

TOTAL WATER REUSE AT A WASTE-TO-ENERGY FACILITY

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ABSTRACT

The 1200 ton/day (1090 t/day) Lancaster County, Pennsylvania, Waste-to-Energy Facility site is situated in an area where valuable resources such as water and sewer are limited. This has necessitated implementation of an innovative water management concept that includes the treatment and total reuse of sanitary and process wastewater. This paper describes the concept whereby resource recovery has become an even greater environmental benefit by protecting and conserving potable water supplies and the cleanliness of the Susquehanna River.

INTRODUCTION

A growing awareness of the need to reduce dependence on sanitary landfills as the sole means of solid waste disposal has led Lancaster County, Pennsylvania to initiate development of a waste-to-energy facility. After an intensive site selection process, Lancaster County selected a 48 acre (194 km²) parcel in Conoy Township as the most suitable site for construction of a 1200 ton/day (1090 t/day) mass burn facility scheduled for completion in early 1991. A site location map is presented in Fig. 1. In addition to being situated adjacent to the Susquehanna River, the facility site lies within a predominantly agricultural area widely known for its dairy, meat and wine products.

During selection of the site, the availability of an adequate water source became a critical issue. Waste-to-energy facilities, like other power generating plants, can use considerable quantities of water. Consequently, large quantities of wastewater are typically generated. Due to the relatively remote location of the Conoy Township site, however, municipal water and sewer services are unavailable. This, coupled with the area's dependence on groundwater resources for agricultural purposes, has necessitated implementation of an innovative water management strategy.

Development of the water management plan included an initial investigation of alternative water supplies and wastewater treatment options followed by an evaluation of the suitability of each alternative. Finally, the most feasible approach was selected for implementation. During the entire process, emphasis was placed on minimizing potential environmental impacts to the site area while securing reliable services for the project.

WATER SOURCES

The 1200 ton/day (1090 t/day) facility is estimated to have a maximum total water demand of approximately 900,000 gal/day (3406 m³/day). Principal water uses are nonpotable needs, such as power cycle cooling, boiler feed and acid gas control, and potable

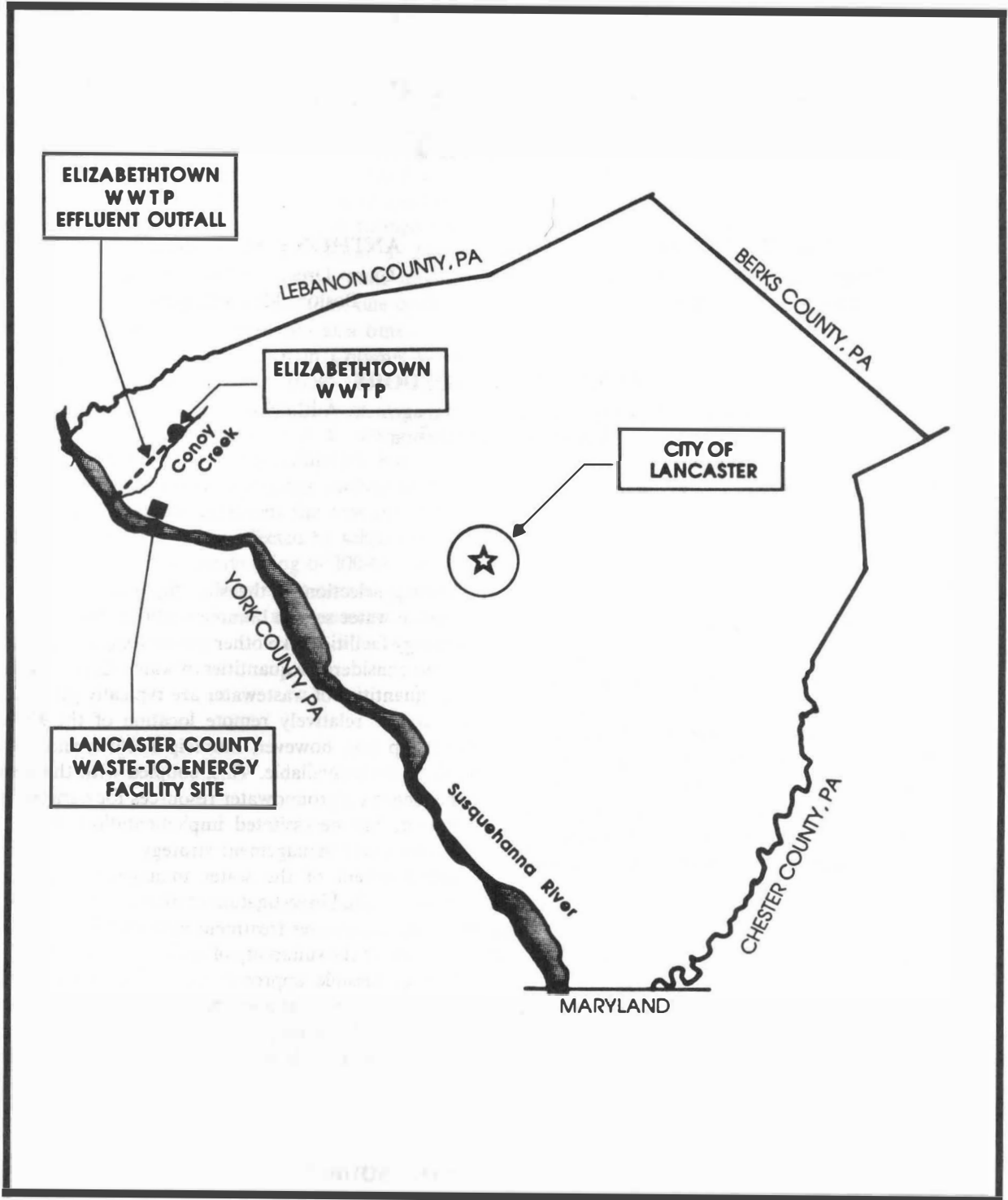


FIG. 1 SITE LOCATION MAP

requirements, such as general clean-up and sanitary uses. Nonpotable requirements are by far the greatest consumers, accounting for over 97% of the total plant demand.

Several water sources were investigated for their ability to meet the facility's water requirements. Municipal water was unavailable at the remote site location. Furthermore, emphasis was placed on preserving groundwater resources due to the relative importance of this resource to the agricultural community. Groundwater was, therefore, ruled out as a source of nonpotable water although the relative insignificant potable demand would be serviced by a well to be constructed on site. Attention then focused on two potential sources for nonpotable needs: river water and wastewater treatment plant effluent.

The most attractive water source initially appeared to be river water. The Susquehanna River, one of Pennsylvania's largest rivers, abuts the facility site. Water from the Susquehanna River is presently used for various functions including municipal water supplies and power cycle cooling for nuclear and fossil fuel-fired power plants along its banks. For example, the City of Lancaster presently supplements its municipal water supplies with water from the Susquehanna River. The Three Mile Island nuclear power plant, which lies approximately 5 miles (8 km) upstream of the site, also uses the Susquehanna River for cooling water purposes. Similarly, this source might adequately service the nonpotable water requirements of the waste-to-energy facility.

The County's Consultants, however, had also had experience with the use of wastewater effluent as an alternative nonpotable water source at three other waste-to-energy projects. It was therefore logical for the firm to investigate using the effluent from a local municipal wastewater treatment plant. A review of the surrounding municipal areas revealed the existence of the Elizabethtown Borough Secondary Wastewater Treatment Plant (WWTP). Subsequent investigations fixed the location of the effluent line, the quantities of effluent and its characteristics. During these investigations, it was discovered that the effluent outfall from the WWTP, which runs 5 miles (8 km) from the WWTP to the Susquehanna River, passes within approximately 1 mile (1.6 km) of the facility site. Sufficient quantities of effluent could be intercepted from the outfall at this closest point to service the nonpotable requirements of the facility.

Detailed environmental and economic analysis of both sources revealed effluent to be the preferred source. Use of effluent would directly reduce the present quantity of effluent discharged to the Susquehanna

River by the WWTP. The river water alternative did not fare well in the comparison due to questions concerning the location of intake and discharge structures. On the project side of the river, there is a wide area of shallow rapids which would require long and costly intake and discharge lines below the river bed. There was also a sensitivity to the potential cost and time necessary to obtain National Pollution Discharge Elimination System (NPDES) and Corps of Engineers permits. Additionally, river water could be preserved for other uses such as drinking water by using wastewater effluent where feasible. In balance, both environmental and economic factors weighed in favor of the use of wastewater effluent over river water.

The use of effluent presented some additional concerns. Perhaps the most significant was the reliability of supply. The County was concerned because a sufficient quantity of water, available on a continuous basis, is essential to run the waste-to-energy facility and that the availability of water would be a critical item in obtaining operating guarantees from full service vendors. Elizabethtown Borough's concerns ran from the effects of a broken effluent line, interrupting service, to the possibility of future reuse of the effluent stream by themselves. These issues were resolved by the County agreeing to a modest annual payment to compensate the Borough for a long-term guarantee of effluent availability and for inspection and maintenance of the effluent line.

WASTEWATER TREATMENT OPTIONS

Both sanitary and industrial wastewater would be generated by the waste-to-energy facility. The quantity of wastewater generated, however, would be significantly lower than water usage due to evaporative processes (e.g., cooling tower, dry scrubbers) employed within the facility.

Several alternatives were investigated for handling of facility wastewater estimated at approximately 200,000 gal/day (757 m³/day). One alternative would be to discharge wastewater following pretreatment to a nearby municipal sewage system. Many waste-to-energy facilities in operation dispose of wastewater this way. Unfortunately, no municipal sewage system exists in the vicinity of the facility site. The closest municipal sewage system is the Elizabethtown WWTP located approximately 5 miles (8 km) up-gradient of the site. However, the pumping head to the WWTP, estimated at approximately 150 ft (45.7 m), is significant and available capacity at this plant is limited. Off-site treatment was therefore considered unfeasible.

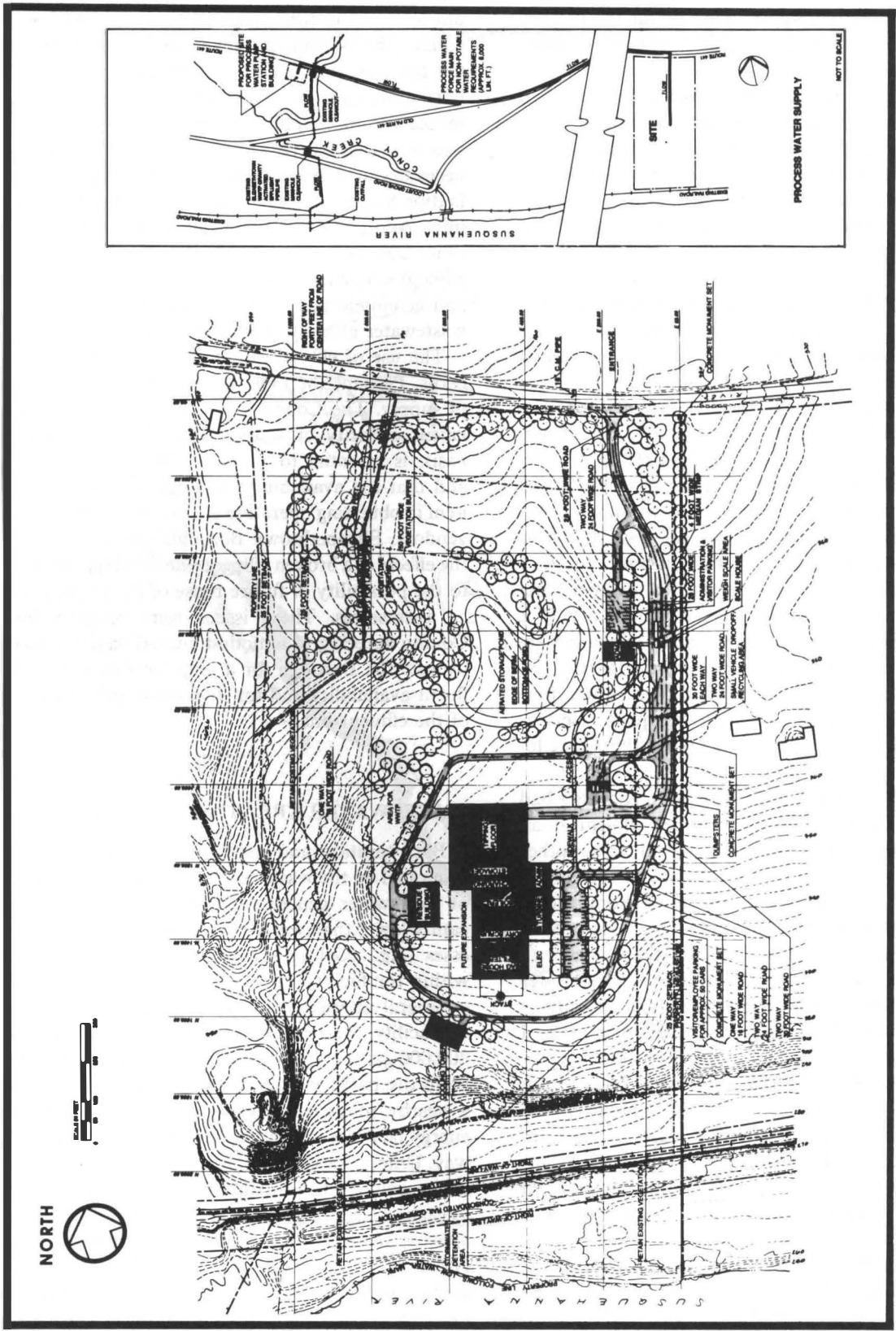


FIG. 2 WASTE-TO-ENERGY FACILITY SITE - CONCEPTUAL SITE PLAN

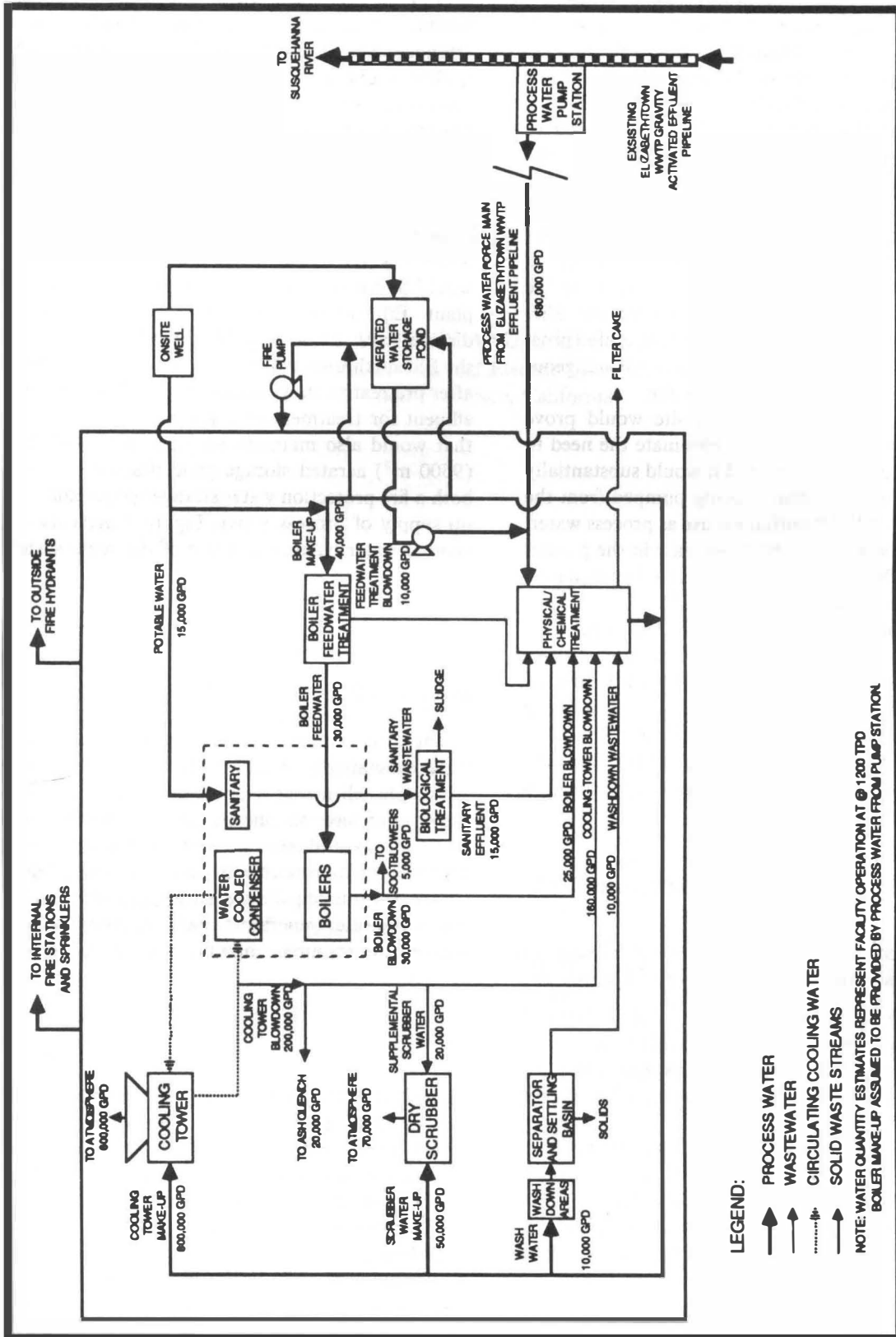


FIG. 3 CONCEPTUAL WATER BALANCE DIAGRAM — TOTAL WATER REUSE

Since treatment off site was not feasible, on-site treatment was necessary. Treated wastewater could then be handled several ways. Treated wastewater could be either discharged directly to the Susquehanna River, discharged back to the Elizabethtown WWTP effluent outfall for final discharge to the Susquehanna River or reused on site. Any wastewater discharged to the Susquehanna either directly or indirectly through the Elizabethtown WWTP effluent outfall must meet applicable federal and state standards. Any treated wastewater discharged was therefore expected to be of similar or higher quality than that discharged by the Elizabethtown WWTP. Since effluent from the Elizabethtown WWTP would be used for nonpotable process water, it was determined to be most advantageous to reuse the facility's wastewater on site.

Reuse of wastewater treated on site would prove beneficial in two ways. It would eliminate the need to discharge wastewater off site and it would substantially reduce the amount of effluent being pumped from the Elizabethtown WWTP outfall for use as process water. The net result would be a 60% decrease in the present quantity of effluent discharged to the Susquehanna River from the Elizabethtown WWTP.

The reuse of industrial wastewater has been practiced in many water-intensive industries where water resources are limited or prohibitively costly. In fact, the concept of industrial wastewater reuse is being applied to other waste-to-energy facilities. The Lancaster facility, however, would represent the first zero wastewater discharge system to be employed in a waste-to-energy project.

WATER AND WASTEWATER MANAGEMENT SYSTEM

As discussed, nonpotable water would be supplied by treated wastewater effluent from the Elizabethtown

WWTP outfall while an on-site well would service potable requirements. The proposed interconnection arrangement is presented in Fig. 2. Operation of the facility would generate two wastewater flows, sanitary and process or industrial wastewater. A portion of the process wastewater would be acceptable for direct make-up to various processes (e.g., ash quench). The remainder would require treatment before reuse.

Per state regulatory requirements, separate treatment facilities would be incorporated for each wastewater flow. Given the manageable flow, sanitary wastes would be handled via a packaged biological treatment plant. Effluent from this plant would be combined directly with secondary effluent being pumped from the Elizabethtown WWTP outfall. Process wastewater, after pretreatment, would be combined with secondary effluent for treatment in a physical/chemical system that would also maintain supplies in a 2,500,000 gal (9500 m³) aerated storage pond designed to serve as both a fire protection water storage system and a backup supply of process water. Figure 3 presents a conceptual water balance diagram of the reuse system.

SUMMARY

The circumstances associated with the Lancaster project dictate that a total water reuse route be chosen. Although, all waste-to-energy projects are not the same, most have significant water demands. Water is a valuable natural resource which should be conserved. Perhaps this approach can lead the way in demonstrating to municipalities that large water consumers and wastewater generators could be integrated to optimize water resources and minimize net environmental impact.