000	152	48	4,070	6%	48	86	86	7,350
	R 12 E. Twp. 32 N	14	3,300	1,300	4,290,000	98	205	17,550	40%	205	371	371	31,690
	R 12 E. Twp. 32 N	23	5,250	2,700	14,175,000	325	169	14,500	10%	169	306	306	26,180
	R 12 E. Twp. 32 N	26	2,700	2,600	7,020,000	161	8	720	1%	8	15	15	1,300
	R 13 E. Twp. 32 N	19	5,300	2,600	13,780,000	316	46	3,970	3%	46	84	84	7,160
	R 13 E. Twp. 32 N	20	5,300	2,600	13,780,000	316	46	3,970	3%	46	84	84	7,160
	R 13 E. Twp. 32 N	21	3,500	1,300	4,550,000	104	15	1,310	3%	15	28	28	2,370
	R 13 E. Twp. 32 N	28	5,000	3,400	17,000,000	390	38	3,280	3%	38	69	69	5,890
	R 13 E. Twp. 32 N	28	4,800	1,300	6,240,000	143	398	33,890	85%	398	718	466	39,870
	R 13 E. Twp. 32 N	28	3,000	650	1,950,000	45	173	14,830	85%	173	313	204	17,450
	R 13 E. Twp. 32 N	29	5,250	2,600	13,650,000	313	40	3,410	3%	40	72	72	6,150
	R 13 E. Twp. 32 N	29	4,700	2,600	12,220,000	281	25	2,110	3%	25	45	45	3,810
	R 13 E. Twp. 32 N	29	4,600	1,050	4,830,000	111	16	1,390	3%	16	29	29	2,510
	R 13 E. Twp. 32 N	29	2,000	1,050	2,100,000	48	3	250	3%	3	5	5	440
	R 13 E. Twp. 32 N	30	5,300	2,600	13,780,000	316	6	530	3%	6	11	11	960
							23,848					34,111	

CURRENT DEMAND	
YEARLY AVERAGE CONSUMPTION (gal/day)	2,108,900
YEARLY AVERAGE CONSUMPTION (gpm)	1,462
MAXIMUM DAILY USE (gpm)	3,071
MAXIMUM HOURLY USE (gpm)	5,265

20-YEAR PLANNING PERIOD	
YEARLY AVERAGE CONSUMPTION (gal/day)	3,002,270
YEARLY AVERAGE CONSUMPTION (gpm)	2,085
MAXIMUM DAILY USE (gpm)	4,378
MAXIMUM HOURLY USE (gpm)	7,506

NOTES:
(3) Huntertown USGS Quad.
(4) Cedarville USGS Quad.
(5) Based on 3.1 persons per home.

UtilityCntrNorth.wb3
WW SUMMARY

10/27/01
06:47 PM

NORTHERN SECTOR WATER SYSTEM

ANNUAL POPULATION INCREASE= 3% PERCENT (1)
DESIGN PERIOD= 20 YEARS (2)

	Range/Township	SECTION	LENGTH	WIDTH	AREA sq.ft.	AREA ACRES	CURRENT DEMAND ESTIMATED CURRENT POP	CURRENT DEMAND (1) (2) AVG DEMAND
(3)	R 12 E, Twp. 31 N	1	5,850	3,500	20,475,000	470	229	19,630
(3)	R 12 E, Twp. 31 N	2	5,900	5,200	30,680,000	704	917	78,410
(3)	R 12 E, Twp. 31 N	3	6,000	5,100	30,600,000	702	2,378	203,330
(3)	R 12 E, Twp. 31 N	4	6,000	4,900	29,400,000	675	246	22,150
(3)	R 12 E, Twp. 31 N	5	6,000	2,700	16,200,000	372	58	5,230
(3)	R 12 E, Twp. 31 N	9	5,200	4,900	25,480,000	585	152	13,710
(3)	R 12 E, Twp. 31 N	10	5,250	5,200	27,300,000	627	2,611	235,010
(3)	R 12 E, Twp. 31 N	15	5,200	2,600	13,520,000	310	303	27,280
(3)	R 12 E, Twp. 31 N	16	5,000	2,600	13,000,000	298	47	4,200
(3)	R 12 E, Twp. 32 N	22	2,600	2,300	5,980,000	137	21	1,940
(3)	R 12 E, Twp. 32 N	27	5,300	2,200	11,660,000	268	1,115	100,380
(3)	R 12 E, Twp. 32 N	28	5,300	5,250	27,825,000	639	166	14,980
(3)	R 12 E, Twp. 32 N	29	5,350	2,650	14,177,500	325	17	1,530
(3)	R 12 E, Twp. 32 N	31	5,200	5,150	26,780,000	615	2,251	202,620
(3)	R 12 E, Twp. 32 N	32	5,400	5,200	28,080,000	645	2,518	226,620
(3)	R 12 E, Twp. 32 N	33	5,250	5,250	27,562,500	633	2,472	222,440
(3)	R 12 E, Twp. 32 N	34	5,250	2,100	11,025,000	253	989	88,980
(4)	R 13 E, Twp. 31 N	5	2,700	1,700	4,590,000	105	137	12,350
(4)	R 13 E, Twp. 31 N	5	2,700	850	2,295,000	53	69	6,180
(4)	R 13 E, Twp. 31 N	4	4,700	3,300	15,510,000	356	37	3,340
(4)	R 13 E, Twp. 31 N	4	4,700	1,550	7,285,000	167	98	8,820
(4)	R 13 E, Twp. 31 N	3	3,300	2,600	8,580,000	197	77	6,930
(4)	R 13 E, Twp. 31 N	3	3,300	1,950	6,435,000	148	48	4,330
(4)	R 13 E, Twp. 32 N	30	5,200	2,700	14,040,000	322	50	4,540
(4)	R 13 E, Twp. 32 N	31	5,300	4,800	25,440,000	584	912	82,130
(4)	R 13 E, Twp. 32 N	29	1,300	2,700	3,510,000	81	13	1,140
(4)	R 13 E, Twp. 32 N	32	1,300	1,300	1,690,000	39	6	550
(4)	R 13 E, Twp. 32 N	29	700	2,700	1,890,000	43	6	540
(4)	R 12 E, Twp. 32 N	22	2,850	2,600	7,410,000	170	27	2,400
(4)	R 12 E, Twp. 32 N	27	5,200	2,900	15,080,000	346	1,172	105,480
(4)	R 12 E, Twp. 32 N	28	5,250	2,600	13,650,000	313	82	7,350
(4)	R 12 E, Twp. 32 N	25	5,200	2,600	13,520,000	310	16	1,460
(4)	R 12 E, Twp. 32 N	34	5,200	3,000	15,600,000	358	1,212	109,110
(4)	R 12 E, Twp. 32 N	35	5,200	5,100	26,520,000	609	1,110	99,880
(4)	R 12 E, Twp. 32 N	36	5,100	5,000	25,500,000	585	610	54,880
							22,173	

YEARLY AVERAGE CONSUMPTION (gal/day)	1,979,850
YEARLY AVERAGE CONSUMPTION (gpm)	1,375
MAXIMUM DAILY USE (gpm)	2,887
MAXIMUM HOURLY USE (gpm)	4,950

NOTES:
(3) Huntertown USGS Quad.
(4) Cedarville USGS Quad.
(5) Based on 3.1 persons per home.

SOUTH SERVICE AREA
POTABLE WATER SYSTEM
DEMAND FORECAST
CURRENT SERVICE AREA

ANNUAL POPULATION INCREASE= 3% PERCENT
DESIGN PERIOD= 20 YEARS

	Range/Township	SECTION	LENGTH	WIDTH	GROSS AREA sq.ft.	GROSS AREA ACRES	PERCENT DEVELOPABLE	NET AREA (ACRES)	CURRENT DEMAND: CURRENT POP	CURRENT DEMAND: (1) (6) AVG DEMAND
ABOITE WWTP GRAVITY FLOW	R 11 E, Twp. 30 N	14	5,300	5,200	27,560,000	631	80%	494	2,060	173,710
	R 11 E, Twp. 30 N	14	(1,500)	1,500	(2,250,000)	(52)	—	—	—	—
	R 11 E, Twp. 30 N	16	5,300	2,600	13,780,000	316	80%	253	1,190	100,660
	R 11 E, Twp. 30 N	22	5,200	3,500	18,370,000	422	80%	337	1,408	119,160
	R 11 E, Twp. 30 N	22	5,300	5,300	28,090,000	645	85%	548	2,123	179,640
	R 11 E, Twp. 30 N	26	3,600	3,100	10,850,000	249	75%	187	410	34,700
	R 11 E, Twp. 30 N	26	3,500	650	2,275,000	52	1%	1	0	0
	R 11 E, Twp. 30 N	27	5,300	5,300	28,090,000	627	80%	502	1,981	166,160
	R 11 E, Twp. 30 N	27	400	(1,900)	(760,000)	(17)	—	—	—	—
COVINGTON LAKE SBT. PUMP STA.	R 11 E, Twp. 30 N	16	5,300	2,600	13,780,000	316	85%	269	1,118	94,590
	R 11 E, Twp. 30 N	16	1,600	5,200	8,320,000	191	85%	162	719	60,910
	R 11 E, Twp. 30 N	10	1,700	1,800	3,060,000	70	85%	60	26	2,250
	R 11 E, Twp. 30 N	10	2,000	1,000	2,000,000	46	85%	39	162	13,730
	R 11 E, Twp. 30 N	11	2,600	2,650	6,760,000	155	85%	132	474	40,210
SYCAMORE HILLS PUMP STATION	R 11 E, Twp. 30 N	2	1,900	2,600	4,940,000	113	85%	96	400	33,910
	R 11 E, Twp. 30 N	3	5,200	3,700	19,240,000	442	80%	353	1,012	85,780
	R 11 E, Twp. 30 N	4	5,200	3,900	20,280,000	466	80%	372	873	73,980
	R 11 E, Twp. 30 N	5	5,200	3,900	20,280,000	466	85%	396	22	1,860
	R 11 E, Twp. 30 N	6	4,000	5,750	23,000,000	528	85%	449	25	2,110
	R 11 E, Twp. 30 N	7	—	—	—	233	85%	198	109	9,240
	R 11 E, Twp. 30 N	8	5,200	5,200	27,040,000	621	85%	528	29	2,460
	R 11 E, Twp. 30 N	9	5,200	5,100	26,520,000	609	75%	457	892	75,590
	R 11 E, Twp. 30 N	16	5,200	5,200	27,040,000	621	75%	466	1,708	144,490
	R 11 E, Twp. 30 N	15	5,200	5,200	27,040,000	621	50%	310	30	2,570
	R 11 E, Twp. 30 N	17	5,200	5,200	27,040,000	621	50%	310	81	6,860
	R 11 E, Twp. 31 N	21	5,100	3,900	19,650,000	451	85%	0	0	0
	R 11 E, Twp. 31 N	22	5,100	5,075	25,882,500	594	85%	0	0	0
	R 11 E, Twp. 31 N	23	5,100	5,350	27,285,000	626	85%	0	0	0
	R 11 E, Twp. 31 N	24	5,100	5,300	27,030,000	621	85%	0	0	0
	R 11 E, Twp. 31 N	25	5,300	2,000	10,600,000	243	85%	0	0	0
	R 11 E, Twp. 31 N	26	2,600	3,300	8,580,000	197	85%	0	0	0
ABOITE CENTER ROAD PUMP STA.	R 10 E, Twp. 30 N	1	5,100	4,100	20,910,000	480	85%	408	68	5,750
	R 10 E, Twp. 30 N	2	5,300	4,000	21,200,000	487	85%	0	0	0
	R 10 E, Twp. 30 N	11	5,200	5,300	27,560,000	633	85%	0	0	0
	R 10 E, Twp. 30 N	12	5,200	300	1,560,000	36	85%	30	2	150
	R 10 E, Twp. 30 N	12	2,400	750	1,800,000	41	85%	35	2	180
	R 11 E, Twp. 30 N	19	—	—	—	200	50%	100	38	3,210
	R 11 E, Twp. 30 N	20	—	—	—	446	40%	178	117	9,890
	R 11 E, Twp. 30 N	7	5,200	3,900	20,280,000	233	85%	198	164	13,820
	R 11 E, Twp. 30 N	18	5,300	3,900	20,670,000	475	85%	403	558	47,220
MIDWEST WWTP SERVICE AREA	R 11 E, Twp. 30 N	2	2,700	3,500	9,450,000	217	85%	184	408	34,550
	R 11 E, Twp. 30 N	3	1,500	2,700	4,050,000	93	85%	79	218	18,540
	R 11 E, Twp. 30 N	1	5,000	3,100	15,500,000	356	85%	302	1,590	134,730
	R 12 E, Twp. 30 N	7	4,700	2,600	12,220,000	281	80%	224	995	84,200
	R 12 E, Twp. 30 N	17	2,600	2,600	6,760,000	155	50%	78	240	20,340
	R 12 E, Twp. 30 N	18	5,200	4,700	24,440,000	561	85%	477	1,189	100,650
	R 11 E, Twp. 30 N	13	5,200	2,600	13,520,000	310	85%	264	1,314	111,390
	R 11 E, Twp. 30 N	14	1,500	1,500	2,250,000	52	85%	44	219	18,540
	R 11 E, Twp. 30 N	11	5,300	2,600	13,780,000	316	80%	253	527	44,680
	R 11 E, Twp. 30 N	11	2,600	2,600	6,760,000	155	85%	132	438	37,120
	R 11 E, Twp. 30 N	12	5,300	5,300	28,090,000	645	75%	484	2,007	170,110
	R 11 E, Twp. 30 N	23	1,800	5,200	9,360,000	215	50%	110	402	34,070
	R 11 E, Twp. 30 N	24	2,600	5,200	13,520,000	310	45%	140	388	32,880
	R 11 E, Twp. 30 N	24	1,200	2,300	2,760,000	63	55%	35	123	10,470
	R 11 E, Twp. 31 N	25					80%	0	0	0
BITTERSWEET PUMP STATION	R 11 E, Twp. 30 N	28	5,300	5,200	27,560,000	633	80%	506	1,977	167,560
	R 11 E, Twp. 30 N	28	5,300	5,200	27,560,000	633	50%	316	206	17,460
	R 11 E, Twp. 30 N	29	5,200	3,750	19,430,000	446	50%	223	399	33,830
	R 11 E, Twp. 30 N	31	2,550	2,000	5,100,000	117	50%	59	57	4,830
	R 11 E, Twp. 30 N	21	5,300	5,200	27,300,000	627	75%	470	1,721	145,880
	R 11 E, Twp. 30 N	19	1,000	2,000	2,000,000	46	50%	23	7	640
	R 11 E, Twp. 30 N	19	2,800	3,300	9,240,000	212	50%	106	35	2,930
	R 11 E, Twp. 30 N	20	2,000	1,800	3,600,000	83	55%	46	1	130
	R 11 E, Twp. 30 N	30	800	2,000	1,600,000	37	40%	15	10	820
	R 11 E, Twp. 30 N	29	600	2,050	1,230,000	28	40%	11	7	600
	R 11 E, Twp. 30 N	30	600	3,200	1,920,000	44	40%	18	12	980
	R 11 E, Twp. 30 N	29	800	3,200	2,560,000	59	45%	27	17	1,450
	R 11 E, Twp. 30 N	20	1,300	5,200	6,760,000	157	40%	63	41	3,480
	R 11 E, Twp. 30 N	20	300	1,200	360,000	8	40%	3	2	180
									33,318	

YEARLY AVERAGE CONSUMPTION (gal/day) 2,738,940
YEARLY AVERAGE CONSUMPTION (gpm) 1,902
MAXIMUM DAILY USE (gpm) 3,804
MAXIMUM HOURLY USE (gpm) 6,847

NOTES:
(6) Based on 3.1 persons per home.

TOTALANALYSIS.wb3
PRESENT WORTH

10/27/01
05:51 PM

SOUTH SERVICE AREA—EXPANDED

POTABLE WATER SYSTEM
DEMAND FORECAST

ANNUAL POPULATION INCREASE= 3% PERCENT
DESIGN PERIOD= 20 YEARS

(1) 13% = Unaccounted for Water
(2) 75 gal/capita/day water usage
2.1 Houses per Acre

Range/Township	SECTION	LENGTH	WIDTH	GROSS AREA sq ft	GROSS AREA ACRES	PERCENT DEVELOPABLE	NET AREA (ACRES)	CURRENT DEMAND: CURRENT POP	CURRENT DEMAND: (1) (2) AVG DEMAND	20-YEAR PLANNING PERIOD: CURRENT % DEVELOPED	CURRENT POP	20-YEAR POP	DESIGN POP	(1) (2) AVG DEMAND
R 11 E, Twp 30 N	14	6,300	5,200	27,560,000	581	85%	494	2,050	173,710	75%	2,050	3,702	2,733	221,820
R 11 E, Twp 30 N	14	(1,500)	1,500	(2,250,000)	(52)	—	—	—	—	—	—	—	—	—
R 11 E, Twp 30 N	16	5,300	2,600	13,780,000	316	85%	269	1,190	100,890	80%	1,190	2,150	1,488	126,110
R 11 E, Twp 30 N	23	5,250	3,500	18,375,000	422	80%	337	1,406	119,150	80%	1,406	2,539	1,758	149,050
R 11 E, Twp 30 N	22	5,300	5,300	28,090,000	645	85%	548	2,123	179,940	70%	2,123	3,835	3,033	257,080
R 11 E, Twp 30 N	26	3,500	3,100	10,850,000	249	75%	187	410	34,790	45%	410	741	741	62,830
R 11 E, Twp 30 N	26	3,500	650	2,275,000	52	1%	1	0	10	1%	0	0	0	10
R 11 E, Twp 30 N	27	5,300	5,300	28,090,000	627	80%	502	1,961	166,160	75%	1,961	3,541	2,614	221,560
R 11 E, Twp 30 N	27	400	(1,900)	(760,000)	(17)	—	—	—	—	—	—	—	—	—
R 11 E, Twp 30 N	19	5,300	2,600	13,780,000	316	85%	269	1,118	94,580	75%	1,118	2,016	1,488	126,110
R 11 E, Twp 30 N	18	1,600	5,200	8,320,000	191	85%	162	719	60,910	80%	719	1,298	896	76,140
R 11 E, Twp 30 N	18	1,700	1,800	3,060,000	70	85%	60	26	2,250	6%	26	48	48	4,050
R 11 E, Twp 30 N	10	2,000	1,000	2,000,000	46	85%	39	162	13,730	75%	162	293	214	18,310
R 11 E, Twp 30 N	11	2,600	2,600	6,760,000	155	85%	132	474	40,210	65%	474	857	730	61,870
R 11 E, Twp 30 N	2	3,800	2,600	9,880,000	227	85%	193	800	67,810	75%	800	1,446	1,067	90,420
R 11 E, Twp 30 N	3	5,200	5,400	28,080,000	645	80%	516	1,477	125,200	55%	1,477	2,668	2,668	226,110
R 11 E, Twp 30 N	4	5,200	5,600	29,120,000	669	80%	535	1,253	106,230	45%	1,253	2,264	2,264	191,850
R 11 E, Twp 30 N	5	5,200	5,700	29,640,000	680	85%	578	32	2,720	1%	32	58	58	4,900
R 11 E, Twp 30 N	5	4,000	5,750	23,000,000	528	85%	449	25	2,110	1%	25	45	45	3,810
R 11 E, Twp 30 N	7	—	—	—	230	85%	196	109	9,280	10%	109	196	196	16,760
R 11 E, Twp 30 N	8	5,200	5,200	27,040,000	621	85%	528	29	2,460	1%	29	53	53	4,470
R 11 E, Twp 30 N	9	5,200	5,100	26,520,000	609	75%	457	892	75,590	40%	892	1,611	1,611	136,510
R 11 E, Twp 30 N	10	5,200	5,200	27,040,000	621	75%	466	1,706	144,490	75%	1,706	3,079	2,273	192,680
R 11 E, Twp 30 N	16	5,200	5,200	27,040,000	621	50%	310	30	2,570	5%	30	55	55	4,640
R 11 E, Twp 30 N	17	5,200	5,200	27,040,000	621	50%	310	81	6,860	5%	81	146	146	12,380
R 11 E, Twp 31 N	31	5,100	3,850	19,635,000	451	85%	383	21	1,800	1%	21	38	38	3,250
R 11 E, Twp 31 N	32	5,100	5,075	25,882,500	594	85%	505	28	2,370	1%	28	50	50	4,280
R 11 E, Twp 31 N	33	5,100	5,350	27,285,000	626	85%	532	147	12,490	5%	147	266	266	22,550
R 11 E, Twp 31 N	34	5,100	5,300	27,030,000	621	85%	527	29	2,480	1%	29	53	53	4,470
R 11 E, Twp 31 N	35	5,300	2,000	10,600,000	243	85%	207	34	2,920	3%	34	62	62	5,280
R 11 E, Twp 31 N	36	2,600	3,300	8,580,000	197	85%	167	28	2,380	3%	28	50	50	4,280
R 10 E, Twp 30 N	1	5,100	4,100	20,910,000	480	85%	408	68	5,750	3%	68	122	122	10,370
R 10 E, Twp 30 N	2	5,300	4,000	21,200,000	487	85%	414	0	0	0%	0	0	0	0
R 10 E, Twp 30 N	11	5,200	5,300	27,560,000	633	85%	538	0	0	0%	0	0	0	0
R 10 E, Twp 30 N	12	5,300	2,600	13,780,000	316	85%	269	15	1,270	1%	15	27	27	2,280
R 10 E, Twp 30 N	12	4,700	2,600	12,220,000	281	85%	238	13	1,120	1%	13	24	24	2,020
R 10 E, Twp 30 N	13	5,200	5,300	27,560,000	633	85%	538	30	2,530	1%	30	54	54	4,580
R 10 E, Twp 30 N	14	5,300	5,300	28,090,000	645	85%	548	30	2,580	1%	30	55	55	4,650
R 10 E, Twp 30 N	23	5,300	5,300	28,090,000	645	85%	548	30	2,580	1%	30	55	55	4,650
R 11 E, Twp 30 N	16	—	—	—	200	50%	100	39	3,310	12%	39	71	71	5,980
R 11 E, Twp 30 N	20	—	—	—	291	40%	116	76	6,430	25%	76	137	137	11,600
R 10 E, Twp 30 N	24	5,200	5,200	27,040,000	621	85%	528	29	2,480	1%	29	53	53	4,470
R 11 E, Twp 30 N	7	5,200	3,900	20,280,000	233	85%	198	164	13,920	15%	164	297	297	25,140
R 11 E, Twp 30 N	19	5,300	3,900	20,670,000	475	85%	403	558	47,290	25%	558	1,009	1,009	85,410
R 11 E, Twp 30 N	2	2,700	5,300	14,310,000	329	85%	279	618	52,390	40%	618	1,116	1,116	94,610
R 11 E, Twp 30 N	2	1,500	2,700	4,050,000	93	85%	79	219	18,540	50%	219	395	395	33,470
R 11 E, Twp 30 N	1	5,000	3,100	15,500,000	356	85%	302	1,590	134,750	95%	1,590	2,872	1,874	141,850
R 11 E, Twp 30 N	1	2,600	2,000	5,200,000	119	85%	101	281	23,800	60%	281	507	507	42,980
R 12 E, Twp 30 N	7	4,700	2,600	12,220,000	281	80%	224	993	84,200	85%	993	1,794	1,169	99,080
R 12 E, Twp 30 N	17	2,600	2,600	6,760,000	155	50%	78	240	20,340	95%	240	433	253	21,410
R 12 E, Twp 30 N	18	2,600	4,700	12,220,000	281	85%	238	594	50,330	45%	594	1,072	1,072	90,880
R 11 E, Twp 30 N	13	5,200	5,200	13,520,000	310	85%	264	1,314	111,350	90%	1,314	2,373	1,460	123,730
R 11 E, Twp 30 N	14	1,500	1,500	2,250,000	52	85%	44	219	18,540	90%	219	395	243	20,590
R 11 E, Twp 30 N	11	5,300	2,600	13,780,000	316	80%	253	527	44,690	40%	527	952	952	80,700
R 11 E, Twp 30 N	11	2,600	2,600	6,760,000	155	85%	132	438	37,120	60%	438	791	730	61,870
R 11 E, Twp 30 N	13	5,300	5,300	28,090,000	645	75%	484	2,007	170,110	85%	2,007	3,626	2,361	200,180
R 11 E, Twp 30 N	23	1,800	5,200	9,360,000	215	55%	118	402	34,070	95%	402	726	423	35,870
R 11 E, Twp 30 N	24	2,600	5,200	13,520,000	310	45%	140	389	32,960	95%	389	702	409	34,690
R 11 E, Twp 30 N	24	1,250	2,300	2,875,000	66	55%	36	123	10,470	95%	123	223	130	11,020
R 11 E, Twp 31 N	25	2,700	3,400	9,180,000	211	80%	169	44	3,730	5%	44	79	79	6,720
R 11 E, Twp 30 N	28	5,300	5,200	27,560,000	633	80%	506	1,977	167,560	75%	1,977	3,571	2,636	223,410
R 11 E, Twp 30 N	29	5,300	5,200	27,560,000	633	50%	316	206	17,460	20%	206	372	372	31,530
R 11 E, Twp 30 N	32	5,250	3,700	19,425,000	446	50%	223	399	33,830	55%	399	721	721	61,100
R 11 E, Twp 30 N	31	2,550	2,000	5,100,000	117	50%	59	57	4,850	30%	57	103	103	8,750
R 11 E, Twp 30 N	21	5,250	5,200	27,300,000	627	75%	470	1,721	145,880	75%	1,721	3,109	2,295	194,500
R 11 E, Twp 30 N	19	1,000	2,000	2,000,000	46	50%	23	7	640	10%	7	13	13	1,150
R 11 E, Twp 30 N	18	2,800	3,300	9,240,000	212	50%	106	35	2,990	10%	35	62	62	5,280
R 11 E, Twp 30 N	32	2,600	1,500	3,900,000	90	50%	45	1	130	1%	1	3	3	230
R 11 E, Twp 30 N	29	800	2,000	1,600,000	37	40%	15	10	820	25%	10	17	17	1,470
R 11 E, Twp 30 N	28	600	2,050	1,230,000	28	40%	11	7	630	25%	7	13	13	1,130
R 11 E, Twp 30 N	20	600	3,250	1,950,000	45	40%	18	12	990	25%	12	21	21	1,790
R 11 E, Twp 30 N	29	900	3,250	2,925,000	67	40%	27	17	1,490	25%	17	32	32	2,690
R 11 E, Twp 30 N	20	1,300	5,250	6,825,000	157	40%	63	41	3,460	25%	41	74	74	6,250
R 11 E, Twp 30 N	20	300	1,200	360,000	8	40%	3	2	190	25%	2	4	4	330

R 12 E, Twp. 31 N	29	4,200	850	3,570,000	82	85%	70	8	680	2%	8	14	14	1,190
R 12 E, Twp. 31 N	29	2,100	2,700	5,670,000	130	85%	111	12	1,040	2%	12	22	22	1,880
R 11 E, Twp. 31 N	19	3,900	2,500	9,750,000	224	75%	168	8	700	1%	8	15	15	1,280
R 11 E, Twp. 31 N	20	5,250	2,500	13,125,000	301	75%	226	11	940	1%	11	20	20	1,690
R 11 E, Twp. 31 N	21	5,350	2,500	13,375,000	307	85%	261	14	1,230	1%	14	26	26	2,220
R 11 E, Twp. 31 N	22	5,250	500	2,625,000	60	80%	48	5	430	2%	5	9	9	770
R 11 E, Twp. 31 N	22	2,625	1,900	4,987,500	114	80%	92	10	810	2%	10	17	17	1,470
R 11 E, Twp. 31 N	22	1,650	250	412,500	9	85%	8	0	40	1%	0	1	1	70
R 11 E, Twp. 31 N	23	5,250	2,650	13,912,500	319	85%	271	15	1,280	1%	15	27	27	2,300
R 11 E, Twp. 31 N	26	3,500	2,650	9,275,000	213	85%	181	10	860	1%	10	18	18	1,540
R 11 E, Twp. 31 N	26	1,750	1,325	2,318,750	53	85%	45	3	220	1%	3	5	5	390
R 11 E, Twp. 31 N	28	5,450	5,300	28,885,000	663	85%	564	31	2,650	1%	31	56	56	4,790
R 11 E, Twp. 31 N	27	5,250	5,300	27,825,000	639	85%	543	30	2,550	1%	30	54	54	4,600
R 11 E, Twp. 31 N	28	5,300	5,300	28,090,000	645	85%	548	121	10,290	4%	121	219	219	18,550
R 11 E, Twp. 31 N	29	5,300	5,200	27,560,000	633	80%	506	26	2,240	1%	26	46	46	4,040
R 11 E, Twp. 31 N	30	5,200	3,850	20,020,000	460	80%	368	19	1,630	1%	19	35	35	2,940
R 10 E, Twp. 31 N	23	4,900	2,300	11,270,000	259	80%	207	32	2,750	3%	32	58	58	4,950
R 10 E, Twp. 31 N	24	5,350	2,300	12,305,000	282	85%	240	13	1,130	1%	13	24	24	2,040
R 10 E, Twp. 31 N	25	5,350	5,350	28,622,500	657	80%	526	27	2,330	1%	27	49	49	4,200
R 10 E, Twp. 31 N	26	5,250	5,000	26,250,000	603	85%	512	28	2,410	1%	28	51	51	4,340
R 10 E, Twp. 31 N	35	5,350	5,100	27,285,000	626	70%	438	20	1,700	1%	20	36	36	3,060
R 10 E, Twp. 31 N	36	5,350	5,300	28,355,000	651	75%	488	24	2,030	1%	24	43	43	3,650
R 11 E, Twp. 31 N	17	3,300	2,100	6,930,000	159	85%	135	7	640	1%	7	14	14	1,150
R 11 E, Twp. 31 N	17	3,300	450	1,485,000	34	85%	29	2	140	1%	2	3	3	250
R 11 E, Twp. 31 N	17	2,000	1,000	2,000,000	46	85%	39	2	190	1%	2	4	4	340
R 11 E, Twp. 31 N	18	3,300	2,600	8,580,000	197	85%	167	9	790	1%	9	17	17	1,420
R 11 E, Twp. 31 N	19	4,300	1,350	5,805,000	133	85%	113	6	540	1%	6	11	11	960
R 11 E, Twp. 31 N	19	3,900	2,900	11,310,000	260	85%	221	12	1,040	1%	12	22	22	1,870
R 11 E, Twp. 31 N	20	5,300	2,800	14,840,000	341	85%	290	16	1,360	1%	16	29	29	2,460
R 11 E, Twp. 31 N	21	5,300	1,950	10,335,000	237	85%	202	11	950	1%	11	20	20	1,710
R 10 E, Twp. 31 N	11	4,850	2,200	10,670,000	245	75%	184	9	770	1%	9	16	16	1,380
R 10 E, Twp. 31 N	12	3,000	600	1,800,000	41	85%	35	2	170	1%	2	4	4	300
R 10 E, Twp. 31 N	13	5,300	3,000	15,900,000	365	85%	310	17	1,460	1%	17	31	31	2,630
R 10 E, Twp. 31 N	12	4,800	2,300	11,040,000	253	85%	215	12	1,020	1%	12	22	22	1,830
R 10 E, Twp. 31 N	14	5,300	4,900	25,970,000	596	85%	507	28	2,380	1%	28	51	51	4,300
R 10 E, Twp. 31 N	22	4,900	2,950	14,455,000	332	85%	282	16	1,330	1%	16	28	28	2,380
R 10 E, Twp. 31 N	24	5,350	3,100	16,585,000	381	85%	324	18	1,520	1%	18	32	32	2,750
R 10 E, Twp. 30 N	25	5,300	5,300	28,090,000	645	85%	548	61	5,150	2%	61	110	110	9,290
R 10 E, Twp. 30 N	35	5,500	5,300	29,150,000	669	85%	569	31	2,670	1%	31	57	57	4,820
R 10 E, Twp. 30 N	36	5,400	5,300	28,620,000	657	85%	558	31	2,620	1%	31	56	56	4,740
R 10 E, Twp. 30 N	36	5,500	5,400	29,700,000	682	80%	545	57	4,620	2%	57	103	103	8,700
R 12 E, Twp. 30 N	19	5,200	5,100	26,520,000	609	10%	61	1	70	2%	1	1	1	130
R 12 E, Twp. 30 N	30	4,800	3,000	14,400,000	331	70%	231	53	4,470	5%	53	95	95	8,080
R 12 E, Twp. 30 N	29	5,300	2,400	12,720,000	292	5%	15	0	10	1%	0	0	0	10
R 11 E, Twp. 30 N	24	2,700	2,600	7,020,000	161	0%	0	0	0	2%	0	0	0	0
R 11 E, Twp. 30 N	24	2,800	1,450	4,060,000	93	0%	0	0	0	2%	0	0	0	0
R 11 E, Twp. 30 N	25	5,200	5,300	27,560,000	633	3%	19	0	10	1%	0	0	0	10
R 11 E, Twp. 30 N	26	4,800	1,800	8,640,000	198	0%	0	0	0	2%	0	0	0	0
R 11 E, Twp. 30 N	29	3,400	1,500	5,100,000	117	0%	0	0	0	2%	0	0	0	0
R 11 E, Twp. 30 N	31	4,100	3,600	14,760,000	339	0%	0	0	0	0%	0	0	0	0
R 11 E, Twp. 30 N	32	5,700	5,200	29,640,000	680	15%	102	5	430	5%	5	9	9	770
R 11 E, Twp. 30 N	33	5,800	2,600	15,080,000	346	20%	69	5	390	5%	5	8	8	690
R 11 E, Twp. 30 N	32	3,600	2,600	9,360,000	215	0%	0	0	0	0%	0	0	0	0
R 11 E, Twp. 30 N	34	5,500	5,200	28,600,000	657	0%	0	0	0	0%	0	0	0	0
R 11 E, Twp. 30 N	35	5,850	5,300	31,005,000	712	10%	71	1	60	2%	1	2	2	150
R 10 E, Twp. 29 N	2	5,200	3,750	19,500,000	448	70%	313	29	2,430	2%	29	52	52	4,360
R 10 E, Twp. 29 N	1	2,800	3,800	10,640,000	244	1%	2	0	10	1%	0	0	0	10
R 10 E, Twp. 29 N	1	5,400	2,800	15,120,000	347	1%	3	0	10	1%	0	0	0	10
R 11 E, Twp. 29 N	47	12,000	6,500	78,000,000	1,791	65%	1,164	99	8,350	2%	99	178	178	15,080
R 11 E, Twp. 29 N	41	7,000	700	4,900,000	112	75%	84	4	350	1%	4	7	7	640
R 11 E, Twp. 29 N	41	3,500	7,200	25,200,000	579	75%	434	85	7,190	4%	85	153	153	12,960
R 11 E, Twp. 29 N	40	7,250	6,100	44,225,000	1,015	75%	761	74	6,319	2%	74	134	134	11,390
R 11 E, Twp. 29 N	39	6,500	1,200	7,800,000	179	85%	152	8	720	1%	8	15	15	1,290
R 11 E, Twp. 29 N	40	2,000	800	1,600,000	37	75%	28	3	230	2%	3	5	5	420
R 11 E, Twp. 29 N	39	3,850	1,500	5,775,000	133	85%	113	6	530	0	6	11	11	950
								38,691					59,098	

YEARLY AVERAGE CONSUMPTION (gal/day)	2,974,640
YEARLY AVERAGE CONSUMPTION (gpm)	2,066
MAXIMUM DAILY USE (gpm)	4,336
MAXIMUM HOURLY USE (gpm)	7,437

YEARLY AVERAGE CONSUMPTION (gal/day)	4,246,770
YEARLY AVERAGE CONSUMPTION (gpm)	2,948
MAXIMUM DAILY USE (gpm)	6,162
MAXIMUM HOURLY USE (gpm)	10,814

SOUTH WATER SYSTEM
20-YEAR EXPENDITURES

ITEM	QUANTITY	UNITS	UNIT COST	INSTALLATION MARKUP	COST
1.5 MG Elevated Storage Tank	2	Each	$1,185,000.00	1.0	$2,370,000
Site Work	2	LS	$11,850.00	1.0	$23,700
Electrical Work	2	LS	$5,925.00	1.0	$11,900
16" PVC, AWWA C-905	23,000	Lin. Ft.	$65.00	1.0	$1,495,000
Hydrants	38	Each	$2,000.00	2.0	$153,400
Valves	29	Each	$750.00	2.0	$43,200
Easements & Rights-of-Way	23,000	Lin. Ft.	$8.00	1.0	$184,000
	0	Lin. Ft.	$0.00	1.0	$0
				SUBTOTAL	$4,281,200
			CONSTRUCTION CONTINGENCY	25.0%	$1,070,300
				SUBTOTAL	$5,351,500

NORTH WATER SYSTEM

20-YEAR EXPENDITURES

ITEM	QUANTITY	UNITS	UNIT COST	INSTALLATION MARKUP	COST
1.0 MG Elevated Storage Tank	1	Each	$795,500.00	1.0	$795,500
Site Work	1	LS	$7,955.00	1.0	$8,000
Electrical Work	1	LS	$3,977.50	1.0	$4,000
16" PVC, AWWA C-905	12,000	Lin. Ft.	$65.00	1.0	$780,000
Hydrants	20	Each	$2,000.00	2.0	$80,000
Valves	15	Each	$750.00	2.0	$22,500
Easements & Rights-of-Way	12,000	Lin. Ft.	$8.00	1.0	$96,000
	NA	Lin. Ft.	$0.00	1.0	$0
	0	Lin. Ft.	$0.00	1.0	$0
	0	Lin. Ft.	$0.00	1.0	$0
					$1,786,000
			CONSTRUCTION CONTINGENCY	25.0%	$446,500
				SUBTOTAL	**$2,232,500**

APPENDIX E

Reference Documents

1) Chestnut Hills Wellfield 2001 Production Well Drilling for AquaSource, Inc., Peerless Midwest, Inc., September, 2001.

2) Assessment of Potential Wellfields in Aboite Area for AquaSource, Inc., Peerless Midwest, Inc., February, 2001.

3) Report on the Development of a Water Distribution System Hydraulic Model, AquaUtility Construction, LP, May, 2001.

4) Preliminary Structural Inspection of the Dupont Water Tower, Dixon Engineer, Inc., April, 2001.

5) Customer Policy Manual, AquaSource, Inc. 2000.

6) Utility Center, Inc. Water Distribution Manual, AquaUtility Construction, Inc., June, 2000

7) Consolidated Master Plan for the Utility Center, Inc. Allen County Water Supply, Treatment, Storage and Distribution Facilities, AquaSource, Inc. August, 1999.

8) Master Plan for the Utility Center, Inc. Allen County Water Supply, Treatment, Storage, and Distribution Facilities – Amendment 1, AquaSource, Inc. July, 1999.

9) Master Plan for the Utility Center, Inc. Allen County Water Supply, Treatment, Storage, and Distribution Facilities, Triad Associates, Inc. March, 1999.

10) Evaluation of Utility Center, Inc.'s Water and Wastewater Systems, American Consulting Engineers, Inc. June, 1998.

11) Recommended Standards for Water Works, GLUMRB, 1997.

12) Aboite and Pleasant Township Wellfield Study, by Peerless-Midwest, February, 2003

13) Whitely County Wellfield Studies, by Peerless-Midwest, Inc. February / December, 2003

IURC Cause No. 41187

File Date: 11/18/03

This Page Has Been Inserted Intentionally.

The exhibit(s) or attachment(s) are not available in electronic form.

For copies of this exhibit/attachment, please contact the IURC Copy Center at 317.232.2642

Additional Notes:

EXHIBITS 1-10

Exhibit M - Population and Water Usage Projections

WATER MASTER PLAN 2004-2006[5]				CALCULATED POPULATION GROWTH				
YEAR	POPULATION	AVERAGE DAY DEMAND (MGD)	PEAK DAY DEMAND (MGD)	YEAR		AVERAGE DAY DEMAND (MGD)[1]	PEAK DAY DEMAND (MGD)[1,2]	PEAK/AVERAGE RATIO[3]
2002	**32,315**	**2.700**	**5.698**	2002	ACTUAL	**2.700**	**5.698**	2.110
2003	*33,069*	*2.778*	*5.859*	2003	ACTUAL	**2.660**	**5.727**	2.153
2004	*33,841*	*2.855*	*6.020*	2004	ACTUAL	**2.830**	**5.635**	1.991
2005	*34,631*	*2.933*	*6.181*	2005	ACTUAL	**3.120**	**6.234**	1.998
2006	*35,439*	*3.010*	*6.342*	2006	ACTUAL	**3.200**	**6.234**	1.948
2007	*36,266*	*3.088*	*6.504*	2007	ACTUAL	**3.210**	**6.550**	2.040
2008	*37,112*	*3.165*	*6.665*	2008	ACTUAL	**3.200**	**6.387**	1.996
2009	*37,978*	*3.243*	*6.826*	2009	ACTUAL	**3.200**	**5.997**	1.874
2010	*38,864*	*3.320*	*6.987*	2010	ACTUAL	**3.160**	**5.366**	1.698
2011	*39,771*	*3.398*	*7.148*	2011	ACTUAL	**3.050**	**5.637**	1.848
2012	*40,699*	*3.475*	*7.309*	2012	PROJECTED	*3.122*	*6.136*	1.966
2013	*41,649*	*3.553*	*7.470*	2013	PROJECTED	*3.195*	*6.281*	1.966
2014	*42,621*	*3.630*	*7.631*	2014	PROJECTED	*3.270*	*6.428*	1.966
2015	*43,616*	*3.708*	*7.792*	2015	PROJECTED	*3.347*	*6.579*	1.966
2016	*44,633*	*3.785*	*7.953*	2016	PROJECTED	*3.426*	*6.734*	1.966
2017	*45,675*	*3.863*	*8.115*	2017	PROJECTED	*3.506*	*6.892*	1.966
2018	*46,741*	*3.940*	*8.276*	2018	PROJECTED	*3.589*	*7.054*	1.966
2019	*47,832*	*4.018*	*8.437*	2019	PROJECTED	*3.673*	*7.220*	1.966
2020	*48,948*	*4.095*	*8.598*	2020	PROJECTED	*3.759*	*7.390*	1.966
2021	**50,090**	**4.250**	**8.920**	2021	PROJECTED	*3.847*	*7.563*	1.966
2002-2008 CAGR	*2.3%*	*2.7%*	*2.6%*	2002-2008 CAGR		*2.9%*	*1.9%*	*-0.9%*
2008-2011 CAGR	*2.3%*	*2.4%*	*2.4%*	2002-2011 CAGR		*-1.6%*	*-4.1%*	*-2.5%*
2012-2021 CAGR	*2.3%*	*2.3%*	*2.2%*	2012-2021 CAGR		*2.35%*	*2.35%*	*0.0%*

Notes:

1). The Average Day Demand and Peak Day Demand data for 2002-2011 was furnished by Aqua Indiana, Inc.

2). The Peak Day Demand is the Two Year Average Peak.

3). The Peak to Average ratio for 2012-2021 is based on the average ratio from 2002-2011. It shold be noted that this ratio could return to the level of the pre-2008 average with a corresponding increase in the projected 2021 peak day.

4). Bolded values are actual water usage values, and italicized values are projected data.

5). The 20 year Planning Population, Average Day Demand, and Peak Day Demand from the 2004-2006 Water Master Plan has been assumed to occur in 2021. Values between 2002 and 2021 have been interpolated based on cumulative annual growth rate (CAGR).

Exhibit N - Population Growth Summary

YEAR	ABOITE TOWNSHIP POPULATION		FORT WAYNE POPULATION		ALLEN COUNTY POPULATION	
1980	11,663	1	178,269	3	294,335	1
1990	18,490	1	172,391	3	300,836	1
2000	28,338	1	205,727	3	331,849	1
2010	35,765	1	253,691	3	355,329	1
2011	-	-	255,824	2	358,327	2
2020	-	-	-		379,731	2
CUMULATIVE ANNUAL GROWTH RATES						
1980-2010	3.81%		1.18%		0.63%	
1980-1990	4.72%		-0.33%		0.22%	
1990-2000	4.36%		1.78%		0.99%	
2000-2010	2.35%		2.12%		0.69%	
2010-2011			0.84%		0.84%	
2010-2020					0.67%	

Source:
1). Indiana Township Census Counts, 1890 to 2010 - STATS Indiana
2). STATS Indiana
3). Fort Wayne-Allen County Economic Development Alliance

Indiana Utility Regulatory Commission
Aqua Indiana, Inc. Utility Center Water System Allen County, Indiana
Water System Operations Audit

EXHIBIT O - AVERAGE DAY AND PEAK DAY DEMAND PROJECTIONS

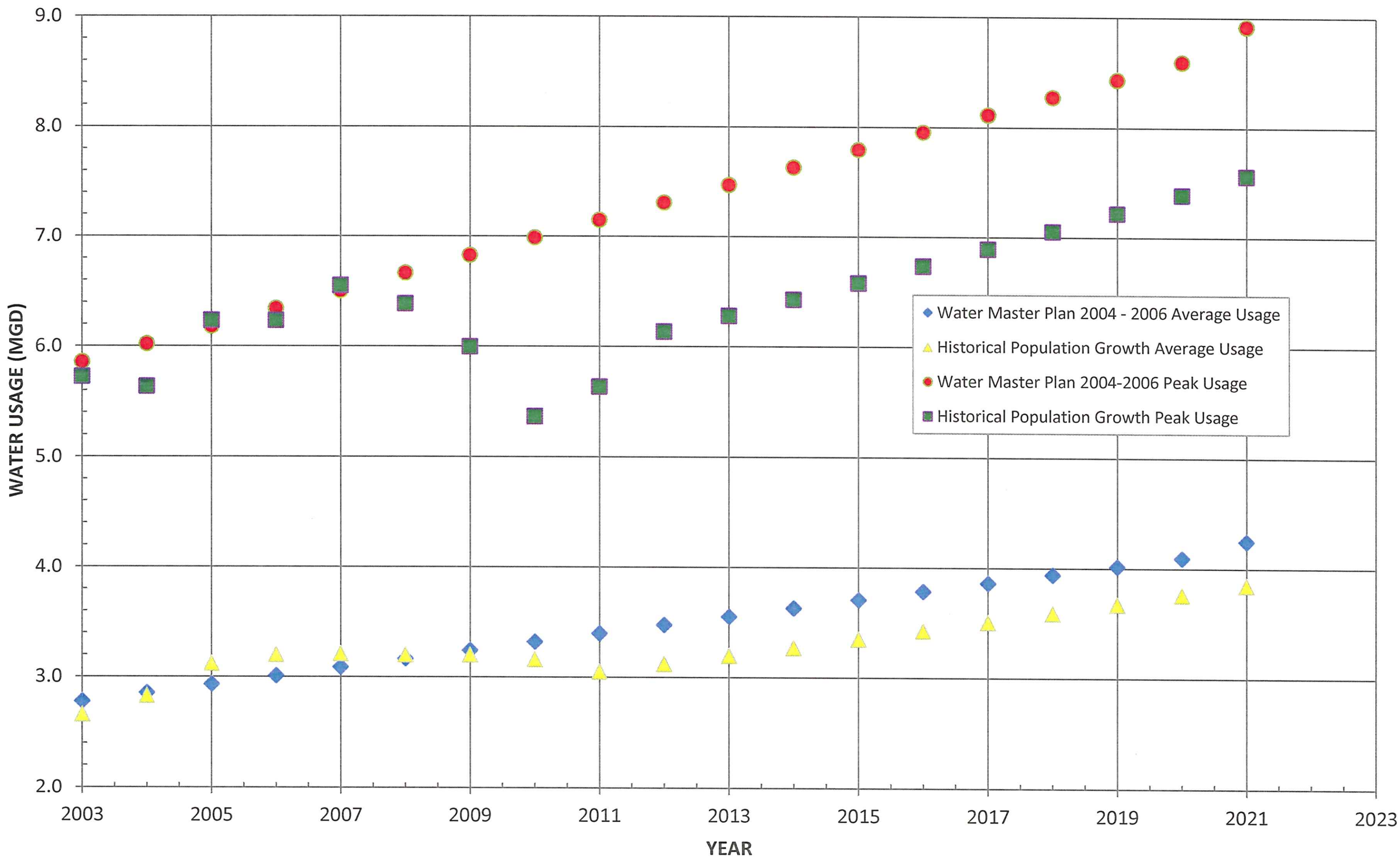


Exhibit P - Analysis of Historical Well Pumping Capacity

Year	Rated Well Capacity											Total Well Pumping Capacity	Two Year Average Peak Production	Total Well Capacity Less Two Year Average Peak	Rated Well Pump Capacity 327 IAC 8-3.3-3	Required Well Capacity to Meet Two Year Average Peak at 90%	Deficit in Well Capacity
	Well 1 [gpm]	Well 2 [gpm]	Well 3 [gpm]	Well 4 [gpm]	Well 5 [gpm]	Well 6 [gpm]	Well 7 [gpm]	Well 8 [gpm]	Well 9 [gpm]	Well 10 [gpm]	Well 11 [gpm]	[MGD]	[MGD]	[MGD]	[MGD]	[MGD]	[MGD]
2002	400	200	485	325	420	360	(1) 350	500	1,000	1,500	(2)	7.474	5.698	1.776	5.314	6.331	1.018
2003	400	200	485	325	420	360	(1) 350	500	1,000	1,500	(2)	7.474	5.727	1.747	5.314	6.363	1.050
2004	400	200	485	325	420	360	(1) 350	500	1,000	1,500	(2)	7.474	5.635	1.839	5.314	6.261	0.948
2005	400	200	485	325	420	360	(1) 350	500	1,000	1,500	(2)	7.474	6.234	1.240	5.314	6.927	1.613
2006	480	340	480	390	310	480	(1) 225	503	975	1,659	(2)	8.088	6.234	1.854	5.700	6.927	1.227
2007	366	341	402	491	402	466	(1) 275	460	869	1,690	(2)	7.901	6.550	1.351	5.468	7.278	1.810
2008	0	0	585	525	425	410	(1) 275	485	900	1,200	(2)	6.523	6.387	0.136	4.795	7.097	2.301
2009	0	0	585	525	425	410	(1) 275	410	811	1,200	(2)	6.287	5.997	0.290	4.559	6.663	2.104
2010	0	0	585	450	425	325	(1) 275	380	870	1,400	(2)	6.386	5.366	1.020	4.370	5.962	1.592
2011	(1) 256	(1) 308	585	450	383	351	(1) 251	323	948	1,446	(2)	6.460	5.637	0.823	4.378	6.263	1.886

(1) Well head capacity insufficient for system conditions - available for operation in backup mode only.
(2) Well #11 pump not installed.

Exhibit Q - Historical Daily Water Demand During June

Date	Total Water Production	Vol in Storage	Total Demand	Date	Total Demand	Date	Total Demand	Date	Total Demand	Date	Total Demand
5/31/2012		2,769,000									
6/1/2012	3,938,000	2,850,000	3,857,000	6/1/2011	3,017,000	6/1/2010	3,203,000	6/1/2008	2,830,000	6/1/2005	4,137,000
6/2/2012	3,483,000	2,867,000	3,466,000	6/2/2011	3,205,000	6/2/2010	3,698,000	6/2/2008	3,547,000	6/2/2005	3,934,000
6/3/2012	3,827,000	2,564,000	4,130,000	6/3/2011	2,658,000	6/3/2010	2,536,000	6/3/2008	3,481,000	6/3/2005	3,405,000
6/4/2012	4,437,000	2,198,000	4,803,000	6/4/2011	3,018,000	6/4/2010	2,970,000	6/4/2008	3,313,000	6/4/2005	2,479,000
6/5/2012	5,327,000	2,585,000	4,940,000	6/5/2011	2,971,000	6/5/2010	3,137,000	6/5/2008	3,513,000	6/5/2005	5,751,000
6/6/2012	5,005,000	2,037,000	5,553,000	6/6/2011	2,941,000	6/6/2010	3,137,000	6/6/2008	2,944,000	6/6/2005	3,080,000
6/7/2012	4,906,000	2,021,000	4,922,000	6/7/2011	4,194,000	6/7/2010	3,140,000	6/7/2008	2,910,000	6/7/2005	3,813,000
6/8/2012	6,075,000	1,716,000	6,380,000	6/8/2011	4,595,000	6/8/2010	2,874,000	6/8/2008	2,902,000	6/8/2005	4,309,000
6/9/2012	5,275,000	1,740,000	5,251,000	6/9/2011	4,085,000	6/9/2010	2,949,000	6/9/2008	3,919,000	6/9/2005	4,196,000
6/10/2012	5,114,000	1,493,000	5,361,000	6/10/2011	3,597,000	6/10/2010	2,767,000	6/10/2008	3,250,000	6/10/2005	4,584,000
6/11/2012	5,227,000	1,706,000	5,014,000	6/11/2011	2,749,000	6/11/2010	3,312,000	6/11/2008	2,979,000	6/11/2005	3,107,000
6/12/2012	5,439,000	1,823,000	5,322,000	6/12/2011	2,759,000	6/12/2010	2,630,000	6/12/2008	3,763,000	6/12/2005	3,500,000
6/13/2012	5,294,000	1,566,000	5,551,000	6/13/2011	2,678,000	6/13/2010	2,630,000	6/13/2008	3,444,000	6/13/2005	2,890,000
6/14/2012	5,487,000	1,392,000	5,661,000	6/14/2011	3,775,000	6/14/2010	2,632,000	6/14/2008	2,067,000	6/14/2005	2,991,000
6/15/2012	5,262,000	887,000	5,767,000	6/15/2011	3,883,000	6/15/2010	3,332,000	6/15/2008	3,441,000	6/15/2005	3,842,000
6/16/2012	5,242,000	1,052,000	5,077,000	6/16/2011	3,144,000	6/16/2010	3,361,000	6/16/2008	2,752,000	6/16/2005	3,303,000
6/17/2012	5,200,000	1,192,000	5,060,000	6/17/2011	3,099,000	6/17/2010	2,816,000	6/17/2008	3,017,000	6/17/2005	3,965,000
6/18/2012	5,376,000	1,030,000	5,538,000	6/18/2011	2,680,000	6/18/2010	3,366,000	6/18/2008	3,832,000	6/18/2005	3,625,000
6/19/2012	5,245,000	1,100,000	5,175,000	6/19/2011	2,618,000	6/19/2010	3,162,000	6/19/2008	3,206,000	6/19/2005	3,169,000
6/20/2012	5,685,000	1,088,000	5,697,000	6/20/2011	2,614,000	6/20/2010	3,162,000	6/20/2008	3,947,000	6/20/2005	4,729,000
6/21/2012	5,174,000	1,501,000	4,761,000	6/21/2011	2,991,000	6/21/2010	3,165,000	6/21/2008	2,909,000	6/21/2005	3,613,000
6/22/2012	5,553,000	1,558,000	5,496,000	6/22/2011	3,312,000	6/22/2010	3,279,000	6/22/2008	2,621,000	6/22/2005	5,290,000
6/23/2012	5,445,000	1,923,000	5,080,000	6/23/2011	2,872,000	6/23/2010	3,672,000	6/23/2008	3,191,000	6/23/2005	4,012,000
6/24/2012	5,601,000	2,144,000	5,380,000	6/24/2011	3,247,000	6/24/2010	2,778,000	6/24/2008	2,615,000	6/24/2005	5,259,000
6/25/2012	5,700,000	1,984,000	5,860,000	6/25/2011	3,303,000	6/25/2010	3,405,000	6/25/2008	3,342,000	6/25/2005	5,194,000
6/26/2012	5,611,000	2,219,000	5,376,000	6/26/2011	3,223,000	6/26/2010	3,249,000	6/26/2008	3,131,000	6/26/2005	4,525,000
6/27/2012	6,113,000	1,937,000	6,395,000	6/27/2011	3,129,000	6/27/2010	3,249,000	6/27/2008	3,343,000	6/27/2005	6,557,000
6/28/2012	5,467,000	2,078,000	5,326,000	6/28/2011	3,433,000	6/28/2010	3,251,000	6/28/2008	2,507,000	6/28/2005	5,237,000
6/29/2012	5,345,000	2,494,000	4,929,000	6/29/2011	3,718,000	6/29/2010	2,502,000	6/29/2008	2,841,000	6/29/2005	4,197,000
6/30/2012	3,920,000	2,745,000	3,669,000	6/30/2011	4,079,000	6/30/2010	3,574,000	6/30/2008	3,135,000	6/30/2005	3,708,000

6/3 - 6/30		6/3 - 6/30		6/3 - 6/30		6/3 - 6/30		6/3 - 6/30		6/3 - 6/30	
Total	147,352,000	Total	147,474,000	Total	91,365,000	Total	86,037,000	Total	88,315,000	Total	114,330,000
Average Daily	5,262,571	Average Daily	5,266,929	Average Daily	3,263,036	Average Daily	3,072,750	Average Daily	3,154,107	Average Daily	4,083,214
Maximum Daily	6,113,000	Maximum Daily	6,395,000	Maximum Daily	4,595,000	Maximum Daily	3,672,000	Maximum Daily	3,947,000	Maximum Daily	6,557,000
6/6 - 6/15		6/6 - 6/15		6/6 - 6/15		6/6 - 6/15		6/6 - 6/15		6/6 - 6/15	
Total	53,084,000	Total	54,782,000	Total	35,256,000	Total	29,403,000	Total	31,619,000	Total	36,312,000
Average Daily	5,308,400	Average Daily	5,478,200	Average Daily	3,525,600	Average Daily	2,940,300	Average Daily	3,161,900	Average Daily	3,631,200
Maximum Daily	6,075,000	Maximum Daily	6,380,000	Maximum Daily	4,595,000	Maximum Daily	3,332,000	Maximum Daily	3,919,000	Maximum Daily	4,584,000

Note: 2012 Total Demand is calculated as the daily water production less the increase in storage volume as of midnight.
Storage data was not available for prior years and total demand is assumed to be equal to daily water production.
Water Production data was not available for 2003, 2004, 2006, 2007 and 2009.
June 3 through 30, 2012 was selected as the period when the elevated storage tanks were not refilled and June 6 through 15, 2012 is the period of most acute depletion of water storage volume.

Indiana Utility Regulatory Commission October 2012
Aqua Indiana, Inc. Utility Center Water System - Allen County, Indiana
Water System Operations Audit

Exhibit R - Historical Daily Water Demand During Peak 28-Day Period

Date	Water Production	Vol in Storage	Total Demand	Date	Total Demand	Date	Total Demand	Date	Total Demand	Date	Total Demand
5/31/2012		2,769,000									
6/1/2012	3,938,000	2,850,000	3,857,000	7/5/2011	4,528,000	6/29/2010	2,502,000	8/12/2008	3,982,000	6/14/2005	2,991,000
6/2/2012	3,483,000	2,792,000	3,541,000	7/6/2011	4,497,000	6/30/2010	3,574,000	8/13/2008	3,898,000	6/15/2005	3,842,000
6/3/2012	3,827,000	2,564,000	4,055,000	7/7/2011	5,183,000	7/1/2010	3,680,000	8/14/2008	4,152,000	6/16/2005	3,303,000
6/4/2012	4,437,000	2,198,000	4,803,000	7/8/2011	5,166,000	7/2/2010	3,789,000	8/15/2008	4,423,000	6/17/2005	3,965,000
6/5/2012	5,327,000	2,585,000	4,940,000	7/9/2011	5,147,000	7/3/2010	3,695,000	8/16/2008	4,282,000	6/18/2005	3,625,000
6/6/2012	5,005,000	2,037,000	5,553,000	7/10/2011	5,147,000	7/4/2010	3,695,000	8/17/2008	4,211,000	6/19/2005	3,169,000
6/7/2012	4,906,000	2,021,000	4,922,000	7/11/2011	5,149,000	7/5/2010	3,697,000	8/18/2008	6,139,000	6/20/2005	4,729,000
6/8/2012	6,075,000	1,716,000	6,380,000	7/12/2011	5,093,000	7/6/2010	4,505,000	8/19/2008	4,256,000	6/21/2005	3,613,000
6/9/2012	5,275,000	1,740,000	5,251,000	7/13/2011	5,171,000	7/7/2010	5,455,000	8/20/2008	3,971,000	6/22/2005	5,290,000
6/10/2012	5,114,000	1,493,000	5,361,000	7/14/2011	5,393,000	7/8/2010	5,044,000	8/21/2008	5,836,000	6/23/2005	4,012,000
6/11/2012	5,227,000	1,706,000	5,014,000	7/15/2011	4,855,000	7/9/2010	3,916,000	8/22/2008	4,483,000	6/24/2005	5,259,000
6/12/2012	5,439,000	1,823,000	5,322,000	7/16/2011	5,140,000	7/10/2010	3,915,000	8/23/2008	4,701,000	6/25/2005	5,194,000
6/13/2012	5,294,000	1,566,000	5,551,000	7/17/2011	5,121,000	7/11/2010	3,915,000	8/24/2008	5,149,000	6/26/2005	4,525,000
6/14/2012	5,487,000	1,392,000	5,661,000	7/18/2011	5,222,000	7/12/2010	3,918,000	8/25/2008	5,561,000	6/27/2005	6,557,000
6/15/2012	5,262,000	887,000	5,767,000	7/19/2011	5,315,000	7/13/2010	4,874,000	8/26/2008	6,026,000	6/28/2005	5,237,000
6/16/2012	5,242,000	1,052,000	5,077,000	7/20/2011	5,514,000	7/14/2010	4,494,000	8/27/2008	4,221,000	6/29/2005	4,197,000
6/17/2012	5,200,000	1,192,000	5,060,000	7/21/2011	5,706,000	7/15/2010	5,368,000	8/28/2008	4,856,000	6/30/2005	3,708,000
6/18/2012	5,376,000	1,030,000	5,538,000	7/22/2011	5,326,000	7/16/2010	3,571,000	8/29/2008	5,481,000	7/1/2005	4,059,000
6/19/2012	5,245,000	1,100,000	5,175,000	7/23/2011	5,290,000	7/17/2010	4,306,000	8/30/2008	4,861,000	7/2/2005	3,294,000
6/20/2012	5,685,000	1,088,000	5,697,000	7/24/2011	4,832,000	7/18/2010	4,306,000	8/31/2008	5,825,000	7/3/2005	3,508,000
6/21/2012	5,174,000	1,501,000	4,761,000	7/25/2011	4,119,000	7/19/2010	4,308,000	9/1/2008	5,811,000	7/4/2005	5,689,000
6/22/2012	5,553,000	1,558,000	5,496,000	7/26/2011	4,953,000	7/20/2010	3,477,000	9/2/2008	5,815,000	7/5/2005	5,738,000
6/23/2012	5,445,000	1,923,000	5,080,000	7/27/2011	5,448,000	7/21/2010	3,559,000	9/3/2008	5,899,000	7/6/2005	5,037,000
6/24/2012	5,601,000	2,144,000	5,380,000	7/28/2011	4,908,000	7/22/2010	5,215,000	9/4/2008	6,094,000	7/7/2005	4,971,000
6/25/2012	5,700,000	1,984,000	5,860,000	7/29/2011	5,469,000	7/23/2010	3,903,000	9/5/2008	4,111,000	7/8/2005	4,276,000
6/26/2012	5,611,000	2,219,000	5,376,000	7/30/2011	4,747,000	7/24/2010	3,617,000	9/6/2008	4,230,000	7/9/2005	3,835,000
6/27/2012	6,113,000	1,937,000	6,395,000	7/31/2011	4,747,000	7/25/2010	3,617,000	9/7/2008	4,278,000	7/10/2005	5,349,000
6/28/2012	5,467,000	2,078,000	5,326,000	8/1/2011	4,748,000	7/26/2010	3,618,000	9/8/2008	4,304,000	7/11/2005	5,865,000
6/29/2012	5,345,000	2,494,000	4,929,000	8/2/2011	5,467,000	7/27/2010	3,584,000	9/9/2008	4,521,000	7/12/2005	5,889,000
6/30/2012	3,920,000	2,745,000	3,669,000	8/3/2011	5,625,000	7/28/2010	5,036,000	9/10/2008	4,881,000	7/13/2005	4,963,000

6/3 - 6/30		7/7 - 8/3		7/1 - 7/28		8/14 - 9/10		6/16 - 7/13	
Total	147,399,000	Total	144,001,000	Total	116,077,000	Total	138,378,000	Total	128,856,000
Average Daily	5,264,250	Average Daily	5,142,893	Average Daily	4,145,607	Average Daily	4,942,071	Average Daily	4,602,000
Maximum Daily	6,395,000	Maximum Daily	5,706,000	Maximum Daily	5,455,000	Maximum Daily	6,139,000	Maximum Daily	6,557,000
6/6 - 6/15		7/10 - 7/19		7/4 - 7/13		8/17 - 8/26		6/19 - 6/28	
Total	54,782,000	Total	51,606,000	Total	42,934,000	Total	50,333,000	Total	47,585,000
Average Daily	5,478,200	Average Daily	5,160,600	Average Daily	4,293,400	Average Daily	5,033,300	Average Daily	4,758,500
Maximum Daily	6,380,000	Maximum Daily	5,393,000	Maximum Daily	5,455,000	Maximum Daily	6,139,000	Maximum Daily	6,557,000

Note: 2012 Total Demand is calculated as the daily water production less the increase in storage volume as of midnight.
Storage data was not available for prior years and total demand is assumed to be equal to daily water production.
Water Production data was not available for 2003, 2004, 2006, 2007 and 2009.
June 3 through 30, 2012 was selected as the period when the elevated storage tanks were not refilled and June 6 through 15, 2012 is the period of most acute depletion of water storage volume.