CHAPTER 1 – EXECUTIVE SUMMARY

In 1998 the Centre Region Council of Governments (COG) voted to endorse the Beneficial Reuse Alternative as the preferred alternative for treated wastewater effluent disposal. The Centre Region COG asked the University Area Joint Authority (UAJA) to further define the Beneficial Reuse Alternative and to develop responses to questions raised by the elected officials. Based on this action, UAJA began a more detailed study of this alternative with the goal of addressing community questions and concerns and preparing an amendment to the Centre Region Act 537 Sewage Facilities Plan for consideration by the municipalities. This Transmission Corridor Study summarizes the work completed by UAJA in response to the direction provided by the Centre Region COG.

The mission of the Beneficial Reuse project is to reuse water to benefit the environment, quality of life and economy of the region. This mission differs significantly from traditional wastewater "disposal" projects, and will be the first such project in Pennsylvania to recognize reuse water as a resource, which can be used for the benefit of the community.

The Beneficial Reuse project consists of the treatment and purification of treated water from the UAJA wastewater treatment plant using microfiltration, and some combination of ozonation, ultraviolet light, and chlorination. The treatment will be followed by transmission and distribution throughout the Centre Region for industrial, agricultural, and commercial reuse, and environmental enhancement projects.

One of the advantages of the project is that it is expandable to meet the future growth of the community. This expandability leads to an incremental approach to water reuse management. UAJA needs to find reuse opportunities for an additional 150,000 gallons per day flow increase each year beginning when the direct discharge to Spring Creek reaches the existing 6.0 MGD discharge permit limit (approximately 2004). If UAJA is successful in marketing the reuse water, demand may be greater than the need to produce.

UAJA can respond to this demand by discharging less water directly to Spring Creek. This incremental approach is advantageous because it allows the cost of the project to be spread over a longer time period.

To satisfy Act 537 sewage facilities planning requirements, UAJA must have a reliable reuse customer that can consistently utilize the reuse water. One of the primary benefits of the Beneficial Reuse Alternative is that the water can be used year-round to enhance the natural environment. In the future and as confidence in the advantages of reuse water grows, the community will have more flexibility as it considers reuse proposals. The Slab Cabin Run sub watershed was identified as a good candidate for environmental enhancement because of the impact of the water withdrawn from the groundwater in this sub watershed by the State College Borough Water Authority. The reuse water could offset some of this withdraw and help maintain the stream flow in Slab Cabin Run.

UAJA has received preliminary interest for industrial, commercial and agricultural reuse amounting to 5% of the total capacity needed or one year's growth in flow. These reuse customers will be supplied through an 8-mile transmission main to be constructed from UAJA through the Dale Summit industrial park to the Slab Cabin Run sub-watershed.

The UAJA Project Management Team recommends the Beneficial Reuse Project be implemented in phases as follows:

- Phase I will consist of nutrient removal modifications to the UAJA treatment facility for the entire projected 9.0 MGD wastewater flow and construction of 0.75 MGD of microfiltration and advanced disinfection capacity for production of reuse water. Additionally, a reuse water transmission main will be constructed to the commercial and industrial customers of the Dale Summit Industrial Park. Finally, a detailed hydrogeological study of the Slab Cabin Run sub-basin will be conducted.

- Phase II will consist of the construction of an additional 0.75 MGD (1.50 MGD total) of microfiltration and advanced disinfection, as well as 0.75 MGD of reverse osmosis if deemed necessary. Additionally, UAJA will extend the transmission main to Slab Cabin Run at South Atherton Street for streamflow augmentation.

- Phase III will consist of the construction of an additional 1.50 MGD (3.00 MGD total) of microfiltration and advanced disinfection, as well as 1.50 MGD of reverse osmosis if deemed necessary. UAJA will extend the transmission main to upper Slab Cabin Run near the intersection of State Routes 45 and 26 for streamflow augmentation and agricultural irrigation and further commericial and industrial reuse.

CHAPTER 2 – INTRODUCTION AND PROJECT HISTORY

The Centre Region of Centre County is blessed with many resources, including very high-quality streams and groundwater supplies. Of these, Spring Creek is an outstanding example and many consider it a famous trout water. Under Pennsylvania Law, Spring Creek is designated a High Quality – Cold Water Fishery with a native trout population. Due to the high quality of this water resource, UAJA's wastewater treatment plant has stringent tertiary discharge limits, including effluent temperature.

When the Centre Region projected that future growth would exceed the existing capacity of the UAJA wastewater treatment plant, the Centre Regional Planning Agency (CRPA) began the process of updating the Act 537 Sewage Facilities Plan for the Townships of College, Ferguson, Halfmoon, Harris, and Patton, along with the Borough of State College. An Act 537 Plan is the official document that outlines the predicted wastewater generated within an area due to existing sources and potential growth, and evaluates alternatives for its safe and economical treatment and disposal. Ultimately this document requires municipal adoption and Department of Environmental Protection (DEP) approval.

Due to the unique nature of Spring Creek and its protection under the Pennsylvania Special Protection Waters Program, a detailed alternative analysis was required for the proposed Act 537 Plan Update. The original Wastewater Treatment and Disposal Alternatives Study was completed in 1996 by the CRPA and evaluated twelve alternatives on a technical and economic basis.

The study reviewed many different options; however, all of the alternatives involved the existing UAJA wastewater treatment plant and its discharge to Spring Creek. Spring Creek had recently been redesignated to the High Quality – Cold Water Fishery status, and new discharge limits were being imposed, including effluent temperature. Since the impacts of temperature changes in the stream resulting from UAJA's discharge were not quantified, further research was needed prior to selecting an alternative for future wastewater treatment and disposal and completion of the Centre Region Act 537 Sewage Facilities Plan.

316(a) THERMAL IMPACTS STUDY

Under Section 316(a) of the Clean Streams Law, UAJA conducted a thermal impacts study of Spring Creek downstream from its current outfall. Pennsylvania law prohibits a temperature increase greater than 2 Degrees Fahrenheit within the stream resulting from the discharge, and also restricts discharges if biological or ecological effects are exhibited.

Lasting over four years, the 316(a) Study concluded that for flows up to 6.0 MGD, the discharge of treated wastewater at UAJA's outfall will have no detrimental effect upon indicator species within Spring Creek. However, as the discharge was theoretically increased over 6.0 MGD, moderate growth impacts are anticipated in the brown trout population. Based on this study, the Pennsylvania Department of Environmental Protection has limited UAJA's NPDES permit to 6.0 MGD on an annual average. For a discharge greater than 6.0 MGD, the DEP has indicated cooling of the wastewater effluent prior to discharge will be required.

ADDITIONAL ALTERNATIVES

The original Wastewater Treatment and Disposal Alternatives Study had proposed twelve alternatives, but the results of the 316(a) Study had indicated that some of the alternatives would not be possible since no discharge at UAJA's facility would be permitted above 6.0 MGD without cooling.

Simultaneously, with the 316(a) Study the CRPA held a number of public meetings with Centre Region municipalities and groups concerned with Spring Creek and the Centre Region throughout the second and third quarters of 1996 to discuss wastewater management options. A number of ideas were discussed during these meetings, including the twelve alternatives in the original wastewater study and some new or innovative approaches to the problem of providing wastewater treatment. One common thread echoed by the various groups and the PA DEP was the idea that the Centre Region should consider recycling some, if not all, of its wastewater instead of discharging it to Spring Creek.

These comments and reports resulted in the creation of two additional alternatives for the Wastewater Treatment and Disposal Alternatives Study, UAJA Temperature Mitigation and Beneficial Reuse, bringing the total number of alternatives to fourteen. These fourteen alternatives can be placed into three categories:

Alternatives Involving an Upgrade of the Current UAJA Spring Creek Pollution Control Facility and Discharge at Some Location within the Watershed

- University Area Joint Authority (UAJA) Facility Upgrade w/ Discharge at Current Outfall [Eliminated due to 316(a) Study]
- Transfer of Treated Effluent from UAJA to Spring Creek below SR 550 Bridge for Discharge
- Transfer of Treated Effluent from UAJA to Bald Eagle Creek for Discharge
- Transfer of Treated Effluent from UAJA to Benner Spring for Discharge
- UAJA Facility Upgrade including Industrial Refrigeration for Temperature Mitigation and Discharge at Current Outfall

Alternatives Involving Transfer of Raw Sewage to Another Location within the Watershed for Treatment & Disposal

- Transfer of Raw Sewage to Upgraded Bellefonte Treatment Facility
- Transfer of Raw Sewage to a New Treatment Facility located on Bald Eagle Creek below Milesburg
- Overland Transfer of Raw Sewage to Upgraded Bellefonte Treatment Facility
- Overland Transfer of Raw Sewage to a New Treatment Facility located on Bald Eagle Creek below Milesburg
- Raw Sewage Transfer to New Treatment Facility located on Buffalo Run

Alternatives Utilizing Land Application or Aquifer Recharge to Recycle Treated Wastewater Within the Watershed

- Transfer of Treated Effluent to Benner Spring for Discharge and Seasonal Spray Irrigation on the Surrounding Rockview Property.
- Transfer of Treated Effluent to the Surrounding Rockview Property for Spray Irrigation and Storage
- Combination Treatment including Spray Irrigation in the Buffalo Run Valley, Transfer of Raw Sewage to a New Treatment Facility on Spring Creek owned by the Spring-Benner-Walker Joint Authority, and Discharge at the Existing UAJA Facility
- Beneficial Reuse

SELECTION OF AN ALTERNATIVE FOR FUTURE STUDY

After presentation of the additional alternatives to the Centre Region Council of Governments (COG), the Wastewater Treatment and Disposal Alternatives Study had been completed. Of the fourteen alternatives, Beneficial Reuse was endorsed by the COG as the alternative of choice, however, it was requested that further study and analysis be completed prior to an official adoption of the alternative under a revised Centre Region Act 537 Plan. The responsibility for further study was delegated to UAJA.

To facilitate this analysis, UAJA formed a Project Management Team (PMT). The PMT was to decide what facets of the project needed further analysis and to recommend to UAJA, and ultimately the elected officials, specific project concepts for implementation. The organizations that participated on the PMT were:

- University Area Joint Authority
- State College Borough Water Authority
- College Township Water Authority
- Pennsylvania State University
- Centre Region COG Administrative Staff
- Centre Regional Planning Agency
- Pennsylvania Department of Environmental Protection
- Senator Corman’s Office

CHAPTER 3 – EVALUATION OF BENEFICIAL REUSE ALTERNATIVE

After UAJA was tasked with the further study of the Beneficial Reuse option, the Project Management Team (PMT) was convened to evaluate the subject areas needing further definition and research. The PMT reviewed many topics and decided that the following subjects required additional evaluation:

1. Determination of Needed Capacity
2. Water Reuse Methods
3. Opportunities for Reuse within Spring Creek Watershed
4. Selection of Water Reuse Methods for Implementation

WASTEWATER CAPACITY

One of the first tasks of the PMT was determining the size of the next wastewater treatment capacity upgrade and a confirmation of the proposed 2.0-MGD increase. Based on updated growth figures from the CRPA, the proposed increment of 2.0 MGD would be insufficient to handle the growth of the Centre Region for the next 20 years.

After a thorough evaluation of the growth trends of the Centre Region, the PMT and CRPA agreed that an increase of 3.0 MGD of wastewater treatment and disposal capacity would be sufficient to handle the expected growth. Assuming the project is adopted during 2000 and implemented by 2003, the added increase in wastewater treatment capacity needed per year is shown in Table 1.

As the Wastewater Treatment and Disposal Alternatives Study outlined, the Beneficial Reuse project can provide an alternative to the Centre Region that allows for controlled growth, without detrimentally impacting the region's fragile water supplies and water resources. After the first portion of the project was developed, other portions of the Centre Region could be explored as growth or environmental needs dictated.

TABLE 1

EXPECTED REUSE INCREMENT RESULTING FROM GROWTH

YEAR	EQUIVALENT DWELLING UNITS INCREASE	FLOW INCREASE
2003	0	0.000 MGD
2008	2855	0.751 MGD
2013	5710	1.502 MGD
2018	8565	2.253 MGD
2023	11420	3.003 MGD

WATER REUSE OPTIONS

The EPA and other organizations have created water reuse categories for the differentiation of water reuse options. These categories have minor differences, however, they all share similar water quality demands. The list of possibilities for the Beneficial Reuse Project is provided below, along with schematics and case studies in Appendix A.

- Urban Reuse
- Agricultural Irrigation
- Environmental Enhancement
- Industrial Reuse
- Indirect Potable Reuse
- Direct Injection

Spray irrigation had been evaluated in the original report and was eliminated due to capital costs, land requirements, and the amount of property needed to adequately store ninety days of effluent during winter months. Additionally, a second alternative utilizing several smaller treatment facilities and community on-lot disposal systems was considered. Ultimately, water reuse through the Beneficial Reuse Project was determined to be the only acceptable non-discharge alternative. Given the DEP's priority placed on

High-Quality, Cold-Water Fisheries, UAJA is required to implement a non-discharge alternative if one is considered feasible.

Urban reuse is the broadest of the reuse categories and includes such options as landscape irrigation, vehicle washing, toilet flushing, fire protection, and heating and cooling supplements. Many of the reuse projects throughout the United States are using some form of urban reuse, and all of the listed options are being considered for UAJA's Beneficial Reuse Project.

Agricultural Irrigation includes providing water for both crops for human consumption or traditional forage crops. Agricultural irrigation reuse projects are very common in Florida and California, especially for orchards and fruit crops. Depending upon the ultimate reuse zone, several large areas of farmland would be adjacent to the transmission main and available for agricultural irrigation.

Environmental Enhancement is the use of reuse water to promote aesthetic and environmentally sound improvements within the reuse zone. Examples of environmental enhancement include stream flow augmentation, wetland rehabilitation and creation, and the development of recreational impoundments. Due to limitations on property and the unique geological characteristics of the Centre Region, each of these alternatives has been evaluated for possible hydrogeological impacts.

Industrial Reuse is specific to the reuser; however, it is comprised of options such as process make-up water, heating and cooling. Several large industrial reuse projects are located in the Northeast United States and this type of reuse is common throughout the United States.

Indirect Potable Reuse is the blending of reuse water with potable water supplies such that the reuse water eventually is incorporated in the drinking water system. The most common type of Indirect Potable Reuse is discharge to surface water reservoirs or water bodies upstream of drinking water intakes. Less common forms involve the reuse water introduced into the groundwater aquifer through surface spreading or rapid infiltration basins.

Direct Injection was the original alternative proposed for implementation in the Beneficial Reuse Project. The reuse water is mixed and diluted by natural means and later withdrawn from potable supply wells for consumption. As a type of indirect potable reuse, Direct Injection is highly monitored and controlled; however, it provides a benefit to an aquifer which is very depleted by groundwater withdrawals.

WATER QUALITY ISSUES

Of primary concern is the quality of the water to be reused within the Centre Region and its possible benefits to the environment and any customers that use it. The final water quality standards that the reuse water must meet depend upon the reuse application and are affected by the level of exposure that the public has to the reuse water. Since the water can come into contact with people or become mixed with the drinking water supply, the PMT has decided that the water should meet the standards of the Safe Drinking Water Act (SDWA). In addition, the PMT recommends that the reuse water meet the additional requirements recommended in the following sources: (Guidelines for Water Reuse, EPA, 1992; Water Reclamation and Reuse Standards, Washington State Department of Health, 1997; Using Reclaimed Water to Augment Potable Water Resources, WEF/AWWA, 1998). All of the recommended standards are included in Table 2.

WATER TREATMENT

The reuse water will be withdrawn from the existing UAJA treatment process after the secondary clarifiers. The clarified effluent meets most of the SDWA standards. The clarified water is also the most cost-effective to subsequently treat by microfiltration (utilization of this water does not require UAJA to expand its existing filters).

After clarification, the water will be microfiltered. Microfiltration is a process that positively excludes particles from passing through a plastic membrane that has an exact pore size. The microfiltration units to be employed at UAJA have a nominal pore size of 0.2 microns or smaller (approximately 1/5 the width of a human hair). Any particle larger than the pore size cannot be forced through the opening and is filtered. Figure 1 shows the pilot-scale microfiltration units in operation at UAJA.

If the results of the pilot testing reveal that microfiltration alone is not sufficient to meet the proposed water quality goals, another membrane filtration technique known as reverse osmosis will be employed. Although similar in nature to microfiltration, reverse osmosis membranes have an extremely small pore size and exclude particles not only on size, but molecular weight. It is the most effective filtering device and is commonly employed to remove salt from seawater to create drinking water. Figure 2 shows a pilot-scale reverse osmosis unit in operation at UAJA.

Regardless of whether reverse osmosis is employed at UAJA, the final treatment process will be advanced disinfection. Some combination of ultraviolet light and ozonation will be employed to destroy pathogens and other potentially harmful compounds such as endocrine disrupters and pharmaceutically active agents. Ultraviolet disinfection is the introduction of light of a specific wavelength that disrupts the activity of cells, causing sterilization. Ozone is an oxidant and actually destroys the cell tissue by dissolving the organic material. Figure 3 shows the existing treatment process at UAJA and the entire proposed treatment process for Beneficial Reuse.

The exact details of the treatment and disinfection of the reuse water will be contained in two future reports. The first report will describe the Basis of Design for the treatment plant and the second report will summarize the Pilot Testing results. Both report are expected in the first quarter of 2000.

CONSISTENT REUSE OPTIONS

Because wastewater flows to UAJA are continuous, UAJA needs a consistent reuse point to allow for successful operation of its wastewater treatment facility. While industrial and urban reuse methods are very attractive, it is unlikely that they will provide UAJA with a reliable and continuos reuse customer at the inception of the project. To locate a consistent reuse method, the PMT evaluated alternatives such as environmental enhancement, indirect potable reuse, and direct injection.

With many of these alternatives interacting with the groundwater system, Meiser & Earl, Inc. of State College was contracted to evaluate the hydrogeological conditions. The following environmental enhancement alternatives, which can provide continuous reuse, were recommended by the PMT for further evaluation:

1. Streamflow Augmentation of Slab Cabin Run
2. Direct Injection into groundwater aquifer

STREAMFLOW AUGEMENTATION OF SLAB CABIN RUN

The original Beneficial Reuse Project concept was to return reuse water from the UAJA to the Slab Cabin Run Watershed for direct injection into the groundwater aquifer. Of the smaller watersheds comprising the Spring Creek Drainage Basin, Slab Cabin Run displays the largest impact from continued growth in the Centre Region. Portions of Slab Cabin Run routinely dry up in the late summer.

With the State College Borough Water Authority removing approximately 2.4 MGD of drinking water from the basin, it was determined that recharging the groundwater aquifer with reuse water would greatly benefit the water budget of the entire watershed. However, many governmental and public entities expressed concern over proceeding to direct injection without having several years of monitoring data from the actual reuse water produced by UAJA.

The Project Management Team for UAJA determined that streamflow augmentation would recharge Slab Cabin Run and would provide much needed water in times of reduced streamflow. Slab Cabin Run is a losing stream, meaning that the water flowing in the stream can be expected to enter the underlying groundwater. The recharge of 3.0

MGD will not be enough to prevent the stream from drying up, but it will reduce the frequency and duration of those events. Conversely, the addition of 3.0 MGD of reuse water to Slab Cabin Run will not have a measurable impact on any flood events during wet periods.

Five reuse zones were selected by the PMT for hydrogeological evaluation by Meiser & Earl, Inc. The reuse zones, all within the Slab Cabin Run Watershed, are shown in Figure 4. Since Slab Cabin Run is losing in various sections of the stream, the reuse water that was discharged to the stream may enter the groundwater aquifer and could possibly be withdrawn from potable supply sources. Based upon this assumption, discharge to Slab Cabin Run would need evaluation as Indirect Potable Reuse.

Since the reuse water may be interacting with groundwater supplies, hydrogeological evaluation of the existing drinking water supply wells was necessary. Of the public water supply wells in the Slab Cabin Run Drainage Basin, the State College Borough Water Authority's Harter-Thomas Wellfield represents the largest. Based upon records available, Meiser & Earl determined that approximately 30% of the water that would be removed from the Harter-Thomas Wellfield at their permitted withdrawal capacity may be water from Slab Cabin Run.

Public Water Supply wells in Lemont and Houserville were also reviewed for possible interaction with Slab Cabin Run. Similar to the upstream reaches, the reuse water may be expected to enter the groundwater aquifer and could eventually reach potable supply wells.

Based on this preliminary study, a more detailed hydrogeological evaluation of the Slab Cabin Run sub-basin is necessary. This is proposed to be included in Phase I of the Beneficial Reuse Project.

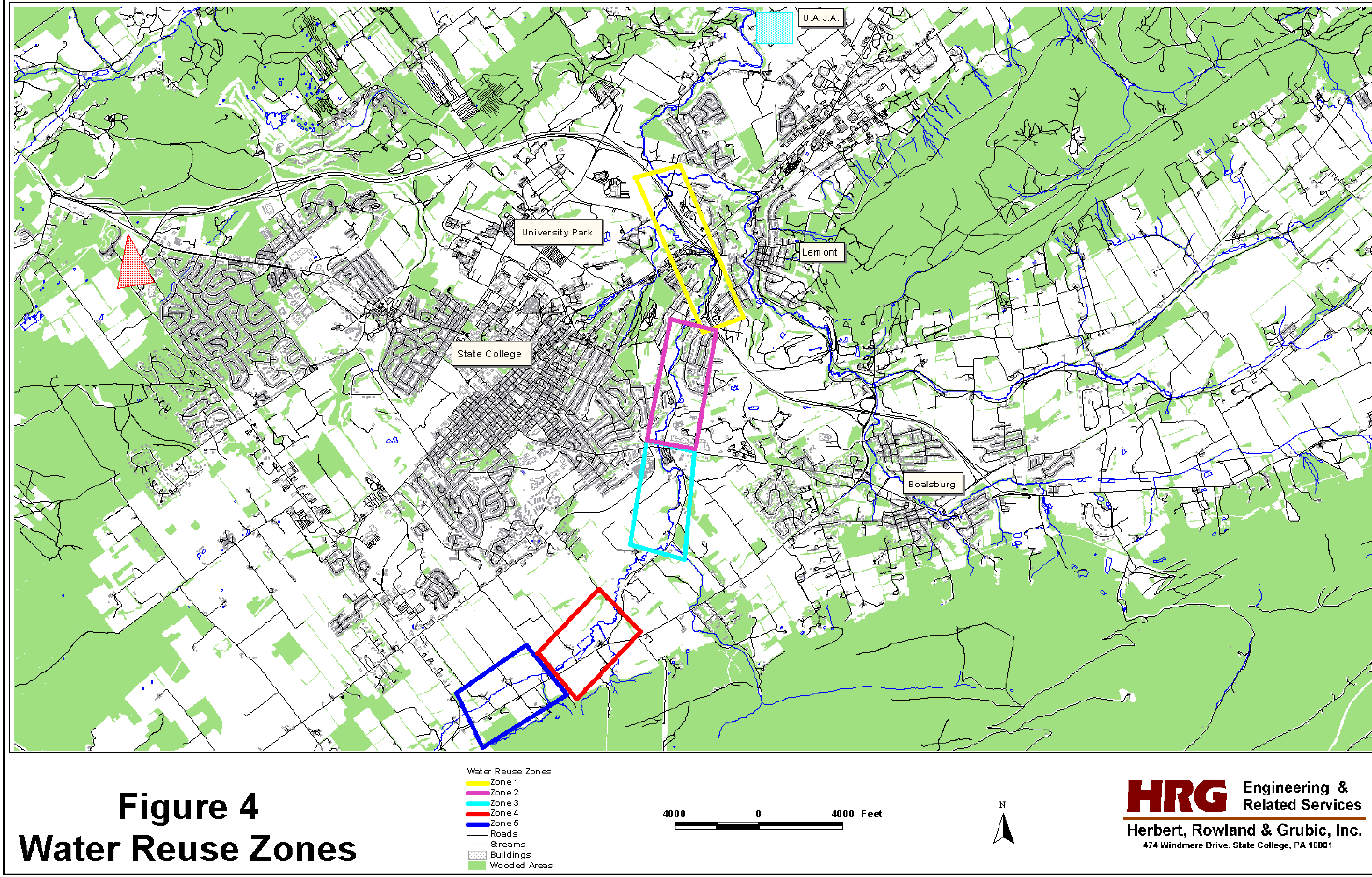

Figure 4
Water Reuse Zones

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WATER QUALITY OF INDIRECT POTABLE REUSE

With hydrogeologic evaluation revealing that the reuse water could potentially have an interaction with groundwater supplies, the water quality impacts of indirect potable reuse were closely reviewed by the PMT. Although dilution factors were consistent with EPA Guidelines, the time of travel for the reuse water would be less than the EPA recommended value of one year. However, the time of travel guidelines are based on public sentiment and fear of the unknown, rather than scientific analysis.

Assuming an extremely high quality source of reuse water, direct consumptive reuse (adding the reuse water directly to the potable water distribution system) is a viable option in some communities and does not include a time of travel guideline. If direct consumption is acceptable without a time of travel component, indirect potable reuse should be also acceptable. With the dilution the immense groundwater reservoir under the Centre Region provides with the reuse water, a time of travel requirement seems excessive.

The PMT also determined that there are other untreated, and in some cases, unmonitored water that enters the drinking water aquifer. Since the late 1970's, the Ferguson Township Sewer and Water Authority has been discharging to Slab Cabin Run the treated wastewater effluent from Pine Grove Mills and the surrounding area. Based upon the previously mentioned hydrogeologic analysis, this wastewater effluent was probably entering the Harter-Thomas Wellfield and entering the drinking water supply. The reuse water quality has approximately 1/50th of the pollutant loading of the Ferguson Township effluent. In addition, untreated stormwater from State Route 26 and State Route 45 can enter the aquifer. Again, the quality of the reuse water is much better than the stormwater.

METHOD OF STREAMFLOW AUGMENTATION

Simulated springs and constructed wetlands are the two proposed methods of streamflow augmentation. Simulated springs would be located where springs and seeps had been extinguished or reduced by urban activities in the drainage basin. To simulate a spring, a diffused discharge would be constructed under the streambed.

Restored wetlands are another alternative for augmenting streamflow in Slab Cabin Run. They also work by diffusing the discharge to the stream. Restored wetlands are commonly constructed as either a free water surface (FWS) or subsurface flow (SF). A FWS wetland is a discharge applied above the soil layer of the wetland, resulting in localized ponding and surface vegetation. The reuse water would have a residence time of approximately 6 days. For a reuse water flow rate of 3.0 MGD, a total wetland area would be approximately 19 acres. In comparison, a SF wetland has the flow introduced into the root zone of wetland vegetation and gravel and sand beds of the wetland floor. For a reuse flow rate of 3.0 MGD and residence time of 6 days, the total wetland area would be approximately 12 acres.

The primary advantage to a wetland discharge is the habitat it would generate for wildlife and fauna, however, they have one disadvantage. As the water migrates through the restored wetland, it would be warmed by the sun. This natural increase in temperature would defeat any advantage gained by cooling the reuse water by artificial or natural means. Any warm water discharge into the Spring Creek Watershed may be detrimental to the existing wild trout fishery.

DIRECT INJECTION TO GROUNDWATER AQUIFER

In the original Beneficial Reuse Report, direct injection to the groundwater aquifer was evaluated in the vicinity of the Harter-Thomas Wellfield. Meiser & Earl, Inc. determined that the zone of influence, the area of influence for one-year's travel time to the Harter-Thomas Wellfield, is significantly larger than previously estimated. EPA Guidelines suggest a one-year travel time from the recharge wells to any drinking water wells.

The Meiser & Earl, Inc. study concluded that injection wells should not be sited in the Nittany Dolomite Geologic Formation (the same formation as the Harter-Thomas wellfield), until the completion of a more detailed hydrogeologic study. Meiser & Earl, Inc. recommended that if injection wells were pursued at this time, they be located in a less porous geologic formation. Unfortunately, as the porosity of the formation drops, the number of wells needed to deliver 3.0 MGD increases. For the successful delivery of 3.0 MGD with 25% additional capacity for reliability, a total of 18 to 25 injection wells could be needed. This greatly increases the cost of direct injection.

INTERMITTENT REUSE POINTS

In May of 1999, UAJA contacted possible consumers of reuse water within the Centre Region. This contact was a follow-up to the work completed in 1996 by the Centre Regional Planning Agency. Of the operations contacted, UAJA received several positive responses. The operations that expressed an interest in receiving reuse water are listed in Table 3.

While these operations would provide UAJA with a reuse consumer base, much of the water use is seasonal in nature. For example, Harner Farms would require approximately 62,000 gpd of water use during the months of June, July, and August, but drops to zero flow for the remaining 9 months of the year. Of the consumers that have expressed an interest in reuse water, Centre Concrete (18,000 gpd) and Rental Uniform Service (60,000 gpd) have consistent daily needs. Peak reuse water demand for most reuse customers will be from May through September.

TABLE 3

INTERMITTENT WATER USERS FOR UAJA BENEFICIAL REUSE PROJECT

USER	REUSE METHOD	AVERAGE DAILY USE
Centre Area Transportation Authority (CATA)	Vehicle Washing	4,000 gpd
Rental Uniform Service (RUS)	Process Water	60,000 gpd
Centre Concrete	Process Water	18,000 gpd
Leitzinger Motors	Vehicle Washing	2,000 gpd
Ferguson Township Offices	Vehicle Washing	1,000 gpd
Harner Farms	Crop Irrigation	62,000 gpd
	TOTAL	147,000 gpd

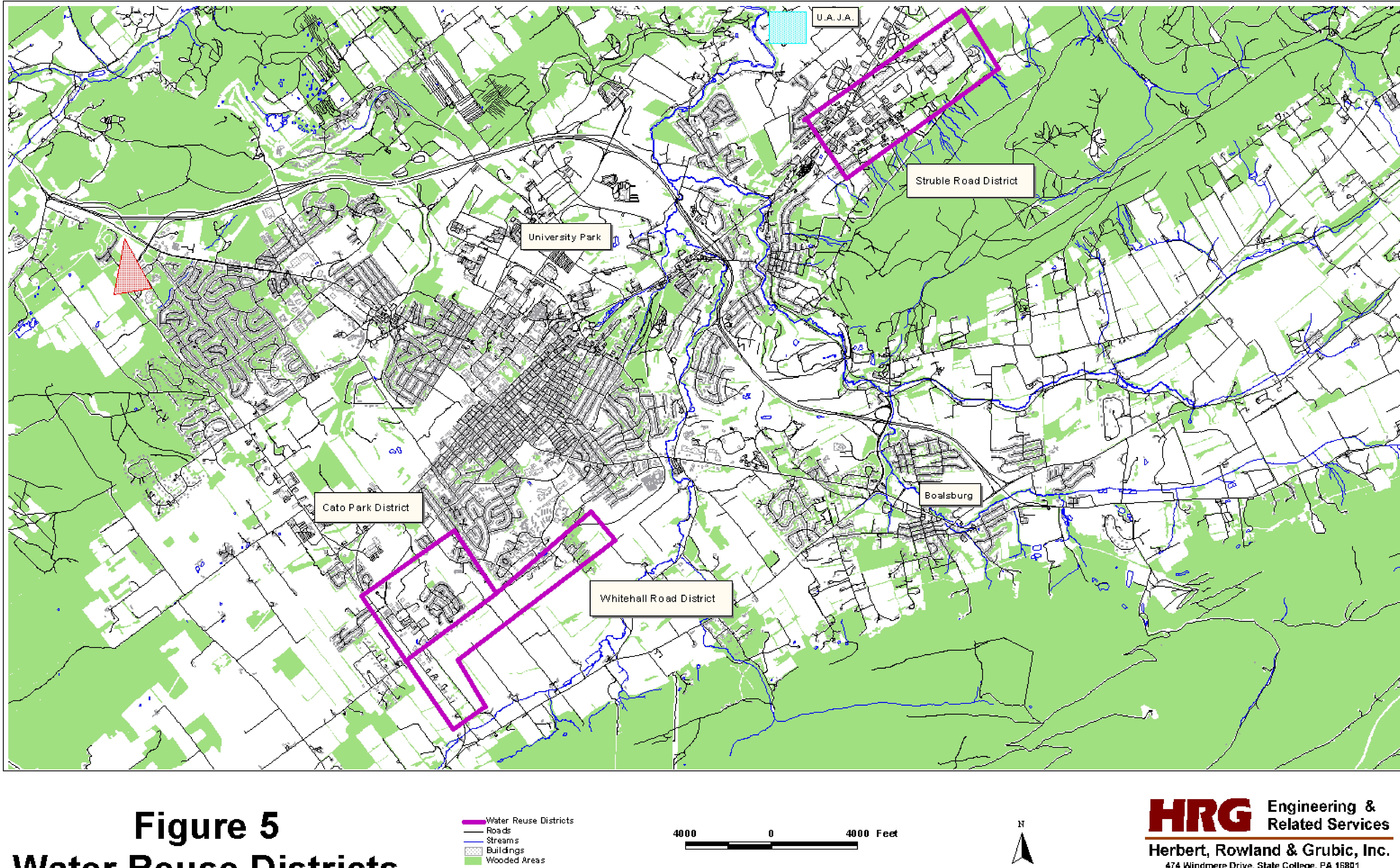

Figure 5
Water Reuse Districts

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The consumers have been broken into several Reuse Districts based on the phase of the Beneficial Reuse Project that would serve the customer. These districts are shown in Figure 5 and consist of the Struble Road District, Whitehall Road District, and CATO Park District.

UAJA has been very successful with creating a new resource, UAJA ComposT, and marketing the product to the community. It took several years for the product to gain acceptance. Now demand exceeds production. The Beneficial Reuse Project will also create a renewable resource that will be inexpensive and of a high quality. Although intermittent reuse at the beginning of the project is expected to be low, it should gain as UAJA proves that it can provide a clean, reliable product.

REUSE WATER DISTRIBUTION SYSTEM

The reuse water distribution system will convey the reuse water from UAJA to various intermittent and continuous reuse points within the service area. The flow of water and pressure supplied will need to be constant, and in effect, the equivalent of a potable water distribution system. To achieve this, UAJA will need to address several issues: adequate storage, residual disinfection, temperature, and reliability.

STORAGE OF REUSE WATER

As outlined in the original Beneficial Reuse report (CRPA 1997), UAJA will store the finished reuse water for approximately 24 hours. This will allow for further testing and analysis to ensure a safe product is leaving the treatment facility. Precast, prestressed concrete tanks will be constructed at UAJA. Additional tanks will be constructed at the UAJA plant to serve the additional phases of the Beneficial Reuse Project. A central pump station would draw from these tanks and pressurize the transmission piping. Piping will be provided to enable the tanks to empty into the treatment plant or stream in a controlled fashion, allowing for periodic maintenance and inspection.

RESIDUAL DISINFECTION OF REUSE WATER

The primary control associated with disinfection of the water is maintaining an adequate disinfectant residual throughout the system, which will prevent biological regrowth within the distribution mains. Two options were considered for providing the necessary disinfection, central disinfection and remote disinfection.

Centralized disinfection would occur at the pumping and storage facility located at the UAJA plant. Sufficient disinfection would need to be provided to allow for a maximum of 0.5 to 1.0 mg/l of residual oxidant at the furthest points in the distribution system.

Remote disinfection would have facilities located at the intersection of the reuse water transmission main with dedicated commercial/industrial distribution lines or the reuse points, with no residual maintained within the actual transmission mains. Although the number of remote disinfection facilities would be small in this phase of the project implementation, additional installations would be needed as further consumers were connected. As the systems were placed in operation, the number of installations and their spatial distribution throughout the watershed could result in the need for additional operators.

Centralized disinfection facilities are recommended for the Beneficial Reuse Project. They are the most cost-effective and efficient methods of delivering the needed residual disinfectant to the reuse water system. Centralized disinfection will allow UAJA to utilize existing personnel on-site, and significantly cut costs for remote monitoring and operation.

UAJA has many options to consider for centralized disinfection including chlorination, chloramination, ozonation, chlorine dioxide addition, or ultraviolet light (UV). Table 5 lists the primary disinfection methods available and the comparative advantages and disadvantages of each.

To complete the UAJA Beneficial Reuse Project, UAJA will utilize a combination of at least two methods for disinfection. To maintain the residual within the transmission main and provide additional disinfection prior to streamflow augmentation, chlorination and ultraviolet light will be used.

For maintaining a residual within the transmission lines, traditional methods of chlorination are still the most cost-effective and reliable. Chlorine gas is introduced into the reuse water, oxidizing any remaining pathogens and providing a residual disinfectant to prevent biological regrowth. While concerns about disinfection byproducts normally favor methods aside from chlorination, the reuse water will have extremely low concentrations of organic compounds. Without these compounds, byproduct formation will be greatly restricted.

At the final reuse point, Ultraviolet Light (UV) disinfection will provide the final treatment. Unlike ozone and chlorine, UV does not oxidize the pathogens, it disrupts cell replication. The added advantage of UV is that it will remove any chlorine residual left within the reuse water prior to streamflow augmentation.

TEMPERATURE EFFECTS OF REUSE WATER

The change in temperature of the reuse water as it travels through the transmission mains is another consideration for the distribution system. In late 1998, UAJA completed basic thermodynamic modeling of the heat loss from the distribution system into the surrounding earth for various times of the year.

The thermodynamic modeling indicated that very little to no heat loss could be expected in the transmission pipeline, if the ground that the pipe passes through is dry. The ground and pipe wall effectively insulates the reuse water, and less than 1 degree Fahrenheit of temperature loss could be expected. However, if the ground is saturated, temperature loss increases dramatically. Reuse water temperatures would approach ground temperatures (62 Degrees Fahrenheit during the worst single month) and these losses could be

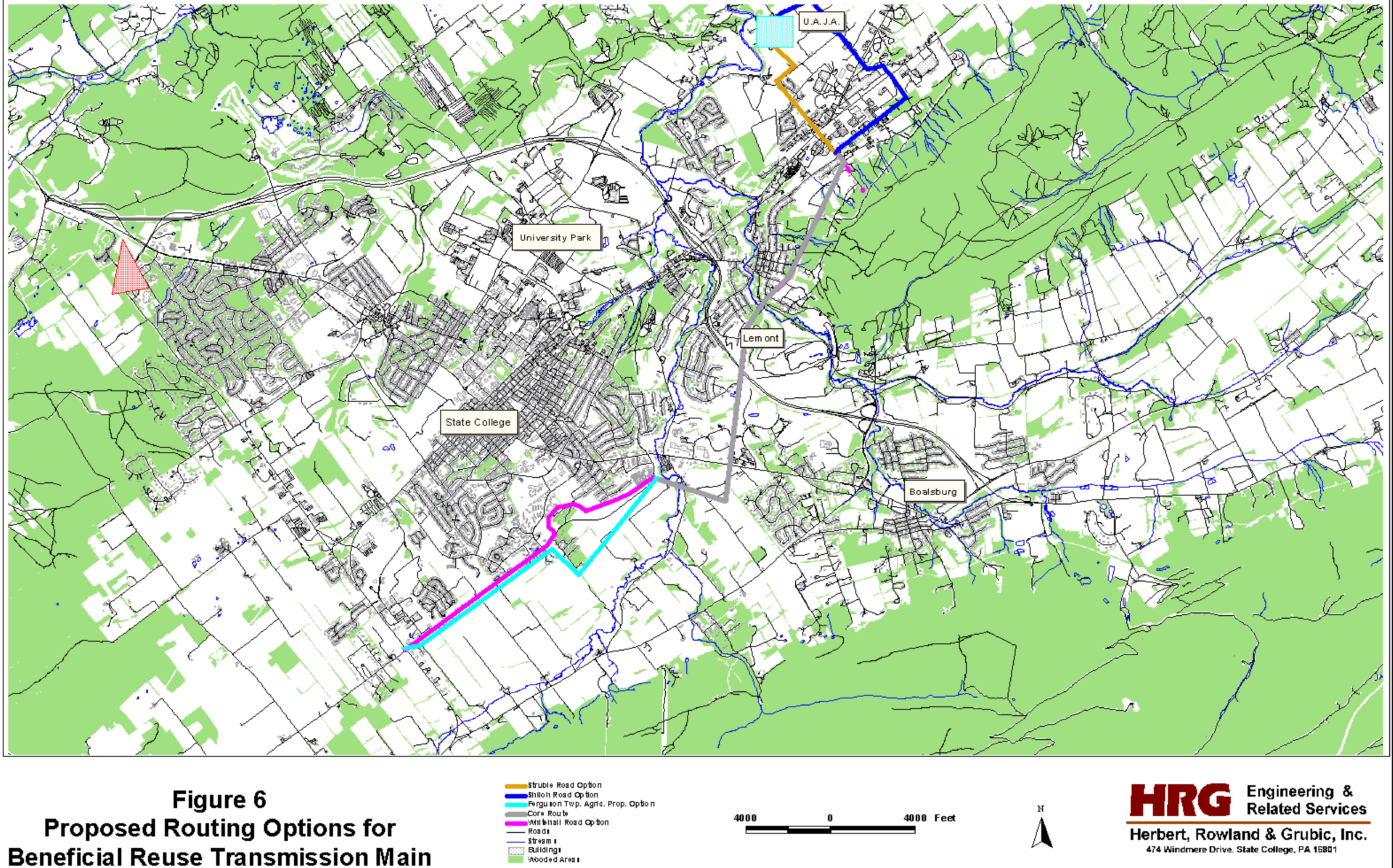

Figure 6
Proposed Routing Options for Beneficial Reuse Transmission Main

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achieved with as little as 3% (1,200 lineal feet) of the total pipe bedding being completely saturated.

Based upon work completed to date, approximately 1.25% of the bedding along the recommended route would be saturated. This would correspond to a temperature decrease of approximately 2.0 Degrees Fahrenheit under the worst conditions. This loss is sufficient to meet summertime stream temperature limits, but does not meet UAJA's goal of matching natural groundwater temperatures.

UAJA is exploring the use of the reuse water in the Struble Road District for commercial heating. According to preliminary estimates, the reuse water contains enough energy to provide for heating of several of the Struble Road businesses that need heat year-round. The reuse water would be in the temperature range of 50 to 54 Degrees Fahrenheit. This will meet UAJA's goal, and at the same time reduce the energy requirements of those businesses using the reuse water for heating.

UAJA has determined that the addition of any water to Slab Cabin Run will benefit Spring Creek. The temperature model that was created for the 316(a) Study by J.E Edinger Associates, Inc. was reprogrammed to account for approximately 2.0 MGD of added flow in Spring Creek at existing temperatures upstream of UAJA's discharge. The model revealed that the additional flow in Spring Creek helped mitigate the influence of the existing UAJA outfall. The actual predicted temperature drop immediately downstream of UAJA's discharge (the Yearick Monitoring Station) was between 0.02 and 0.38 Degrees F (0.01 and 0.21 Degrees C) and the number of hours per year that the stream temperature would be above 65 Degrees F (18 Degrees C) dropped by 20.

RELIABILITY OF REUSE WATER TRANSMISSION MAIN

A final consideration for the transmission mains is the allowance for future growth and reliability. Since the transmission main would be constructed through several urbanized areas and demand is expected to increase with time for the reuse water, capacity above the initial 3.0 MGD should be provided. Additionally, UAJA has to provide a consistent and reliable reuse water supply for users, coupled with the distribution system serving as an outfall for approximately 33% of UAJA's total flow. Based on these factors, redundant transmission lines have been evaluated.

Redundant transmission lines would provide continuous service to reuse customers, even during a line break (usually caused by construction activities near the transmission mains). Line breaks can usually be repaired in less than one day, so the threat to reuse customers is minimal and does not justify the additional cost of a redundant transmission main. In addition, the reuse customers can switch to the potable water supply for the duration of a line break. As interest in the reuse water spreads around the region, the transmission line can be extended to completely surround the community and loop all the way back to UAJA.

TRANSMISSION MAIN ROUTING

To reach the southern portion of Struble Road and interface with the Penelec right-of-way, UAJA must cross State Route 26 and the commercial district surrounding the Nittany Mall. Two options have been outlined for this portion of the routing and are labeled the Struble Road and Shiloh Road routings in Figure 6. The Struble Road route leaves the southern portion of the UAJA property, crosses Trout Road and proceeds west to Struble Road. The transmission mains would follow Struble Road to the SR 26-Struble Road intersection and would cross SR 26 through boring and jacking methods.

The Shiloh Road option leaves the eastern boundary of the UAJA property and borders Shiloh Road to the intersection of the Benner Pike and Shiloh Road. The transmission main would then proceed across the Benner Pike, along the Nittany Mall property, and across Route 26 to the Dale Summit Industrial Park. The transmission line would continue west along Carolean Drive and intersect with Struble Road. While significantly longer than the Struble Road option, this routing provides the best access to the Dale Summit Reuse District. Therefore, this is the preferred route.

For the initial routing selection, the Shiloh Road option is the best alternative for supplying reuse water to the industrial and commercial customers in the Struble Road Reuse District. The Struble Road option would require spur lines to adequately feed reuse water to the Reuse District and these lines will increase maintenance costs.

The routing of the transmission mains is similar to the single line routing shown in the original Beneficial Reuse report. The core of the transmission main will utilize an existing Penelec Right-of-Way to avoid construction through private property in Lemont and facilitate the easiest crossing of State Route 322. The core route is identical for all alternatives and routings and is labeled as “Core Route” on Figure 6.

As in the initial portion of the routing, two options exist for the final segment of the transmission main. The options are labeled Whitehall Road and Ferguson Township Agricultural Properties and are shown in Figure 6. The Whitehall Road option extends from the crossing of Slab Cabin Run and the transmission main and proceeds along the State right-of-way to the CATO Industrial Park, the last proposed reuse zone on the transmission main.

In contrast, the Ferguson Township Agricultural Properties option parallels the Whitehall Road option, however remains outside the State right-of way. This reduces overall project costs and provides greater access to the agricultural properties in Ferguson Township.

CHAPTER 4 – CONCLUSION AND RECOMMENDATIONS

The Beneficial Reuse Project provides the Centre Region with an innovative and environmentally sensitive approach to wastewater treatment and disposal. Since its inception in 1997, many community groups and governmental bodies have closely followed the project and its progression from concept plan to the recommended alternative by the Council of Governments.

This report serves as the engineering evaluation of the transmission corridor and the intermittent and continuous reuse points that have been included under the Beneficial Reuse concept. Based upon our evaluation, input from the Project Management Team, and the initial hydrogeological report by Meiser & Earl, Inc., we recommend the Beneficial Reuse Project be implemented in phases as follows:

- **Phase I will consist of nutrient removal modifications to the UAJA treatment facility for the entire projected 9.0 MGD wastewater flow and construction of 0.75 MGD of microfiltration and advanced disinfection capacity for production of reuse water. Additionally, a reuse water transmission main will be constructed to the commercial and industrial customers of the Dale Summit Industrial Park. Finally, a detailed hydrogeological study of the Slab Cabin Run sub-basin will be conducted.**

- **Phase II will consist of the construction of an additional 0.75 MGD (1.50 MGD total) of microfiltration and advanced disinfection, as well as 0.75 MGD of reverse osmosis if deemed necessary. Additionally, UAJA will extend the transmission main to Slab Cabin Run at South Atherton Street for streamflow augmentation.**

- **Phase III will consist of the construction of an additional 1.50 MGD (3.00 MGD total) of microfiltration and advanced disinfection, as well as 1.50 MGD of reverse osmosis if deemed necessary. UAJA will extend the**

transmission main to upper Slab Cabin Run near the intersection of State Routes 45 and 26 for streamflow augmentation and agricultural irrigation and further commercial and industrial reuse.

In addition to the proposed phasing of the Beneficial Reuse Project, the PMT recommended the following options be implemented:

- **The streamflow augmentation method should be simulated springs or seeps.** Streamflow augmentation will allow UAJA to easily monitor the effects of Beneficial Reuse on Slab Cabin Run. Further expansion of the Beneficial Reuse Project could accommodate restored wetlands as another recharge option.

- **The residual disinfectant for the transmission mains should be chlorine.** Chlorination is the cheapest and most effective method of providing a long-term oxidant residual in water transmission mains. The reuse water should be dechlorinated by ultraviolet light disinfection at the Slab Cabin Run recharge zones.

- **The transmission main should be constructed of a single 20" Ductile Iron Pipe.** The majority of the cost of the transmission main is easement acquisition and pipeline installation. While Ductile Iron pipe is more expensive, the long-term reliability of the pipe at moderate pressures justifies the cost. A single 20" Ductile Iron Pipe will be able to provide 8.0 MGD of reuse water to the Centre Region should the community decide to produce more reuse water and discharge less to Spring Creek.

- **UAJA should continue to pursue heating and cooling modifications in the Struble Road Reuse District.** The opportunity to provide an economical heating and cooling alternative to the industries and commercial businesses of the Struble Road District is extremely appealing. The transfer of heat would provide UAJA with reuse water temperatures near naturally occurring groundwater temperatures and provide the additional benefit of reducing the amount of fossil fuels used by the participants.