FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Wastewater Treatment Facilities for the Columbus, Ohio Metropolitan Area

Prepared by the

United States Environmental Protection Agency

Region V

Chicago, Illinois

and

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EXECUTIVE SUMMARY

( ) Draft Supplemental Environmental Impact Statement
(X) Final Supplemental Environmental Impact Statement

U.S. Environmental Protection Agency, Region V
230 South Dearborn Street
Chicago, IL 60604

1. NAME OF ACTION

Administrative (X)
Legislative ( )

2. LEGAL BASIS FOR ACTION

The U.S. Environmental Protection Agency (EPA) is the administering agency for a major federal environmental program, provided for by Title II of the Clean Water Act, entitled "Grants for Construction of Treatment Works." This program allows the EPA administrator to provide financial aid to any state, municipality, intermunicipal agency, or interstate agency for the construction of publicly owned water pollution control facilities. The program encourages reduction of point sources of water pollution and improvement of water quality.

The EPA's granting of funds for a water pollution control facility requires a review to comply with the National Environmental Policy Act (NEPA) and may require an environmental impact statement (EIS). Each proposed water pollution control facility is evaluated on a case-by-case basis by the appropriate EPA regional office to determine whether the proposed facility is expected to have significant environmental effects. This review is utilized in determining whether the proposal appears to be a cost-effective solution to area water quality problems.

Given that the Columbus project involved; 1) substantial changes in the proposed action and possible significant environmental impacts associated with those changes; and 2) new information which raises substantial concerns not addressed in the original EIS, it was reasonable and prudent for USEPA to proceed with the preparation of a supplemental EIS in accordance with 40 CFR 1502.9(c).

3. PURPOSE AND NEED FOR PROJECT

The city of Columbus, owns and operates two major wastewater treatment facilities. The Jackson Pike WWTP is located in southwest Columbus. The Southerly WWTP is located approximately 8 miles south of downtown Columbus. Both of these plants discharge to the Scioto River and will require upgrading to ensure compliance with revised National Pollutant Discharge Elimination System (NPDES) permits.

Original NPDES permits for Jackson Pike and Southerly set effluent limitations of 30 mg/l (30-day average) for five-day carbonaceous biochemical oxygen demand ($CBOD_5$) and total suspended solids (TSS). In 1985, the NPDES permits for both plants were revised. Tables 1 and 2 present the effluent standards of the revised permits. The limits vary on a seasonal basis. $CBOD_5$ and TSS limits are more stringent and standards for ammonia and dissolved oxygen have been added to the permits. The plants are required to be in compliance with these final effluent limits by July 1, 1988. Until that time, the Jackson Pike and Southerly plants are operating under interim limits of 25 mg/l for $CBOD_5$ and 30 mg/l for TSS.

4. PROJECT HISTORY

In 1976, the city of Columbus prepared the Columbus Metropolitan Facilities Plan for wastewater management up to the year 1995. The 1976 facilities plan concluded that the cost-effective solution to improved wastewater treatment was rehabilitation and expansion of both the Jackson Pike and Southerly WWTPs.

After reviewing the original facilities plan, the USEPA initiated preparation of an EIS on the 1976 facilities plan. The EIS, when completed in 1979, contained recommendations for wet stream treatment and solids handling

TABLE 1. NPDES FINAL EFFLUENT LIMITS
JACKSON PIKE WWTP

PARAMETER	CONCENTRATION SUMMER (30-day/7-day)	WINTER (30-day/7-day)	MAY (30-day/7-day)
Suspended Solids (mg/1)	16.0/24.0	30.0/45.0	26.0/39.0
$CBOD_5$ (mg/1)	8.0/12.0	20.0/30.0	13.0/19.5
Ammonia (mg/1)	1.0/1.5	5.0/7.5	2.5/3.75
Fecal Coliform (count/100 ml)	1000/2000	--	--

The Dissolved Oxygen shall be maintained at a level of not less than 7.0 mg/1 and shall be monitored continuously and the lowest value reported daily.

The Chlorine Residual shall be maintained at a level not to exceed 19 ug/1 and shall be monitored continuously and the highest value reported daily (summer only).

Source: OEPA Permit No. 4PF00000*GD
Summer = June - October
Winter = November - April

TABLE 2. NPDES FINAL EFFLUENT LIMITS
SOUTHERLY WWTP

PARAMETER	CONCENTRATION SUMMER (30-day/7-day)	WINTER (30-day/7-day)	MAY (30-day/7-day)
Suspended Solids (mg/l)	16.0/24.0	30.0/45.0	26.0/39.0
$CBOD_5$ (mg/l)	8.0/12.0	25.0/40.0	13.0/19.5
Ammonia (mg/l)	1.0/1.5	5.0/7.5	2.0/3.0
Fecal Coliform (count/100 ml)	1000/2000	--	--

The Dissolved Oxygen shall be maintained at a level of not less than 7.0 mg/l and shall be monitored continuously and the lowest value reported daily.

The Chlorine Residual shall be maintained at a level not to exceed 26 ug/l and shall be monitored continuously and the highest value reported daily (summer only).

Source: OEPA Permit No. 4PF00001*HD
Summer = June - October
Winter = November - April

that differed from the recommendations of the original facilities plan. The differences in wet stream treatment recommendations were due to process selection, reliability, and design criteria differences. With regard to solids handling, the EIS differed from the original facilities plan by proposing that land application and composting rather than incineration/ landfill be adopted as the primary means of solids disposal.

In order to address the differences in design parameters between the EIS and the original facilities plan, in the final EIS USEPA directed Columbus to establish a Design Finalization Overview Team (DFOT) to review and recommend the final design parameters for both plants.

The DFOT Report was completed in May of 1984. On July 9, 1984, the city submitted a Plan of Study which set the groundwork for a facilities plan update. The Plan of Study for the facilities plan update proposed significant changes from the original facilities plan. Therefore, the DFOT Report was never formally reviewed by Ohio EPA or USEPA.

The Columbus Metropolitan Area Facilities Plan Update (FPU) Report was submitted to Ohio EPA in December 1984. The FPU recommended phasing out the Jackson Pike WWTP and sending all flow to an upgraded and expanded Southerly WWTP. Ohio EPA reviewed this document and prepared detailed comments and questions for the city.

In September of 1985, the city submitted the Revised Facilities Plan Update (RFPU) as a supplement to the FPU. The specific objectives of the RFPU were:

- To revise the recommendations of previous documents based on revised design parameters;
- To respond to comments by Ohio EPA relative to the FPU;
- To present conclusions and recommendations of planning analyses undertaken since completion of the FPU; and to develop treatment facilities which would serve the city's needs though the year 2015.

The RFPU contained the following basic conclusions and recommendations:

- It is cost effective to expand the existing Southerly WWTP to treat all wastewater from the Columbus service area and to phase out the existing Jackson Pike WWTP.

- Phasing out the Jackson Pike WWTP will have no significant adverse environmental impacts.

- The Southerly WWTP expansion will be based upon a design average flow of 178 MGD and a peak process flow of 300 MGD. Peak flows of up to 430 MGD may be generated from a CSO control program. Flow in excess of 300 MGD would be settled and chlorinated prior to discharge.

- The proposed treatment facilities would utilize a semi-aerobic process.

- Additional standby incineration capacity beyond that presently under construction at Southerly is not recommended since sludge composting and land application of digested sludge will continue as the preferred method of solids disposal.

5. EIS ISSUES

During review of the Revised Facility Plan Update, a number of potentially significant environmental impacts were identified. These impacts were the subject of USEPA's action to issue a Notice of Intent (June 11, 1986) to prepare a supplemental EIS. This supplemental EIS addresses the following issues:

- The reliability of the semi-aerobic process to effectively treat the wastewater to meet NPDES permit limits.

- Water quality impacts resulting from a single plant discharge.

- The imact on river flow resulting from the elimination of Jackson Pike's flow.

- The impacts expected from the fulfillment of the population projections and development for the planning area.

- Environmental effects of the sludge treatment and disposal alternatives.

- The induced growth and secondary environmental effects of an expanded Southerly WWTP.
- The cost-effective treatment of combined sewer overflows as an integral part of the system.
- The impact of expanding the south end of Interconnector by extending the 156-inch gravity sewer to Southerly and placing four 78-inch pipes across the Scioto River.
- The reliability of the Southerly WWTP as the only plant treating sewage in Columbus.
- The economic effects of the proposed plan. What is the cost-effective solution to the wastewater management problems in Columbus?

NOTE: USEPA has prepared this SEIS based on the conditions as of 1985.

6. WASTEWATER MANAGEMENT ALTERNATIVES

In addition to a no action alternative, three comprehensive management alternatives were evaluated in the Supplemental EIS. They include the following:

- Two-Plant: Upgrade Southerly and Jackson Pike, provide wet stream treatment and solids handling at both plants.
- Two-Plant One Solids: Upgrade Jackson Pike and Southerly, provide all solids handling at Southerly.
- One-Plant: Eliminate Jackson Pike, upgrade and expand Southerly.

Each comprehensive wastewater management alternative includes the following components:

- Interconnector/Headworks
- Biological Process
- Sludge Management

Options for each of these components were also evaluated. They include the following:

- Interconnector/Headworks
  - A/A-1 (additional pumping, force mains, and headworks)
  - B/B-1 (extension of gravity sewer and separate headworks)
  - B/B-2 (extension of gravity sewer and entirely new headworks)

- Biological Process
  - Semi-aerobic
  - Trickling Filter/Activated Sludge (TF/AS)

- Sludge Management
  - JP-B (Primary Sludge (PS) Thickening, Waste Activated Sludge (WAS) Thickening, Anaerobic Digestion, Dewatering, Incineration/Landfill, Land Application)

  - JP-C (PS Thickening, WAS Thickening, Anaerobic Digestion, Thermal Conditioning, Incineration/Landfill, Land Application)

  - SO-C (PS Thickening, WAS Thickening, Anaerobic Digestion, Dewatering, Incineration/Landfill, Composting)

  - SO-D (PS Thickening, WAS Thickening, Anaerobic Digestion, Dewatering, Incineration/Landfill, Composting, Land Application)

  - SO-F (PS Thickening, WAS Thickening, Dewatering, Incineration/ Landfill, Composting)

Table 3 summarizes each wastewater management alternative with its respective component option.

Each of the component options were evaluated with respect to technical criteria consisting of cost, reliability, flexibility, implementability, and operational convenience. The optimum option to fulfill each component was selected for both the one-plant and two-plant alternatives.

<u>One-Plant Alternative</u>

The selected component options for the one-plant alternative include:

- Interconnector/Headworks Option B/B-1
- Biological Process - Semi-Aerobic
- Sludge Management Option SO-D

TABLE 3 SUMMARY OF ALTERNATIVES AND OPTIONS

WASTEWATER MANAGEMENT ALTERNATIVE	COMPONENT	OPTION *
ONE-PLANT	INTERCONNECTOR/HEADWORKS	A/A-1 B/B-1 B/B-2
	BIOLOGICAL PROCESS	SEMI-AEROBIC TF/AS
	SLUDGE MANAGEMENT	SO-C SO-D SO-F
TWO-PLANT	BIOLOGICAL PROCESS	SEMI-AEROBIC TF/AS
	SLUDGE MANAGEMENT	SO-C SO-D SO-F JP-B JP-C
TWO-PLANT ONE SOLIDS	BIOLOGICAL PROCESS	SEMI-AEROBIC TF/AS
	SLUDGE MANAGEMENT	SO-C SO-D SO-F

* DETAILED DESCRIPTION IN CHAPTER 5.

The Interconnector/headworks option B/B-1 consists of extending the 156-inch diameter gravity Interconnector Sewer to Southerly, using four parallel 78-inch pipes for the Scioto River crossing, and constructing separate headworks at Southerly for the Interconnector flow. This option was selected based on cost and reliability. Option B/B-1 was approximately the same cost as option A/A-1 (force mains) and 15 percent less costly than option B/B-2 (gravity sewer and entirely new headworks). The gravity sewer was considered to be more reliable than the force main since there is less chance that the gravity sewer will rupture. Furthermore, failure of a gravity sewer normally results in infiltration to the conduit, while a rupture of the force mains would cause exfiltration to the environment. In addition, the gravity sewer does not rely on the operation of a pumping facility to perform.

The semi-aerobic process is a modified form of the conventional activated sludge process which currently exists at the Southerly WWTP. It differs from conventional activated sludge in that the first 25 percent of the reaction basin is not aerated. Only mixing is provided. This maintains that a portion of the basin is in an anaerobic or anoxic state, depending on the level of nitrates present. The process also includes an internal mixed liquor recycle loop to provide the capability of recycling nitrates from the last bay of the aeration basin back to the first bay to accomplish denitrification.

The semi-aerobic process was selected over the trickling filter/activated sludge process due to its reliability. The semi-aerobic process is considered more reliable due to the fact that more process control flexibility is inherent in the process. Furthermore, the trickling filter process would be difficult to implement in that it would require major restructuring of the conduits between the existing primary clarifiers and aeration basins. The trickling filter/activated sludge process would also be subject to an adverse environmental review due to its resultant odor and pests.

The selected sludge management option for the one-plant alternative, SO-D, includes gravity thickening of PS, centrifuge thickening of WAS, anaerobic digestion, centrifuge dewatering, composting, land application, and incineration/landfill. This is consistent with the current sludge management scenario at Southerly, with the exception of land application. Southerly does not land apply sludge at the present time. However, land application is employed at Jackson Pike.

Option SO-D was chosen over SO-C and SO-F because it provides more flexibility and reliability in that it includes three methods of final disposal.

Two-Plant Alternative

The two-plant alternative does not require expansion of the Interconnector Sewer or additional headworks at Southerly. Therefore, selection of an Interconnector/headworks option was not necessary. The two-plant alternative does require new headworks for Jackson Pike located at the plant site.

The selected component options for the two-plant alternative include:

- Biological Process - Semi-Aerobic
- Sludge Management Option SO-D
- Sludge Management Option JP-B

The semi-aerobic process was selected over the trickling filter/activated sludge process for the Jackson Pike and Southerly WWTPs under the two-plant alternative for the same reasons which were presented for the one-plant alternative. These reasons include more reliability with the semi-aerobic process due to process flexibility; and difficulty in implementing the trickling filter/activated sludge process due to existing plant configuration and environmental concerns. In addition, the semi-aerobic process is 20 percent less costly than the trickling filter/activated sludge process.

Similar to the one-plant alternative, option SO-D was selected for Southerly under the two-plant scenario. Option SO-D provides more flexibility and reliability due to three methods of final disposal: composting, land application, and incineration/landfill.

Option JP-B was selected for Jackson Pike under the two-plant scenario based on cost and ease of operation. Option JP-B includes gravity thickening of PS, centrifuge thickening of WAS, anaerobic digestion, centrifuge dewatering, incineration/landfill, and land application. Option JP-B is approximately 16 percent less costly than option JP-C which includes thermal conditioning in addition to the processes included in JP-B. Thermal conditioning is difficult and expensive to operate and maintain. Therefore, it is recommended that the thermal conditioners be phased out of service when they reach the end of their useful life.

The two-plant one solids alternative was eliminated from consideration following the analysis of the one-plant and two-plant solids options. The analysis showed that it was less costly to maintain solids processing at both Southerly and Jackson Pike if both facilities are providing liquid treatment.

7. EVALUATION OF COMPREHENSIVE WASTEWATER MANAGEMENT ALTERNATIVES

The one-plant and two-plant comprehensive wastewater management alternatives were evaluated based on the same technical criteria used to evaluate the component options. These criteria included present worth cost, reliability, flexibility, implementability, and operational convenience.

In addition to the technical evaluation, an environmental evaluation was performed for the one-plant and two-plant alternatives. The evaluation considered physical, biological, and human environmental criteria. Physical criteria included water, air quality, and prime agricultural land. Biological criteria included terrestrial and aquatic biota as well as threatened and endangered species. The human or man-made environmental criteria included land use, noise, energy, economics, transportation, and historic and archaeologic resources. Indirect environmental consequences such as induced growth were also considered.

Technical Evaluation

Table 4 presents the capital, annual O&M, and total present worth costs for the one-plant and two-plant alternatives. The two-plant alternative exhibits a total present worth cost approximately 10 percent lower than the one-plant alternative.

Both the one-plant and two-plant alternatives are equal with respect to their reliability in meeting the final effluent limits. However, the two-plant is considered more reliable with respect to shock loads. Under the one-plant alternative, a plant upset at Southerly could result in a significant loss of biological treatment capacity and may cause a serious water quality problem. However, if the shock and/or toxic load can reach only one of the two plants, the impact may not be as severe.

The two-plant alternative is judged more flexible than the one-plant alternative. With both facilities operational, the city would have more flexibility to adapt to increased future flow, to more stringent effluent limits, and to address combined sewer overflows. The two-plant alternative would leave more land available at Southerly for expansion. The two-plant alternative would improve and upgrade Jackson Pike to provide a solid 100 MGD treatment capacity. The two-plant alternative would allow for future expansion of the Interconnector system to divert more flow to Southerly while optimizing the use of the Jackson Pike facility.

The two-plant alternative is considered easier to implement since the majority of the facilities already exist. Most of the construction would consist of rehabilitation of existing facilities. There would be no expansion of the conveyance system between the plants under this alternative.

TABLE 4. ALTERNATIVE COST SUMMARY

	Capital	Annual O&M	Total Present Worth
One-Plant [Southerly]	268,711,000	16,849,000	436,911,000
Two-Plant [So. and JP]	**207,076,000**	19,078,000	**397,016,000**
Difference From One-Plant	**-61,635,000**	+2,229,000	**-39,895,000**
Percent Difference	**-30**	+13	**-10**

NOTE: These costs are based on a 2008 average flow of 154 MGD and a peak flow of 231 MGD. Present worth costs are in 1988 dollars.

The one-plant alternative is considered easier to operate and maintain since all facilities would be consolidated at one location.

Environmental Evaluation

The environmental evaluation identified four major impacts which were in the following areas:

- Surface water quality
- Surface water flows
- Aquatic biota/habitat
- Endangered species

Surface Water Quality

The principal variable affecting surface water quality under either alternative is the location of wastewater discharge. Comparable levels of treatment will be provided under either the one-plant or two-plant alternative, and either alternative will protect stream standards for DO and ammonia.

Regardless of the one-plant or two-plant alternative, the treated effluent will contain a residual wasteload, which will be assimilated by the river, resulting in a downstream DO sag. The severity of the sag, and the extent of the river affected, vary between alternatives.

Under the no action alternative, no improvement in the degraded water quality conditions in the Scioto River would occur. With projected future growth in the sewered population (and corresponding increases in wastewater flows), age-related deterioration of the existing WWTPs and increases in urban non-point runoff due to continued urban growth, further deterioraton in current water quality conditions would be expected. Under these conditions, more frequent water quality standard violations could be expected and the impacted zone of the Scioto River below Southerly may be extended to Circleville, interfering with other point source discharges.

The two-plant alternative would release the residual effluent DO demand to the Scioto River at two locations (Jackson Pike and Southerly). Two DO sags would therefore result; however, neither sag would result in contravention of water quality standards. Significant improvements to in-stream DO conditions would result from this alternative. Because significant pollutant loads would continue to enter the Scioto River upsteam of Jackson Pike (from urban runoff and CSOs from Whittier Street), the degree of water quality improvement below Jackson Pike would be less complete than below the Southerly WWTP. Under certain flow conditions, DO levels below the 5.0 mg/l standard could occur below Jackson Pike, related to CSO loadings. However, the presence of Jackson Pike effluent during low flow events could lessen the DO impacts of CSOs and upstream urban runoff.

The impacts of the one-plant alternative would be variable for the river reach between Jackson Pike and Southerly, and depending on background river flow conditions at average river flow levels, water quality would be improved by the elimination of Jackson Pike effluent. However, under critical low flow conditions, elimination of the Jackson Pike effluent would reduce Scioto River flows by nearly 90 percent, while a large background pollutant load would remain in the form of urban runoff and CSO loading. This situation would result in a significant reduction in the river's wasteload assimilative capacity due to reductions in flow volume, velocity, and reaeration. Decay of pollutants from upstream sources could, therefore, result in severe water quality deterioration in slow, shallow pools during warm weather, low flow events.

Downstream of the Southerly WWTP, the DO sag resulting from the one-plant alternative would be more severe and would affect a longer stretch of the river, when compared with the two-plant alternative. This situation results from the release of the entire residual wastewater DO demand from Columbus at a single point in the river, creating a greater assimilative demand. In addition, the increased nutrient release under the one-plant alternative would further stimulate algal biomass below Southerly which may depress low flow DO below in-stream standards due to algal metabolism. The combination of these factors results in a possiblility that the one-plant alternative may impact the Circleville area, interfering with other point source dischargers near Circleville. Based on these considerations, the two-plant alternative is considered preferable over the one-plant alternative with regard to water quality impacts.

Surface Water Flows

The no action and the two-plant alternatives will have little or no impact on surface water flows in the Scioto River. The one-plant alternative would cause significant reductions in flows in the Scioto River during dry weather periods in the eight-mile reach between the Jackson Pike and Southerly WWTPs. This reduction in flow would have negative impacts on water quality, aquatic biota, and recreation in that portion of the Scioto River.

Aquatic Biota/Habitat

The no action alternative would result in continuation of the current low dissolved oxygen and high residual chlorine condition and related aquatic habitat degradation in the Scioto River below Columbus. Pollution intolerant species would continue to be excluded from the affected areas of the Scioto River, below the Jackson Pike WWTP and below the Southerly WWTP.

Under the two-plant alternative, water quality should improve which in turn would have a favorable impact on aquatic biota and habitat. Sensitive species that currently inhabit the area should persist and increase in abundance. New species may move into the area and increase community diversity. However, more sensitive species may suffer due to marginal DO levels immediately below each of the two treatment plants. In addition, the continuing negative impacts of general urban runoff and pollutant loads from the Whittier Street CSO will prevent free biological recovery in the Central Scioto.

The one-plant alternative would impact aquatic habitat and biota due to the elimination of the discharge at Jackson Pike, the increase in discharge at Southerly, and the placement of four 78-inch sewer pipes across the Scioto River near Southerly.

The elimination of the Jackson Pike discharge would decrease the flow in the Scioto River between Jackson Pike and Southerly. Under critical low flow conditions, a significant loss of benthic habitat area would result. This condition could dissrupt spawning, feeding, and migratory activities of the fish. Furthermore, as previously discusssed under low flow conditions the loss of the Jackson Pike discharge could result in degraded water quality conditions which in turn would have negative impacts on aquatic biota.

Under normal flow conditions, the elimination of the Jackson Pike WWTP discharge would result in improved water quality conditions to the extent that this effluent affects water quality. These improvements would result in favorable aquatic community responses.

The increased discharge at the Southerly WWTP would result in an increase in the length of the river affected by the DO sag. Degradation of aquatic communities can be expected in the vicinity of the DO sag.

Construction across the Scioto River would have localized, short-term impacts on aquatic biota and habitat. Impacts will stem primarily from increases in sediment transport and deposition downstream of the construction site. Fish would suffer fewer short-term impacts than benthos as they can avoid the construction site, but stresses and mortalities should be expected. Increased turbidity would also temporarily damage habitat of species which use pools due to lowered oxygen levels caused by organic loads associated with eroded soils. The distance affected and the degree of stress would depend on the amounts of sediment which would be displaced; however, mitigation techniques should minimize impacts.

Endangered Species

Terrestrial endangered species should not be affected by the no action alternative. However, the aquatic endangered species habitat would suffer due to continued degradation of water quality. Several federal and state designated endangered and rare fish have been sighted in the Central Scioto River mainstem within the past five to seven years, and those species would most likely be disturbed. The degraded habitat would prevent their populations from growing in the affected areas.

Small populations of other endangered or rare fish live in tributaries to the Scioto River where water quality is better. The Central Scioto River mainstem potentially could provide habitat for these species if water quality was improved. Continued degradation of water quality would decrease the chances for these fish to expand their ranges into the Scioto River.

Endangered aquatic species should benefit from implementation of the two-plant alternative. Improvements in water quality should allow the endangered fish species that have been identified in the Scioto River to increase in number and allow the species inhabiting tributaries to expand their ranges. Specific information on the tolerances of these species to turbidity and lowered DO is not available, preventing an assessment of the conditions under which these species would establish permanent breeding populations. Increased habitat for feeding, however, should benefit populations.

Long-term impacts of the one-plant alternative stem from: 1) modified water quality below Jackson Pike and Southerly, and 2) reduction in flow between the Jackson Pike and Southerly WWTPs.

Below Jackson Pike, water quality would be somewhat improved under most flow conditions. These improvements may encourage rare, threatened, and endangered aquatic fauna to increase in range and abundance entering the Scioto River from tributaries or less impacted river areas further downstream.

Under the one-plant alternative, however, the critical low flow conditions will be the limiting factor on re-colonization of the Upper Scioto River (between Jackson Pike and Southerly) by rare, threatened, and endangered species. Because of the nearly 90 percent reduction in river flows during low flow conditions, residual DO demands from other upstream sources will result in degraded water quality in shallow, still pools during warm weather. Under these conditions, the sensitive species will be reduced or eliminated, cancelling the benefits to water quality which will occur under higher flow conditions.

The nearly 90 percent reduction in river flows between Jackson Pike and Southerly under low flow conditions, will exert additional negative impacts on aquatic fauna due to the physical effects of reduced flows and diminished habitat area. Reduced velocities associated with low flow could stress some species and possibly limit their range. Because many of the species feed in riffles, drying out of riffles also could hinder the movement of these species into the affected river segment.

Table 5 summarizes the technical and environmental evaluations.

8. PREFERRED PLAN

Based on the technical and environmental evaluations, the two plant alternative is recommended as the preferred plan.

Implementation of two-plant alternative requires the following actions:

- Upgrade the Jackson Pike WWTP to treat an average flow of **70** MGD and a peak process flow of 100 MGD.
- Upgrade the Southerly WWTP to treat an average flow of **84** MGD and a peak process flow of 131 MGD.
- Complete the north end of the Interconnector Sewer to allow Jackson Pike flows to be diverted to the Southerly WWTP when **dry weather flows exceed 70 MGD and wet weather** flows exceed 100 MGD.

TABLE 5 ONE PLANT/TWO PLANT COMPARISON

CRITERION	ONE-PLANT	TWO-PLANT
PRESENT WORTH COSTS		X
RELIABILITY		X
FLEXIBILITY		X
EASE OF IMPLEMENTATION		X
EASE OF OPERATION AND MAINTENANCE	X	
SURFACE WATER QUALITY		X
SURFACE WATER FLOWS		X
AQUATIC BIOTA		X
ENDANGERED SPECIES		X

X = PREFERRED ALTERNATIVE

- Construct new headworks at Jackson Pike rated at a capacity of 100 MGD which include screening, pumping, and grit removal.

- Modify the existing aeration basins at each plant to operate in the semi-aerobic mode.

- Add two new aeration basins to the existing Center Train at the Southerly WWTP.

- Replace the existing rectangular clarifiers at the Southerly WWTP with six new circular clarifiers.

- Add two new rectangular clarifiers to the B Plant at Jackson Pike.

- Construct chlorination, dechlorination, and post aeration facilities at both Jackson Pike and Southerly.

- Modify the four existing decant tanks at Southerly to be utilized as gravity thickeners.

- Modify two of the existing anaerobic digesters for use as gravity thickeners at Jackson Pike.

- Add one new centrifuge for thickening at both Jackson Pike and Southerly.

- Rehabilitate the existing anaerobic digesters at both Jackson Pike and Southerly.

- Add two new dewatering centrifuges at Southerly.

Solids disposal will be accomplished at Southerly in the following manner:

- 50 percent of the solids will be incinerated and the ash landfilled. The two most recently installed incinerators will be utilized. It is not recommended that the older incinerators be renovated.

- 25 percent of the solids will be composted at the Southwesterly Composting Facility. The compost will be marketed as a soil conditioner.

- 25 percent of the solids will be land applied on nearby farmland.

Solids disposal will be accomplished at Jackson Pike in the following manner.

- 50 percent of the solids will be incinerated and the ash landfilled. The two existing incinerators should be renovated.
- 50 percent of the solids will be land applied on nearby farmland.

The preferred plan does not incorporate measures to deal with combined sewer overflows. A detailed CSO study is required to determine a cost-effective solution to CSO problems within the planning area.

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This Final Supplemental Environmental Impact Statement (SEIS) is published by the Environmental Impact Unit of the U.S. Environmental Protection Agency (USEPA), Region V. The Final Environmental Statement (ES) which forms the basis of this SEIS was prepared under contract to USEPA by Science Applications International Corporation (SAIC), McLean, Virginia, and Triad Engineering Incorporated, Milwaukee, Wisconsin. Staff from USEPA, SAIC, and Triad Engineering involved in preparation of the ES/SEIS included:

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CHAPTER 1. PURPOSE AND NEED FOR ACTION

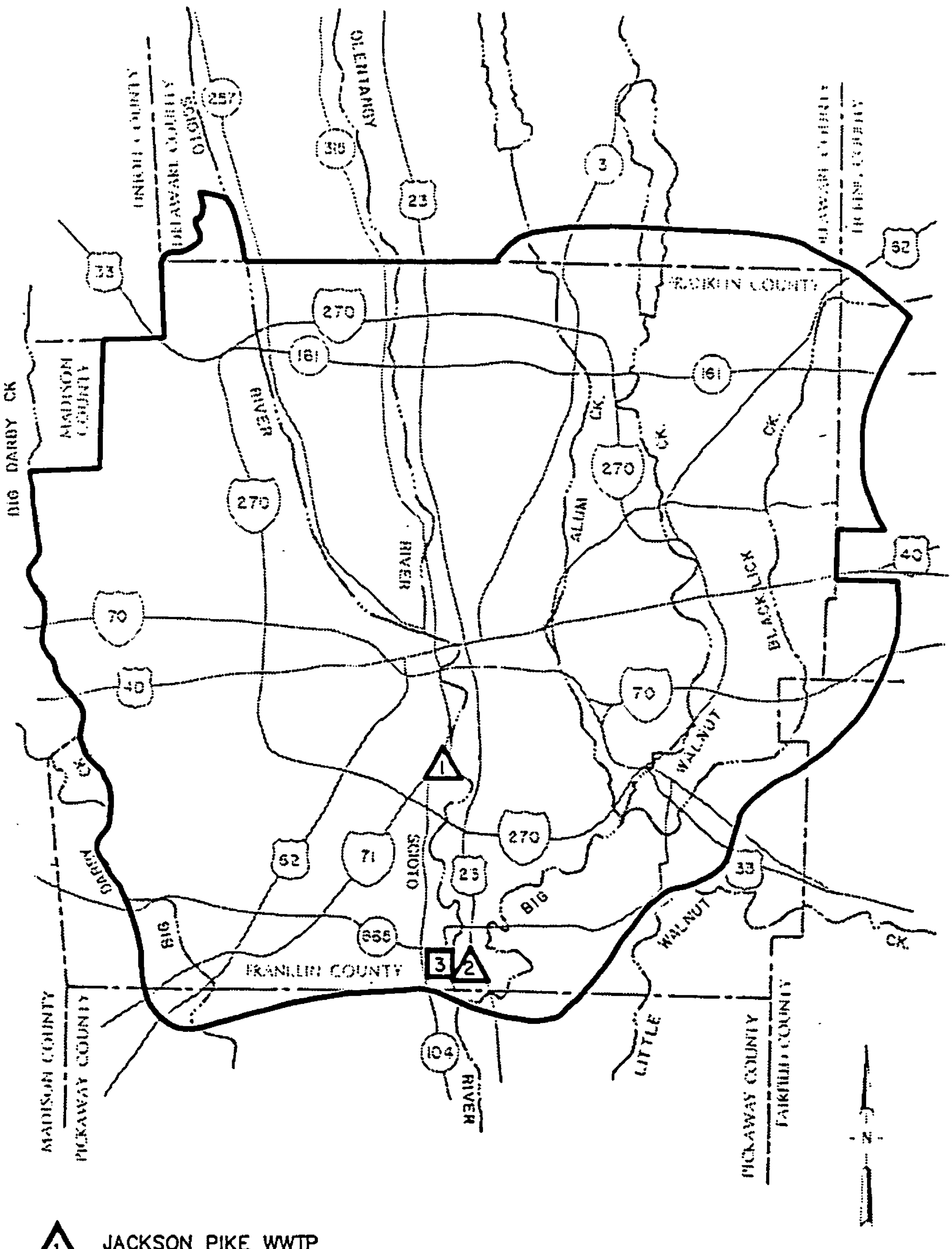
1.1 PROJECT BACKGROUND

This Supplemental Environmental Impact Statement (SEIS) addresses plans submitted by the city of Columbus, Ohio, to meet wastewater treatment needs in the Columbus Facilities Planning Area (FPA). The planning area includes essentially all of Franklin County and portions of surrounding counties. The planning area boundaries were reconfirmed by the Ohio Environmental Protection Agency (EPA) in a letter to the city of Columbus on October 23, 1986. This approved planning area is depicted in Figure 1-1.

The city of Columbus, owns and operates two major wastewater treatment facilities. The Jackson Pike Wastewater Treatment Plant (WWTP) in southwest Columbus was constructed in the late 1930's with an original hydraulic design capacity of approximately 115 MGD. The Southerly WWTP is located 8.5 miles south of downtown Columbus. The Southerly plant was constructed in 1967 with a hydraulic design capacity of 100 MGD. Both of these plants discharge to the Scioto River.

Formal facilities planning for the Columbus metropolitan area was initiated on October 3, 1974, when the city contracted with Malcolm Pirnie, Inc., for preparation of a facilities plan. On December 12, 1974, a Step 1 grant application to request Federal Funds to conduct planning and a plan of study were submitted to the Ohio EPA. The plan of study was subsequently approved, and a grant was made to the city by USEPA on September 23, 1975.

In 1976, the city of Columbus prepared the Columbus Metropolitan Facilities Plan for wastewater management up to the year 1995. The 1976 facilities plan concluded that the most cost-effective solution to improved wastewater treatment was rehabilitation and expansion of both Jackson Pike and Southerly wastewater treatment plants. Since then, the following studies and reports on the Columbus, Ohio, wastewater treatment system have been prepared:



JACKSON PIKE WWTP

SOUTHERLY WWTP

SOUTHWESTERLY COMPOST FACILITY

PLANNING AREA BOUNDARY

APPROXIMATE SCALE: 1 INCH = 4.12 MILES

FIGURE 1-1
PLANNING AREA

- USEPA Environmental Impact Statement Reports

  - Draft Environmental Impact Statement (EIS) - February 1978

  - Evaluation of the Wastewater Treatment Process Proposed for Columbus, Ohio, in the Draft EIS - July 1978

  - Final EIS - June 1979

- USEPA - Advanced Waste Treatment Task Force Review - 1979

- Columbus Metropolitan Area Facilities Plan Update prepared in the following segments:

  Segment 1 - Interim Solids Handling Facilities - 1980
  Segment 2 - Long-term Solids Handling Facilities - 1982
  Segment 4 - Combined Sewer Overflow - 1983
  Segment 5 - Blacklick Interceptor - 1981

- Design Finalization Overview Team (DFOT) Review Report - May 1984

- Columbus Metropolitan Area Facilities Plan Update Report - December 1984

- Draft Central Scioto River Mainstem Comprehensive Water Quality Report August 1983 - (Revised February 1985)

- Revised Facilities Plan Update - September 1985

- Municipal Compliance Plan - September 1985

After reviewing the original facilities plan, the USEPA initiated preparation of an EIS. The 1979 Final EIS contained recommendations for wet stream treatment and solids handling that differed from the recommendations of the original facilities plan. It primarily focused on the selection of additional mainstream treatment and solids handling facilities at Jackson Pike and Southerly WWTP's as well as construction of separate sanitary sewer interceptors within the Columbus planning area. The 1979 EIS made the following recommendations:

- Completion of the Interconnector Sewer between the Jackson Pike WWTP and Southerly WWTP.

- Installation of facilities for the addition of metal salt coagulant to the raw wastewater and the influent to the clarifiers for phosphorus removal flexibility at the Southerly and Jackson Pike plants.

- Utilization of a two-stage wastewater treatment concept which includes trickling filters followed by activated sludge at the Jackson Pike plant.

- Continued use of the single-stage activated sludge process at the Southerly plant.

- Pretreatment and regulation of brewery flows.

- Effluent filters, that are capable of treating 80 to 85 percent of the hydraulic capacity, at each plant.

- Expansion of the chlorine disinfection capacity and addition of post aeration and declorination processes at Jackson Pike and Southerly.

- Optimum utilization of existing sludge handling facilities, two operable sludge incinerators at each plant, and additional dewatering equipment.

- Investigation and implementation of alternatives to incineration.

Based on future flexibility considerations and dissatisfaction with the performance of the thermal conditioners, the 1979 EIS included a recommendation for continued testing of a chemical conditioning-belt press system as a possible alternative for the production of an autogenous sludge cake. It was stated that thermal conditioning could be abandoned in favor of this new method in the future depending on advances in belt press dewatering technology.

The 1979 EIS did not recommend completing the sludge line. Rather, it was recommended in the EIS that additional facility planning be conducted to evaluate alternative solids handling options. The alternatives suggested by the EIS included strip mine reclamation projects, composting, and land application. Upon implementation of an alternative disposal technique, incineration would become a backup system.

The 1979 EIS evaluated 11 subareas for connection to the Columbus sewer system. Only 3 (Minerva Park, Blacklick, and Rocky Fork) had a documented need for sewer service. The EIS recommended that additional facility planning was required in the remaining 8 subareas to establish the need for regional sewers during the planning period.

In order to address the differences in design parameters between the Draft EIS and original facilities plan, USEPA in the Final EIS required that Columbus establish a Design Finalization Overview Team (DFOT) "as a separate but integral part of the Value Engineering Team to review and recommend the final design parameters of both plants." AWARE, Inc., was selected as the DFOT by the city in 1982 and the report was completed in May 1984. On July 9, 1984, the city submitted a Plan of Study which set the groundwork for a facilities plan update. The DFOT Report was not formally reviewed by USEPA or OEPA, since significant changes were proposed in the Plan of Study for a Facilities Plan Update.

Approximately 9 years have passed since completion of the original facilities plan with little implementation of the 1979 EIS recommendations. Deterioration of the concrete structures and other facilities at the Jackson Pike WWTP has occurred during this time. (O&M at Jackson Pike was a concern in the late 1970's.) Recently, the city decided to reevaluate the facilities plan and introduced the Columbus Metropolitan Area Facilities Plan Update Report, December 1984, as an update to the original facilities plan. This plan represents the first time that a single wastewater treatment plant alternative for Columbus was proposed.

The Revised Facilities Plan Update Report (RFPU), September 1985, supplements the Facilities Plan Update Report (FPU) and related facilities planning documents. The specific objectives of the RFPU were: (1) to revise the recommendations of previous documents based upon revised design parameters and NPDES permit limits; (2) to present the conclusions and recommendations of planning analyses undertaken since completion of the FPU; (3) to respond to comments by the OEPA relative to the FPU; and (4) to develop treatment facilities which would serve the city's needs through the year 2015.

1.2 PURPOSE AND NEED FOR PROJECT

As with most major metropolitan areas, Columbus has experienced a wide range of air, water, and land pollution control problems. Columbus is increasingly looking toward its natural resources for recreation and an improved quality of life. One area of concern to citizens and local officials is the resolution of environmental problems relating to wastewater management. The most significant concern centers on water quality.

The quality of the Scioto River is impacted by the effluent from the two treatment plants and combined sewer overflows (CSO). Currently, the effluent from Jackson Pike and Southerly does not meet ammonia and BOD standards set by their respective National Pollutant Discharge Elimination System (NPDES) permits. In addition, during periods of wet weather (high groundwater resulting from rain or snow melt) clear water enters the sanitary system and is conveyed to the treatment plant. The Jackson Pike and Southerly WWTPs are unable to treat the increased flow and bypass it directly to the Scioto River.

In order to reduce the overloading of the system, overflow points were established in the combined sewer area where both sanitary and stormwater are collected in the same pipe. During periods of wet weather these combined sewer overflows discharge untreated wastewater directly to the Scioto River. According to the 1979 EIS, this can occur up to 50 times a year.

Finally, the most significant need for action relates to the Clean Water Act which currently mandates that all wastewater treatment facilities be in compliance with NPDES permit limits by July 1, 1988.

1.3 DECISION TO PREPARE A SUPPLEMENTAL EIS

USEPA is required to prepare a supplemental EIS in accordance with 40 CFR 1502.9(c) which states:

(c) Agencies
(1) Shall prepare supplements to either draft or final environmental impact statements if:

(i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or

(ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

(2) May also prepare supplements when the agency determines that the purposes of the Act will be furthered by doing so.

(3) Shall adopt procedures for introducing a supplement into its formal administrative record, if such a record exists.

(4) Shall prepare, circulate, and file a supplement in the same fashion (exclusive of scoping) as a draft and final statement unless alternative procedures are approved by the Council.

Given that the Columbus project involved 1) substantial changes in the proposed action and possible significant environmental impacts associated with those changes; and 2) new information which raises substantial concerns not addressed in the original EIS, it was reasonable and prudent for USEPA to proceed with the preparation of a supplemental EIS.

Federal funding for wastewater treatment projects is provided under Title II of the Federal Water Pollution Control Act. The dispersal of Federal funds to local applicants or communities is made via the Municipal Wastewater Treatment Works Construction Grants Program administered by USEPA. If a community chooses to construct a wastewater collection and treatment system with USEPA grant assistance, the project must meet all applicable requirements of the Grants Program. The Clean Water Act (CWA) stresses that the most cost-effective alternative is the one that will result in minimum total resource costs over the life of the project, as well as meet federal, state, and local requirements. Nonmonetary costs also must be considered, including social and environmental factors. The analysis for choosing the cost-effective alternative is based on both capital costs and operation and maintenance costs for a 20-year period. Selection of the most cost-effective alternative must also consider social and environmental implications of the alternative. An alternative with higher monetary costs but lesser social and environmental impacts may be selected over an alternative that has low monetary costs but undesirable environmental impacts.

1.4 DESCRIPTION OF THE GRANT APPLICANT'S PROPOSED ACTION

The proposal by the applicant, the city of Columbus, for wastewater treatment was submitted as the 1985 Revised Facilities Plan Update (RFPU) and includes the following major elements:

- The Jackson Pike Wastewater Treatment Plant (WWTP) would be phased out of service by 1993, with flows transported to the Southerly WWTP through the completion of the existing Interconnector Sewer.
- The Southerly Wastewater Treatment Plant would be enlarged to treat all wastewater flow from the service area until the year 2015.
- The design average wastewater flow is 178 MGD with a peak process flow of 300 MGD. Wastewater flows in excess of 300 MGD would be settled and chlorinated prior to discharge. Peak flow of up to 430 MGD may be generated from a CSO control program.
- The proposed treatment facilities would use a semi-aerobic process.
- The disposal of solids would be through composting and land application, with incineration as a back-up.

The RFPU proposes to divert wastewater flows from Jackson Pike to Southerly via completion of the north end of the Interconnector Sewer and modification at the south end. They also propose to abandon the existing pump station and force main at the south end of the Interconnector and replace them with a 156-inch diameter gravity interceptor to the Southerly WWTP. The gravity crossing of the Scioto River would consist of four 78-inch parallel lines placed beneath the river bed.

The 1985 RFPU recommends that the Jackson Pike Wastewater Treatment Plant be abandoned in the early 1990's and wastewater flows be conveyed to an expanded and upgraded Southerly plant for treatment and discharge.

The RFPU states that combined sewer overflow control is not warranted based upon water quality modeling and sampling results. As required in the NPDES Permit, the city intends to continue to monitor overflows.

The RFPU also proposes abandoning the existing headworks at Southerly and replacing it with a new headworks designed for a peak hydraulic flow of 430 MGD and peak process flow of 300 MGD.

Composting and land application are proposed as the primary methods of solids disposal although incineration facilities would be maintained for contingency puposes.

1.5 ISSUES

During the review of the Revised Facilities Plan Update, a number of possible significant environmental impacts were identified. These issues were the subject of USEPA's action to issue a Notice of Intent (June 11, 1986). The environmental impacts that were identified include:

- Impacts expected from the fulfillment of the population projections and development for the planning area.
- The reliability of the Southerly WWTP needs to be evaluated in the EIS process. (The ability of Southerly to meet its NPDES limits was a major concern in the original EIS due to the unique problems it has experienced from the Anheuser-Busch (AB) BOD loadings). An analysis needs to be done to verify the reliability of the currently proposed treatment process to effective meet NPDES limits.

- The concerns about the water quality and stream use impacts related to a one-plant discharge and other upstream and downstream impacts.
- The alternatives for environmentally acceptable sludge treatment and disposal.
- The induced growth and secondary environmental effects of an expanded Southerly WWTP.
- The cost-effective treatment of combined sewer overflow as an integral part of the system.

The RFPU covered a 30-year planning period (1985-2015), however, federal regulations require a USEPA review and cost-effective decision based upon a 20-year planning period. Within the city's 30-year planning period, four phases were contemplated.

Phase 1: Upgrade Jackson Pike and Southerly treatment plants in order to meet Clean Water Act requirements of permit compliance by July 1, 1988. These components are detailed in the Municipal Compliance Plan with a construction schedule. The proposed improvements were estimated to cost $147,241,718. A list of these improvements is provided below.

Southerly WWTP	Jackson Pike WWTP
Sitework	Aeration Tanks
Preaeration	Chlorine Tanks
Primary Settling	
Aeration Tanks	
Secondary Settling	**Interconnector**
Effluent Filters*	
Chlorine Tanks	Interconnector (North Segment)
Dilution Water Pumps	
Gravity Thickeners	
Dewatering Centrifuges	
Sludge Cake Storage	
Lime Stabilization	
Primary Electrical Dist.	
I&C	

* deleted from the plan

Phase 2: The improvements required during this phase are needed to stay in compliance. The city's recommendation calls for abandoning Jackson Pike with its replacement of capacity at Southerly by 1993.

Phase 3: This phase addresses facilities and sizing to accommodate combined sewer overflows.

Phase 4: If population projections increase as expected, additional capacity and interceptors will be needed at Southerly beginning in 2000. This phase addresses facilities needed for this growth.

USEPA has prepared this SEIS based on facilities that existed as of 1985. This base was used since the completed NEPA review in 1979 recommends different conclusions than the 1985 Revised Facilities Plan Update. The planning period used is 1988 - 2008. The USEPA review was conducted as it would have been had the city sought Federal review and compliance with NEPA prior to undertaking the construction in 1986. Although the city was required to attain NPDES permit limits by 1988, that requirement does not change the base for analysis under the Construction Grants Program.

This SEIS will not refer to the Columbus project phases since the city has not completed facilities planning for their Phases 3 and 4, but will emphasize the facilities required for a 20-year solution of wastewater treatment needs. With this as a given the scope of this SEIS was limited to the 20-year needs of the Columbus FPA without design for CSO capacity or future interceptors. USEPA's analysis determined the cost-effective alternative for treating dry weather flows to identify potential grant awards consistent with the proposed facilities.

During the development of this SEIS including data gathering on the facilities plan update, USEPA has funded two grant requests which were consistent with the 1979 EIS. Both of these actions were reaffirmations which determined that those facilities were consistent with the cost-effective two-plant alternative as identified by the 1979 EIS. These actions approved: 1) construction at Southerly of 3000 feet of interceptor sewer (north end Interconnector) between the existing Jackson Pike and Southerly treatment plants, along with construction at Southerly of chlorine contact tanks, dechlorination, and post aeration facilities (1986); and 2) rehabilitation at

Southerly of the existing grit removal and primary settling tanks, new final clarifiers, instrumentation and control for both the final clarifiers and existing aeration tanks, and necessary site restoration (1987).

1.6 EIS PROCESS AND PUBLIC PARTICIPATION

On July 22, 1986, the USEPA held two sessions of the Scoping Meeting in Columbus after the decision to prepare a supplemental EIS was announced in the Notice of Intent of June 11, 1986. The Scoping Meeting, which was advertised to the general public and public officials, was held to gather public input in developing the scope of issues to be addressed in the SEIS. The scope of the SEIS included the issues in the Notice of Intent and those raised at the scoping meeting.

The draft SEIS was issued on January 22, 1988. It is comprised of two volumes; one contains the SEIS, and the second includes the appendices. A Public Hearing was held in Columbus at City Hall on February 16, 1988. Two sessions were convened by USEPA at 1:00 p.m. and 7:00 p.m. to receive public comment. The analysis and conclusions of the SEIS were summarized in a brief presentation. The following major issues were raised by those commenting on the draft document:

- **Annexation**

  Commentors, both at the Public Hearing and in writing, questioned whether USEPA could require the city of Columbus to provide service without annexation in light of the 1979 EIS and the federally funded Blacklick Interceptor.

- **Service Area**

  Several commentors requested additional clarification on the service area for the recommended treatment facilities. Two local governments requested that USEPA review the situation as it relates to the Blacklick Interceptor which passes near and presents a cost-effective opportunity for them.

- Odor

  One commentor at the Public Hearing questioned to what extent the city of Columbus is committed to controlling odors and if the city plans to incorporate state-of-the-art controls and containment.

- Process Design

  - Average Wastewater Flows and Loads
    The city commented that they do not agree with flows and loads presented in the draft SEIS.

  - Peak Wastewater Flows/Peaking Factor
    The city recommended that the peak flow should be larger than that presented in the SEIS. They believe the difference is based on the peaking factor.

  - Nitrification
    The city commented that they do not feel the SEIS recommendation provides adequate aeration capacity for nitrification. They also provided revised nitrification data for review.

- Water Quality

  Numerous questions were raised on the discussions in the draft SEIS on water quality. Previous water quality modeling efforts have been interpreted differently by some commentors who believe the one-plant alternative has advantages over the two-plant alternative.

Following the close of the 45-day comment period, this Final SEIS was prepared which incorporates the results of the public input on the Draft SEIS. The individuals and organizations on the mailing lists, any additional requestors, and those who comment on the SEIS will receive copies. After a 30-day comment period following publication of the Final SEIS, USEPA will issue a Record of Decision (ROD) identifying the cost-effective environmentally sound alternative for the Columbus FPA. This ROD will then form the basis for any funding decisions by the USEPA.

This Final SEIS presents textual changes in highlighted or boldface text. A Chapter 8 which responds specifically to all comments on the Draft SEIS has been added. Also, Chapter 9 has been added which includes revised pages to the appendix as needed to respond to comments. The entire appendix of this SEIS was not reprinted.

CHAPTER 2. ENVIRONMENTAL SETTING

The environmental setting, for purposes of description and analysis, can be defined as the natural environment and the man-made environment. The natural environment includes the land and underlying geologic structure; the air, water, and mineral resources; and the naturally occurring vegetation and animal life. The man-made environment includes the structures man has built for shelter, transportation, industry, commerce, and recreation. In describing the man-made environment, certain characteristics are important such as: land use patterns, demographic and economic characteristics, the exploitation of natural resources, and the degradation of air and water quality that has been encouraged by technology, urbanization, and an agressive attitude toward the natural environment. The presentation of land use patterns and demongraphic characteristics are presented in Chapter 4 as design criteria. The following discussions present more of the conditions of the environment at the onset of this review.

2.1 NATURAL ENVIRONMENT

Located in central Ohio, the study area includes the city of Columbus, Ohio; most of the 552 square mile area of Franklin County, including numerous satellite communities; and a portion of Delaware County near the Hoover reservoir. Columbus, the capital of Ohio and a major commercial and industrial center, is located in the central portion of the county. This urban area accounts for 20 percent of Franklin County and contains over one-half of the Scioto River Basin population. The remaining, primarily rural, land is utilized mainly for agriculture, including the grazing of cattle.

In this section, the following characteristics are described:

- Atmosphere
- Water
- Land
- Biota.

2.1.1 Atmosphere

2.1.1.1 Climate

The climate of Franklin County may be characterized as continental. The region is subject to invasions of continental, polar air masses from central and northwest Canada during winter, and tropical, Gulf air masses in summer and occasionally in fall and winter. Precipitation is abundant, about 37 inches, and is distributed rather evenly throughout the year. The maximum monthly precipitation total was 10.7 inches and the greatest 24-hour rainfall rate was 4.8 inches. The snow season lasts from December through February, with 5 to 7 inches falling during each of these months. Annual snowfall totals average 28 inches, but have varied from 5 to 47 inches. The maximum amount to fall in one month was 29 inches.

Winds, for the most part, are from the south-southwest at 9 mph, with a high frequency of calms or low wind speeds. Wind direction frequency varies considerably throughout the year, as evidenced by the frequently changing weather patterns. Damaging winds and local flooding sometimes occur during thundershowers. An average of 42 thunderstorms occur during the year, most frequently during the late spring and summer months. Additional climate data is provided in Table 2-1.

2.1.1.2 Air Quality

The city of Columbus lies within the Metropolitan Columbus Intrastate Air Quality Control Region (AQCR) as designated by USEPA. The region is subject to National Ambient Air Quality Standards (NAAQS) and to standards imposed by the State of Ohio Environmental Protection Agency (Ohio EPA has designated standards identical to the NAAQS). These standards are listed in Table 2-2.

Areas where the NAAQS are not being attained are designated non-attainment areas. In such areas, the State is required to develop permit requirements which will bring the area into compliance with the NAAQS. Specifically, new or modified sources locating in these regions must obtain a high degree of emission control and obtain emission reductions, offsets, or tradeoffs for problem pollutants. Currently, portions of Columbus are designated non-attainment for total suspended particulates.

TABLE 2-1. SELECTED CLIMATOLOGICAL DATA FOR COLUMBUS, OHIO

Month (Yrs. in Record)	Precipitation in Inches: Water Equivalent: Normal (97)	Water Equivalent: Maximum Monthly (36)	Water Equivalent: Minimum Monthly (36)	Water Equivalent: Maximum in 24 hrs. (28)	Snow, Ice Pellets: Normal (29)	Snow, Ice Pellets: Maximum Monthly (28)	Snow, Ice Pellets: Maximum in 24 Hrs. (28)	Wind: Mean Wind Speed M.P.H. (26)	Wind: Prevailing Direction (14)	# of days: Thunder-storms (36)
J	2.87	8.29	0.53	4.81	7.0	18.4	7.2	10.3	SSW	<0.5
F	2.32	4.33	0.38	2.15	5.9	15.6	8.9	10.5	NW	1
M	3.44	9.59	0.61	3.40	5.2	13.5	8.6	10.8	SSW	2
A	3.71	6.36	0.67	2.37	0.8	7.1	6.3	10.2	WNW	4
M	4.10	9.11	1.61	2.72	<0.1	<0.1	<0.1	8.6	S	7
J	4.13	9.75	1.25	2.93	0.0	0.0	0.0	7.5	SSW	8
J	4.21	9.46	0.48	3.82	0.0	0.0	0.0	6.7	SSW	8
A	2.86	7.96	0.58	3.79	0.0	0.0	0.0	6.4	NNW	6
S	2.41	6.18	0.51	2.02	<0.1	<0.1	<0.1	6.8	S	3
O	1.89	5.24	0.11	1.87	0.1	1.3	1.3	7.6	S	1
N	2.68	5.40	0.80	2.05	2.8	15.2	8.2	9.5	S	1
D	2.39	5.07	0.46	1.63	5.9	17.3	8.7	9.8	W	<0.5
YR	37.01	9.75	0.11	4.81	27.7	18.4	8.9	8.7	SSW	42

Notes:

Annual extremes have been exceeded at other sites in the locality as follows: maximum monthly precipitation 10.71 inches in January 1937; minimum monthly precipitaion 0.10 inches in October 1924; maximum monthly snowfall 29.2 inches in February 1910. Information extracted from data compiled by the National Climatic Center.

TABLE 2-2. USEPA AND OHIO EPA AMBIENT AIR QUALITY STANDARDS*

Pollutant	Duration	Restriction	Maximum Allowable Concentrations** Primary	Secondary
Total Suspended Particulates	Annual geometric mean	Not to be exceeded	75 $\mu g/m^3$	60 $\mu g/m^3$***
	24-hour concentration	Not to be exceeded more than once per year	260 $\mu g/m^3$	150 $\mu g/m^3$
Sulfur Dioxide	Annual arithmetic mean	Not to be exceeded	80 $\mu g/m^3$ (0.03 ppm)	
	24-hour arithmetic mean concentration	Not to be exceeded more once per year	365 $\mu g/m^3$ (0.14 ppm)	
	3-hour arithmetic mean concentartion	Not to be exceeded more than once per year		1300 $\mu g/m^3$ (0.5 ppm)
Carbon Monoxide	8-hour arithmetic mean concentration	Not to be exceeded more than once per year	10 mg/m^3 (9.0 ppm)	
	1-hour mean concentration	Not to be exceeded more than once per year	40 mg/m^3 (35.0 ppm)	
Ozone	1-hour mean concentration	Not to be exceeded on more than one day per year, average over three years	0.12 ppm (244 $\mu g/m^3$)	
Nitrogen Dixoide	Annual arithmetic mean	Not to be exceeded	0.53 ppm 100 $\mu g/m^3$)	
Lead	3-month arithmetic mean concentration	Not to be exceeded	1.5 $\mu g/m^3$	

Notes:

Primary standards are established for the protection of public health
Secondary standards are established for the protection of public welfare

*USEPA and Ohio EPA Air Quality Standards are identical
**400 CFR 50.4 - 50.12
***Air Quality Guidelines

$\mu g/m^3$ = micrograms per cubic meter
ppm = parts per million
mg/m^3 = milligrams per cubic meter

The Ohio EPA has established numerous air quality monitoring stations throughout the State. Within the Columbus AQCR, the following pollutants are monitored: TSP at 16 sites, PM-10 (particulate matter of less than 10 micron diameter) at one site, lead at two sites, sulfate at one site, sulfur dioxide at six sites, oxides of nitrogen at one site, carbon dioxide at three sites, and ozone at three sites. Data for sites in and around Franklin County are summarized in Table 2-3.

2.1.1.3 Odors

Southern areas of Franklin County have been plagued by ambient odors for many years. The 1979 EIS noted that one positive impact of the proposed project would be the reduction of odors that plagued the Jackson Pike and Southerly WWTPs. To date, many odor complaints have still been made to local, State, and Federal agencies. It appears that the main cause of odor in the area is the Southwesterly Composting Facility.

Southwesterly Composting was first put into service in August 1980. The first known registered complaint was filed in January of 1981. A subsequent study by Ohio EPA confirmed that "...objectionable odors are frequently emitted from the facility" (Ohio EPA 1981). In particular, the process of sludge mixing and breaking of an incompletely composted pile were felt at that time to be the operational causes of the objectionable odors. In addition, it has been stated by several individuals that the type of odor is easily distinguishable, e.g., a septic sewage odor is attributed to the primary clarifiers and/or anaerobic digestors at the Southerly Waste Water Treatment Plant (WWTP); a burnt ash sewage odor is attributable to the incinerators at Southerly WWTP; and finally, an earthy sewage odor is attributable to the Southwesterly Composting Facility (McCarthy 1986). Similar descriptions have been offered by Maxwell (1986) and Bonk (1986).

2.1.2 Water

2.1.2.1 Hydrology

The two wastewater treatment plants (WWTPs) that are the subject of this environmental review (Jackson Pike and Southerly) are located on the Scioto

TABLE 2-3. AIR QUALITY DATA FOR THE FRANKLIN COUNTY LOCAL AREA

Pollutant (Units) Avg. Time	Year	Columbus	Franklin Co.	Grandview Heights	Grove City
TSP (ug/m3) Annual	1985	57	34.6	45.8	38.6
	1984	71.7	41.8	48.9	41.8
	1983	67.9	41.1	48.7	39.8
TSP (ug/m3) 24-Hr	1985	184	93	116	93
	1984	209	104	127	99
	1983	229	127	154	120
SO2 (ug/m3) Annual	1985	37.3	20.1		
	1984	64.3	18.1		
	1983	40.4			
SO2 (ug/m3) 24-Hr	1985	170	90		
	1984	260	71		
	1983	224			
SO2 (ug/m3) 3-Hr	1985	339	190		
	1984	572	193		
	1983	828			
CO (mg/m3) 1-Hr	1985	12.6			
	1984	16.1			
	1983	18.4			
CO (mg/m3) 8-Hr	1985	7.2			
	1984	10.2			
	1983	9.8			
NOx (ug/m3) Annual	1985	46.7			
	1984	44.4			
	1983	42.8			
OZONE (ug/m3) 1-Hr	1985	225			
	1984	212			
	1983	231			
LEAD (ug/m3) 3-Mo	1985	0.35			
	1984	0.62			
	1983	0.57			

The maximum values of several downtown sites has been reported.

River. The Scioto River is a major tributary of the Ohio River, originating in northwestern Ohio (west of Kenton) and flowing 135 miles southeast to the Ohio River at Portsmouth. The river basin drains 6,510 square miles in 31 counties of central and southern Ohio.

The study area in Franklin and Pickaway Counties, is part of the Central Scioto River Basin. This basin is located on a flat glacial till plain with the mainstem flowing from north to south and its tributaries following well-defined gorges. The Scioto River enters Columbus from the northwest, joins with the Olentangy River within the City, and then flows south. To contain erosion and flooding, the river channel within Columbus has been modified, reinforced with concrete, and bounded by levees.

North of Columbus, the Scioto River is somewhat incised, with a substrate alternating between exposed limestone bedrock and largely silt/muck deposits. However, south of the city, the river valley is broad and poorly defined, flowing over a buried valley filled with glacial outwash material (mostly coarse sand and gravel). In this area, the channel is typical of a large compound river, exhibiting meanders and riffle-pool sequences. Flooding in this area covers extensive areas of the floodplain (OEPA 1983).

There are two major Scioto River tributaries in the study area. They are the Olentangy River (543 square miles) entering roughly five miles upstream of the Jackson Pike WWTP, and Big Walnut Creek (557 square miles) entering about one mile downstream of the Southerly WWTP.

The major tributaries affecting the water quality of the Scioto River between Columbus and Circleville are the Olentangy River (confluence at RM 132.2); Big Walnut Creek (confluence at RM 117.2), with its tributaries Alum Creek and Blacklick Creek; Walnut Creek (confluence at RM 102.1); and Big Darby Creek (confluence at RM 100.8). Flow summaries and water quality characterizations for these Scioto River tributaries are provided in the following discussions. These discussions are excerpted from the most recent 305(b) reports (biennial water quality reports prepared by the individual States).

- Olentangy River

The Olentangy is crucial to the Scioto River because it provides the only guaranteed release below Griggs Reservoir, and thus during critical low flow periods may be the only source of dilution to the Jackson Pike WWTP. A minimum flow of 5 cfs is required leaving Delaware Reservoir above the town of Delaware, but flow almost always exceeds this minimum. Low flow into the Scioto from the Olentangy usually exceeds 19 cfs and almost never drops below 10 cfs. Effluent from the Delaware WWTP enters the Olentangy River, at RM 24.8, and affects water quality for a short distance downstream. However, this does not significantly degrade water quality at the confluence with the Scioto River. Nevertheless, water quality in the lower 10 miles of the Olentangy is rated FAIR (OEPA 1986b) and the last half-mile before entering the Scioto received a POOR rating. The ratings are based on low faunal diversity indices and violations of fecal coliform, iron, and lead water quality standards. Combined sewer overflows and urban runoff from Columbus have been noted as the major causes of the poor water quality. Dissolved oxygen usually exceeds 7.0 mg/l, but the Columbus Consolidated Environmental Information Document (URS Dalton 1986) reports violations of DO standards (5.0 mg/l) during low flow conditions. Elevated nitrate levels have also been reported and may contribute to the DO problem.

- Big Walnut Creek

The water quality of the lower segment of this creek, before it enters the Scioto, was not rated in the 305(b) report. The two main tributaries into this creek, Blacklick and Alum Creeks, both have water quality problems. Blacklick Creek is given a FAIR rating due to serious violations of water quality standards for dissolved oxygen, ammonia, and fecal coliform. Blacklick Estates WWTP is currently the major source of degradation, although the Reynoldsburg WWTP also discharged into this creek in the past. Alum Creek is given a GOOD rating, but the lower portion (below the two reservoirs) is subject to urban point source and nonpoint source pollution, as is Big Walnut Creek downstream of the Alum Creek confluence. Sporadic dissolved oxygen and total iron WQS violations have been reported in these areas, but data are insufficient to assess overall water quality.

- Walnut Creek

Although the upper reaches of Walnut Creek have exhibited some water quality problems, due to effluents from Crown Zellerbach and the Baltimore WWTP, the lower 24.3 mile section leading to the confluence with the Scioto River is rated GOOD in the 305(b) report. Fish and macroinvertebrate community indices reflected good water quality, with a possible decline reflected in the macroinvertebrates downstream of RM 5.5. This decline may have been due to the effects of organic enrichment from nonpoint source runoff from agricultural lands. The CWQR (OEPA 1986a) reports violations of total iron water quality standards near the mouth of Walnut Creek, which could also reflect agricultural runoff (iron bound to eroded soil). The reported dissolved oxygen concentrations always exceeded 5.0 mg/l.

- Big Barby Creek

  This tributary is characterized as having exceptional water quality in the 30-mile segment upstream of its confluence with the Scioto River (OEPA 1986B). Concentrations of nitrogen compounds, total phosphorus, and BOD were relatively low and not indicative of problems. Heavy metals concentrations were indicative of point and nonpoint sources but did not reflect severe loadings problems. Dissolved oxygen concentrations generally were high.

The Olentangy River floodplain is narrow, with an average width of about 1,500 feet. The river flows through a gorge section, from north of Worthington upstream to Delaware, Ohio. It has an average slope of 6.2 feet per mile.

The river stretch in that portion of the study area north of the Jackson Pike WWTP is interrupted by two major impoundments, three low head dams on the Scioto River, and one impoundment on the Olentangy River. These structures supply Columbus with drinking water sources, flood control, and recreational sites. They are discussed below in upstream-to-downstream order.

- O'Shaughnessy Reservoir was built in 1924 **and upgraded in 1987 to include an electric power plant that has a maximum generating capacity of five megawatts and requires 1,380,000 cubic feet per second to generate maximum power. This plant generates auxiliary power and is not expected to alter the river's water quality.** The area of the seven-mile-long pool is 829 acres. The concrete spillway is 70 feet high and 1,005 feet long. The dam is located at RM 148.8.

- The Julian Griggs Reservoir was built in 1905 for water supply. The six-mile-long reservoir is also pipular for power boating and a park and marina exist along the shoreline. The concrete ogee dam is 33 feet high and 500 feet long. It is located at RM 138.8.

- The Dublin Road Water Treatment Plant withdraws water from behind a low head dam about 17.7 feet high by 310 feet long. The dam is at RM 133.4. **(This plant is considered to be part of the Griggs Reservoir.)**

- The Delaware Reservoir is located on the Olentangy River. Completed in 1951, the reservoir primarily serves as flood control although the conservation pool is operated to provide five cubic feet per second during low flow conditions to preserve downstream water supply and pollution abatement uses. The Olentangy River joins the Scioto at RM 132.3.

- The Main Street Dam is a low head dam 15.7 feet high and 545 feet wide. It creates a pool for a downtown park. The pool is not used to control releases downstream. The dam is at RM 131 (OEPA 1983).

- The Greenlawn Avenue Dam, like the Main Street Dam, is not used for water conservation. It is a low head dam 11 feet high, 422 feet wide and is located at RM 129.6.

The flow regime of the Scioto River can be characterized by river discharge data taken at United States Geological Survey (USGS) gaging stations. However, in analyzing this data for current river discharges, the period of record considered must recognize the effect of flood control and water supply impoundments, the most recent of which is the Delaware Dam (constructed in 1951). These impoundments have a moderating effect during flood conditions reducing peak downstream discharges. During low flow conditions, water supply withdrawals have occasionally resulted in no discharge passing the Dublin Dam; Scioto River flows downstream are then supplied solely by Delaware Dam releases on the Olentangy River.

The primary source of river flows is from precipitation with the greatest amount of precipitation occurring from February to July and the least amount from August to January. Previous studies indicate a certain amount of groundwater inflow to the river during low flow periods (OEPA 1983).

Of the water bodies in the study area, low flow conditions are the most critical on the Scioto River. Columbus is authorized, by a 1913 statute, to divert all flows of the Scioto River for the purpose of maintaining the public water supply. Since the Griggs Reservoir and the Dublin Dam were designed for public water supply, this statutory authority has resulted in occasional "no flow" conditions over the Dublin Dam. The only assured water sources during low flow periods are from the Delaware Reservoir and the two WWTPs.

The Corps of Engineers has guaranteed a minimum release of 5 cfs from the Delaware Reservoir, to preserve water supply and water quality uses making the Olentangy the principal source of dilution water for the Columbus WWTPs under extreme low flow conditions. The Jackson Pike WWTP can contribute as much as 98 MGD (85 MGD on average) of discharge to the Scioto River Study area, which represents 90 to 95 percent of the extreme low flow discharge in the river stretch between the two WWTPs. Downstream of Southerly WWTP, Big Walnut Creek and other tributaries provide additional water inflow.

According to the Federal Emergency Management Agency's (FEMA) Flood Insurance Study for Franklin County and the City of Columbus, the floodplain of the Scioto River can be divided into two fairly distinct topographic subdivisions: a gorge section, with narrow valleys, from the Delaware County line to approximately Interstate Highway 670 (crossing just north of Valleyview); and an alluvial section with wide floodplains and rolling uplands, from the Interstate Highway 670 crossing downstream to the Pickaway County line. Floodplain development along the Scioto River is extensive, varying from residential to industrial.

The Olentangy River flows south through Franklin County and joins the Scioto River near the southeasterly corporate limits of Grandview Heights, within the Columbus metropolitan area. The land along the Olentangy River floodplain is mostly open area and farm land in the upper reaches of Franklin County. However, the lower several miles of the river, from Worthington to the mouth, are mainly developed. Major transportation arteries, with their associated bridges and interchanges, lie adjacent to the stream. Many industrial and research facilities, several wholesale and retail distribution centers and several park areas adjoin the Olentangy in the lower reaches. Very little land adjacent to the stream along the lower three miles is available for future development.

The history of flooding along the Scioto River, and particularly along the Olentangy River, indicates that a major flood can occur during any season. However, the majority of floods have occurred during the period from January to March and have usually been the result of spring rains and/or rapid snowmelt. The worst floods of this century occurred on March 25, 1913; in January 1952; and on January 21-22, 1959.

In response to the flood of 1913, flood protection measures were implemented. The Scioto River channel improvement project widened the channel, constructed levees and revetments, and increased bridge spans. After the 1959 flood, Dry Run levee was raised and strengthened, and a levee was constructed along Dublin Road. In 1951, Olentangy River flows were regulated, for the first time, by the Delaware Dam and Lake Project. Although the areas along the Scioto River protected by levees would probably be safe from minor flooding events, the extent of major flooding events, such as the 100-year flood, would be unlimited, as if the levees were not present.

2.1.2.2 Groundwater

Groundwater quality analyses are available from the USGS and the Ohio Department of Health for inorganic chemical characteristics, but organic analysis data are limited. In 1985, the Ohio EPA began testing the ground water quality of four large radial wells used to provide the City of Columbus with roughly 10 percent of its drinking water supply. In 1987, a regular program of testing these four wells is expected to begin (Button 1986).

2.1.2.3 Surface Water Quality

The Scioto River from O'Shaughnessy Reservoir (RM 148.8) to Chillicothe, Ohio (RM 70.7) is a moderately polluted, turbid, warm water stream fed by several tributaries of similar or better quality. The most significant water quality impact is observed below the two Columbus wastewater treatment plants, at river miles (RM) 127.1 and 118.4. Previous studies (1980-1982) have described degraded conditions measured in chemical/physical water quality parameters and biological indices, below the two treatment plants. Despite continued improvement over the past two decades, a substantial part of the river between Columbus and Circleville does not yet meet the goals of the Clean Water Act. Less severe problems occur downstream from Circleville and upstream from Griggs Dam (RM 138.8) and in the Olentangy and Scioto Rivers adjacent to Columbus. The problems in Griggs Reservoir and in the Olentangy are primarily due to runoff and/or combined sewer overflow (CSO).

In the Scioto River, low levels of dissolved oxygen have historically been the greatest problem associated with the two wastewater plant discharges (Jackson Pike and Southerly). Improvements made in these treatment facilities in the last 20 years have contributed to improvements in water quality downstream. The most noted water quality improvement has been increased dissolved oxygen levels. Appendix G presents graphs of STORET data for DO, BOD_5, and NH_3+NH_4^--N (ammonia) from 1971 to 1986 at six stations between the Jackson Pike WWTP and Circleville. Regressions on each graph (dashed line) indicate a general trend of improving conditions (increasing DO, decreasing BOD_5 and decreasing ammonia) over the referenced time period.

Flow records from a USGS station just downstream from the Jackson Pike wastewater treatment plant indicate wide fluctuations in flow, with a minimum of 47 cfs and a maximum of 68,200 cfs during the period from October, 1920 through September, 1985 (Shindel, et al. 1986). The impact of wastewater treatment facilities on water quality is highest during periods of critical low flow.

The O'Shaughnessy and Griggs Reservoirs, upstream from Columbus, are a source of drinking water for the City. As Columbus is authorized to divert the entire flow of the Scioto River for public water supply, during periods of critical low flow there may be little or no water flowing over the dam at the Dublin Road water treatment plant (RM 133). Under these flow conditions, the Scioto River relies upon its confluence with the Olentangy River (RM 132.3) to replenish its flow, at a minimum of 5 cfs (regulated at Delaware Dam). During critical low flow periods, the input from the Olentangy provides the only upstream dilution to the Jackson Pike WWTP (RM 127.1).

The Scioto River between Columbus and Circleville is greatly affected by wastewater discharge from the city of Columbus. The combined discharge from the two Columbus wastewater treatment plants (Jackson Pike at RM 127.7 and Southerly at RM 118.4) constitutes up to 95 percent of the total discharge of the river during low flow periods. The effects of point and nonpoint pollution sources on Scioto River water quality have been demonstrated in the CWQR (OEPA 1986a), based on instream chemical and physical data from 1980-1982. The most notable negative impacts occurred downstream from the Jackson Pike WWTP. Dissolved oxygen (DO), BOD_5, total Kjeldahl nitrogen (TKN), nitrate (NO_3-N), total phosphorus (P-T), and total zinc (Zn-T) concentrations reflected heavy loadings of domestic and commercial/industrial pollutants.

Dissolved oxygen (DO) is reported to exhibit the classic decline and recovery downstream from both the Jackson Pike and Southerly WWTPs (OEPA 1986a). However, the data presented in the CWQR do not support this observation. Instead, these data suggest a steady decline in DO downstream from Jackson Pike, with recovery beginning at least 10 miles downstream from Southerly and continuing to Chillicothe (RM 70.9). At times, DO concentrations drop at Circleville (RM 102.1). There may be a slight increase in DO at

RM 115.3, three miles downstream of the Southerly WWTP, probably reflecting the input from Big Walnut Creek at RM 117.2. Low dissolved oxygen levels are considered the overriding water quality problem in this portion of the Scioto River, although conditions have improved over the past two decades and are anticipated to continue improving. This improvement is the result of increasing DO and decreasing BOD_5 loading in the WWTP effluents. However, over the past 5 years (1980-1985), the occurrence of WQS violations for DO (i.e., concentration of less than 5 mg/l mean or less than 4 mg/l minimum) has not steadily declined, according to a frequency analysis of daytime DO data (OEPA 1986a).

Ammonia creates an oxygen demand, thereby lowering DO concentrations in receiving waters. On this basis, the CWQR attributes improved DO conditions in the Scioto, in part, to the significant reduction in ammonia loading from the two WWTPs over the past two decades. However, a frequency analysis of ammonia data between 1980 and 1985 reveals that there was not a substantial improvement in ammonia levels between 1980 and 1985 (OEPA 1986a). Concentrations exceeding 2.0 mg/l were not unusual downstream from the WWTPs and concentrations exceeding 1.0 mg/l were common (30-50 percent of the measurements).

The major input of ammonia is from the two WWTPs. A sharp increase in ammonia concentrations occurs just downstream of the Jackson Pike WWTP, followed by a gradual decline to the Southerly WWTP, where a small increase occurs, and then a progressive decline downstream to Circleville. Ammonia concentrations between Jackson Pike and Southerly often exceed 1.0 mg/l and annual maxima may exceed 3.0 mg/l. Downstream of Circleville, concentrations are usually between 0.2 mg/l and 1.0 mg/l.

Upstream of the WWTPs, ammonia concentrations remain less than 1.0 mg/l and often fall to less than 0.2 mg/l. The major source of ammonia in that portion of the river is runoff and CSO outfalls to the Olentangy and the Scioto mainstems.

Ammonia is one of several nitrogen species which exert a DO demand. Total Kjeldahl nitrogen (TKN) is often used as a measure of collective DO demand due to nitrogen. TKN concentrations in the Scioto follow the same general distributional pattern as ammonia, with the two WWTPs providing the major inflow.

Nitrate nitrogen (NO_3-N) concentrations reflect both point and nonpoint sources. Upstream from Griggs Dam, both the Griggs Reservoir and the O'Shaughnessy Reservoir are enriched with nitrogen, presumably from agricultural runoff. Concentrations in excess of 4.0 mg/l are not uncommon and violations of the WQS for drinking water (10.0 mg/l) have been reported. However, much of this water is withdrawn at the Dublin Road water treatment plant. Consequently, NO_3-N concentrations downstream of the waterworks dam (RM 133) are reduced due to the diluting effect of water entering from the Olentangy River, which exhibits lower nitrate levels (NO_3-N = 2.3 mg/l).

Downstream from Jackson Pike, ambient river nitrate concentrations rise markedly to concentrations of greater than 5 and even of up to 10 mg/l during periods of low flow. Nitrate concentrations steadily decline downstream from the initial increase caused by the Jackson Pike WWTP effluent. Wastewater input from the Southerly WWTP does not have a marked effect on ambient nitrate concentrations, although it may retard the rate of decline downstream. Nitrate contributions from the WWTPs have increased over the past several years due to improved nitrification practices adopted for the purpose of reducing ammonia levels in the effluent.

Total phosphorus (P-T) concentrations are almost exclusively related to point source input. The major contribution comes from the Jackson Pike WWTP where ambient river concentrations rise dramatically, usually in excess of 1.0 mg/l and often to greater than 2.0 mg/l. Downstream from the Jackson Pike WWTP spike, concentrations decline steadily but never drop quite as low as upstream levels.

The most commonly found heavy metals in the Scioto are zinc, lead, copper, and iron. Cadmium, chromium, and nickel are found less frequently. Total zinc (Zn-T) concentrations in the river are significant, however, zinc rarely exceeds the WQS (300 µg/l). The Zn-T distribution reflects the impact of the Jackson Pike WWTP and, to a lesser extent, urban nonpoint sources. Concentrations are at their maximum near Jackson Pike and decline progressively downstream.

Total lead (Pb-T) and iron (Fe-T) increase slightly in a downstream direction through the study area. Both reflect primarily nonpoint source input. Iron is associated with both agricultural and urban runoff and is strongly bound to suspended solids, while lead is associated primarily with urban runoff. WQS violations have been frequently reported for iron, but violations of the 30 µg/l WQS for Pb-T have been minimal. Total copper (Cu-T) distribution reflects inputs in the Columbus and Circleville areas, but in general the levels are fairly low.

Water Quality Ratings of River Segments

The 305(b) report lists six segments of the Scioto mainstem in the study area. They are rated as follows:

- O'Shaughnessy Dam to upstream from the Olentangy River confluence (RM 148.8-132.4) - GOOD: High nutrient loads but low algal density characterized this section. Other physical/chemical water quality parameters were good, and fish and macroinvertebrate indices reflected background conditions, although increasing stress was evidenced in Griggs Reservoir.

- Olentangy River confluence to Frank Road (RM 132.2-127.7) - FAIR: Both fish and macroinvertebrate communities reflected structural and sublethal stresses due mainly to contributions from urban nonpoint sources and combined sewer overflows, and the partially impounded nature of this segment causing elevated contaminant levels in trapped sediments.

- Frank Road to confluence of Walnut Creek (RM 127.7-106.1) - FAIR/GOOD: Most extensive chemical/physical and biological water quality degradation occurred in this segment, but rating has been upgraded from POOR to FAIR/GOOD because 1985 sampling revealed full or partial attainment of biological potential (based on species diversity indices) at several locations.

- Confluence of Walnut Creek to confluence of Big Darby Creek (RM 106.1-100.8) - GOOD: Good assemblage of fish and macroinvertebrates reflected near complete recovery of upstream impacts, with improvements continuing through 1985.

- Confluence of Big Darby Creek to near Delano (RM 100.8-78.3) - FAIR: Fish and macroinvertebrate communities improved over previous years. Slight stresses were still apparent, but diminished downstream. In 1981, there was judged to be a potential for impact from complex toxic substances downstream from Circleville. In 1984-1985, almost complete recovery of fish and macroinvertebrate communities was reported between RM 100.8 and 99.7.

- Near Delano to Bridge Street in Chillicothe (RM 78.3-70.7) - GOOD: Fish and macroinvertebrates typical of organically enriched warm-water river.

Surveys of fish and macroinvertebrate communities have been used as indices of water quality (OEPA 1986a; OEPA 1986b; Olive 1971). Diversity indices are most commonly used and serve as one basis for classifying water quality in the 305(b) report (OEPA 1986b). In both the CWQR (OEPA 1986a) and the 305(b) reports, improvements in species diversity were noted as indicative of improving water quality conditions in the Scioto River between Columbus and Circleville. These biotic changes were attributed to overall increases in DO, due to upgraded water treatment practices.

It was also noted in the CWQR that improved diversity has been accompanied by the reappearance of pollution-intolerant fish species (including several sport fish). However, an increase in external anomalies (e.g., lesions, fin erosion) has also been recorded. An attempt has been made to associate the anomalies with the effects of low oxygen on intolerant species, and the CWQR predicted that the incidence of anomalies will decrease as DO continues to increase. However, this prediction overlooks the potential effect of chemical contaminants, such as chlorine, heavy metals and various organic chemicals, to which external and internal anomalies are usually linked.

Fecal coliform bacteria are commonly used as raw sewage tracers. Over the past decade, there has been a general decline in fecal coliform concentrations in the segment of the Scioto River between the Jackson Pike WWTP and Circleville. However, this decrease is in large part attributed to increased chlorination at the WWTPs. Consequently, the fecal coliform count can no longer be reliably used as an indicator of raw sewage. Further, increased chlorine is a water quality concern which can have an impact on the river fauna (including, for example, external anomolies).

2.1.3 Land

2.1.3.1 Topography and Physiography

The Columbus planning area includes the city of Columbus, Ohio, most of Franklin County, and small adjacent portions of Delaware, Licking, Fairfield, and Pickaway Counties. The topography of the study area is characterized by level to rolling relief, with altitudes ranging from 1130 feet above sea level in the northeast to 665 feet above sea level along the southern border.

The major stream valleys in the northern portion of Franklin County run parallel to each other, converging towards the centrally located valley of the Scioto River. Tributaries of the Scioto River include the Olentangy River and Darby, Walnut, Blacklish, and Alum Creeks. The Scioto River gradient within the Facilities Planning Area (FPA) averages about 4.4 feet per mile.

2.1.3.2 Surficial and Bedrock Geology

The FPA is located within the glaciated till plain of Central Ohio (Goldthwait et al. 1961). The Till Plains section of the Central Lowlands physiographic province constitutes about four-fifths of Franklin County. Formed when preglacial features were buried by glacial deposits, the Till Plains are flat except in areas adjacent to streams. The remaining one-fifth of Franklin County is occupied by the Appalachian Plateau rising eastward near Big Walnut Creek from an escarpment of north-south scarps and terraces at an elevation of 800 feet. The general area was glaciated during at least two different glacial periods. Evidence of Illinoian glaciation has been found in the form of fine, well-sorted sands in buried valleys beneath the more recent Wisconsin age glacial till (SCS 1980a). Dominant soils formed in these deposits are Eldean, Ockley, Warsawy, and Wea soils.

The surface deposits in the FPA are mostly ground moraine. The landscape has an average of about 50 feet of till over bedrock. There are two distinct tills within the ground moraine. The northeastern third of the FPA consists of a medium-lime clay loam till that contains a high percentage of sandstone and coarse shale fragments from the underlying bedrock. The dominant soils formed here include Bennington, Cardington, and Pewamo soils. The southwestern two-thirds of the ground moraine consist of a high-lime till that contains a high percentage of limestone and coarse dolomite fragments from the underlying limestone bedrock. Among the soils formed in this ground moraine are Kokomo, Celina, and Crosby soils. There are three end moraines in the FPA: the London Moraine in the southwest corner, the Pickerington Moraine in the northeast corner, and the Powell Moraine in the extreme southwest corner.

The bedrock underlying the glacial deposits is sedimentary. It has a north-south strike and a dip of 20 to 30 feet per mile to the east. Ages range from lower Devonian in the west to lower Mississippian in the east of the FPA. Lithologies consist of dolomitic limestone, shale, and sandstone.

The Raisin River Formation, dolomitic limestone exposed in places in the valleys of Big and Little Darby Creeks, is the oldest member of the Devonian System in the FPA. The formations within the Devonian System to the east are younger and located above the Raisin River. These include the Columbus and Delaware Limestones and the Ohio and Olentangy Shales. The limestone is along the Scioto River Valley and the shale is along the northern Olentangy River Valley.

The Mississippian System is exposed in the valleys of Big Walnut and Rocky Fork Creeks. The formations include, from oldest to youngest, Bedford Shale, Berea Sandstone, Sunbury Shale, and Cuyahoga Sandstone. These formations occur as alternating beds of shale and sandstone.

The geologic formations that occur near the surface in the Scioto River Basin are of sedimentary origin. They are comprised of two general classes: (1) consolidated layers of sandstone and shale, and (2) unconsolidated deposits of clay, sand, and gravel. Sandstone formations may yield sizable quantities of water; however, the degree of cementation of the individual grains and the composition of the formation often deter the flow of water through the formation. Shale may temporarily store sizable quantities of water; however, water does not readily pass through it. Water in the glacial sand and gravel deposits occurs in the pore spaces; therefore, permeability, thickness, and regional extent of the water-bearing formation determine the quantity of water available.

Limestone bedrock is the principal source of underground water for the Mill Creek and Scioto River basins. The Silurian and Devonian carbonates underlie the entire basin at depths ranging from 1 to more than 220 feet. Industrial wells developed in these formations have reported yields in excess of 450 gallons per minute. The southern glacial outwash deposits of the Sciota River yield more than 200 gallons per day. These relatively thick lenses of sand and gravel may be recharged by the Scioto River.

2.1.3.3 Soils of the Facilities Planning Area

Soil characteristics influence the design and location of septic tank systems and landfills as well as the suitability of sites for land application of sewage sludge. Soil infiltration rates under different cover conditions, permeability, land slopes, depth to the bedrock/water table, and the relation of these factors to the ground water system determine the suitability of a site for solid or liquid waste disposal.

The soils have been mapped in detail for the entire FPA (SCS 1977, 1978, 1979, 1980a, 1980b, 1981, 1982). The association map (Figure 2-1) is provided to convey a general concept of soils in the FPA. The four major soil associations, covering 75 percent of Franklin County, are described below.

The Bennington-Pewamo association is characterized as deep, nearly level and gently sloping, somewhat poorly drained, and very poorly drained soils formed in medium textured and moderately fine textured glacial till. This association covers about 29 percent of Franklin County. It is found on relatively broad flats, depressions, low knolls, and ridges. The soils have low potential for most building site development and sanitary facilites. The seasonal wetness, ponding, slow or moderately slow permeability, and low strength are the main limitations.

The Crosby-Kokomo-Celina association is characterized as deep, nearly level to sloping, moderately well drained, somewhat poorly drained, and very poorly drained soils formed in medium textured and moderately fine textured glacial till. This association covers about 12 percent of Franklin County.

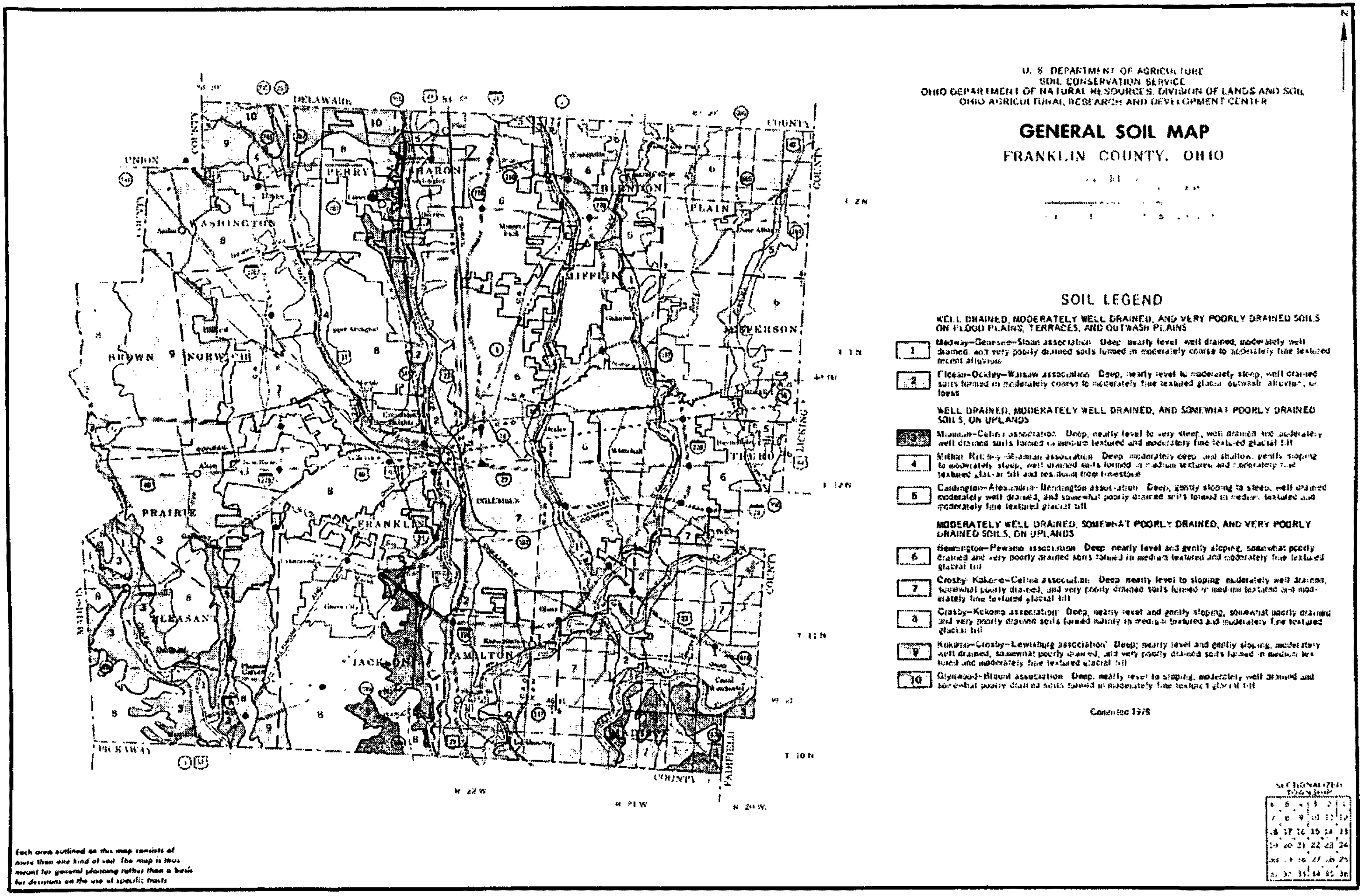


FIGURE 2-1. GENERAL SOIL MAP OF FRANKLIN COUNTY, OHIO

It is found on broad flats with depressions, knolls, and ridges. The Crosby and Kokomo soils have low potential for building site development and sanitary facilities. Celina soils have medium potential for these uses. Seasonal wetness, slow or moderately slow permeability, and low strength are the major land use limitations.

The Crosby-Kokomo association is characterized as deep, nearly level and gently sloping, somewhat poorly drained, and very poorly drained soils formed mainly in medium textured and moderately fine textured glacial till. This association covers about 24 percent of Franklin County. It is found on broad flats with slight rises, low knolls, and depressions. The soils are mainly nearly level and gently sloping with sloping areas along some drainageways. Most areas have low potential for most building site development and sanitary facilities. The seasonal wetness, slow or moderately slow permeability, and ponding are the main limitations to use.

The Kokomo-Crosby-Lewisburg association is characterized as deep, nearly level and gently sloping, moderately well drained, somewhat poorly drained, and very poorly drained soils formed in medium textured and moderately fine textured glacial till. This association covers about 10 percent of Franklin County. It is found on broad flats with depressions, low knolls, and some discontinuous ridges. The Kokomo and Crosby soils have low potential for building site development and sanitary facilities, and the Lewisburg soils have medium potential for these uses. Soil wetness, slow or moderately slow permeability, and erosion hazard on the Lewisburg and Crosby soils are the main limitations.

Most of the soil associations are described as having low potential for building site development and sanitary facilities. Some of the limitations can be partially or fully overcome by specially designed facilities. Building sites could be landscaped for good surface drainage away from foundations and septic tank absorption fields. In some places artificial drainage can reduce the wetness limitation and swell potential if proper design and installation procedures are used.

2.1.4 Biota

2.1.4.1 Terrestrial Biota

The FPA is situated within the Temperate Deciduous Forest Biome. Once covered primarily by climax beech forest, most of the land in Franklin County has been cleared for agricultural use. Forested areas which currently cover only about 5 percent of the county are limited to relatively small scattered woods, stream bank areas, and floodplains. Table 2-4 identifies several natural terrestrial areas that have been determined to have unique natural vegetation.

Dominated by agricultural lands, the FPA is characterized by relatively low wildlife populations and diversity. With modern agricultural practice, it is common to plant "fence row to road ditch," leaving little year-round herbaceous cover, undisturbed breeding habitat, or natural food for wildlife. Therefore, the principal wildlife habitat in the FPA is provided by the available farm woodlots and vegetation along streams. Species which are abundant in the farm fields include the cottontail rabbit, the fox squirrel, the red fox, and the woodchuck. For these species, the farm land provides adequate forage, while nearby woods provide protective cover and nesting sites. Raccoons, weasels, opossums, muskrats, and minks are found in wetland areas and forests associated with streams and ponds. Species associated with upland forest habitat, including white-tailed deer, gray squirrels, and gray foxes, are also found in many parts of the FPA.

Each spring and fall millions of bird migrants of several hundred species pass through Ohio to and from their breeding grounds. About one-third of these nest in the west-central region (Thomson 1983). This is the region which contains the FPA. Once vast forest land, central Ohio is now predominantly farmland. Those areas which serve to provide habitat include remaining forests, bogs, tree-lined rivers (e.g. the Scioto River), sewage treatment ponds, golf courses, airports, quarries, and landfills.

The greatest number of migrant and overwintering waterfowl in Ohio can be found in the Scioto River watershed. In the northern half of the central Scioto River basin mallards and black ducks are commonly found nesting, along

TABLE 2-4. NOTEWORTHY NATURAL TERRESTRIAL AREAS

Area	Location	Description
Blacklick Woods Metropolitan Park	Southwest of Reynoldsburg	One of the finest unspoiled woodlands of central Ohio. A beech-maple to elm, ash, oak swamp-forest. Dedicated as a State Nature Preserve, April 1973.
Blendon Woods Metropolitan Park	Northeast of Columbus, along Route 161	An area of rough terrain and second growth timber, much kept as wilderness area. Upland and swamp forests.
Darby Creek Metropolitan Park	East side of Darby Creek, on Koebel-Suydam Road	An upland area of primarily oak-hickory forest. Eroded hillsides along the creek provide suitable habitat for prairie species vegetation.
Highbanks Metropolitan Park	Sharon Twp. and also Orange Twp., Delaware County	Ohio shale bluff and oak forest along the East bank of the Olentangy River. Dedicated as a State Nature Preserve, April 1973.
Sharon Woods Metropolitan Park (Spring Hollow)	Sharon Twp.	A good beech-maple forest containing large white oaks.
Flint Ravine	Sharon Twp. crosses Rt. 23 to the Olentangy River.	A terrain rich in fauna and flora that has been kept in a wild state.
Gahana Woods State Nature Preserve (Dehlendorf Woods)	Jefferson Twp. Gahanna, 1/2 mi. south of Haven Corners Rd., on the west side of of Taylor Station Road.	A beech-maple and ash forest with mixed mesophytics, and pin oak, silver maple and buttonbush swamp in lower regions. Dedicated January 1974.
Rocky Fork Natural Area	Rocky Fort Creek vicinity	A rugged ravine on Rocky Fork Creek, a tributary of Big Walnut Creek.
Scioto River Bank at Dublin	Extends south from Dublin Bridge and west of U.S. Rt. 33 ca 1 mile, including an old limestone quarry	The type locality of _Trillium nivale_, and also contains one of the best colonies of _Thuja occidentalis_ in its native habitat in central Ohio.
Welch's Beech Woods	Washington Twp. and Also Concord Twp., Delaware County.	Mature beech woods of exceptional quality on the Powell Moraine.

Source: Malcolm Pirnie, Inc. July 1976.

with some blue-vinged teal. On the Scioto River south of Columbus the wood duck is the principal breeding species.

Nesting habitat requirement for the wood duck are water, mature timber with suitable nesting cavities and brood voer, all within close proximity. When nest sites are not available near water, the wood duck may nest one to two miles from the nearest body of water.

When the reservoirs in northern Columbus freese, many waterfowl fly to the segment of river below the Jackson Pike WWTP. The warm effluent keeps the river from freezing, making it attractive as a source of food and protection to the migrating and residential flocks (Watts 1987).

A diversity of bird fauna has been observed at the Jackson Pike WWTP. This site has been identified by Thomson (1983) as one of the good birding sites in Ohio. Thomson described the small ponds at the entrance of the WWTP as a noteworthy area for songbirds and also as a possible area to find a great blue heron or a belted kingfisher. The sludge pond attracts shorebirds from April through October. Rare species that have been seen here include piping, lesser golden, and black-bellied plovers; whimbrel; willet; ruddy turnstone; Willson's and red-necked phalaropes; long-billed dowitcher; red knot; and western, white-rumped Baird's stilt, and buff-breasted sandpipers. **The piping plover is a federally endangered species. Sitings of these birds are considered to be accidental or casual. No recent sitings of the piping plover have been recorded.** The most commonly seen species during the late summer movement of shorebirds are greater and lesser yellowlegs, solitary sandpipers, and pectoral sandpipers. Another pond on the site is attractive to blue-winged teals, wood ducks, and American coots, and which the water is low, shorebirds feed along the muddy edges.

2.1.4.2 Aquatic Biota

The streams within the FPA are classified as "warm water habitat" by the Ohio EPA. Water quality and habitat conditions in the individual streams affect the species diversity and the abundance of aquatic biota found in each stream. The following discussion addresses fisheries, macroinvertebrates, and bivalve mollusks as indicators of existing water quality conditions. The primary focus is the mainstem Scioto River, although tributaries are also discussed.

Biological and chemical/physical sampling conducted in the central Scioto River mainstem during 1979, 1980, and 1981 clearly illustrated a significant impact on the area between the Jackson Pike WWTP and Circleville (OEPA 1986a). Both fish and macroinvertebrate communities were degraded and biological indices were well correlated with the observed pattern of dissolved oxygen concentrations. Fish sampling conducted during 1979-1986 revealed improved conditions between Columbus and Circleville, as reflected in Figure 2-2. The cumulative distance of mainstem with low mean composite index values (less than 8.0) was significantly reduced, from 26.9 miles in 1979 to 0.7 miles in 1985 for that area between the Jackson Pike WWTP and Circleville (OEPA 1986a). Further improvements occurred in 1986 when none of the sampling locations fell below 8.0 and several rose above 9.5.

Fisheries: Mainstem Scioto River

Fish can be one of the most sensitive indicators of the quality of the aquatic environment in that they constitute a conspicuous component of the aquatic community (Smith 1971). The relative abundance and distribution of fish in the central Scioto River were determined, through electrofishing, in 1979 (Yoder et al. 1981) and 1980-1981 (Ohio EPA 1986a). The study area extended for 74.8 miles between the O'Shaughnessy Dam and Chillicothe. The results of these studies are reported and discussed in detail in the Comprehensive Water Quality Report (CWQR) (OEPA 1986a). Much of the information presented in this section is derived from the the CWQR, unless stated otherwise.

The study area was divided into six segments based primarily on the position of major point sources of wastewater and physical features. The limits of these segments are given in Table 2-5. River segments 3 and 4 are situated within the Columbus Facilities Planning Area.

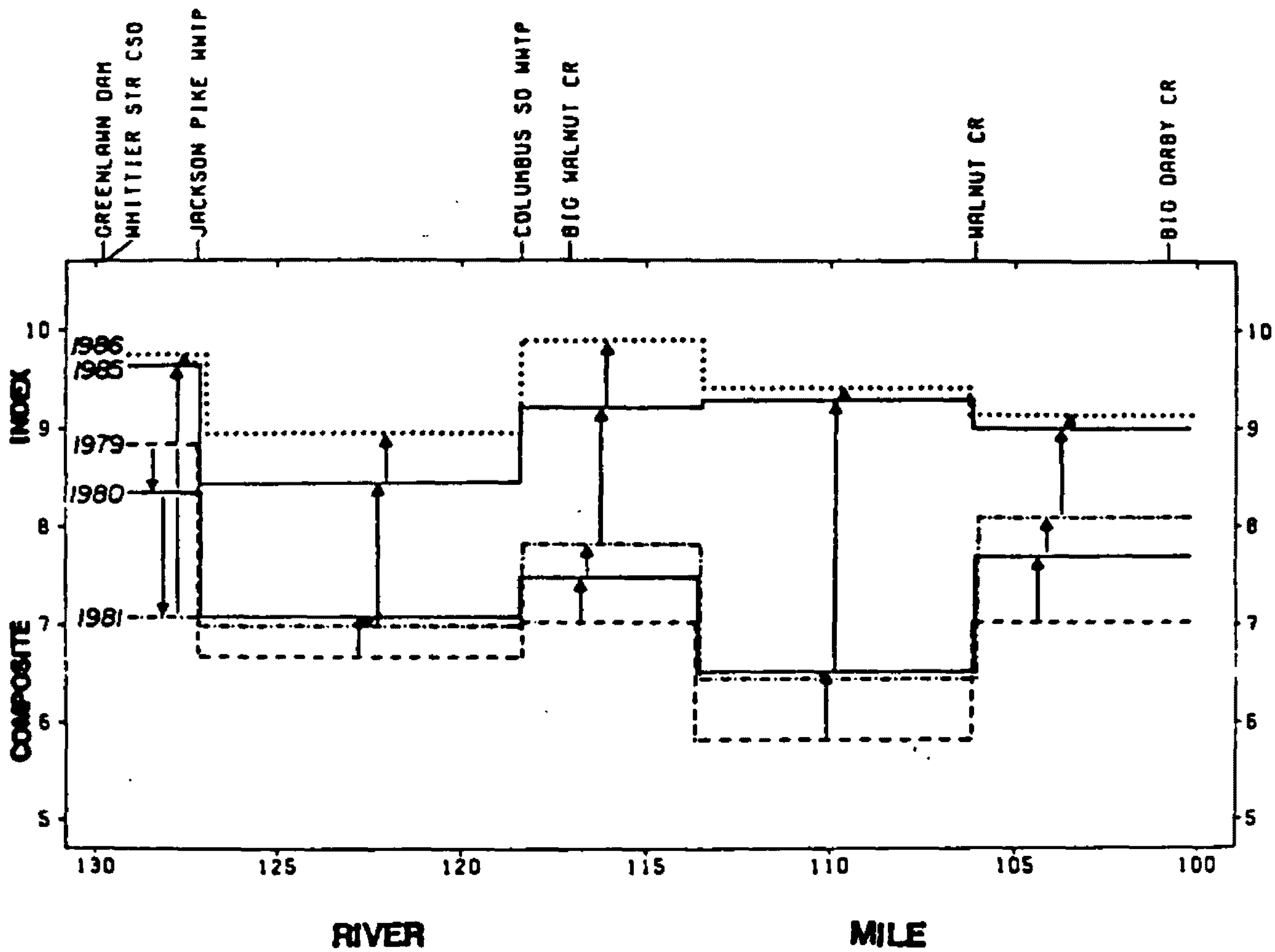


FIGURE 2-2. COMPARISON OF SEGMENT MEAN COMPOSITE INDEX VALUES OF THE MIDDLE SCIOTO RIVER MAINSTEM

NOTE: Based on electrofishing results during the period July-September 1979, 1980, 1981, 1985, and 1986 (lines and arrows indicate direction of change between each year). Source: OEPA 1986a.

TABLE 2-5. LOCATION AND DESCRIPTION OF THE SIX RIVER SEGMENTS

River Segment	Subsegment	Location and Description
1	1A	RM 145.5-138.7; Downstream from O'Shaugnessy dam to Griggs dam.
	1B	RM 138.6-134.0; Downstream from Griggs dam to Dublin Rd. WTP dam.
2	2A	RM 133.9-129.7; Downstream from Dublin Rd. WTP dam to Greenlawn dam.
	2B	RM, 129.1-127.2; Downstream from Greenlawn dam to upstream from Jackson Pike WWTP.
3		RM 127.1-118.9; Downstream from Jackson Pike WWTP to upstream Columbus Southerly WWTP 002 raw wastewater bypass.
4	4A	RM 118.8-116.7; Downstream Southerly 002 bypass to upstream from CSOE-Picway EGS.
	4B	RM 116.6-108.9; Downstream from CSOE-Picway EGS to RM 108.9.
	4C	RM 108.8-99.7; Downstream from RM 108.9 to upstream from Container Corporation of America (CCA) 001.
5		RM 99.6-89.7; Downstream CCA and Circleville WWTP to upstream from Scippo Cr. (PPG)
6		RM 89.6-70.7; Downstream from Scippo Cr. to Bridge St. in Chillicothe

Source: Ohio EPA 1986a.

A cumulative total of 68 species and nine hybrids were sampled in the entire 1979-1981 period. These species are listed in Table 2-6. A total of 72 species and 10 hybrids were sampled for the 1979-1986 study period. The same cumulative numbers were collected in 1986 as for the entire period, indicating an increase in diversity over time. General indications of the relative tolerance to pollution of many species in Table 2-6 may be derived from Table 2-7.

In the 1979 sampling, common carp, river carpsucker, and golden redhorse dominated catch by weight, comprising 73, 6, and 3 percent of total weight, respectively. In 1980, common carp, river carpsucker, and the smallmouth buffalo dominated catch by weight, comprising 66, 11, and 4 percent of total weight respectively. In 1981, common carp, river carpsucker, and golden redhorse again dominated the catch, contributing 52, 12, and 9 percent of total weight respectively. In 1986, the catch was dominated by the same three species as in 1981, with the common carp contributing 62 percent of total biomass, the river carpsucker at 11 percent and the golden redhorse at 5 percent. The golden redhorse is considered to be less pollution tolerant than the common carp, river carpsucker and small mouth buffalo, and its gradual increase in biomass reflects improved habitat. The common carp biomass showed a decreasing trend over the study period, while the river carpsucker showed an increasing trend, suggesting improving habitat conditions (see Tables 2-6 and 2-7).

In terms of numbers of fish caught, the dominant species show more variation from year to year. In 1979, gizzard shad, common carp, and bluegill dominated the catch, comprising 16, 16, and 8 percent of total numbers, respectively. In 1980, the common carp, river carpsucker, and green sunfish dominated catch, accounting for 18, 11, and 10 percent of total numbers caught, respectively. The gizzard shad decreased to 5 percent of the catch in 1980. However, in 1981, it was once again the most dominant fish by number, comprising 27 percent of the total catch. Other dominant species for 1981 were the common carp and golden redhorse, accounting for 12 and 10 percent of catch numbers, respectively. In 1986, the gizzard shad and common carp remained the two most dominant species, followed by the spotfin shiner. The percentages of total numbers caught are gizzard shad: 14; common carp: 12;

TABLE 2-6. OVERALL COMPOSITION OF THE FISH COMMUNITY IN THE CENTRAL SCIOTO RIVER MAINSTEM

Species Name	1979 Mean No/Km	1979 % By Number	1979 Mean Kg/Km	1979 % By Weight	1980 Mean No/Km	1980 % By Number	1980 Mean Kg/Km	1980 % By Weight	1981 Mean No/Km	1981 % By Number	1981 Mean Kg/Km	1981 % By Weight
Shortnose gar (*Lepisosteus platostomus*)	-	-	-	-	-	-	-	-	0.02	0.02	0.013	0.02
Longnose gar (*Lepisosteus osseus*)	0.28	0.20	0.135	0.19	1.07	1.01	0.421	0.56	0.70	0.64	0.492	0.86
Goldeye (*Hiodon alosoides*)	-	-	-	-	-	-	-	-	0.04	0.04	0.004	0.01
Mooneye (*Hiodon tergisus*)	-	-	-	-	0.02	0.02	0.005	0.01	0.04	0.04	0.004	0.01
Gizzard shad (*Dorosoma cepedianum*)	21.77	16.18	1.272	1.77	5.30	5.04	0.493	0.65	29.74	26.91	2.591	4.53
Grass pickerel (*Esox americanus*)	-	-	-	-	0.07	0.07	0.008	0.01	0.09	0.08	0.009	0.02
Bigmouth buffalo (*Ictiobus cyprinellus*)	0.31	0.23	0.843	1.18	0.39	0.37	0.789	1.05	0.66	0.60	1.177	2.06
Black buffalo (*Ictiobus niger*)	0.21	0.15	0.329	0.46	0.46	0.43	0.652	0.86	0.33	0.30	0.371	0.65
Smallmouth buffalo (*Ictiobus bubalus*)	0.97	0.72	1.600	2.23	2.62	2.49	3.348	4.44	1.65	1.49	2.458	4.30
Quillback (*Carpiodes cyprinus*)	1.24	0.92	0.748	1.04	1.13	1.07	0.672	0.89	0.97	0.88	0.682	1.19
River carpsucker (*Carpiodes carpio*)	6.07	4.51	4.288	5.98	11.21	10.65	8.013	10.65	10.38	9.39	7.358	12.87
Highfin carpsucker (*Carpiodes velifer*)	0.14	0.10	0.065	0.09	0.05	0.04	0.015	0.02	0.09	0.08	0.042	0.07
Silver redhorse (*Moxostoma anisurum*)	0.94	0.70	0.309	0.43	1.30	1.23	0.745	0.99	1.16	1.05	0.841	1.47
Black redhorse (*Moxostoma duquesnei*)	1.03	0.77	0.591	0.82	0.78	0.74	0.443	0.59	1.35	1.22	0.797	1.39
Golden redhorse (*Moxostoma erythrurum*)	5.96	4.43	2.374	3.31	6.29	5.98	2.704	3.58	10.54	9.53	5.241	9.16
Shorthead redhorse (*Moxostoma macrolepidotum*)	0.66	0.49	0.321	0.45	0.49	0.46	0.212	0.28	0.59	0.54	0.281	0.49
River redhorse (*Moxostoma carinatum*)	0.09	0.07	0.065	0.09	0.05	0.04	0.052	0.07	0.04	0.04	0.052	0.09
Northern hog sucker (*Hypentelium nigricans*)	0.71	0.52	0.141	0.20	0.32	0.31	0.076	0.10	1.13	1.02	0.661	0.81
White sucker (*Catostomus commersoni*)	0.37	0.28	0.128	0.18	0.69	0.66	0.325	0.43	0.68	0.62	0.273	0.48
Spotted sucker (*Minytrema melanops*)	0.78	0.58	0.272	0.38	0.95	0.90	0.469	0.62	0.57	0.52	0.344	0.60
Common carp (*Cyprinus carpio*)	21.02	15.62	52.354	73.01	19.33	18.36	50.154	66.50	13.22	11.97	29.594	$1.75
Goldfish (*Carassius auratus*)	2.23	1.66	0.630	0.88	2.46	2.34	0.954	1.26	0.99	0.89	0.367	0.64
Golden shiner (*Notemigonus crysoleucas*)	2.42	1.80	0.239	0.33	1.20	1.14	0.088	0.12	1.49	1.35	0.026	0.05
River chub (*Nocomis micropogon*)	0.02	0.02	0.001	0.00	0.02	0.02	0.000	0.00	0.29	0.26	0.012	0.02
Creek chub (*Semotilus atromaculatus*)	0.09	0.07	0.003	0.00	0.02	0.02	0.000	0.00	-	-	-	-
Suckermouth minnow (*Phenacobius mirabilis*)	0.83	0.61	0.001	0.00	0.83	0.79	0.003	0.00	0.70	0.64	0.002	0.00
Emerald shiner (*Notropis atherinoides*)	-	-	-	-	-	-	-	-	0.62	0.56	0.003	0.00
Silver shiner (*Notropis photogenis*)	0.11	0.08	0.001	0.00	0.14	0.13	0.000	0.00	0.36	0.32	0.002	0.00
Rosyface shiner (*Notropis rubellus*)	0.02	0.02	0.000	0.00	-	-	-	-	0.26	0.24	0.001	0.00
Rosefin shiner (*Notropis ardens*)	0.08	0.06	0.000	0.00	-	-	-	-	-	-	-	-
Striped shiner (*Notropis chrysocephalus*)	1.51	1.12	0.079	0.11	0.11	0.11	0.004	0.00	0.15	0.14	0.003	0.01
Steelcolor shiner (*Notropis whipplei*)	0.92	0.68	0.002	0.00	0.36	0.34	0.002	0.00	0.99	0.89	0.008	0.01
Spotfin shiner (*Notropis spilopterus*)	2.89	2.15	0.006	0.01	1.31	1.24	0.005	0.01	4.62	4.18	0.024	0.04
Sand shiner (*Notropis stramineus*)	0.52	0.38	0.001	0.00	-	-	-	-	0.04	0.04	0.000	0.00
Mimic shiner (*Notropis volucellus*)	-	-	-	-	-	-	-	-	0.02	0.02	0.000	0.00
Bullhead minnow (*Pimephales vigilax*)	0.32	0.24	0.001	0.00	0.07	0.07	0.000	0.00	-	-	-	-
Fathead minnow (*Pimephales promelas*)	-	-	-	-	0.02	0.02	0.000	0.00	-	-	-	-
Bluntnose minnow (*Pimephales notatus*)	3.56	2.64	0.007	0.01	.74	0.70	0.002	0.00	1.05	0.95	0.004	0.01
Central stoneroller (*Campostoma anomalum*)	0.88	0.65	0.010	0.01	0.18	0.17	0.002	0.00	0.20	0.18	0.004	0.01
Common carp x Goldfish	0.18	0.13	0.126	0.18	0.25	0.24	0.238	0.32	0.13	0.12	0.140	0.24
Channel catfish (*Ictalurus punctatus*)	0.90	0.67	0.562	0.78	0.95	0.91	0.774	1.03	0.97	0.88	0.788	1.38
Yellow bullhead (*Ictalurus natalis*)	0.07	0.05	0.009	0.01	0.09	0.09	0.015	0.02	-	-	-	-
Brown bullhead (*Ictalurus nebulosus*)	0.11	0.08	0.018	0.03	0.16	0.15	0.025	0.03	0.02	0.02	0.005	0.01
Black bullhead (*Ictalurus melas*)	0.09	0.07	0.009	0.01	0.02	0.02	0.005	0.01	-	-	-	-
Flathead catfish (*Pylodictis olivaris*)	0.09	0.07	0.099	0.14	0.12	0.11	0.167	0.22	0.04	0.04	0.032	0.06

NOTE: Inclusive of RM 145.5-70.7 and the lower sections of three tributaries, 1979-1981. (Species are ranked phylogenetically).
Source: Ohio EPA 1986a.

TABLE 2-6. OVERALL COMPOSITION OF THE FISH COMMUNITY IN THE CENTRAL SCIOTO RIVER MAINSTEM (CONT.)

Species Name	1979 Mean No/Km	1979 % By Number	1979 Mean Kg/Km	1979 % By Weight	1980 Mean No/Km	1980 % By Number	1980 Mean Kg/Km	1980 % By Weight	1981 Mean No/Km	1981 % By Number	1981 Mean Kg/Km	1981 % By Weight
Stonecat (Noturus flavus)	-	-	-	-	-	-	-	-	0.02	0.02	0.001	0.00
Brindled madtom (Noturus miurus)	0.07	0.05	0.002	0.00	-	-	-	-	-	-	-	-
Trout-perch (Percopsis omiscomaycus)	-	-	-	-	-	-	-	-	0.02	0.02	0.000	0.00
Brook silverside (Labidesthes sicculus)	0.16	0.12	0.001	0.00	-	-	-	-	0.04	0.04	0.000	0.00
White bass (Morone chrysops)	1.25	0.93	0.102	0.14	0.11	0.11	0.009	0.01	0.07	0.06	0.008	0.01
White crappie (Pomoxis annularis)	5.92	4.40	0.268	0.37	3.27	3.10	0.119	0.16	0.67	0.61	0.050	0.09
Black crappie (Pomoxis nigromaculatus)	1.30	0.97	0.061	0.09	2.33	2.21	0.140	0.19	0.55	0.50	0.052	0.09
Rock bass (Ambloplites rupestris)	3.00	2.23	0.278	0.39	3.49	3.32	0.328	0.43	2.59	2.35	0.355	0.62
Smallmouth bass (Micropterus dolomieui)	4.75	3.53	0.564	0.79	3.16	3.00	0.338	0.45	2.90	2.63	0.352	0.62
Spotted bass (Micropterus punctulatus)	0.29	0.21	0.012	0.02	0.10	0.09	0.007	0.01	0.53	0.48	0.029	0.05
Largemouth bass (Micropterus salmoides)	2.78	2.07	0.818	1.14	2.08	1.97	0.691	0.92	1.36	1.23	0.320	0.56
Warmouth (Lepomis gulosus)	0.09	0.07	0.004	0.01	0.02	0.02	0.001	0.00	-	-	-	-
Green sunfish (Lepomis cyanellus)	8.48	6.30	0.210	0.29	10.62	10.09	0.374	0.50	3.14	2.84	0.128	0.22
Bluegill (Lepomis macrochirus)	10.57	7.86	0.456	0.64	8.90	8.46	0.354	0.47	6.80	6.15	0.364	0.64
Orangespotted sunfish (Lepomis humilis)	3.29	2.44	0.045	0.06	0.94	0.90	0.024	0.03	0.77	0.70	0.038	0.07
Longear sunfish (Lepomis megalotis)	6.26	4.65	0.151	0.21	4.20	3.99	0.152	0.20	1.76	1.59	0.054	0.09
Pumpkinseed (Lepomis gibbosus)	2.81	2.09	0.121	0.17	1.50	1.42	0.054	0.07	0.44	0.40	0.022	0.04
Bluegill x Pumpkinseed	0.02	0.02	0.001	0.00	-	-	-	-	-	-	-	-
Green sunfish x Bluegill	0.09	0.07	0.006	0.01	0.18	0.17	0.009	0.01	0.02	0.02	0.001	0.00
Green sunfish x Pumpkinseed	-	-	-	-	0.74	0.70	0.047	0.06	0.09	0.08	0.009	0.02
Longear sunfish x Bluegill	0.02	0.02	0.001	0.00	-	-	-	-	-	-	-	-
Bluegill x Orangespotted sunfish	0.18	0.13	0.005	0.01	0.05	0.04	0.001	0.00	-	-	-	-
Green Sunfish x Orangespotted	-	-	-	-	0.14	0.13	0.008	0.01	0.15	0.14	0.013	0.02
Pumpkinseed x Longear Sunfish	-	-	-	-	0.02	0.02	0.001	0.00	-	-	-	-
Orangespotted x Pumpkinseed	-	-	-	-	-	-	-	-	0.04	0.04	0.002	0.00
Sauger (Stizostedion canadense)	1.09	0.81	0.318	0.44	0.52	0.49	0.182	0.24	0.53	0.48	0.222	0.39
Walleye (Stizostedion vitreum)	0.16	0.12	0.033	0.05	0.09	0.09	0.026	0.03	0.13	0.12	0.104	0.18
Logperch (Percina caprodes)	0.65	0.48	0.009	0.01	0.02	0.02	0.000	0.00	0.09	0.08	0.002	0.00
Johnny darter (Etheostoma nigrum)	0.02	0.02	0.000	0.00	0.02	0.02	0.000	0.00	-	-	-	-
Greenside darter (Etheostoma blennioides)	0.05	0.04	0.000	0.00	0.07	0.07	0.000	0.00	0.09	0.08	0.001	0.00
Rainbow darter (Etheostoma caeruleum)	-	-	-	-	0.02	0.02	0.000	0.00	-	-	-	-
Freshwater drum (Aplodinotus grunniens)	0.86	0.64	0.599	0.84	1.12	1.06	0.662	0.88	0.77	0.70	0.558	0.98

	1979	1980	1981
Distance Fished	42.05 km	42.93 km	45.25 km
Number of Species	58	57	58
Number of Hybrids	5	6	5

Cumulative Species 68

NOTE: Inclusive of RM 145.5-70.7 and the lower sections of three tributaries, 1979-1981. (Species are ranked phylogenetically).
Source: Ohio EPA 1986a.

TABLE 2-7. SPECIES GROUP DESIGNATIONS USED TO ASSESS COMMUNITY COMPOSITION PATTERNS IN THE MAINSTEM SCIOTO RIVER AND MAJOR TRIBUTARIES.

Group	Species of Genera Included
GS	Gizzard shad (Dorosoma): omnivores, highly pollution tolerant
G	Carp, goldfish (Cyprinus, Carrasius): omnivores, highly pollution tolerant
R	Round-bodied catostomidea (Moxostoma, Hypentelium, Minytrema, Catostomus): insectivores, moderately to highly polluttion intolerant
C	Deep-bodied catostomidea (Carpiodes, Ictiobus): mixed omnivores and insectivores - moderately pollution tolerant
M	Minnows, chubs (Semotilus, Pimephales, Hybopsis, Nocomis, Phenacobius, Campostoma): insectivores, herbivores, generalists - most highly intolerant to intolerant but some highly pollution tolerant
N	Shiners (Notropis, Notemigonus): insectivores - highly pollution intolerant to moderately pollution tolerant
B	Basses, crappies (Micropterus, Pomoxis): top carnivores, moderately pollution intolerant
S	Sunfishes (Lepomis): insectivores, top carnivores, highly pollution tolerant to moderately intolerant
F	Catfishes, drum (Ictalurus. Pylodictis, Aplodinotus): top carnivores, insectivores, one piscivore - highly to moderately pollution tolerant
V	Sauger, walleye (Stizostedion): Piscivores
W	Large River (Morone, Alosa, Hiodon): piscivores
L	Gars (Lepisosteus): piscivores
O	Other (rare and uncommon species not included in abovde group designations)

NOTE: Information on feeding preferences and selective level of pollution tolerances is included when known.

SOURCE: Adapted from Ohio EPA 1983a.

and spotfin shiner: 10. The most recognizable trends are that gizzard shad fluctuated annually while the common carp exhibited a gradual decline. Of the other species mentioned, the golden redhorse is the least pollution tolerant.

OEPA used percent similarity and relative community composition to assess changes in the composition of the Scioto River fish community over the 75 mile study area. Similarity matrices showed a three-year trend of decreasing faunal organization in the upstream segments and increasing similarity in the lower reaches. The Ohio EPA indicated that this data may reflect increased stresses upstream from Columbus and improved conditions downstream. However, this postulate is not entirely consistent with OEPA water quality discussions (OEPA 1986a and 1986b), which suggest improving water quality conditions in upstream segments attributed to improvements in wastewater treatment.

Notable differences in community composition exist between the six river segments studied. In terms of total biomass, the 1980 fish community sampled from Segment 1 (see Table 2-5 for key to segments) was dominated by carp-goldfish (G), round-bodied Catostomidae (R), bass-crappie (B), and sunfish (S) groups. (Refer to Table 2-7 for key to lettered species designations.) The remaining segments, including the Columbus study area, were each comprised mainly of carp-goldfish (G) and deep-bodied Catostomidae (C) groups (over 80 percent combined biomass). The round-bodied Catostomidae (R) and catfish-drum (F) groups increased in their contribution to total biomass further downstream in Segment 6. Numerically, there was a gradual downstream shift from a sunfish (S), bass-crappie (B), and round-bodied Catostomidae (R) predominant composition to a carp-goldfish (G) and deep-bodied Catostomidae (C) community. Data from 1979 (Yoder et al. 1981) exhibited very similar community composition to that found in 1980.

Compositional differences in fish communities between the six river segments studied in 1981 are characterized in Figures 2-3 and 2-4. Comparing the 1980 and 1981 data, a noticeable change occurred in Segment 1 in 1981, with the round-bodied Catostomidae (R) replacing carp-goldfish (G) as the predominant group in terms of total biomass. Numerical composition in 1981 also differed from that of the previous year. In Segment 1, the round-bodied Catostomidae (R) and gizzard shad (GS) groups were equal in compositional

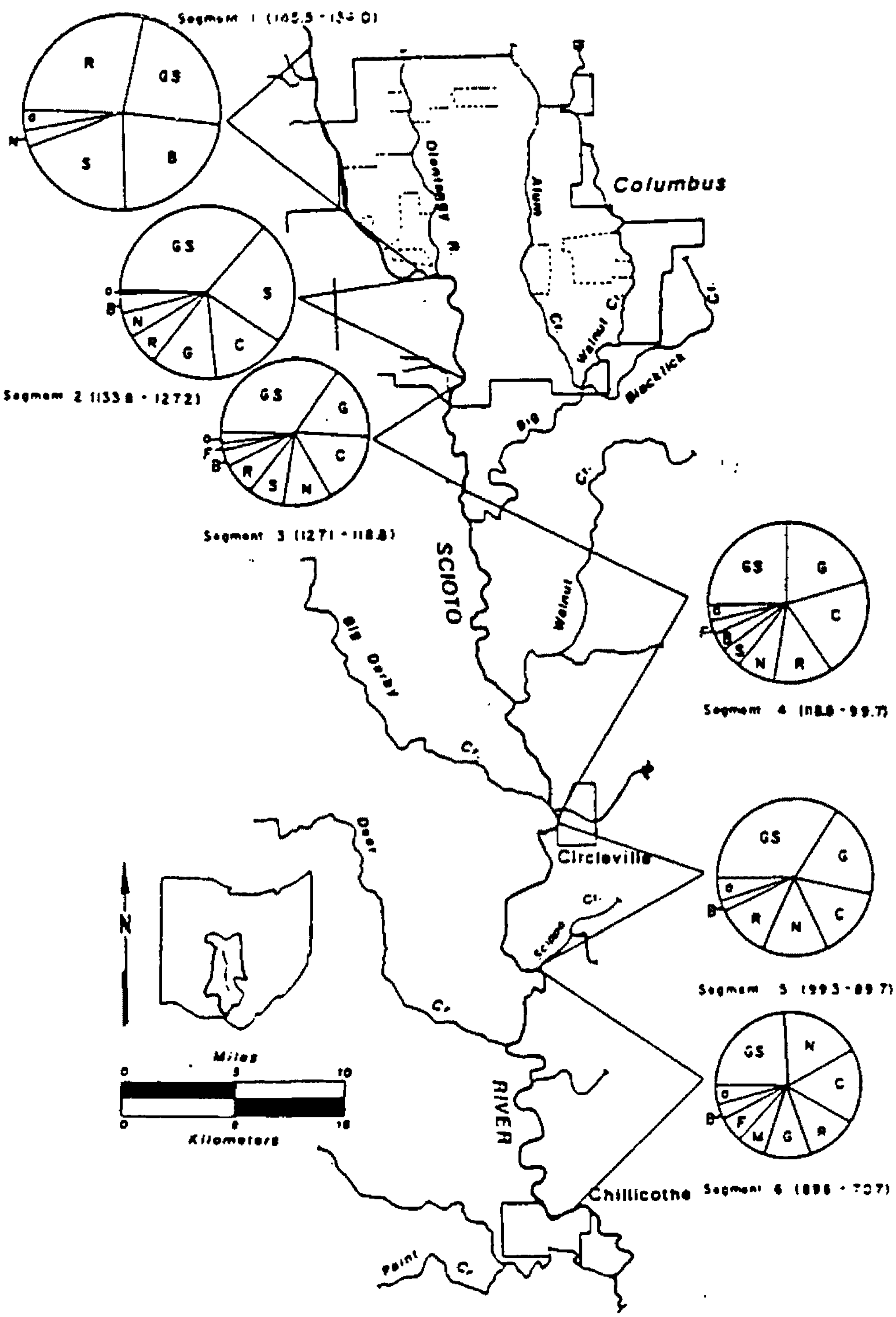


FIGURE 2-3. COMPOSITION OF THE FISH COMMUNITY BY NUMBER IN THE CENTRAL SCIOTO RIVER MAINSTEM

NOTE: Study area based on numbers during July-October 1981. Species group symbols are those given in Table 2-8. The size of each circle is proportional to the mean density (numbers/km) of fish in each segment. Source: Ohio EPA 1986a.

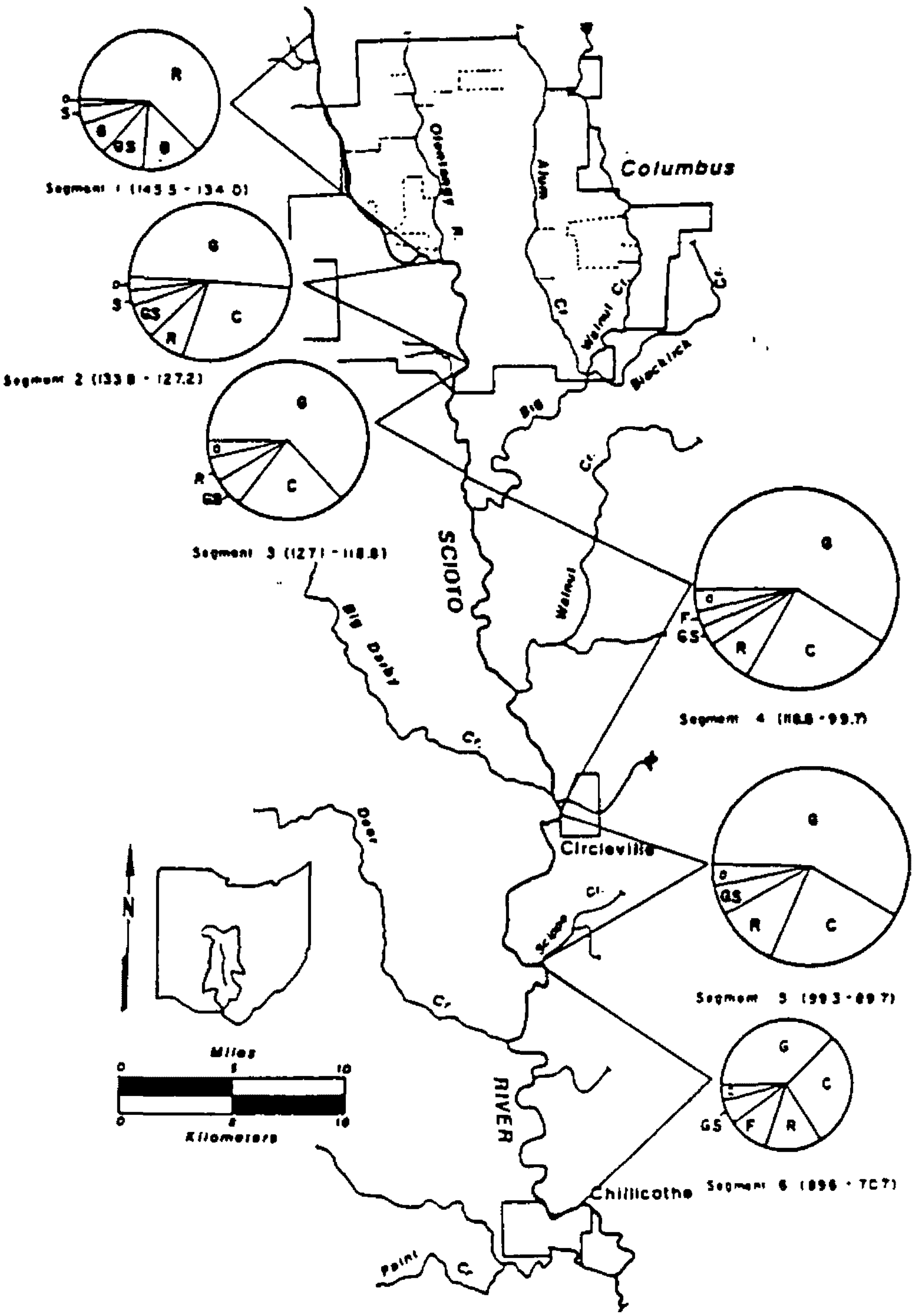


FIGURE 2-4. COMPOSITON OF THE FISH COMMUNITY BY WEIGHT IN THE CENTRAL SCIOTO RIVER MAINSTEM

NOTE: Study area based on weight during July-October 1981. Species group symbols are those given in Table 2-8. The size of each circle is proportional to the mean biomass (kg/km) of fish in each segment. Source: Ohio EPA 1986a.

dominance to the sunfish (S) and bass-crappie (B) groups. The fish community from Segment 2 through 5, including the Columbus study area, was dominated by the gizzard shad (GS), carp-goldfish (G), and deep-bodied Catostomidae (C) groups. The sunfish (S) group was equally important above the Jackson Pike WWTP, in Segment 2.

Compared to the 1979 and 1980 data, the 1981 data showed a predominance of the pollution-tolerant groups (C and G) downstream from Columbus. In general, these results indicate somewhat improved conditions in this section of the mainstem.

The composite index (Gammon 1976), which incorporates density, biomass, and the Shannon index (a diversity index), was used to evaluate the overall condition of the fish community. The composite index values were plotted against river mile for the 1979, 1980, and 1981 results. The results of this comparison are depicted in Figure 2-5. The mean number of species per zone was also plotted against river mile for this same period. The results of this second comparison are depicted in Figure 2-6. Downstream from the Jackson Pike WWTP, the composite index values declined. In 1979-1980, similar patterns of gradual decline, followed by a gradual recovery, occurred downstream from the Jackson Pike WWTP, the Columbus Southerly WWTP, the Container Corporation of America, and the Circleville WWTP. This pattern was weakly evident in 1981. The mean composite index values in 1981 were considerably lower than in previous years, especially immediately downstream from Greenlawn Dam.

A comparison of mean composite index scores for 1981, 1985, and 1986 is shown in Figure 2-7. From 1981 to 1985, all stations improved, particularly those between Southerly and Walnut Creek. Not only do these stations have higher overall values, but the decline apparent in 1981 is also less pronounced in 1985.

The composite index is used to assess structural characteristics of fish communities, which are described in terms of biomass, abundance, and diversity. The OEPA has also analyzed fish sampling results using the Index of Biotic Integrity (IBI) (Karr 1981, Fausch et al. 1984; as cited in OEPA 1986a) which incorporates both structural and functional characteristics in

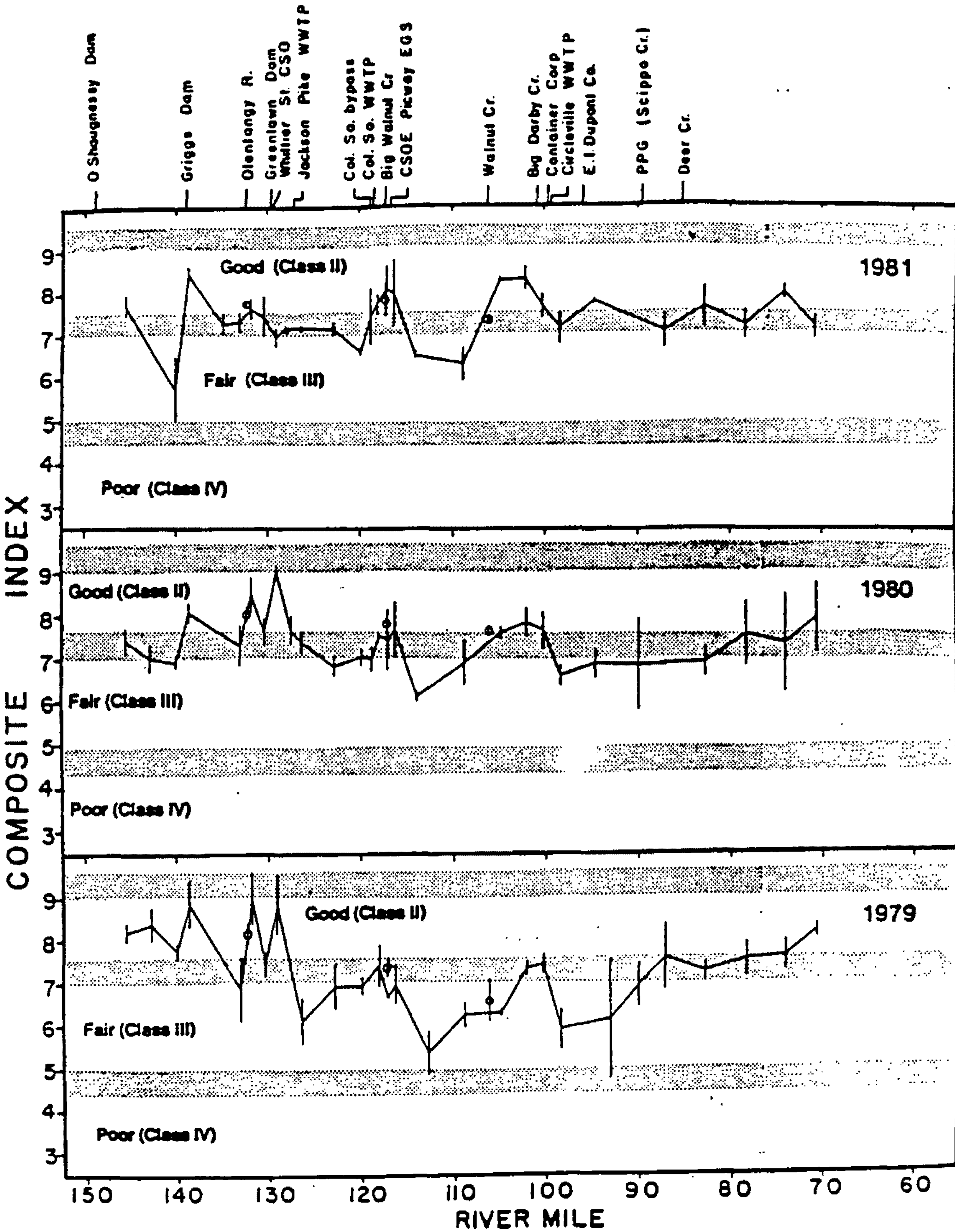


FIGURE 2-5. LONGITUDINAL TREND OF THE MEAN (AND STANDARD ERROR) COMPOSITE INDEX IN THE CENTRAL SCIOTO RIVER MAINSTEM

NOTE: Sampling period from 1979 through 1981. Shaded areas indicate boundaries and overlap between biological criteria classes. (Open circles represent tributary location values). Source: OEPA 1986a.

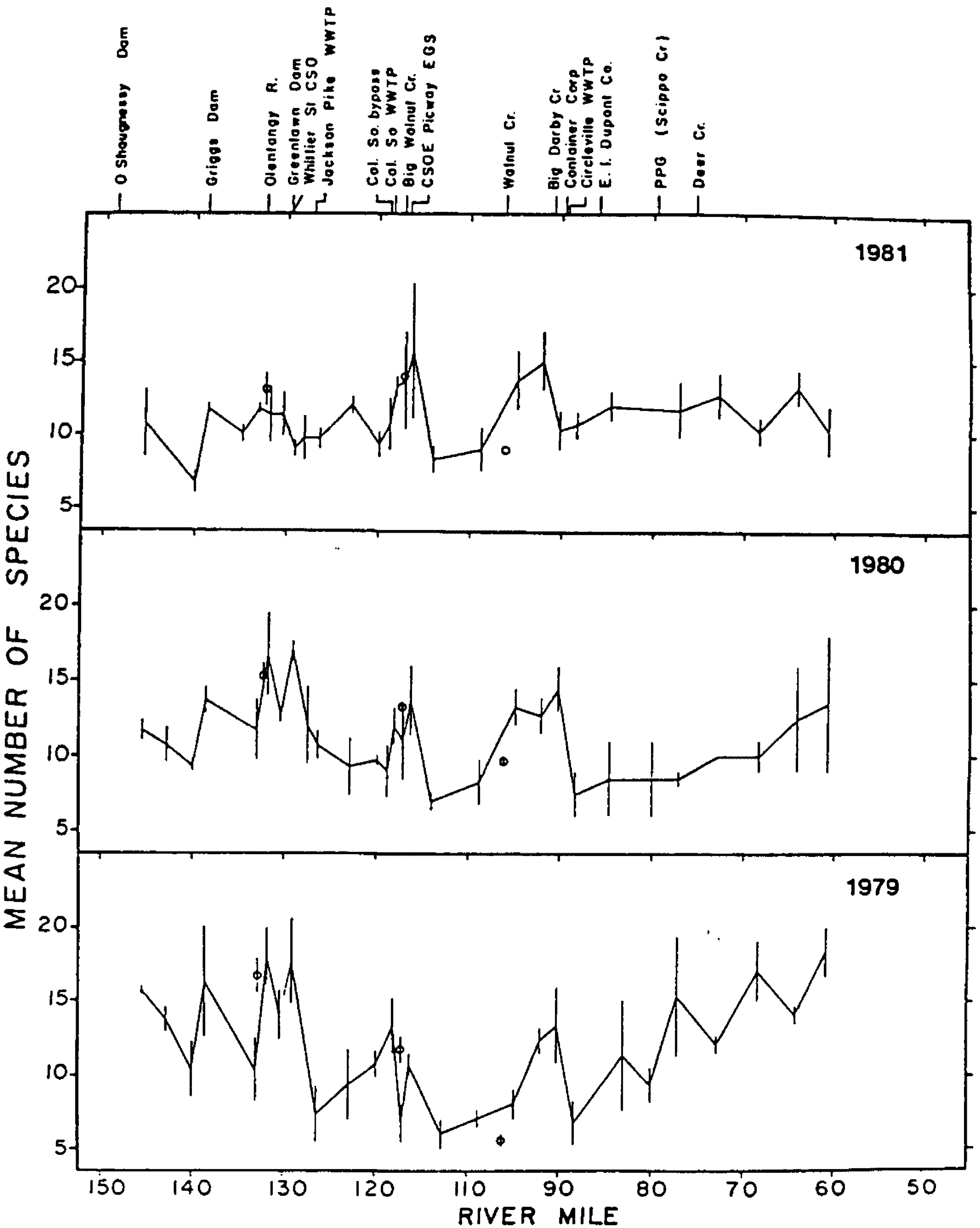


FIGURE 2-6. LONGITUDINAL TREND OF MEAN (±SE) NUMBER OF SPECIES/ZONE IN THE CENTRAL SCIOTO RIVER MAINSTEM

NOTE: Study conducted during the 1979 (bottom), 1980 (middle), and 1981 (top) sampling periods (open circles represent tributary location values). Source: Ohio EPA 1986a.

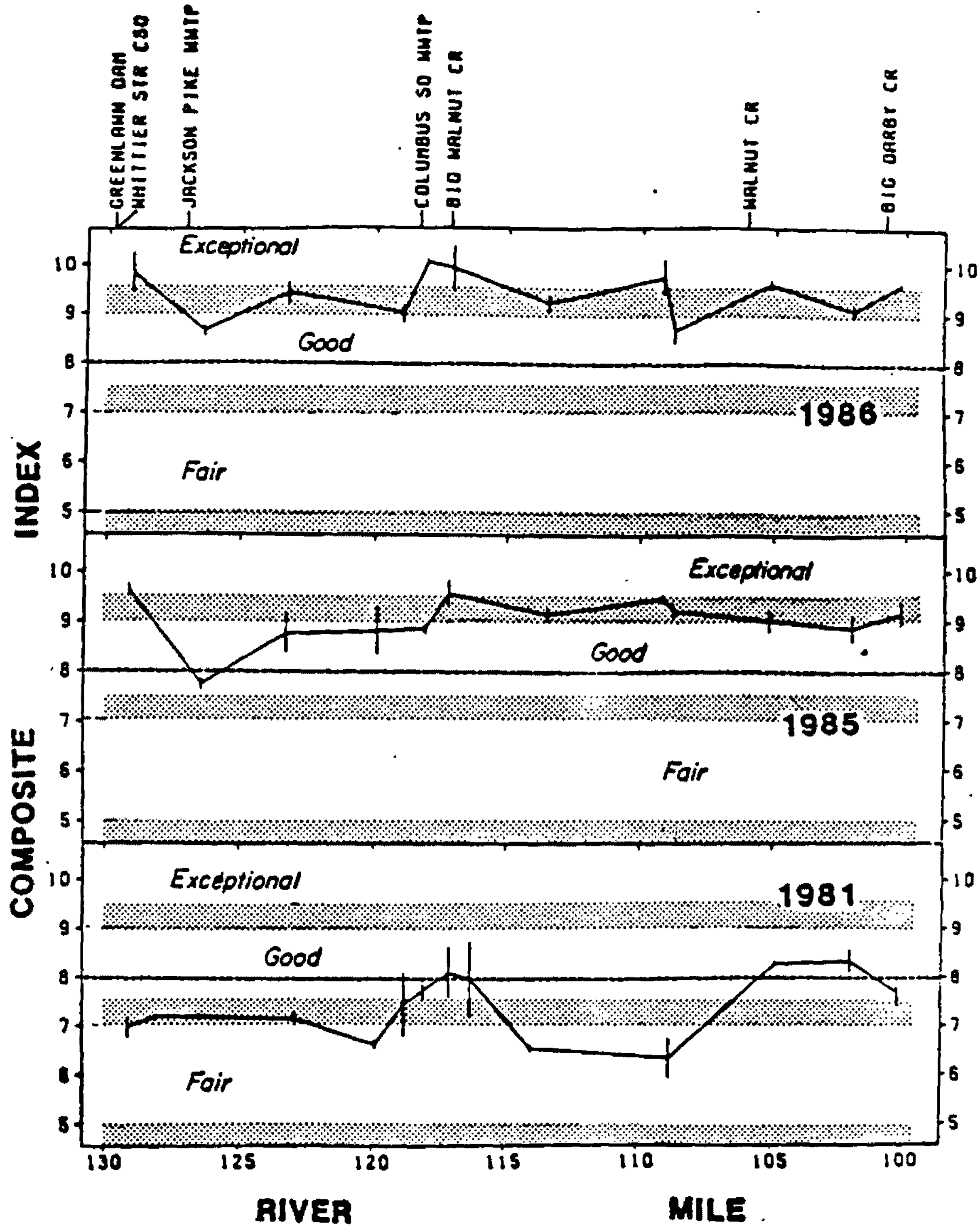


FIGURE 2-7. COMPARISON OF MEAN (AND STANDARD ERROR) COMPOSITE INDEX VALUES

NOTE: At sampling locations in the central Scioto River mainstem based on sampling conducted in the summers of 1981, 1985, and 1986. (Shaded areas separate biological criteria category boundaries).
Source: OEPA 1986a.

the assessment of aquatic communities. The characteristics, or metrics, used in the IBI, are listed in Table 2-8. Each sampling location is assigned a score of 5 (best), 3, or 1 (worst) for each metric, based on the criteria shown in Table 2-8. The scores are then added and the total used to describe the fish community at that particular sampling location. The highest possible index score is 60, which would describe a virtually undisturbed habitat in a pristine environment. Scores above 50 are excellent. Scores between 20 and 30 indicate an impacted community with little structural and functional integrity.

Scores for selected sampling locations are shown in Table 2-9. Scores in the 20-30 range were much more common from 1979-1981 than from 1985 to 1986. In 1985 and 1986, most stations had scores in the 36-44 range, indicating marginally good to good conditions, but with some problems remaining. The metrics which reflected problems in the aquatic community were as follows: higher portion of hybrids, higher incidence of external anomalies, higher percentage of omnivores, and lower percentage of round-bodied suckers and/or insectivorous species.

While all stations improved over time, some longitudinal trends persisted throughout the study period. The station immediately below the Whittier St. CSO (RM 129.1) was always higher on both indices than all stations between Jackson Pike and Southerly (RM 126.4-RM 119.9). The station just below Southerly (RM 118.1) always scored higher than the station just upstream from it (RM 119.9). This observation correlates with modeling information in the CWQR which shows that the dissolved oxygen sag below Jackson Pike reaches its lowest point just above Southerly.

From RM 118.1 to RM 109.2, the Index of Biotic Integrity declines in all years but the delcine was more prounounced from 1979-1981 than from 1985-1986. This trend is also evident in the Composite Index. According to the CWQR, the gradual decline in dissolved oxygen concentration below Southerly is primarily responsible for the decline in structure and function of the fish community throughout this segment of the river. These conditions are probably linked to the impacts of the Southerly WWTP discharge.

TABLE 2-8. METRICS AND NUMERICAL RANKINGS USED IN THE INDEX OF BIOTIC INTEGRITY

Metric	5	3	1
Cumulative Species	>35	22-34	>22
Numbers/km[a]	>350	175-350	<175
Sunfish Species	>6	3-6	<3
Sucker Species	>8	4-8	<4
Intolerant Species	>9	5-9	<5
% Round-bodied Catostomids	>40	15-40	<15
% Omnivores	<25	25-50	>50
% Insectivorous Cyprinidae & Catostamidae	>30	10-30	<10
% Carp/Goldfish	<5	5-20	>20
% Top Carnivores	>10	5-10	<5
% Hybrids	<0.5	0.5-3	>3
% Anomalies	<0.2	0.2-3	>3

[a]less than 50 individuals/km scores 1 in all proportional metrics.

Source: Adapted from table provided by Yoder, January 1987a.

TABLE 2-9. INDEX OF BIOTIC INTEGRITY (IBI) SCORES FOR THE SCIOTO RIVER MAINSTEM

River Mile	1979	1980	1981	1985	1986
129.1	32	34	26	34	36
126.4	22	26	22	24	32
122.9[a]	24	30	28	32	40
119.9[b]	26	22	26	32	34
118.1	34	36	32	44	44
117.1	22	26	26	44	36
112.8[c]	6	26	24	36	36
109.2	-	-	-	42	44
108.8	8	14	26	38	36
104.8[d]	10	36	32	44	44
102.0	46	40	38	46	48
100.2	32	28	22	40	44

a RM 123.3 in 1985 and 1986.
b Moved to RM 119.0 in 1986.
c RM 114.0 in 1979 and RM 113.5 in 1985 and 1986
d RM 105.2 in 1985 and 1986.

NOTE: Study conducted during 1979-1986 using a modification for boat electrofishing samples. Source: Ohio EPA 1986a.

The sampling station below the Whittier St. CSO (RM 129.1) showed little improvement from 1979 to 1986 on the IBI scale, although the composite index for that station (Figures 2-5, 2-7) and for the segment including that station (Figure 2-3) showed considerable improvement. This indicates that the community is more impacted functionally than structurally. Improvements at the Whittier Street CSO site were due to increased numbers of fish and increased diversity, which included an increase in numbers of desirable groups (such as sunfish) and pollution tolerant species. Despite this improvement, no new insectivores moved in and the percentage of ominvores and hybrids increased. As a result, the community supports a large number of individuals and species, giving it a high structural rating, but the species are predominantly pollution and silt tolerant. Incidence of external anomalies and percentage of sunfish hybrids were consistently high and resulted in lower IBI scores.

The IBI scores for the sampling station below Jackson Pike (RM 126.4) were lower than those below the CSO for all years, but showed more overall improvement from 1979 to 1986. Composite index values for this station were also lower than for those just below the CSO. Effluent loadings of BOD, TSS and NH3-N showed increases or remained about the same over this time period but loadings of chlorine decreased, although levels are still considerably high. Reduction in chlorine may account from some of the noted improvement in IBI scores below Jackson Pike.

The metrics accounting for improvement at the Jackson Pike station were number of species and number of fish per kilometer. New species which moved into the area and contributed to increased diversity were sunfish and intolerant species. The percentage of top carnivores increased and the percentage of omnivores decreased, which improved the community functionally. Metrics indicating continuing problems at the station were a substantial increase in percentage of anomalies, disproportionately small numbers of the round-bodied catostimid group, and disproportionately large occurrences of hybridization among species.

At the station immediately below Southerly (RM 118.1), metrics reflecting improvement included increased density, and increased numbers of sunfish species, intolerant species and sucker species. A portion of the increase in sucker species was due to increases in numbers of round-bodied catostimids, which is one of the more sensitive types of suckers. It is noted that while the percentage of anomalies did not increase on the metric scale, despite the increase in pollution tolerant species, this station had a consistently high percentage of anomalies in all years. The percentage of anomalies actually showed some reduction in percentages from 1979-1986.

The station at RM 108.8 reflects the impacts of decreasing dissolved oxygen downstream from Southerly. This station is situated where DO concentrations whould be near their lowest (i.e., near the maximum DO sag). Metrics from 1979 reflect this observation, being very low in all categories except percent anomalies, percent hybrids, percent top carnivores and number of sucker species. The more sensitive sucker species are not represented. From 1979 to 1986, eight out of eleven categories improved on the metric scale. This station is typical of most stations below Southerly in that it showed substantial improvement over time.

In summary, both indices show that the fish communities improved over time at all stations. The greatest improvement occurred below Southerly and the least occurred between the Whittier St. CSO and Jackson Pike. The segment between Jackson Pike and Southerly showed moderate improvement. These results correlate well with the fact that reductions in waste water loadings were greatest below Southerly in the referenced time period.

The stations in the river below Southerly show the greatest increase in IBI scores and composite index scores over time. The improvement is attributed to reductions in loadings of BOD, solids, and ammonia, which reduced the severity of oxygen depletion. The reductions were primarily a result of decreased bypassing at Southerly. Loadings of chlorine also decreased at Southerly during this time period, further reducing stress-inducing factors to the aquatic environment below Southerly.

The frequency of external anomalies among individual fish from 1979-1981 (all species combined) was assessed in the study area as a possible indication of sublethal stress based on data in Table 2-10. The incidence of external anomalies ranged from as little as 9 percent in Segment 1 (1979 and 1980) to

TABLE 2-10. INCIDENCE OF LESIONS, TUMORS, FIN EROSION, AND EXTERNAL PARASITES AMONG INDIVIDUAL FISH COLLECTED IN SIX SEGMENTS OF THE SCIOTO RIVER

Segment	Number of Fish Affected/ Total Number of Fish			Percent Affected		
	1979	1980	1981	1979	1980	1981
Segment 1 (RM 145.5-134.0)	0/1839	0/1177	11/991	0%	0%	1.2%
Segment 2 (RM 133.9-127.2)	62/1256	29/1005	47/996	4.9%	2.9%	4.7%
Segment 3 (RM 127.1-118.9)	3/309	6/273	4/381	1.0%	2.2%	1.1%
Segment 4 (RM 118.8-99.7)	3/709	38/1075	54/1360	0.4%	3.5%	4.0%
Segment 5 (RM 99.6-89.7)	3/281	2/185	3/277	1.0%	1.1%	1.1%
Segment 6 (RM 89.6-70.7)	4/901	3/327	7/608	0.4%	0.9%	1.2%
Olentangy River (RM 132.3, 0.5)	11/261	0/179	15/162	4.2%	0%	9.3%
Big Walnut Cr. (RM 117.2, 0.5)	0/134	1/181	9/186	0%	0.6%	4.8%
Walnut Cr. (RM 106.1, 0.4)	1/42	7/126	4/33	2.4%	5.6%	12.1%

Source: Ohio EPA 1986a.

as much as 12.1 percent in the mouth of Walnut Creek. Located upstream of the Jackson Pike WWTP, fish in Segment 2 consistently had high affliction rates ranging from 2.9 percent in 1980 to 4.9 percent higher than background in 1979. Since this segment is partially impounded, it has a tendency to exaggerate the impact of intermittent inputs of heavy metals, oxygen demanding wastes, and other detrimental substances. Segment 4, which receives loadings of oxygen demanding wastes from the Southerly WWTP, had high percentages of affected fish in 1980 (3.5 percent) and 1981 (4.0 percent). These results correspond well with the degradation implied by the composite index.

OEPA developed a method combining the composite index and narrative biological criteria to evaluate the condition of the central Scioto River mainstem based on the 1979-1981 data. Based on these evaluations, the primary cause of observed negative effects on the mainstem fish community was determined to be the change in water quality attributable to point sources of wastewater. Less serious effects were attributed to urban and possibly agricultural nonpoint sources. Physical factors identified included river discharge, the influence of tributaries and dams, and variable habitat quality.

Of the 38 total active point sources located in the mainstem study area, the Jackson Pike WWTP and the Columbus Southerly WWTP were identified as having the greatest impact on the mainstem fish communities. The primary impact was from the discharge of oxygen-demanding wastes, which resulted in lower dissolved oxygen concentrations downstream from each WWTP. In combination with elevated concentrations of ammonia and zinc, the low dissolved oxygen levels depressed fish community diversity and abundance, resulting in a fish fauna comprised of predominantly tolerant species.

OEPA considers the potential for the full recovery of the central Scioto River mainstem fish communities to be good, primarily because of the existence of the high number of relatively undamaged tributaries (which provide a refuge for endemic species) and the apparent lack of serious residual effects (i.e., habitat modification, contaminated sediments) in the mainstem. The main tributaries expected to contribute to the recovery are Big Walnut Creek, Walnut Creek, Big Darby Creek, and Deer Creek. The recovery observed in the vicinity of the Columbus Southerly WWTP in 1980 and 1981 was considered partially a function of the availability of Big Walnut Creek as a refuge and repopulation epicenter. Tributaries undoubtedly played a part in the observed recovery upstream from Circleville in 1981. This location was in close proximity to both Walnut and Big Darby Creeks. The continued recovery of the mainstem fish communities, however, is dependent on efforts aimed at further reducing point source loadings of BOD_5, NH_3-N, suspended solids, and other detrimental substances (OEPA 1986a).

Fisheries: Tributaries to the Scioto River

Alum Creek, near the Franklin County line, supports 51 species of fish. Minnows, including the rosyface shiner, the bluntnose minnow, and the stone-roller minnow, are the most abundant. Also found in large numbers is the orange-spotted sunfish.

Nine of the 47 species of fish in Hellbranch Run are found along the entire length of the stream. Several of the species occurring in this stream, including shiners and minnows, are characteristic of prairie streams such as Hellbranch Run. These streams are frequently turbid, rich in organic matter, and have a lower gradient (Phinne 1967).

Of the 74 species of fish that occur in Big Walnut Creek, six species, including the endangered muskellunge, are introduced. Two other endangered species listed by the Ohio Department of Natural Resources (ODNR) that occur in Big Walnut are the blacknose shiner and the American brook lamprey. The large population of minnows in the stream serves as a source of food for other fish (Cavender and Crunkilton 1974).

Due to its high water quality and diversity of aquatic habitats, Big Darby Creek supports an unusually large variety of fish. One Federally endangered species (Scioto madtom) and several State-endangered species have been found in Big Darby Creek (bigeye shiner, river redhorse, tippecanoe darter, sand darter, and silver lamprey) (Cavender 1982). During the 1981 Scioto madtom survey, Cavender (1982) collected 59 species, representing 80 percent of all species recorded for a 10-year period.

Macroinvertebrates

Benthic macroinvertebrates have been widely used in pollution studies involving flowing waters since they have a number of characteristics that make them useful indicators of water quality. They form permanent or semi-permanent stream communities, are less transient than fish, are less sporadic in occurrence than microrganisms, and usually occur in statistically significant numbers. Species composition and community structure of benthos are determined by environmental factors that have existed throughout the life span of the organisms. Consequently, most types of pollution can alter the existing community structure.

A number of macroinvertebrate studies have been conducted in the Scioto River during the past 15 years (Olive and Smith 1975 cited in OEPA 1986a). The most recent survey was conducted by Ohio EPA in 1981. A summary of these findings and a detailed comparison to previous studies are contained in the CWQR (OEPA 1986a).

Figure 2-8 illustrates the number of benthic macroinvertebrate taxa collected at stations along the Scioto River in 1974, 1980, and 1981. Community composition and density of benthic macroinvertebrates between RM 130 and RM 106 reflects considerable variability. In general, the numbers of taxa are depressed in a stretch of the Scioto between Whittier Street CSO/Jackson Pike WWTP and Southerly, with rapid recovery at the confluence of Big Walnut Creek. Below Big Walnut Creek, the numbers of taxa remain relatively constant. The rapid recovery at the confluence of Big Walnut Creek is believed to result from benthos repopulating the Scioto as "drift" from the higher quality aquatic environment of Big Walnut Creek.

Data from 1980 and 1981 are typified by the general pattern described above. Data from 1974 also reflected the characteristic decline from Whittier Street/Jackson Pike through Southerly; however, the downstream recovery was much more gradual, and the numbers of taxa did not return to the upstream levels until much further downstream (below Deer Creek). This observation correlates well with water quality records and other observations which indicate improved habitat conditions in the downstream Scioto in recent years.

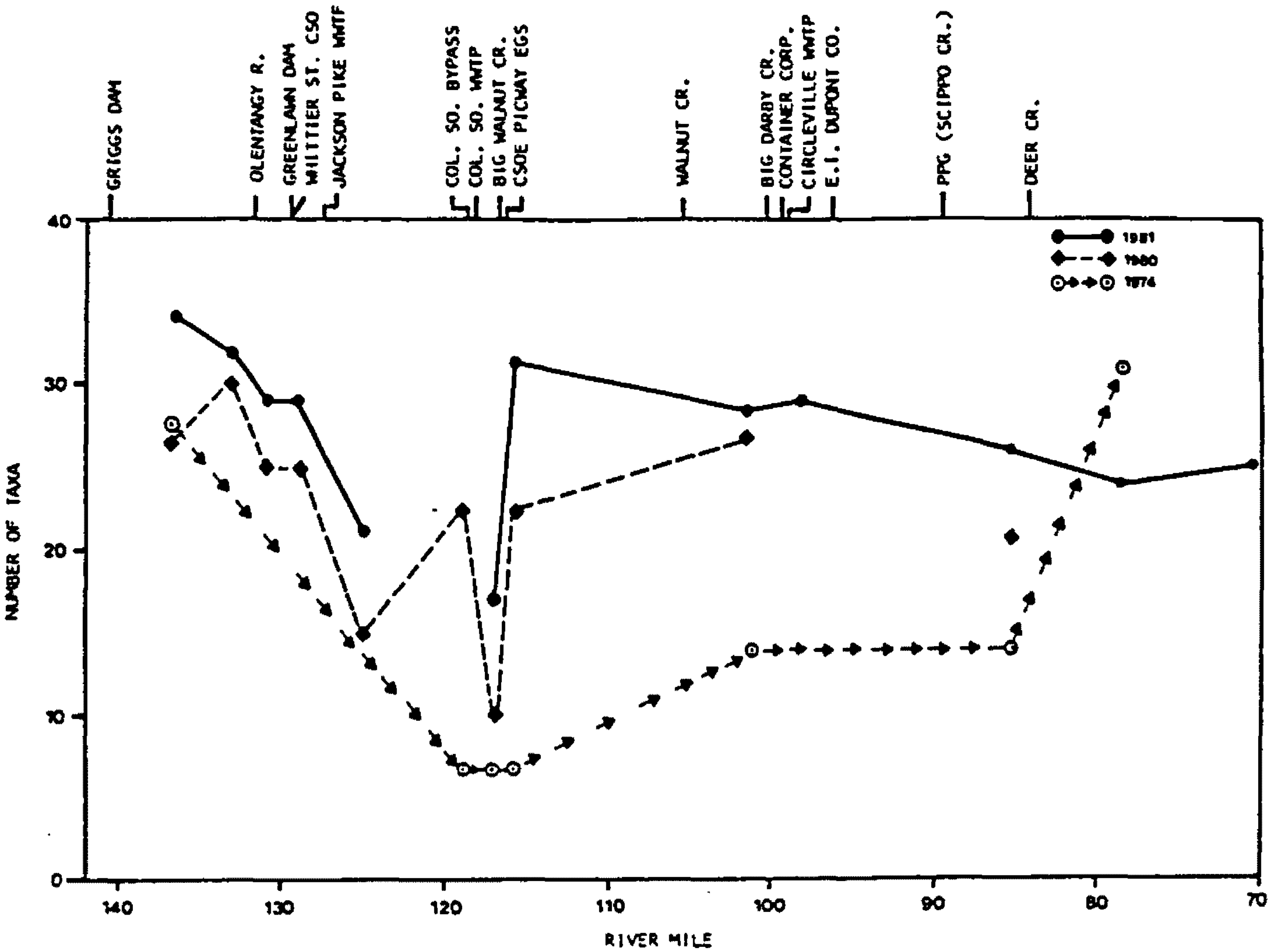


FIGURE 2-8. NUMBER OF BENTHIC MACROINVERTEBRATE TAXA

NOTE: Collected from artificial substrata/samplers in the central Scioto River mainstem study area in 1974, 1980, and 1981.
Source: Ohio EPA 1986a.

Reductions in bypassing at Southerly during low flow periods in 1981 and higher effluent qualities are hypothesized as influencing the improvement in benthos (OEPA 1986a).

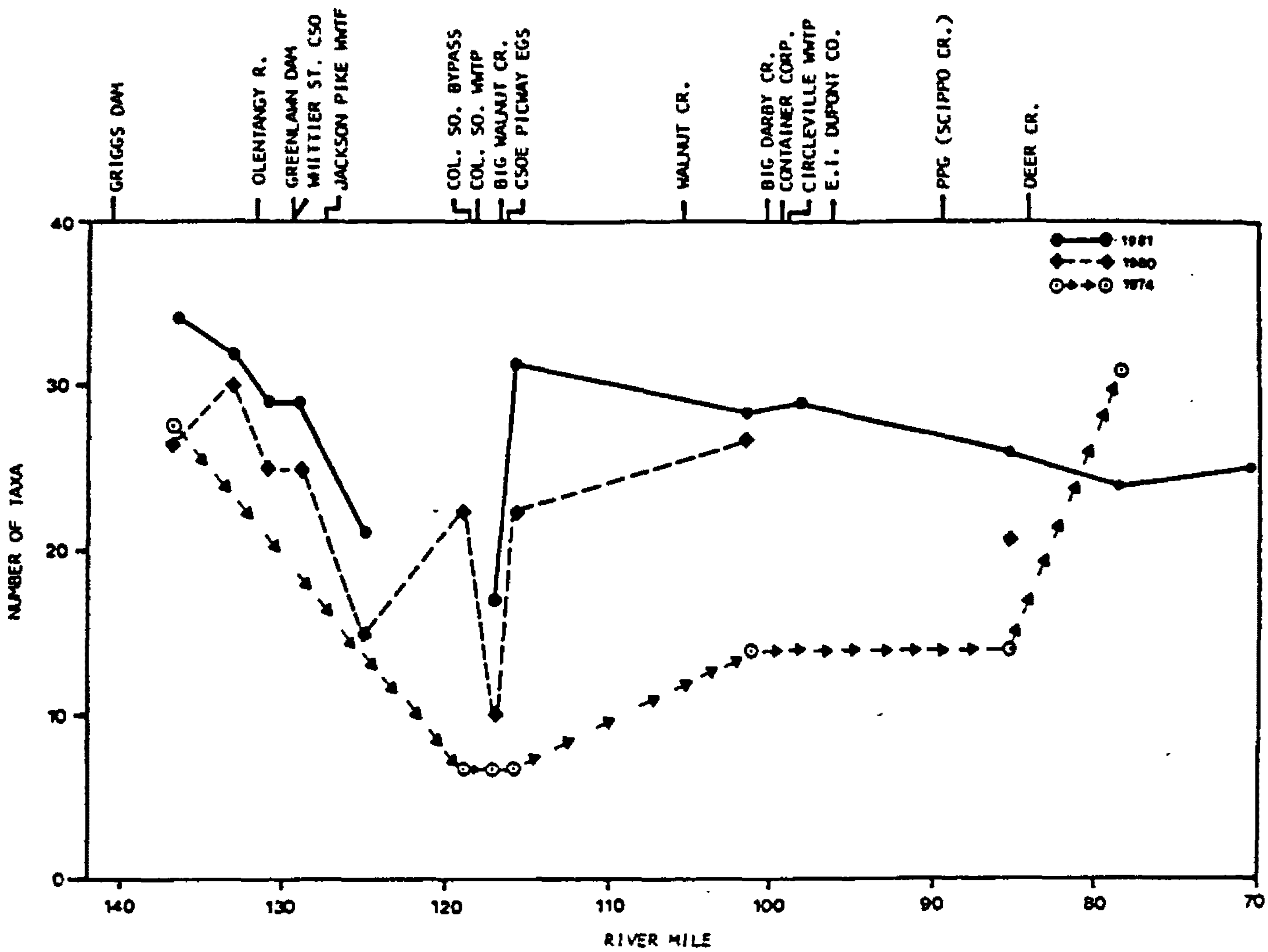
Most recent macroinvertebrate data (1981) reflected strong improvement in water quality compared to past sampling efforts, especially these by Olive in 1969 and OEPA in 1974. Stations downstream from the Columbus WWTP in these surveys reflected severe water quality degradation while comparable 1981 stations had consistently higher diversity, larger number of taxa, and improved species composition.

Mollusks

Mollusk populations of the Scioto River have not been thoroughly sampled and described since Higgins (1856). Fauna below the WWTP effluent discharges are considered significantly reduced and almost nonexistent (Stansbury 1986). Stansbury indicated that sampling between 1955-1970 revealed some species of mollusks in the banks of the Big Darby Creek near its confluence with the Scioto River and within the Circleville Riffle, a mixing zone of the Scioto River and Big Darby Creek. Some species were also found in Big Walnut Creek. No species of mollusks were found in the Scioto River proper. Stansbury noted that relatively good fauna may be found above and below areas significantly influenced by WWTP effluent, particularly above the Jackson Pike WWTP. The potential for reestablishing a viable mollusk population through the removal of inadequately treated WWTP effluent may be good, although other limiting factors (e.g., pesticides) may affect the repopulation of these areas.

2.1.4.3 Wetlands

National Wetland Inventory Maps are not available for the Columbus area; however, several of the soil series within the FPA indicate good potential for wetland habitat. These series include Carlisle, Condit, Kokomo, Montgomery, Pewamo, Sloan, and Westland. Using these series as an indication of wetland coverage within the FPA, an estimated 15.7 percent of Franklin County could potentially be comprised of wetlands. If these lands are used for agricultural purposes, they may not be designated wetland areas within State or Federal regulatory jurisdiction. The Scioto River wetlands appear to have



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2.1.4.4 Endangered and Threatened Species

Appendix H lists all rare animal and plant species known to occur or with the potential of being found within the FPA. Federal and State status of these species are provided.

Plants

Several Ohio State threatened plant species have been sighted in the FPA based on records of the ODNR Natural Heritage Program. The locations of these plants in the FPA is well removed from the Scioto River, so they should not suffer from direct impacts. The sighted species are the following: Narrow-leaved Toothwort (Dentaria mulfida), Three-birds Orchid (Triphora trianthopora), Prarie False Indigo (Baptisia lactea), Spider Milkweed (Asclepias virdis), and Showy Lady's-slipper (Cypripsadium reginae).

Terrestrial Animals

Four Federally endangered animal species may be present within the FPA. These species are the Indiana bat (Myotis sodalis), the bald eagle (Haliaeetus leucocephalus), the peregrine falcon (Falco peregrinus), and Kirtland's warbler (Dendroica kirtlandii).

The Indiana bat was sited in Pickaway County and it is likely that it may be found within the FPA (Multerer 1986). The Indiana bat winters in caves and is found along streams and adjacent woodlots during summer. The Indiana bat has been found to use loose bark of a dead tree for the nursery roost, but sometimes the bats temporarily move to the bark crevices of a living shagbark hickory tree (Humphrey et al. no date).

The bald eagle, the peregrine falcon, **and the piping plover** have been recorded within the FPA (Thomson 1983). All of the federally endangered bird species migrate through the FPA, but none of these species have been known to nest in Ohio (Milterer 1986; Ohio Department of Natural Resources 1983).

Mollusks

None of the Federally endangered bivalve mollusks are expected to be found within the FPA (Multerer 1986). However, 13 of the 16 unionid mollusks listed by Ohio as endangered animals have been recorded from the Scioto River below Columbus, Ohio (Stansbury 1986). The endangered unionid mollusks recorded below Columbus are listed in Appendix H. One of these species, Lampsilis orbiculata (pink mucket pearly mussel), is also listed as a Federally endangered species, but has not been recorded in the area in the recent past. Based on records of the ODNR Natural Heritage Program, only five of the species listed in Appendix H have been sighted in the FPA since 1950. These species are: Simpson's Shell, Cob Shell, Club Shell, Northern Riffle Shell, and Fragile Heelsplitter (Stansbury 1987).

Fishes

No Federally endangered fish species are expected to occur within the mainstem Scioto River in the proposed impact area (Multerer 1986). Only one Federally endangered fish, the Scioto madtom (Noturus trautmani), is found within the Facilities Planning Area. However, this species is found only in Big Darby Creek.

The Scioto madtom (Noturus trautmani) is a fish species endemic to the facilities planning area which is FPA listed as both Federal and State endangered. This particular species is considered endemic to Big Darby Creek. Cavender (1982) conducted a 1-year survey (Nov. 1981-Oct 1982) on Big Darby Creek in an attempt to find the extant population of the Scioto madtom; however, this species was not collected and has not been collected to date (Cavender 1986). Assuming the Scioto madtom is not extinct, Cavender (1982) hypothesized that it lives in the lower end of Big Darby Creek, but is so rare that in most years it cannot be sampled by seining. The other hypothesis is that the Scioto madtom no longer lives in Big Darby Creek (its habitat was taken over by other species), but it may live elsewhere in the Scioto River basin.

Eight state-listed fish have been sighted in the Columbus study area, based on ODNR Natural Heritage Program data. These species are: blacknose shiner, Tippecanoe darter, spotted darter, slenderhead darter, northern brook lamprey, mooneye, river redhorse, and paddlefish. Two additional species, lake chubsucker and shortnose gar were reported by OEPA as being sighted in the study area (OEPA 1986a).

The river redhorse, mooneye, and shortnose gar were the endangered species collected in 1985 and 1986 by OEPA during the Scioto River surveys. These species were also caught during the 1979-1981 surveys of the Scioto mainstem. Known populations of blacknose shiner, slenderhead darter, and spotted darter currently exist on tributaries to the Scioto (Fritz 1986). The lake chubsucker was collected in the Scioto by OEPA during the 1981 survey but not during 1985 and 1986 surveys. The paddlefish has not been seen on the Scioto or in the study area since 1976.

The river redhorse was the state endangered fish most often found during the fish surveys conducted during 1979-1981 and 1985-1986 by OEPA on the central mainstem of the Scioto River. It was captured at several locations ranging from RM 138.6 to RM 70.7. The population in the Scioto may be growing because the numbers caught each year have increased steadily. In 1986 eight were caught and prior to that between one and four had been caught per year.

The river redhorse is generally found on medium sized streams having gravelly or rocky bottoms and continuous strong flow. It is highly sensitive to siltation, turbudity, and intermittent flow. It feeds in pools on small mollusks, snails, and insects. Spawning occurs in spring and is proceeded by upstream movements. The spawning fish gather in schools over shallow gravelly riffles.

Little information exists on the habits and life history of the mooneye. In 1986 it was sighted at RM 102 and RM 100.2 in the Scioto. It is generally found in larger pools of streams and in open areas of reservoirs. Its diet consists primarily of insects and small fish caught near the waters surface. It spawns in spring.

A population of Tippecanoe darters is believed to exist in Big Darby Creek near the town of Fox and in Deer Creek. This darter is usually found on riffles with slow or moderate currents and a bottom of clean gravel and sand. The species spawns during spring along fringes or riffles in water three to eighteen inches deep. The Tippecanoe darter, like most darters is highly intolerant of silt. In winter months it abandons riffles for pools two to five feet deep where currents are sluggish.

The slenderhead and spotted darters are similar to the Tippecanoe darter in habitat requirements and life cycle. These darters are intolerant of turbidity and spawn in spring on riffles. Both darters are commonly found in larger clean streams among larger rocks in swift currents. The slenderhead exhibits more variability in habitat selection than the spotted darter. The spotted darter is believed to have a relict distribution pattern in the Ohio River basin.

The lake chubsucker, shortnose gar, and paddlefish are not common inhabitants of the central mainstem of the Scioto River. These species are most commonly found in ponds, oxbows, or backwaters where currents are sluggish. Waters are clean and submerged aquatic vegetation abundant. Such habitat is apparently not well developed within the Columbus study area. Thus presence in the Scioto is historically rare.

2.2 MAN-MADE ENVIRONMENT

The objective of this section of the environmental setting chapter is to discuss present socioeconomic characteristics of the planning area that are essential for identifying and assessing primary and secondary impacts of the proposed action as presented in Chapter 6. Therefore, the description of the man-made environment focuses on the following factors:

- Income (Economy)
- Public Service
  - Transportation
  - Water and Sewer Services

- Other Public Utilities
- Public Safety
- Health Care
- Education
- Community Services

- Public Finance
- Cultural Resources.

2.2.1 Income

There are five aspects of income that are used to indicate the economic health or stability of an area. These aspects are listed below:

- Unemployment
- The number of new jobs created
- The number and type of employers
- The number and type of jobs in the area
- Personal income levels.

Using these indicators, the Columbus area appears to have a healthy economy and diverse economic base.

The area's unemployment rate has remained low, even during recessionary times. According to the Ohio Bureau of Employment Services, the area's unemployment rate peaked at 9.3 percent in the 1982 recession; the State's rate peaked at 12.5 percent; and the Nation's rate peaked at 9.6 percent. Franklin County's unemployment rate remained under these levels at 8.8 percent. This rate dropped to 6.2 percent for the first 6 months of 1985 (Columbus Area Chamber of Commerce 1985). Franklin County outperformed the Nation in number of new jobs created during the period between 1978 to 1984. Over 42,000 new jobs were added to the Columbus MSA employment base during that period. This brought the total number of persons employed in the county to 557,000. This figure represents an average increase of 7,000 jobs per year in Franklin County. As these figures indicate, the area is not susceptible to recessionary trends and has a strong growing economy.

Columbus weathered the 1982 recession better than expected for several reasons. First, it is not an industrial town. Columbus has a service-based economy. The largest employer is the State University followed by the State government. Combined, these two State institutions provide 48,000 jobs. The Federal government is the third largest employer with 10,533 employees. Table 2-11 lists the number and type of firms in the Columbus area along with the number of employees each industry employs. As this table indicates, service industries provide the largest number of jobs, over 94,000. Table 2-12 lists the employment trends of these industries. As this table indicates, the financial and service industries are the fastest growing sectors of the local economy. Second, Columbus is the corporate headquarters for two Fortune 500 companies and over 250 firms with sales in excess of $10 million. Some of these firms include Borden, Inc.; Bob Evans Farms; Nationwide Investing; Wendy's International; and The Limited Co. Finally, the city of Columbus and its Chamber of Commerce actively promote economic development in the region. This policy has resulted in a diverse economy that is able to absorb fluctuation in the national economy.

As a result of this diverse economy, income levels are higher than average in the Columbus area. The per capita income in Franklin County is higher than the MSA, State, and Nation. The county per capita income is 102 percent of the national average and 106 percent of the State average (see Table 2-13). The per capita incomes for political subdivisions within Franklin County are shown in Chapter 6. Several areas within the county have unusually high income levels. These areas include Bixby, Dublin, Riverlea, Marble Cliff, Upper Arlington, and Worthington. Comparing growth rates with income levels indicates that the county is growing both in the upper income and lower income communities. The growth rate for Dublin, a community with an average per capita income of $18,392 was 29.1 percent, while the rate for Urbancrest, a community with an average per capita income of $5,091 was 23.4 percent in the period between 1980 and 1984. The per capita income in 1984 for Franklin County was $13,035. The county's median family income in 1980 was $20,970. This was 104 percent above the State median family income and 105 percent above the Nation. The median family income in the State was 7.6 percent above the median national family income in 1969; this difference had decreased to 5 percent by 1979. Furthermore, the median family income in

TABLE 2-11. INDUSTRIES OF FRANKLIN COUNTY (1982)

	Number of Firms/ Establishments	Annual Payroll ($000)	Number of Employees
Agricultural Services Forestry, Fisheries	197	$ 25,596	1,736
Mining	73	$ 18,899	984
Contract Construction	1,353	$ 293,775	13,640
Manufacturing	1,003	$1,375,581	63,899
Transportation and Other Public Utilities	534	$ 478,871	20,581
Wholesale Trade	1,702	$ 579,953	29,150
Retail Trade	4,565	$ 802,207	80,760
Fire	2,087	$ 635,173	38,289
Services	6,354	$1,287,821	94,516

Sources: Bureau of the Census 1983; Columbus Area Chamber of Commerce 1985.

TABLE 2-12. COLUMBUS MSA EMPLOYMENT (1978-1983) TRENDS

	1987 Employment	1983 Employment	% of Total 1983 Employment	Percent Change 1978-1983
Finance, Insurance, and Real Estate	34.6	44.2	8.5%	+27.6
Services	92.5	110.1	21.3%	+19.0
Wholesale/Retail	127.5	132.9	25.7%	+4.2
State and Local Government	82.8	85.9	16.6%	+3.7
Transportation & Public Utilities	23.6	23.2	4.5%	-1.6
Manufacturing	116.2	99.2	19.2%	-14.6
Mining	1.3	1.0	.2%	-19.2
Construction	22.2	17.1	3.3%	-22.7

Source: Columbus Area Chamber of Commerce 1985.

TABLE 2-13. PER CAPITA INCOME LEVELS FOR THE COLUMBUS MSA

	Personal Income Average Annual Growth Rate*	Per Capita Personal Income		Per Capita Income as a % of National Average in 1984
		1980	1984	
State of Ohio	7.48	$9,401	$12,326	97
MSA	8.35	$9,282	$12,609	99
Delaware	9.98	$9,251	$12,508	98
Franklin	8.11	$9,577	$13,035	102
Fairfield	9.22	$8,771	$12,025	94
Licking	8.57	$8,625	$11,621	91
Madison	8.77	$7,696	$10,016	100
Union	9.41	$8,720	$11,479	90

Source: Bureau of Economic Analysis 1986.

Franklin County was 2.7 percent above the State income in 1969, but was only .3 percent higher in 1979. By 1979, the county income was 12.7 percent higher than the city income level, up from 8.8 percent in 1969. This reflects a concentration of higher income white collar households in the suburban areas. Median family income levels are also higher for Franklin County than the U.S. or Ohio. Median family income is discussed further in chapter 6.

2.2.2 Public Service

Local governments provide a number of essential services. These include fire and police protection, water and sewer service, local roads, and public education. Public utilities provide other services such as electricity. Those services that are required as part of the development process or require a large physical plant are part of a community's infrastructure. This infrastructure includes water and sewer lines, roads and bridges, and in some communities electric and gas lines. Many communities require impact fees to pay for these services or require a staged development plan to limit the impacts of growth upon these services. Although local planners advocate such sound planning practices, these techniques are not formally practiced in the Columbus area. This rapid and uncontrolled development has placed a strain on many of the area's essential services. In most cases each of these essential services has been strained as a result of this constant and ever increasing growth.

The Development Committee for a Greater Columbus is in the process of studying the area's infrastructure needs. This committee is working with the Mid Ohio Regional Planning Commission (MORPC) and other public agencies to set criteria for funding availability, health and safety standards, and minimizing the impacts of development on the local community. Bridge repairs, road repairs, increasing the city's water supply, and upgrading the sewer system are the four areas of most concern to this local citizens group. The committee recommends a consistent method of financing capital improvement projects and increased surtaxes and fees to finance these improvements (Development Committee for a Greater Columbus 1986). It is the responsibility of the State and local government to anticipate necessary improvements and incorporate the funds to provide these improvements in the budget process.

Below is a discussion of each of these services:

- Transportation
- Water and Sewer Services
- Other Public Utilities
- Public Safety
- Health Care
- Education
- Community Services (Cultural Activities)
- Recreation.

2.2.2.1 Transportation

Transportation systems, both public and private, play a vital role in the growth and economy of the Columbus Metropolitan Area. Because of Columbus' strategic location, its transportation systems provide easy access to the markets throughout the United States. As a result, Columbus is becoming a major distribution center.

The Columbus Metropolitan Area has a network of more than 200 miles of expressways. This network of roads consists of local streets and an inner beltway that feeds into the outer beltway at various junctions. The following roads serve the city of Columbus: I-71, east; I-70, south; State Road 315, west; and I-670, south. Interstates 70 and 71 (670 when it is completed) and State Road 315 comprise the inner beltway. I-670 will be completed in the early 1990s. Traffic congestion usually occurs east and north of the downtown Columbus area during morning and evening rush hours. It is expected that I-670, when it is operational, will relieve much of the traffic congestion from I-71.

The northwestern section of the Columbus Metropolitan Area is experiencing severe traffic congestion during morning and evening rush hours and on weekends. The roads in this area have exceeded their overall traffic capacity. As a result, Bethel Road from east of Sawmill Road to Olentangy River Road is expanding to four lanes. This project has already been funded and is under construction. There is a plan to widen Sawmill Road but it has not yet been funded. Road improvements for the Dublin area have not been planned.

During morning and evening rush hours, traffic congestion occurs near and around I-270 access roads. Projects that have been funded include widening Broadway from two to five lanes from Southwest Boulevard to I-270, widening Cemetery Road from Leap Road to I-270, and widening Cemetary Road from two to four lanes from Main Street to Leap Road.

The city of Columbus receives financial assistance from the Ohio State Department of Transportation to maintain all roadways (including State owned) for the Columbus Metropolitan Area. Developers are 100 percent responsible for repairing and constructing roadways within their areas of construction. Through negotiations with the city or Planning Commission, developers become responsible for offsite improvements, such as widening a roadway on the outskirt of their jurisdiction.

Four airports located in Franklin County serve the Columbus Metropolitan Area. Port Columbus International Airport is owned and operated by the city of Columbus. There are direct flights from Port Columbus International Airport to 22 major cities, including New York, Boston, Washington, Chicago, and Los Angeles. Port Columbus International Airport is not directly accessible from any of the interstates. Major traffic congestion usually occurs during rush hours between the airport and downtown Columbus. By the early 1990s, traffic congestion should be reduced when the I-670 interchange is completed.

Other airports that serve the Columbus Metropolitan Area are Don Scott, Bolten Field, and Rickenbacker. Don Scott, a general aviation airport, is owned and operated by Ohio State University. It is the fourth busiest airport in the State, and serves private and corporate jets. Don Scott Airport is located in the northwestern part of Franklin County. The city of Columbus owns and operates Bolten Field Airport. This airport serves only private planes. Rickenbacker Airport is the largest air-freight hub of the Flying Tigers Air Cargo Company. The Columbus Port Authority owns and operates this airport.

Columbus is a major rail junction for the Chessie, Conrail, and Norfolk and Western railroad lines. Conrail's new Buckeye Yards have enabled local businesses to conveniently and economically transport supplies and products in and out of Central Ohio.

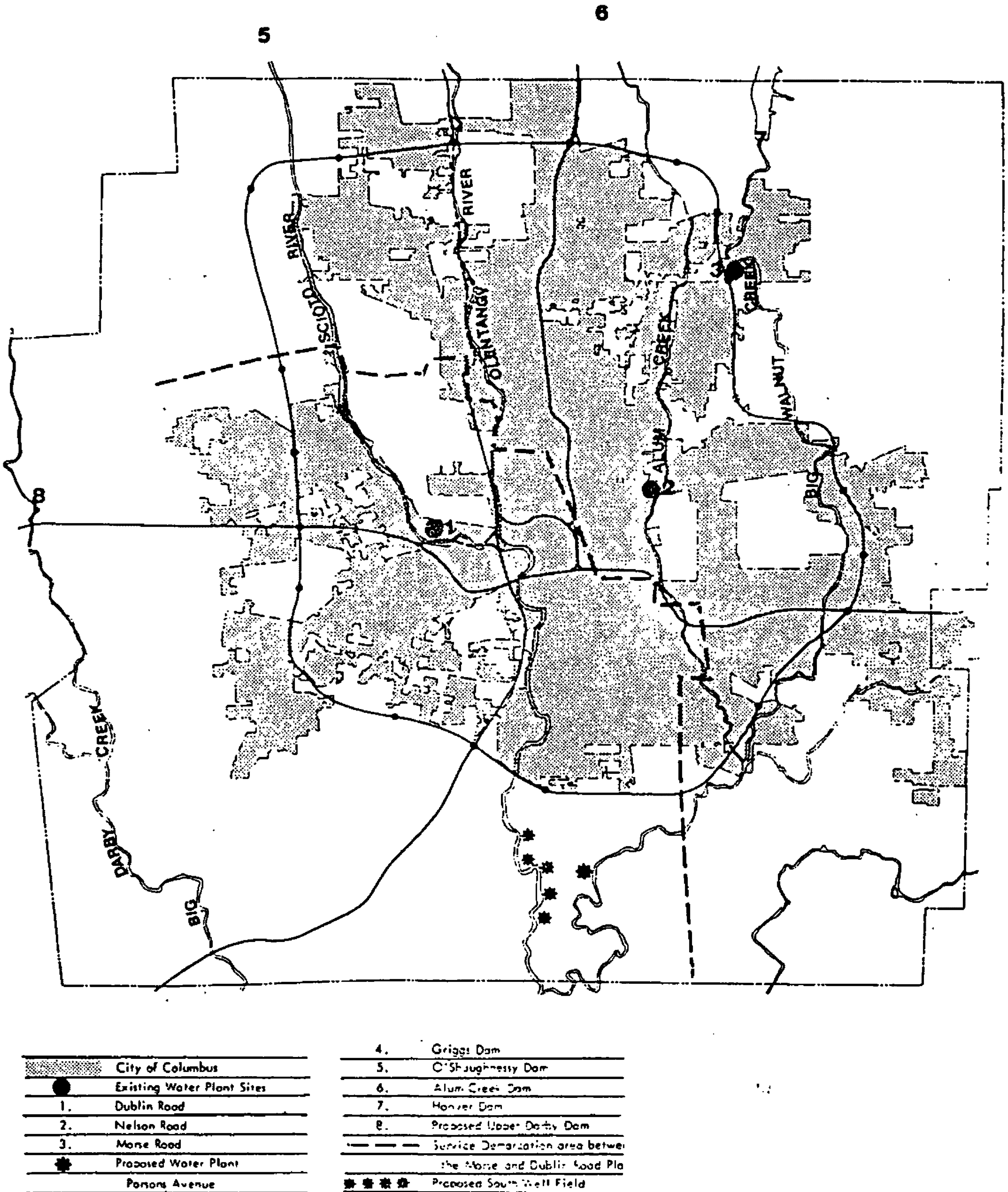
Over 100 trucking companies provide freight movement for Columbus businesses with at least 19 companies transporting goods to any North American location.

The Central Ohio Transit Authority (COTA) provides bus transportation within the Franklin County service area. COTA is expanding its bus routes to serve the nonradial travel patterns of suburban residential and work areas by use of crosstown route expansion and reverse commute planning.

2.2.2.2 Water and Sewer Services

The Columbus Division of Water serves over 200,000 accounts in the greater Columbus metropolitan area. Each year, over 45 billion gallons of water are treated and pumped to supply the industrial, commercial, and domestic needs of a growing Columbus. Operating with an annual budget of over $50 million, the Division maintains 17,000 fire hydrants and over 2,500 miles of water lines. The Scioto River, Big Walnut Creek, and the South well field are sources of raw water for the Division's three treatment plants. The combined supply capacity of these facilities is over 175 million gallons a day.

Figure 2-9 shows the location of city water treatment plants and reservoirs. Reservoirs include O'Shaughnessy and Alum Creek located in Delaware County, Hoover located partly in Delaware County, and Griggs located in northwestern Franklin County. A sewer interceptor line runs under the Griggs reservoir. This interceptor line is reaching capacity. If an overflow occurs, this water source may be contaminated. Water from these sources is treated at the Dublin Road and Morse Road plants; the Nelson Road plant serves as a backup. The deep well field on Parsons Avenue has been completed. This facility is presently used to supplement the current surface sources as well as to be the primary source of water to new development in the southern part of Franklin County.



SOURCE: 1979 EIS

FIGURE 2–9
COLUMBUS WATER SYSTEM

The safe yield of water from these sources is presently 175 MGD; peak load is 235 MGD (City of Columbus 1986c). This capacity is sufficient to sustain the present rate of growth until the year 2000 provided additional sources are found by 1991 (Development Committee for a Greater Columbus 1986). During the summer of 1986, the city was forced to implement a dry water conservation program. To meet long-term demands, however, new sources must be developed. One source under consideration is the Upper Darby Creek. Development of this source is still in the planning stage.

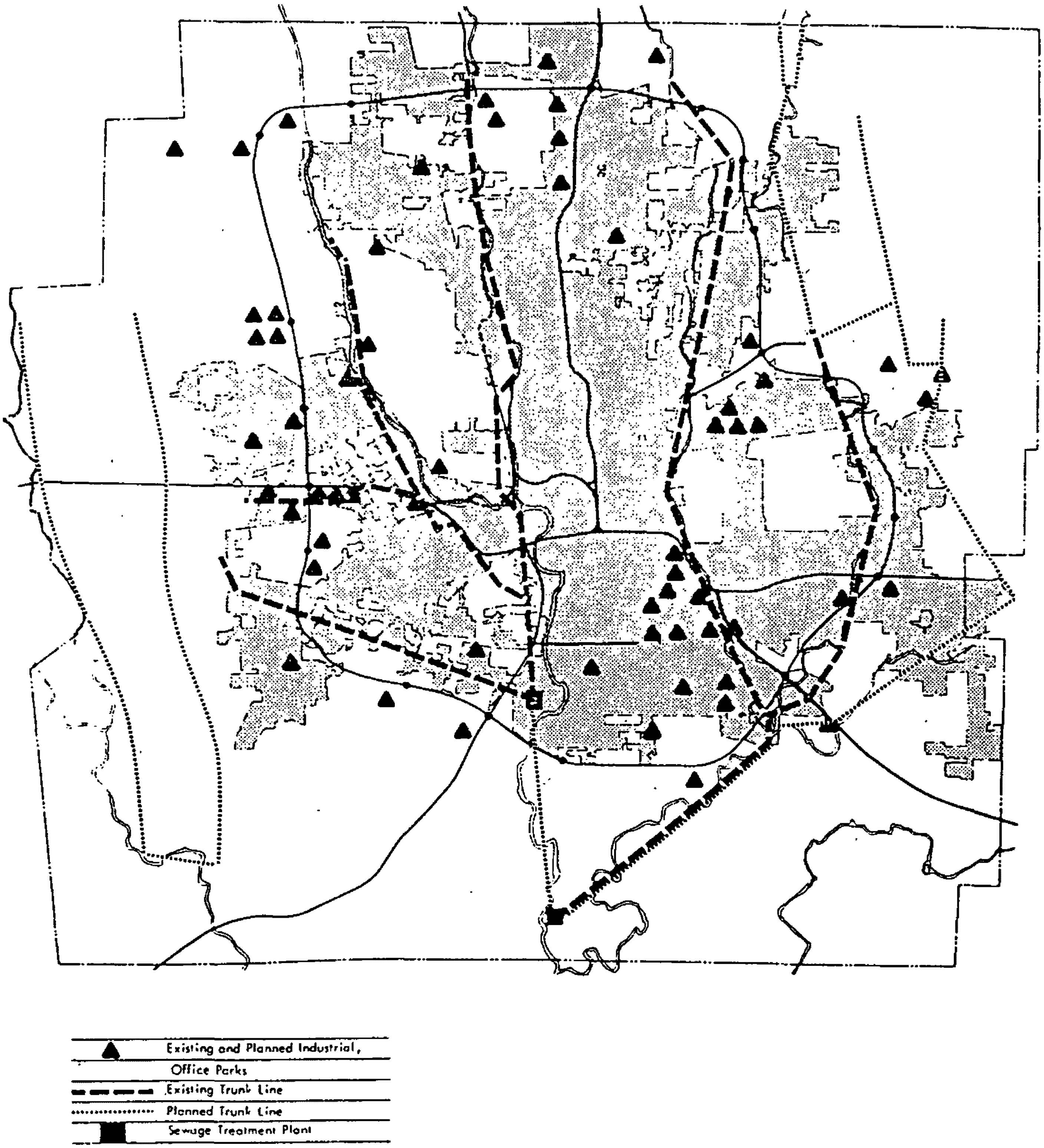
The city of Columbus sewer system consists of over 2,780 miles of storm, sanitary, and combined sewers. The system receives an average of 149 million gallons of severage per day at the Southerly and Jackson Pike Treatment Plants. Figure 2-10 shows the location of sewer facilities and the existing service areas. The system is primarily a gravity system with minimal pumping and conforms to the downstream flow which runs north-south through Franklin County (City of Columbus 1986c).

2.2.2.3 Other Public Utilities

Natural gas, oil, and coal are all produced in Ohio, with coal the most abundant resource. Ohio ranks fifth among the states in coal production and has a supply of coal that is estimated to be enough for about 500 years. Ohio has excellent electric generating capacity, well in excess of demand. Nearly 96 percent of Ohio's electricity comes from coal-fired boilers.

The Columbus area is served by Columbus and Southern Ohio Electric Company, one of the eight operating companies of the American Electric Power system. This system operates in six states and has a generating capacity of over 22 million kilowatts. About 85 percent of this generation is from coal-fired units.

The city of Columbus, through the Division of Electricity, provides power for the city's street lighting and other facilities. This plant is also a member of the American Electric Power Grid System. The Columbus Refuse and Coal Fired Municipal Electric Plant, owned and operated by the city of Columbus, generates electricity through the burning of refuse. The plant is capable of burning 3,000 tons of refuse per day and has the capacity to generate 90 megawatts of electricity (City of Columbus 1986b). Columbus plans to purchase new collection vehicles and expand its collection area once the shredder system is upgraded.



SOURCE: COLUMBUS, OHIO, DEPARTMENT OF DEVELOPMENT DIVISION OF PLANNING

FIGURE 2–10
SEWER TRUNK DESIGN VS. INDUSTRIAL PARK SITES

Additional electricity is generated by the recently completed O'Shaugnessy Power Plant adjacent to the reservoir. This plant's peak generating capacity is five megawatts. It provides street lighting to several subdivisions within the city (approximately 2,000 to 6,000 homes) and is operated by the Water Division (Bowman 1988).

Columbus Gas of Ohio, Inc. distributes natural gas throughout Columbus and the surrounding area. Gas is fed into the city system through five border stations located on all sides of the city. This gas goes into a high-pressure loop system which nearly parallels the outerbelt. From this high-pressure belt, the pressure is reduced to medium pressure (5-50 psig), intermediate pressure (1-5 psig), and low pressure for distribution to the 260,984 residential, 16,505 commercial, and 208 industrial customers in the area.

2.2.2.4 Public Safety

There are 55 different public safety agencies operating at various levels of government in Franklin County. Although all of these agencies work hard to meet the needs of the citizens they serve, there is an obvious duplication of services when so many different units are operating in one area. The problem is compounded by the city's separate annexation pattern. There are many pockets of unincorporated areas nestled within Columbus. These areas are served by the Franklin County Police and Fire Departments. This sporadic pattern of development forces the rural-oriented County Sheriff's office to increase its surveillance in urbanized areas.

In February 1977, MORPC completed a report on fire protection services in Franklin County. It describes and analyzes services available in all townships and incorporated areas. According to the report, Franklin County is served by a total of 25 fire departments:

- 15 township departments
- 5 city departments
- 3 village departments
- 2 federal facilities
- 1 unincorporated private department.

Seven jurisdictions have contract arrangements for fire services. Coordination of fire services is not the responsibility of any single organization. Several groups perform various training, prevention, and coordination functions.

The City Fire Department has 843 employees and the following fire equipment: 28 stations, 4 heavy rescue vehicles, 28 engine companies, 4 paramedics, 10 ladder companies, and 9 squads. The city plans to hire an additional 108 recruits in fiscal year 1987 (City of Columbus 1986b).

There are 31 different police forces operating in Franklin County. These units vary from the part-time marshall monitoring a small village to the city of Columbus police force which includes over 1,500 full-time employees. The County Sheriff patrols the entire county but has a special contract for the unincorporated areas of Praire, Hamilton, Norwick, and Washington townships. The towns of Pleasant, Jackson, Truro, Jefferson, Cain, and Brown do not have a contract for increased service nor do they have their own police force. The County Sheriff has 10 to 12 patrol cars on duty per shift. There is one deputy per car.

According to Chief Kramer, the Franklin County Sheriff's office is understaffed and is experiencing an increase in crime as the county shifts from a rural area to a suburban/urban economy. The crowded roads have decreased the sheriff's response time. Traffic accidents are more frequent and more serious. In 1985, there were less than 10 fatal accidents in the county. In the first nine months of 1986, this number had increased to 23. The newly renovated county jail is at capacity and is considering further expansion.

The sheriff's department keeps a fire radio in all patrol cars in order to keep in constant touch with the fire service. On July 1, 1986, the county expects to implement 911 service from its new communication center at the Old Woman's Work House. At that time, the County Sheriff will be responsible for dispatching all fire and police equipment (Kramer 1986).

2.2.2.5 Health Care

The Columbus area has 12 operating hospitals with 5,565 beds. This is approximately one bed for every 160 persons. The area has 2,500 physicians, leaving one physician for every 350 individuals. In addition, there are 90 dentists in the area and 90 clinics serving the area. Six of these clinics are financed by the city of Columbus. The city also offers a variety of at home nursing services.

Of the 12 hospitals, one (Grant Medical Center) has a Lifeflight operation that carries critically injured patients as far as 125 miles away to its emergency care facility. Childrens Hospital in Columbus, one of the three largest pediatric care facilities in the nation, will open its expanded research facility in 1987. Ohio State University is a leader in diagnostic care and is an authorized cancer center. According to the American Hospital Association, Columbus health care costs are lower than the national average (Columbus Area Chamber of Commerce 1985).

2.2.2.6 Education

There are 17 different school districts operating 226 public schools in Franklin County. In addition, there are 26 private and parochial schools with over 12,000 students. There are 13 colleges located in the county with an enrollment exceeding 75,000 students. In addition, there are 35 public libraries: one main branch, 20 branches in the city of Columbus, and 14 suburban branches (Columbus Area Chamber of Commerce 1986).

In the public school system, there are 141,289 students and 7,804 teachers; this results in a student teacher ratio of 18 students per teacher. Almost half of these students or 66,158 pupils attend one of the city of Columbus' 130 schools. The remaining 75,131 students are divided between the remaining 16 districts. Since these districts are considerably smaller than the Columbus school system, the city offers special programs for the learning disabled or visually or hearing impaired to students outside the city's school district boundaries (Columbus Area Chamber of Commerce 1985).

In 1971, the Columbus school system had a record high enrollment of 111,000 students. Enrollment has declined due to a national decline in birth rates and a realignment of suburban school districts associated with a 1979 Desegregation Ruling by the U.S. Supreme Court. In 1985, enrollment leveled off.

The system's enrollment decreased and the district was forced to close some schools. Now that the birth rate is increasing and the overall population in the city of Columbus is also increasing, the district is studying the possibility of reopening six closed schools for the 1987 school year (Lower 1987). These schools will be used to help augment the city's alternative school and neighborhood school programs. The Columbus area population is well educated in 1980. Over 73 percent had a high school education and 21.2 percent were college graduates (Bureau of the Census 1983). Figure 2-11 shows the various school districts within Franklin County. The smaller developed districts such as Bexley, Whitehall, Upper Arlington, and Grandview Heights, have experienced declining enrollments and have been forced to close some of their schools. School districts located in growth areas, such as Dublin, Worthington, and Hilliard, have inceasing enrollments and plan to build new facilities. The Dublin school district is forced to lease space in order to accommodate its enrollment. All of these growing suburban areas are overcrowded.

Prior to 1986, annexation into the city of Columbus occurred without the requirement that the newly annexed area be included in the Columbus Independent School District. In 1986, this policy changed. Today all properties annexed into the city are to be included in the Columbus Independent School District.

2.2.2.7 Community Services

The Columbus area has an adequate number of diverse community services. There are over 120 neighborhood associations, 88 shopping centers, 69 hotels and motels with over 10,000 rooms, over 750 Protestant churches, 54 Catholic churches, and 11 Jewish synagogues. Additional services include the following:

City Parks	141	Country Clubs	15	Skating Rinks	7
Metropolitan Parks	7	Golf Courses	25	Swimming Pools	50
State Parks	6	Indoor Movies	25	Tennis Courts	12
Auto Race Tracks	2	Major Auditoriums	9	YMCAs	8
Ball Fields	120	Museums	9	YWCAs	2
Bowling Facilities	30	Outdoor Movies	6		

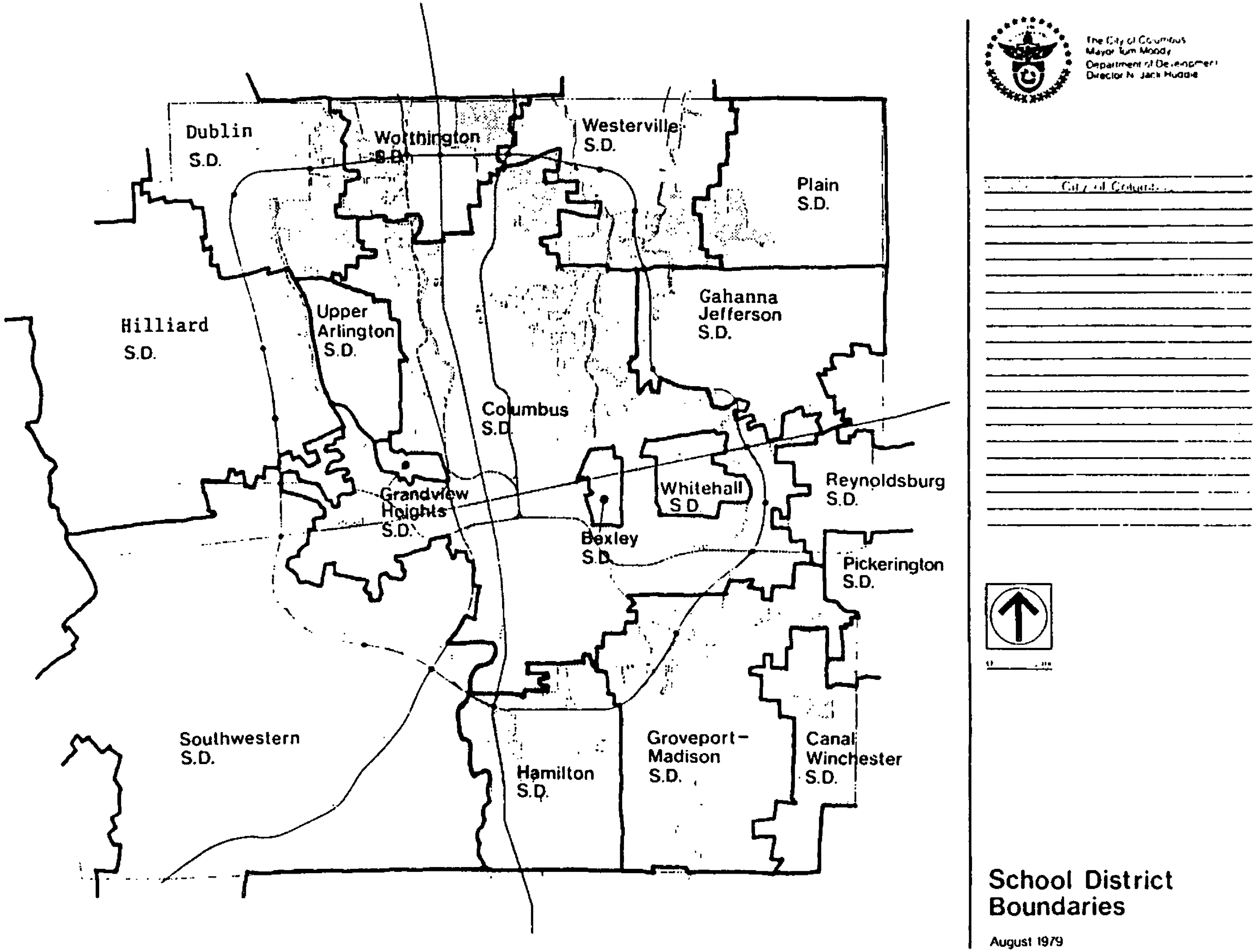


FIGURE 2-11. SCHOOL DISTRICT BOUNDARIES

Cultural events and activities include:

- The Columbus Symphony Orchestra
- The Ballet Metropolitan
- Music in the Air
- The Columbus Museum of Art
- The Center of Science and Industry
- The Ohio Historic Center
- The Greater Columbus Arts Festival
- A 100-acre city-owned zoo
- The Ohio State Fair.

2.2.2.8 Recreation

The Scioto River provides opportunities for a variety of active recreational uses, and serves as a major scenic resource for the Columbus community. Access to the Scioto River is available through scenic easements and a series of 21 parks located along the river in Franklin County.

The majority of water-related recreational activity centers around the O'Shaughnessy and Julian Griggs Reservoirs in the northern section of the river. Boating and fishing are the major active uses, while picnicking, hiking, bicycling, and sightseeing are the predominant passive uses. In 1986, there were 132 boats registered for primary use on Griggs Reservoir and 143 boats for use on O'Shaughnessy (Bazler 1987). There are 243 boat docks available for rental at the two reservoirs through the City of Columbus Recreation and Parks Department. Demand for these docks is high (Slaughter 1987). Boat launching ramps are located on each side of the Scioto River for day-boating use, which is permitted from 7:00 am until 11:00 pm. No quantitative studies of recreational river use have been undertaken, but indications are that it is relatively high in the portions of the Scioto River north of Jackson Pike WWTP.

Fishing occurs along the entire length of the river in the FPA, but is most active north of Greenlawn Dam. The latest creel survey of the Scioto River, taken between O'Shaughnessy Reservoir and Greenlawn Dam between April 14 and October 12, 1986, revealed a total fishing pressure of 153,080 angler hours. Approximately 133,044 fish were caught and 58,470 were kept (Schaefer 1987).

Swimming or bathing is prohibited by city ordinance at any location along the Scioto River within the Columbus city limits, in order to protect the city's water supply and for public safety reasons (Deitz 1987).

The downtown core of Columbus, upstream of the Jackson Pike site, hosts a series of water-related urban parks that provide paddleboat concessions, pontoon pleasure and shuttle rides, a floating amphitheatre, scenic overlooks, fishing piers, waterskiing exhibitions, boat races, and riverfront festivals.

Limited access and limited recreational quality restrict recreational activities from Frank Road to the juncture of Big Walnut Creek and the Scioto River in Harrison County. Recreation activities along the lower portion of the Scioto, south of the Jackson Pike WWTP, consist largely of duck hunting and fishing.

In 1974, a master plan for the waterways of Columbus was prepared and adopted to protect and enhance the water resources of the county. "The Watercourse Plan for Columbus and Franklin County" (City of Columbus 1974) is the only land-use master plan adopted by Columbus and Franklin Counties. The plan proposes a major park network along the seven watercourses that flow through the county, including the Scioto River. The master plan identifies the land along the southern portion of the Scioto River for potential development as parks and scenic open space.

The northern portion of the river, from the zoo in Delaware County through downtown Columbus, is identified for a variety of uses consisting of urban waterfront parks, open space, and waterfront development. The watercourse plan has been used as a guide to development in the area, although the corresponding zoning needed to fully implement the plan is lacking. The northern section of the river has developed more or less according to the plan. Currently, the city of Columbus is pursuing the purchase of conservation and scenic easements along the lower Scioto River as opportunities arise.

Even lacking more quantitative data, it is evident that the Scioto River is heavily used as a community resource, and will experience additional pressure in the future as a result of projected development in the Columbus area, and anticipated demand along the river's edge. Currently, there are proposals for a floating restaurant and a heliport along the Scioto River in the downtown area; several of the area's incorporated municipalities have park projects in the planning stage that will make use of the river as either an active recreational or aesthetic resource.

2.2.3 Public Finance

The study area includes most of Franklin County and parts of Fairfield, Delaware, and Licking Counties. Table 2-14 compares the per capita property taxes with the per capita expenditures for these four municipalities. Of these four counties, Franklin has the highest tax rate and the highest expenditure level. This is due to the large number of incorporated areas within Franklin County. Most of these incorporated areas have their own school districts. Although the State makes a large contribution to school district operations from the State Foundation Fund, schools are largely financed through the local property tax.

The largest incorporated area within Franklin County is the city of Columbus. The city's fiscal health is an indicator of the area's economic vitality. Columbus has a strong and growing economy. The performance of the city income tax over the last 3 years reflects this strength. The economic outlook suggests sustained growth in 1987. The city continues to increase its revenue base through annexation. Most of the recent annexations have been for properties located within the municipal boundaries. Table 2-15 lists the most recent annexations.

TABLE 2-14. PER CAPITA TAXES BY COUNTY

County	Property Tax per Capita	Per Capita Expenditure	Expenditure Distribution				
			Education	Highways	Public Welfare	Health & Hospitals	Police Protection
Ohio	227	729	48.1	5.8	4.7	7.1	4.8
Franklin	217	752	47.1	4.0	7.0	3.1	6.3
Fairfield	163	571	50.2	7.7	2.1	15.8	3.1
Delaware	177	502	53.8	8.5	2.6	3.7	3.5
Licking	200	527	57.1	7.9	3.7	2.3	3.2
Madison	199	541	58.2	10.5	4.6	1.9	3.4
Union	169	527	41.4	9.8	6.4	22.8	1.7

Based on 1976-77 Financial Reports

Source: Bureau of the Census 1983a

TABLE 2-15. COLUMBUS ANNEXATIONS SINCE 1986

Year	Fringe Annexation		Infill Annexations	
	Cases	Acres	Cases	Acres
1980	7	1,157	15	66
1981	1	365	17	91
1982	1	72	21	169
1983	2	448	12	116
1984	6	288	22	205
1985	11	616	20	277
1986 to Present	4	164	23	1,041
Totals	32	3,110	130	1,965

In anticipation of decreased Revenue Sharing funds, the city cut its 1987 budget. The city increased user charges and regulatory fees to compensate for this $10 million loss. Although cuts were made, basic services will receive full funding in FY 1987. Public safety forces are slated to expand as the city grows. The police budget includes two classes totaling 65 recruits and a police cadet program expected to free up more officers for patrol. The fire budget funds three classes with a total of 108 recruits. Equipment replacement, particularly for refuse collection and roadway maintenance, is especially critical due to the age of the fleet.

In 1986, the city's long-term credit rating was increased by both national rating agencies. Standard & Poor's Corporation and Moody's Investors Service currently rate Columbus as AA+ and Aa, respectively. These ratings constitute the highest credit quality position in Columbus' history. The city's short-term ratings also reflect Columbus' credit quality, with a Standard & Poor's rating of SPI+ and Moody's rating of MIG-1 and VMIG-1. The 1987 Executive Budget combines the city's operating and capital budgets to allow for a greater understanding of the relationship between capital projects and operating costs. It also provides for dual and simultaneous consideration of each city division's total operations, both in the operating arena and in the capital improvements area.

The Division of Planning prepares an annual Growth Potential report as part of an overall Columbus development strategy. The report attempts to identify the Columbus metropolitan area's future population growth in residential development, determine the site of such development, and assess the city's ability to accommodate that growth. Specific capital project proposals are developed to address the needs identified in the Growth Potential report. The report indicates that growth is expected on the far south side of Columbus.

The city of Columbus has a FY 1987 operating budget of $437.3 million. The city's general fund generates revenues of $212.5 million. These revenues will fund 49 percent of the FY 1987 operating budget. Special revenues, internal services, and block grants comprise 7.5 percent of the city's operating budget. The enterprise fund comprises the remaining 43.5 percent of the budget. The city has four enterprise operations. These are as follows:

- Airports with an estimated revenue of $19,815,755 in 1987
- Electricity with an estimated revenue of $49,738,804 in 1987
- Water with an estimated revenue of $74,982,467 in 1987
- Sewers with an estimated revenue of $93,915,047 in 1987.

The next largest revenue source for general fund operations is the income tax. In 1987, this source is expected to yield $139.5 million or 64.7 percent of total general fund revenues. This estimate exceeds project 1986 receipts by $8.3 million, or 6.3 percent, and reflects continued economic growth. The city of Columbus levies a 2 percent income tax on all wages, salaries, commissions, and other compensation paid by employees and on the net proceeds of business operation in the city. The most recent tax increase, 0.5 percent, was approved by the votors on November 2, 1982, and became effective on January 1, 1983. Pursuant to Columbus City Code, Section 361.36, 75 percent of all income tax collections are deposited in the general fund for general fund operations, and 25 percent of collections are deposited in a separate fund to service debt on capital improvements.

2.2.4 Cultural Resources

2.2.4.1 Historic Resources

The Columbus area is the second largest metropolitan area in Ohio, second only to Cleveland. Columbus was established as the state capital by the Ohio General Assembly soon after statehood in 1812 and was named for Christopher Columbus. Columbus was made the seat of Franklin County in 1824.

Improvements in transportation corridors spurred growth in the Columbus area. During the 1840's, Columbus was linked to the National Road (from Maryland) and to the Ohio and Erie Canel. By 1850, the first railroad arrived, and by 1900, the population of Columbus exceeded 100,000 people. The city contained a diversity of industry and government services important to Ohio. The areas surrounding the city remained predominantly rural and agricultural until after the second world war. World War II agricultural lands have been converted to subdivisions in a large-lot sprawl pattern. The Columbus metropolitan area of today covers over 2,000 square miles, making it geographically the largest metropolitan area in Ohio.

The Ohio Historical Society (OHS) was established in 1885. Its headquarters are in Columbus. **The Ohio Historic Preservation Office, a division of the Ohio Historical Society, maintains the Ohio Historic Inventory (OHI) which is a collection of over 60,000 historic properties throughout the state. The OHI contains properties that have been: 1) listed in the National Register of Historic Properties; 2) determined eligible for listing in the National Register; and 3) determined not eligible for listing in the National Register or not evaluated against the National Register criteria.**

The National Register of Historic Places lists 27 historic sites or structures (excluding archaeological sites) in Delaware County; 34 in Fairfield County (2 additional structures are eligible); 99 in Franklin County (11 additional structures and sites are eligible, and 27 are pending inclusion on the Register); 39 in Licking County (1 additional is eligible); 6 in Madison County; and 15 in Pickaway County (1 additional structure is eligible) (See Appendix I.)

2.2.4.2 Archaeologic Resources

Information about archaeologic resources was obtained primarily from the archaeologic survey report prepared for the Columbus Southerly and Jackson Pike Wastewater Treatment Plants, published January 25, 1985, by John E. Blank, Ph.D., Department of Anthropology, Cleveland State University. Archaeologic resources are derived from a succession of prehistoric cultures, extending back in time to a period of 18,000 years B.C., that made extensive use of the Scioto River Valley.

The archaeologic background analysis of the Blank survey (see Appendix J) was used to characterize prehistoric cultural information. This background analysis suggests that prehistoric manifestations would occur on the raised elevations on both the floodplains and terraces of the Scioto River throughout the project area.

According to William S. Dancey, Ph.D., an Associate Professor of Anthropology at Ohio State University, in a letter dated January 2, 1987, "...the valley floor and bluff edges of the rivers in the study area were preferred locations for human settlement." Further, he stated that "...within the study area, where intensive surveys have been conducted (e.g., along Big Darby Creek from Orient to S.R. 40, Alum Creek in the Westerville vicinity, and the Scioto River from I-270 to Circleville), sites have been found to be nearly continuous along the floodplain and on adjacent bluffs." Dr. Dancey concluded in his letter that "...development of any kind in the region will encounter archaeologic sites and because of the poorly known character of the sequence and structure of prehistoric occupation nearly all sites are potentially significant by any measure."

The National Register of Historic Place lists: 1 archaeologic site in Delaware County; 3 in Fairfield County; 6 in Franklin County; 5 in Licking County; 1 in Madison County; and 5 in Pickaway County. The Ohio Historic Inventory lists those archaeologic sites that may or may not be eligible for inclusion to the National Register but are, nonetheless, important cultural resources to the State. The site inventory of the Division of Archaeologic Services of the Ohio Historic Preservation office includes over 500 sites from Franklin County and over 330 sites within Pickaway County.

CHAPTER 3. EXISTING FACILITIES

This chapter describes the Jackson Pike and Southerly Wastewater Treatment Plants, the Combined Sewer Overflow System, and the Southwesterly Composting Facility.

Figure 3-1 shows the locations of the two treatment plants, the composting facility and the area served by combined sewers. Separation of a portion of the combined sewer area is currently underway. This area is noted on the map.

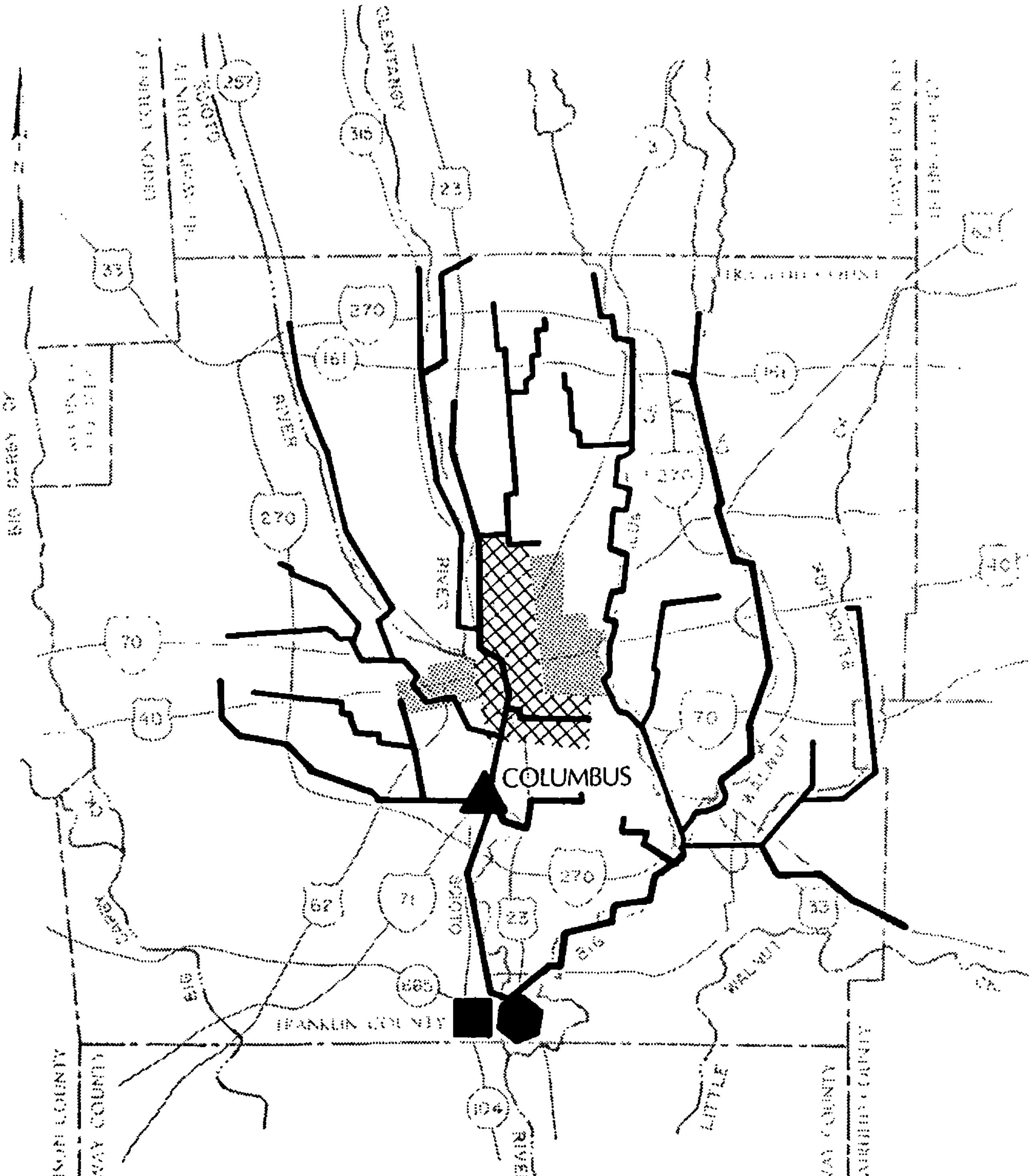
The following sections of this chapter will define the equipment, influent and effluent characteristics, and the overall condition of the facilities.

3.1 JACKSON PIKE WASTEWATER TREATMENT PLANT

The Jackson Pike Wastewater Treatment Plant began operation in 1937. The plant was modernized and expanded in capacity in the mid-fifties. Currently there are two parallel flow trains for wet stream treatment consisting of preaeration, primary settling, aeration, and final clarification. The original train is called Plant A, and the newer train is called Plant B. The two trains operate relatively independently of each other during liquid processing but share sludge handling facilities.

3.1.1 Major Interceptors

Wastewater arrives at the Jackson Pike plant by the 108-inch diameter Olentangy-Scioto Interceptor Sewer (O.S.I.S.) and the 72-inch diameter Big Run Interceptor Sewer. The maximum hydraulic capacity of the Jackson Pike plant is 100 MGD. Currently average daily flows are approximately 84 MGD. The plant accepts all of the flow from the Big Run Interceptor but limits the flow from the O.S.I.S. so the hydraulic capacity of the plant will not be exceeded. The major diversion point for the O.S.I.S. flows is at the Whittier Street Storm Standby Tanks.



JACKSON PIKE WWTP

SOUTHERLY WWTP

SOUTHWESTERLY COMPOST FACILITY

SEPARATION UNDERWAY OR COMPLETE

COMBINED SEWERS REMAINING

MAJOR INTERCEPTOR

APPROXIMATE SCALE:
1 INCH = 4.12 MILES

FIGURE 3-1
COLUMBUS METROPOLITAN AREA
INTERCEPTORS & TREATMENT FACILITIES

The major portion of a connecting sanitary interceptor sewer (i.e., the Interconnector) is currently in place between the Jackson Pike and Southerly WWTPs. Currently the Interconnector consists of approximately 7 miles of 150-inch and 156-inch diameter sewer. It begins 3000 feet from the Jackson Pike WWTP and connects with a pump station on the west side of the Scioto River near the Southerly WWTP. In September of 1986, USEPA provided funding for the construction of the remaining 3,000 feet of the sewer (Figure 3-2), which will complete the Interconnector between the two plants. Included in the north end construction will be a diversion chamber which will connect the Interconnector with the O.S.I.S. north of Jackson Pike. When completed, the Interconnector will allow the flow to Jackson Pike to be controlled by diverting excess flows to Southerly.

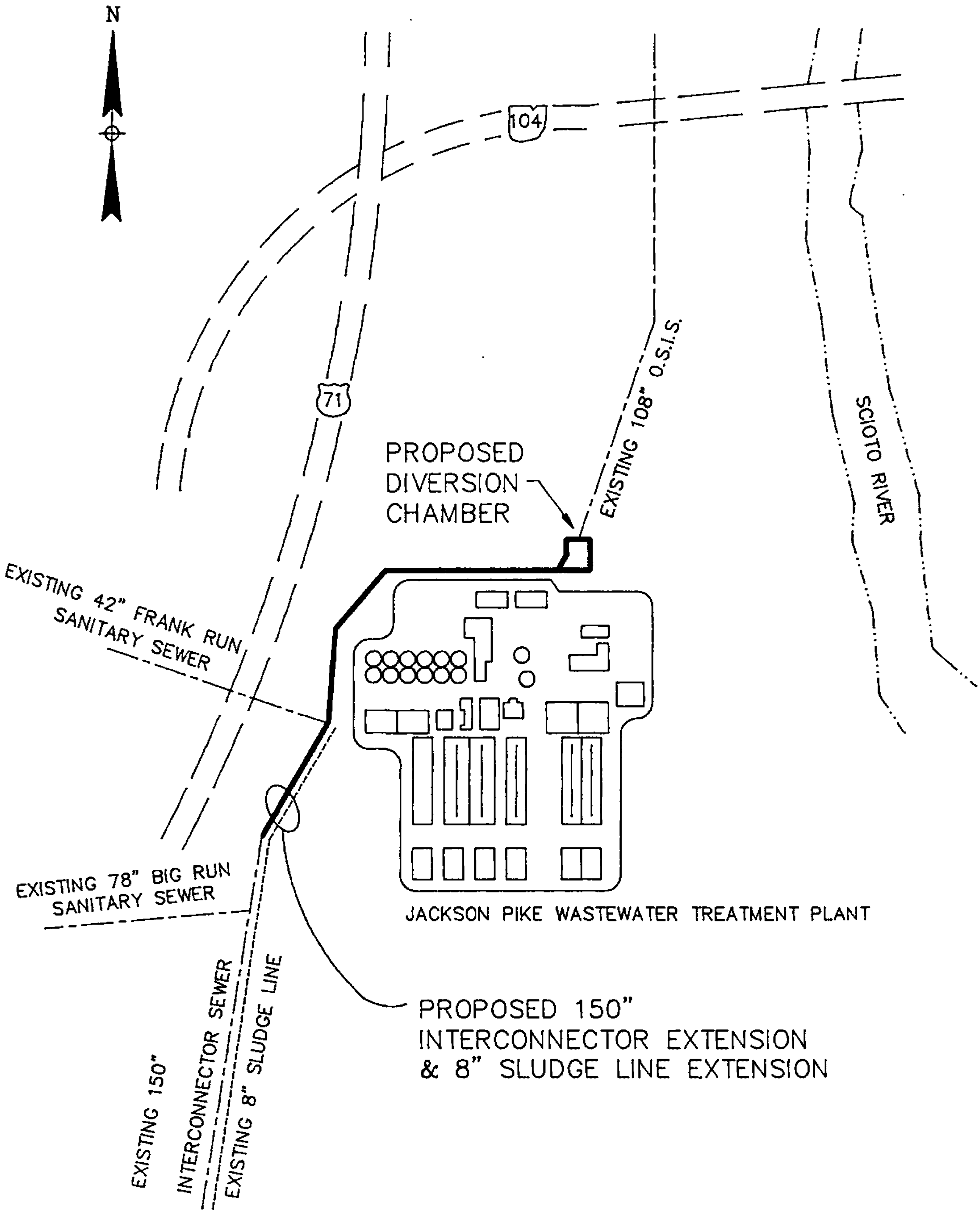
3.1.2 Preliminary Treatment (O.S.I.S. Flows)

Preliminary treatment is provided for flows entering Jackson Pike through the O.S.I.S. at a facility called the Sewer Maintenance Yard which is located approximately one mile north of Jackson Pike. These preliminary treatment facilities were constructed in 1948. They are rated at a capacity of 160 MGD and provide preliminary screening and grit removal for flows in the O.S.I.S. prior to their arrival at Jackson Pike.

3.1.3 Major Treatment Processes

The Jackson Pike Wastewater Treatment Plant consists of the following treatment processes:

- Preliminary Treatment
- Primary Treatment
- Secondary Treatment
- Disinfection
- Solids Handling
- Solids Disposal.



SOURCE: REVISED FACILITY PLAN UPDATE

FIGURE 3-2
NORTH END INTERCONNECTOR

Figure 3-3 shows a flow schematic of the Jackson Pike WWTP. Table 3-1 identifies the specific unit processes and their respective facilities.

3.1.4 System Performance

Wastewater characteristics and operating performance for the Jackson Pike plant were assembled from monthly summaries of plant operating data. These parameters are presented in Tables 3-2 through 3-4. The following sections discuss these tables.

3.1.4.1 Influent Wastewater Characteristics

Influent wastewater characteristics for 1985 are shown at the top of Table 3-2. The average influent carbonaceous biochemical oxygen demand ($CBOD_5$) and total suspended solids (TSS) concentrations of 145 and 185 mg/l represent low to medium strength domestic sewage. Ammonia and phosphorus concentrations represent a weak domestic sewage.

3.1.4.2 Final Effluent Quality

The effluent wastewater characteristics for 1985 are shown at the bottom of Table 3-2. The yearly average $CBOD_5$ and TSS concentrations are 16 mg/l and 8 mg/l, respectively. Table 3-3 shows the 1985 monthly average raw, settled, and final concentrations for $CBOD_5$ and TSS. The annual average removal rate for $CBOD_5$ is 90 percent. The TSS annual average removal rate is 96 percent. Table 3-4 presents monthly nitrification data for 1985. Effluent ammonia concentrations range from 57 to 90 percent of influent ammonia concentrations.

Effluent limitations for the Jackson Pike plant are specified in OEPA Permit No. 4PF00000*HD. The plant is currently operating under interim effluent limitations established by the permit. The interim limitations require a 25/30 effluent (i.e. CBOD/TSS; 30-day average). The permit also sets forth a compliance schedule for attainment of compliance with final effluent limitations. The final limits established by the permit for the Jackson Pike plant have been previously presented in Table 1-1. The final limits are more stringent than the interim limits with respect to $CBOD_5$ and

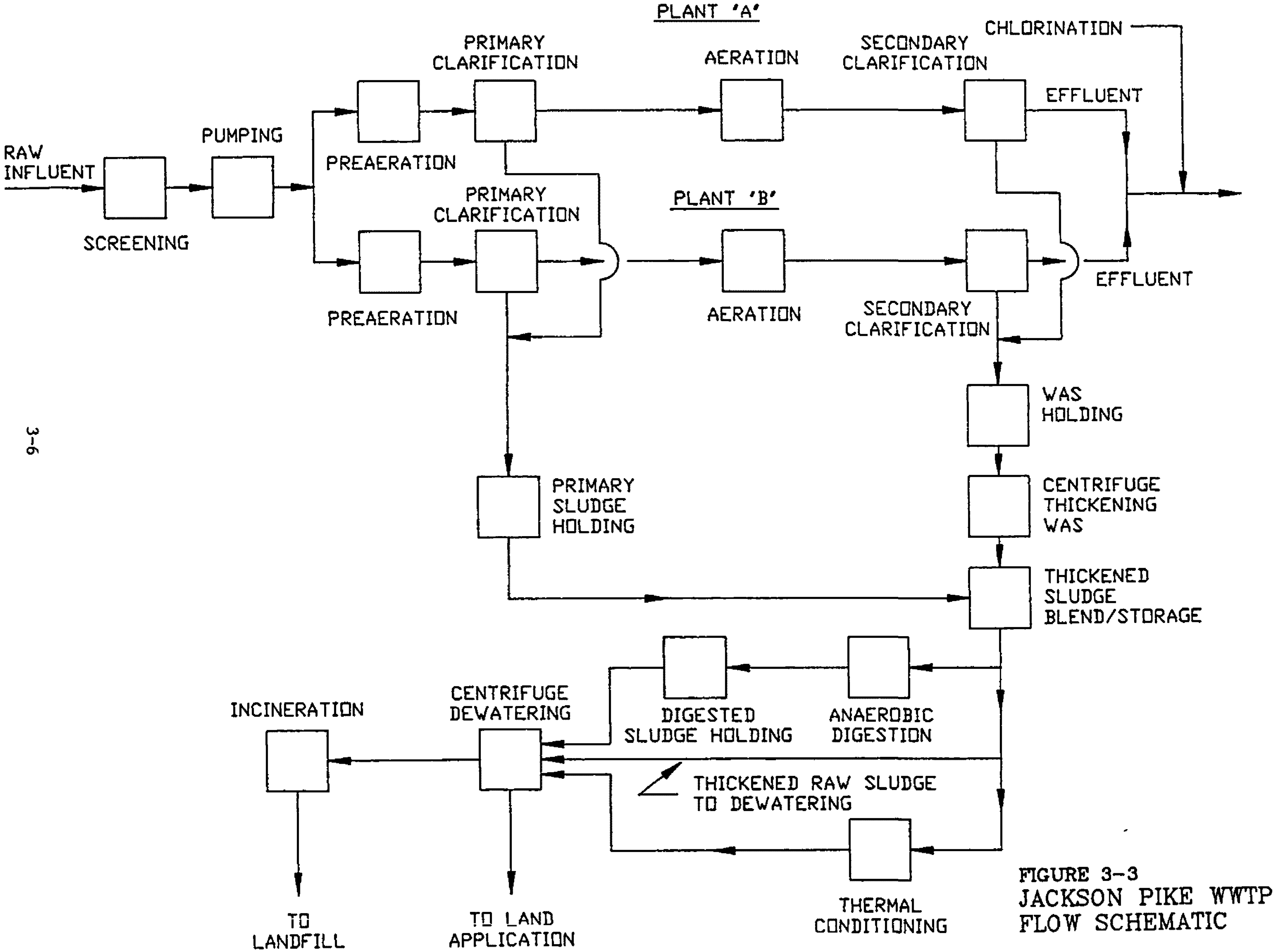


FIGURE 3-3
JACKSON PIKE WWTP
FLOW SCHEMATIC

TABLE 3-1. JACKSON PIKE EXISTING FACILITIES

Process	Facilities/Condition	Comments/Sizes/Capacities
Screening	Two mechanically cleaned bar screens with 1-1/2" openings, west screen replaced in 1983	
Pumping	Two variable speed at 55 MGD (32 ft TDH) Two constant speed at 27.5 MGD (27.5 ft TDH) One constant speed at 60 MGD (30 ft TDH)	165 MGD
Preaeration	Plant A - 2 tanks at 180 ft x 26 ft x 15 ft SWD Plant B - 2 tanks at 113 ft x 26 ft x 15 ft SWD	1.05 MG total volume 0.66 MG total volume
Blower for Preaeration and Aeration	4 at 21,000 cfm 2 at 15,000 cfm 2 at 3,000 cfm 3 at 12,500 cfm	
Primary Clarification	Plant A - 4 tanks at 150 ft x 80 ft x 10 ft SWD Plant B - 4 tanks at 150 ft x 80 ft x 10 ft SWD Twelve sludge pumps at 250 gpm each	48,000 SF total surface area 48,000 SF total surface area
Aeration	Plant A - 8 tanks at 900 ft x 26 ft x 15 ft SWD Plant B - 4 tanks at 900 ft x 26 ft x 15 ft SWD	21.0 MG total volume 10.5 MG total volume
Secondary Clarification	Plant A - 8 tanks at 153 ft x 60 ft x 12.5 ft SWD Plant B - 4 tanks at 153 ft x 60 ft x 12.5 ft SWD six return sludge pumps; one at 6,944 gpm, one at 5,555 gpm, one at 5,902 gpm, one at 3,889 gpm, and two at 3,472 gpm each	73,440 SF total surface area 36,720 SF total surface area
Chlorination	By direct injection into discharge pipeline	
Waste Activated Sludge Holding	One 78-foot x 14-foot x 8-foot deep basin (two) standby units	0.065 MG of storage

TABLE 3-1. JACKSON PIKE EXISTING FACILITIES (cont.)

Process	Facilities/Conditions	Comments/Sizes/Capacities
Primary Sludge Holding	One 85-foot dia., 25.25-foot SWD	1 MG of storage
Centrifuge Thickening (WAS)	Two solid bowl centrifuges	550 gpm/unit, 400 HP/unit Feed Solids 1% Thickened WAS 4%
Anaerobic Digestion	Eight Primary Digesters: 70-foot dia., 27.5-foot SWD Six Secondary Digesters: 85-foot dia., 23.5-foot SWD	Volume: 1.6×10^6 CF Total 6.3 MG Primary 6.0 MG Secondary
Digested Sludge Holding	One 85-foot dia., 25.5-foot SWD	1.0 MG of storage
Thermal Conditioning	Two Reactors installed 1972, Expanded 1978 to 4 reactors	200 gpm/unit
Centrifuge Dewatering	Six solid bowl centrifuges Installed 1976	100 gpm/unit, 100 HP/unit Feed Solids 3% Dewatered Cake 16-18%
Incineration	Two multiple-hearth incinerators 7-hearths, 22.25-foot diameter	170 wet tons/day Feed Solids 16-18%
Ash Lagoon	Two lagoons	Total storage capacity 48,000 cy; Cleaned as needed
Landfill	Incinerator ash landfilled on an as-needed basis through contract operation	
Land Application		
Sludge Transport and Application	Contract Operation	Transport 130-150 tons/day Application 70-200 tons/day Approximate Unit Cost of $11/wet to
Application Sites	Required Acreage 2,000 Ac/yr Available Acreage 10,000 Ac	Application 260 days/yr Seasonal peaks dependent on weather and cropping patterns

TABLE 3-2. 1985 OPERATING DATA JACKSON PIKE WWTP

Parameter	Average	Maximum Monthly Average	Minimum Monthly Average
INFLUENT			
Flow, mgd	84.3	95.1	74.5
$CBOD_5$, mg/l	145.0	179.0	124.0
TSS, mg/l	185.0	235.0	141.0
COD, mg/l	359.0	429.0	275.0
Ammonia, mg/l	11.0	14.4	6.3
Nitrite, mg/l	0.17	0.57	0.02
Nitrate, mg/l	0.9	4.8	0.2
TKN, mg/l	20.6	24.9	15.1
Total Phosphorus, mg/l	6.4	7.8	4.8
EFFLUENT			
TSS, mg/l	8.0	16.0	5.0
$CBOD_5$, mg/l	16.3	25.5	2.03
DO, mg/l	4.6	6.9	3.4
COD, mg/l	39.6	47.9	30.1
Ammonia, mg/l	3.1	5.0	0.6
Nitrite, mg/l	0.58	1.37	0.15
Nitrate, mg/l	10.4	13.3	8.3
TKN, mg/l	4.9	6.9	2.2
Total Phosphorus, mg/l	4.4	6.2	3.3
Fecal Coliform (count/100 ml)	9.2	20.0	3.5

Source: Plant Operating Reports

TABLE 3-3. JACKSON PIKE WWTP 1985 PERFORMANCE DATA

	Raw (mg/l)	Settled (mg/l)	% Removal Raw to Settling	Final (mg/l)	% Removal Raw to Final
$CBOD_5$					
January	179	102	43	21	88
February	159	95	40	18	89
March	133	100	25	12	91
April	132	91	31	22	83
May	135	72	47	13	90
June	164	98	40	17	90
July	137	95	31	15	89
August	141	99	30	2	99
September	142	101	29	18	87
October	167	113	32	26	84
November	125	65	48	7	94
December	124	69	44	7	94
Average	145	92	37	16	90
SUSPENDED SOLIDS					
January	182	66	64	10	95
February	173	98	43	9	95
March	172	75	56	7	96
April	149	65	56	7	95
May	186	61	67	7	96
June	235	83	65	9	96
July	219	100	54	5	98
August	190	86	55	8	96
September	182	69	62	5	97
October	193	79	59	16	92
November	192	55	71	9	95
December	141	56	60	6	96
Average	185	74	64	8	96

Source: Plant Operating Reports

TABLE 3-4. JACKSON PIKE WWTP NITRIFICATION DATA - 1985

	Ammonia (mg/l)			Nitrite (mg/l)		Nitrate (mg/l)	
	Raw	Final	% Reduction	Raw	Final	Raw	Final
January	13.4	2.8	79	0.05	1.37	0.4	11.1
February	11.5	1.7	85	0.41	0.61	1.8	13.3
March	9.3	1.7	82	0.38	0.35	1.0	11.7
April	10.6	4.2	60	0.14	0.59	0.4	10.2
May	9.8	2.2	78	0.12	0.47	0.3	11.0
June	12.0	4.3	64	0.02	0.50	0.2	9.9
July	10.4	4.4	58	0.02	0.54	0.2	9.6
August	11.5	5.0	57	0.02	0.62	0.2	8.3
September	13.4	5.0	63	0.02	0.60	0.2	9.1
October	14.4	3.8	74	0.02	0.52	0.2	10.1
November	6.3	0.6	90	0.32	0.15	0.6	10.5
December	9.0	1.9	79	0.57	0.68	4.8	9.6
Average	11.0	3.1	72	0.17	0.58	0.9	10.4

Source: Plant Operating Reports

TSS, and include discharge limitations on ammonia and establish a minimum dissolved oxygen concentration which must be maintained in the final effluent. The compliance schedule stipulates that construction of wet stream facilities must be completed prior to May 23, 1988, and final effluent limitations must be attained no later than July 1, 1988.

Operating data presented in Table 3-2 through 3-4 illustrates that the Jackson Pike WWTP is not capable of consistently meeting the final effluent limitations without upgrading and expansion. The monthly average $CBOD_5$ concentrations shown in Table 3-3 exceed the final 30-day permit limits six months of the year. The required minimum dissolved oxygen concentration of 7.0 mg/l was never achieved (Table 3-2). Ammonia limits were exceeded for the months of June through October (Table 3-4).

3.1.5 Present Condition of Plant

In August and September of 1985, a detailed survey of the facilities at the Jackson Pike Wastewater Treatment Plant was conducted. The purpose of the survey was to determine the remaining useful service life of existing equipment and structures. The conclusions of the survey, taken from the General Engineering Report and Basis of Design prepared by URS Dalton (January 1986), are listed below:

- Tanks — Visual inspection of the open-air tanks out of service indicates that the majority of the concrete deterioration has occurred above the water line, with the concrete below in good condition. A complete handrail system is needed around all the open-air tanks but can only be constructed after concrete restoration.

- Buildings — Work is required on all buildings, some of which are in need of more extensive rehabilitation than others. Those requiring the most work are either the oldest or subjected to the most severe environment. These include the Incinerator Buildings, Boiler Building, Sludge Control House No. 2 and the Bar Screen Building.

• Power System	The power system is generally adequate and in good condition. Two transformer substations in the Aeration Control Building "A" should be replaced along with the motor control center in Aeration Control Building "B". The power generator system should be abandoned. Part of the site is not lighted and should have pole fixtures installed.
• Instrumentation & Control	Inadequate. The I&C system requires complete replacement and expansion to meet final NPDES limitations.
• HVAC	In general, the buildings appear to have adequate heating and the heating equipment overall has been kept in good condition. Buildings that have ventilation equipment generally have the equipment in operation. Each building should be evaluated on an individual basis to determine heating and ventilation requirements.
• Plumbing	Adequate. Some renovation required.
• Wet Stream Process	There is a significant amount of useful life in the raw sewage pumps, the main air blowers, and the primary sludge pumping system. However, the primary collection mechanisms, air diffusion equipment and secondary clarifier equipment need to be replaced.
• Solids Handling	Adequate, but requires renovations and minor expansions due to the need for increased pollutant removals.

3.2 SOUTHERLY WASTEWATER TREATMENT PLANT

The Southerly Wastewater Treatment Plant began operation in 1967 with a single treatment train. In the early seventies, an additional wet stream train was constructed. The original wet stream treatment train is termed the Center Section. The newer train is called the West Section.

3.2.1 Major Interceptors

Southerly receives approximately 50 to 60 MGD via the Big Walnut Sanitary Outfall Sewer which serves the northeast, east, and southeast portions of Columbus and Franklin County. An additional 5 MGD of flow is carried to Southerly by the Interconnector Sewer which serves a portion of western Columbus.

3.2.2 Interconnector Pump Station

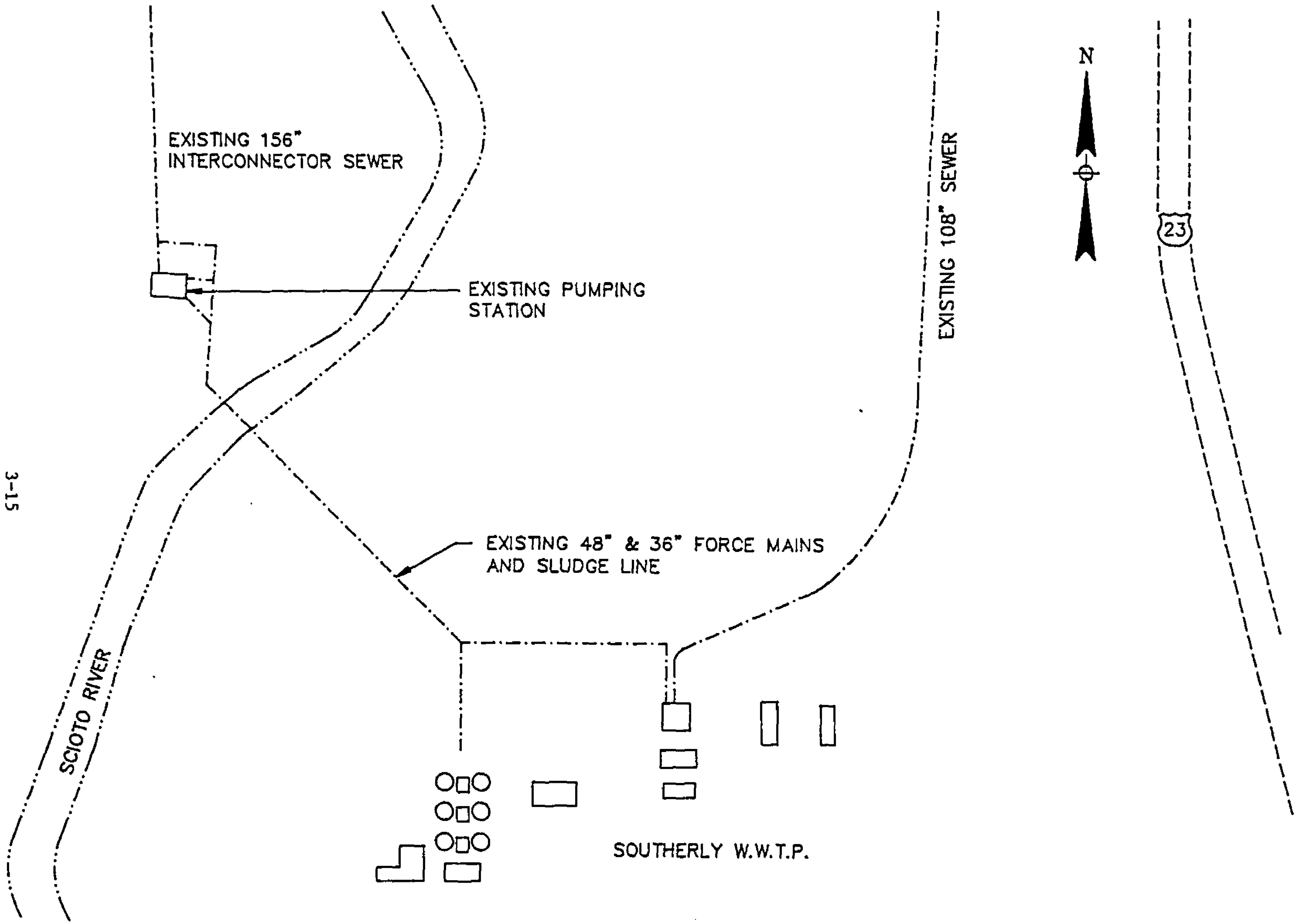
The purpose of the Interconnector Pump Station is to pump flows from the Interconnector across the Scioto River to the Southerly WWTP. The Interconnector Pump Station is located on the south end of the Interconnector near Southerly (Figure 3-4). Flows from the 156-inch Interconnector Sewer enter a 58-foot wide by 25-foot long by 16-foot deep chamber to be distributed to three channels containing coarse bar racks and mechanically-cleaned bar screens. Each channel is 6 feet wide by 30 feet long. Flows from the screening channels enter a 20-foot wide by 66-foot long by 23-foot high wet well and are pumped by two 20 MGD and two 30 MGD extended shaft centrifugal pumps through one 36-inch and one 48-inch force main to the Southerly headworks. **The pump station is rated at a capacity of 70 MGD with the largest pump out of service.**

3.2.3 Treatment Processes

The Southerly Wastewater Treatment Plant consists of the following treatment processes:

- Preliminary Treatment
- Primary Treatment
- Secondary Treatment
- Disinfection
- Solids Handling
- Solids Disposal

A schematic flow diagram of the facilities is presented in Figure 3-5. Table 3-5 identifies the specific unit processes and their respective facilities.



SCALE: 1"=500'
SOURCE: REVISED FACILITY PLAN UPDATE

FIGURE 3–4
SOUTH END INTERCONNECTOR

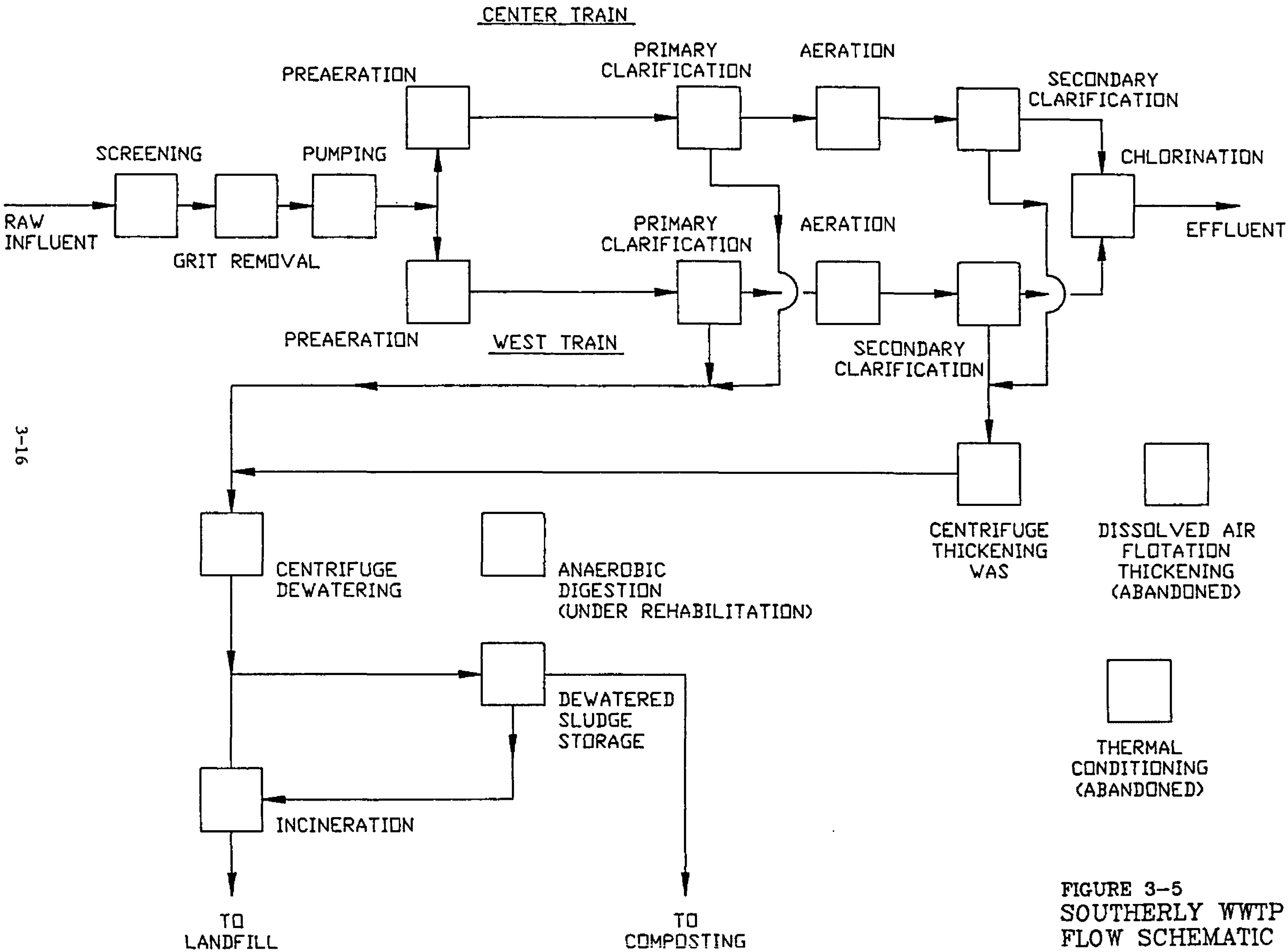


FIGURE 3-5
SOUTHERLY WWTP
FLOW SCHEMATIC

TABLE 3-5. SOUTHERLY WWTP EXISTING FACILITIES

Process	Facilities/Condition	Comments/Sizes/Capacities
Screening	Four bar racks with 5.5-inch openings Four mechanical bar screens with 1-inch openings	
Grit Removal	Two aerated grit tanks at 44.5 ft x 20 ft x 13.5 ft SWD Two aerated grit tanks at 51.2 ft x 20 ft x 13.5 ft SWD Two variable speed blowers at 960 cfm each	0.39 MG total volume
Pumping	Three variable speed pumps at 35 MGD (38 feet TDH) Two variable speed pumps at 65 MGD (42 feet TDH) One constant speed pump at 35 MGD (38 feet TDH)	170 MGD
Preaeration	Center Train - 4 tanks at 112.7 ft x 26 ft x 15.5 ft SWD West Train - 4 tanks at 112.7 ft x 26 ft x 15.5 ft SWD Three constant speed blowers at 3,400 cfm each	1.36 MG total volume 1.36 MG total volume
Primary Clarification	Center Train - 4 tanks at 80 ft x 165 ft x 10 ft SWD West Train - 4 tanks at 100 ft x 170 ft x 10 ft SWD Twelve sludge pumps at 150 gpm each	52,800 SF total surface area 68,000 SF total surface area
Aeration	Center Train - 4 tanks at 26 ft x 900 ft x 15 ft SWD West Train - 6 tanks at 26 ft x 900 ft x 15 ft SWD Nine blowers at 20,000 cfm each	10.5 MG total volume 15.8 MG total volume
Secondary Clarfication	Center Train - 4 tanks at 89 ft x 170 ft x 12.5 ft SWD West Train - 4 tanks at 104 ft x 180 ft x 10.5 ft SWD Return sludge pumps - 4 at 7,000 gpm each, 4 at 10,500 gpm each, 4 at 8,100 gpm each, 4 at 12,000 gpm each Waste-activated sludge pumps - 8 at 200 gpm each	
Disinfection	Six 2,000 lb/day chlorinators Six 8,000 lb/day evaporators One chlorine contact basin at 260 ft x 260 ft x 7 ft SWD	
Dissolved Air Flotation Thickening (WAS)	Four units @ 1,900 SF/unit (Abandoned 1978 used as WAS concentration tanks)	

TABLE 3-5. SOUTHERLY WWTP EXISTING FACILITIES (cont.)

Process	Facilities/Condition	Comments/Sizes/Capacities
Centrifuge Thickening (WAS)	Four solid bowl centrifuges Pre-Project 88, Contract #19 Not yet fully operational	200 gpm/unit Feed Solids 1% Thickened WAS 5%
Anaerobic Digestion	Four Primary Digestions; 85-foot dia., 25.25-foot SWD Two Secondary Digesters; 85-foot dia., 25.25-foot SWD Construction date 1965	Volume of 972,000 CF total 4.8 MG primary 2.4 MG secondary
Thermal Conditioning	Three Reactors Installed 1974, Abandoned 1980	200 gpm/unit
Centrifuge Dewatering	Six solid bowl centrifuges Operational approx. 7 years Dewatered cake 16-18%	100 gpm/unit Feed solids 3.5%
Dewatered Sludge Storage	One storage bin.	Volume of 400 cy/300 wet tons
Transport to Composting	4-8 trucks @ 25 wet tons Hrs of operation 56 hrs/wk	Haul distance of 7 miles roundtrip
Composting	Extended aerated static pile system	120-200 wet tons/day dependent on sludge and weather
Compost Disposal	Product removed by truck	Disposal through bulk sales to public and private consumers
Incineration	Two existing multiple hearth units; Two new multiple hearth units under construction	150 wet tons/day existing 260 wet tons/day new
Ash Lagoon	Two lagoons	Total storage capacity 76,000 cy; Cleaned as needed
Landfill	Incinerator ash landfilled on an as-needed basis through contract operations	

Construction of additional facilities is presently taking place at Southerly. These new facilities were not included in Table 3-5. This construction phase is called Project 88. This construction is being undertaken by the city as part of their Municipal Compliance Plan to bring the treatment facilities into compliance with revised NPDES permit limits by July 1, 1988. It includes the following:

- 4 preaeration tanks
- 2 primary settling tanks
- 6 aeration tanks
- 6 secondary settling tanks
- chlorination/dechlorination/post aeration facilities
- 4 gravity thickeners
- 4 DPF dewatering presses
- sludge cake storage facilities
- lime stabilization facilities.

3.2.4 System Performance

Monthly summaries of wastewater characteristics and operating performance for the Southerly plant were assembled from plant records and reports. These summaries are presented in Tables 3-6 through 3-8. The following paragraphs discuss these tables.

3.2.4.1 Influent Wastewater Characteristics

Influent wastewater characteristics for 1985 are shown at the top of Table 3-6. The average $CBOD_5$ and TSS levels of 171 mg/l and 193 mg/l, respectively, represent medium strength domestic wastewater. The ammonia and phosphorus concentrations represent a weak domestic sewage.

3.2.4.2 Final Effluent Quality

The bottom of Table 3-7 shows average, maximum monthly average, and minimum monthly average parameters for the Southerly plant effluent during 1985. These values do not incorporate the flow that is bypassed directly to

TABLE 3-6. SOUTHERLY WWTP 1985 OPERATING DATA

Parameter	Average	Maximum Monthly Average	Minimum Monthly Average
INFLUENT			
Flow, MGD	64.8	87.2	51.7
TSS, mg/l	193.0	222.0	139.0
$CBOD_5$, mg/l	171.0	238.0	115.0
COD, mg/l	433.0	546.0	328.0
Ammonia, mg/l	12.4	18.9	8.2
Nitrite, mg/l	0.04	0.14	0.02
Nitrate, mg/l	0.2	0.3	0.2
TKN, mg/l	24.6	33.6	17.7
Total Phosphorus, mg/l	7.5	9.4	5.1
EFFLUENT			
TSS, mg/l	8.0	18.0	5.0
$CBOD_5$, mg/l	11.0	17.0	7.0
DO, mg/l	8.1	8.8	7.6
COD, mg/l	38.0	53.0	27.0
Ammonia, mg/l	3.8	7.8	1.2
Nitrite, mg/l	0.63	1.13	0.28
Nitrate, mg/l	5.0	8.6	2.2
TKN, mg/l	5.8	10.6	3.2
Total Phosphorus, mg/l	1.4	2.6	0.8
Fecal Coliform (count/100ml)	386.0	950.0	119.0

Source: Plant Operating Reports

TABLE 3-7. SOUTHERLY WWTP 1985 PERFORMANCE DATA

	Raw (mg/l)	Settled (mg/l)	% Removal Raw to Settling	Final (mg/l)	% Removal Raw to Final
$CBOD_5$					
January	183	122	33	14	92
February	149	109	27	11	93
March	139	92	34	10	93
April	160	97	39	13	92
May	163	123	25	17	90
June	183	142	22	15	92
July	171	128	25	8	95
August	189	132	30	7	96
September	233	151	35	8	97
October	238	185	22	8	97
November	115	88	23	9	92
December	134	91	32	9	93
Average	171	122	29	11	94
SUSPENDED SOLIDS					
January	198	85	57	7	96
February	191	88	54	10	95
March	174	74	57	13	93
April	193	79	59	9	95
May	196	99	49	18	91
June	212	120	43	7	97
July	210	96	54	5	98
August	199	86	57	6	97
September	222	83	63	7	97
October	210	120	43	5	98
November	139	75	46	10	93
December	168	65	61	6	96
Average	193	89	54	8	96

Source: Plant Operating Reports

TABLE 3-8. SOUTHERLY WWTP NITRIFICATION DATA - 1985

	Ammonia (mg/l)			Nitrite (mg/l)		Nitrate (mg/l)	
	Raw	Final	% Reduction	Raw	Final	Raw	Final
January	12.9	5.0	61	0.04	1.13	0.2	3.1
February	11.0	5.7	48	0.05	0.94	0.3	2.2
March	9.2	2.9	68	0.06	0.85	0.3	2.8
April	11.1	3.3	70	0.05	0.52	0.2	4.7
May	11.6	4.0	66	0.02	0.63	0.2	4.1
June	13.9	4.8	65	0.02	0.97	0.2	4.6
July	11.3	1.8	84	0.02	0.55	0.2	7.1
August	12.3	1.2	90	0.02	0.28	0.2	7.5
September	18.0	3.1	83	0.02	0.52	0.2	8.6
October	18.9	7.8	59	0.02	0.56	0.2	6.3
November	8.2	3.0	63	0.14	0.33	0.3	4.0
December	10.7	2.8	74	0.04	0.30	0.2	4.4
AVERAGE	12.4	3.8	69	0.04	0.63	0.2	5.0

Source: Plant Operating Reports

the Scioto River. The annual average $CBOD_5$ and TSS concentrations are 11 mg/l and 8 mg/l, respectively. Table 3-7 shows the 1985 monthly average raw, settled, and final concentrations for $CBOD_5$ and TSS. The $CBOD_5$ annual average removal rate is 94 percent. The TSS annual average removal rate is 96 percent. Table 3-8 presents monthly nitrification data for 1985. The effluent ammonia concentrations range from 48 to 90 percent of the influent ammonia concentrations.

Similar to the Jackson Pike WWTP, the Southerly WWTP is also operating under interim effluent limits of 25/30 as established in OEPA Permit No. 4PF00001*HD. This permit also sets forth a compliance schedule for attainment of compliance with final effluent limitations. The final effluent limits were presented in Table 1-2. The limits are more stringent with regards to $CBOD_5$, TSS, and fecal coliform levels than the interim limits. The final limits also include standards for dissolved oxygen and ammonia which are not included in the current permit. The Southerly WWTP must attain compliance with the final limits by July 1, 1988. Based on the operating data presented in Tables 3-6 through 3-8, the Southerly WWTP is not be capable of meeting these final limits on a consistent basis without some upgrading or expansion. The $CBOD_5$ limits were exceeded for the months of May and June (Table 3-7), and the ammonia limits were exceeded six months of the year (Table 3-8).

3.2.4.3 Operational Considerations

Storm flows periodically cause hydraulic overloading and operational upsets at Southerly. In the past, when the biological portion of the plant was threatened by potential flooding, untreated influent was diverted to the treatment plant bypass. In 1983, a cooperative effort by Ohio EPA and the City to reduce bypassing resulted in another method of resolving this problem termed Blending of Flows.

When incoming flows begin to increase, the plant increases pumping rates. When the biological part of the plant begins to show signs of potential washout, then flow to the biological part is fixed. Influent flows above this fixed flow, but less than the capacity of the primary tanks, are bypassed around the biological portion and blended with the final effluent, thus receiving only primary treatment and chlorination. Once the primary treatment facilities are operating at capacity, then influent flow above that rate is bypassed directly to the Scioto River through a 108-inch diameter pipe originating in the screen building.

In reviewing plant operating data it is difficult to pinpoint the exact flow rate above which flows must be blended or bypassed. Blending occurs at flows as low as 45 MGD and bypassing occurs at flows as low as 65 MGD. Table 3-9 gives information on the frequency of bypassing and blending. The average flow values in the table include treated, blended, and bypassed flows. The occurrences of blending and bypassing seem to correspond with the level of precipitation and the time of year. The monthly average precipitation for 1984 through 1986 is 3.0 inches. The greatest frequency of bypassing and blending occurs when the total monthly precipitation exceeds this average. However, during February and March of 1986, the monthly precipitation totals are slightly below average and bypassing and blending occurs in significant amounts. This may be due to snowmelt.

Southerly has also been plagued in the past by bulking problems. A bulking sludge exhibits poor settling characteristics and poor compactability. Filamentous organisms are one of the principle causes of bulking due to their poor floc-forming and settling characteristics. Excessive organic loads in the form of carbohydrates in the wastes can cause excessive growths of filamentous bacteria, which in turn cause bulking.

The Anhueser-Busch Brewery contributes a considerable amount of organic load to the Southerly plant. The brewery has a contract with the city dated August 11, 1981, which limits their discharge to 45,000 lbs/day BOD averaged over a month and 75,000 lbs/day BOD on a daily basis. It is estimated that the brewery contributes 40 percent of the organic load and 6 percent of the hydraulic load to the Southerly WWTP. Thus, the brewery loads are suspect as a significant contributor to the bulking problem.

TABLE 3-9. SOUTHERLY WWTP FLOW DATA

Month/Year	Flow* Average (MGD)	Blending Freq. (days)/ Total (MG)	Bypassing Freq. (days)/ Total (MG)	Precipitation Total (Inches)
1/84	56.7	2/ND	2/ND	1.04
2/84	68.2	10/ND	8/ND	1.97
3/84	78.0	3/ND	9/ND	3.89
4/84	84.5	4/ND	12/ND	4.10
5/84	78.2	0/0	16/ND	4.93
6/84	57.7	0/0	0/0	0.71
7/84	56.7	0/0	1/ND	3.15
8/84	54.9	0/0	0/0	2.96
9/84	53.5	0/0	0/0	1.48
10/84	54.5	0/0	2/ND	2.91
11/84	62.0	0/0	5/ND	4.41
12/84	64.5	0/0	3/ND	2.84
1/85	60.6	0/0	0/0	1.31
2/85	83.1	8/ND	6/ND	1.67
3/85	77.6	8/ND	4/ND	3.78
4/85	68.2	2/ND	1/ND	0.56
5/85	67.6	10/ND	2/ND	4.96
6/85	56.3	0/0	4/ND	1.41
7/85	63.5	0/0	6/ND	6.88
8/85	55.2	3/1.9	2/6.1	ND
9/85	51.4	0/0	0/0	ND
10/85	53.5	0/0	0/0	1.98
11/85	101.2	16/292	13/366	10.67
12/85	73.7	6/41	3/57	1.81
1/86	65.1	5/31	2/7.6	1.54
2/86	86.7	15/231	6/207	2.96
3/86	80.3	8/95	4/192	2.61
4/86	57.7	0/0	0/0	1.31
5/86	52.3	2/5.7	0/0	2.47
6/86	64.2	12/84	3/52	5.53
7/86	62.8	10/65	4/9.0	3.60
8/86	56.2	ND	0/0	1.61
9/86	58.5	ND	2/0.3	3.44
10/87	65.0	ND	4/81	4.16
11/86	60.6	ND	2/16	3.00
12/86	75.4	ND	4/125	2.81

* Flow includes blended, bypassed, and treated flows.

Source: Plant Operating Reports

ND - No Data Available

3.2.5 Present Condition of Plant

In August and September of 1985 an engineering team surveyed both Columbus wastewater treatment plants. Their purpose was to determine the remaining useful service life of the existing facilities. The results of the Southerly survey, taken from the General Engineering Report and Basis of Design (January 1986) are listed below:

- **Tanks** — Minor concrete rehabilitation is needed. Many of the tanks, walls, and walkways exhibit vertical and transverse cracks.
- **Buildings** — Work is required on practically all of the buildings to repair cracks in the concrete, roof leaks, and damaged handrails.
- **Electrical** — A new primary loop is required for future expansion.
- **HVAC** — The majority of the buildings appear to have inadequate or no ventilation and some facilities have less heat than is required. The equipment does not operate or is in poor condition due to an apparent lack of regularly scheduled preventive maintenance.
- **Plumbing** — Some O&M renovation required.
- **Instrumentation & Control** — The I & C system requires renovation and expansion.
- **Wet Stream Process** — The wet stream process equipment is well maintained but it is incapable of effectively treating its design capacity of 100 MGD. Sometimes flows are bypassed around the biological portion of the plant and receive only primary treatment and chlorination or else they are directly bypassed to the Scioto River.
- **Solids Handling** — All sludge pumps should be replaced. Digesters need to be rehabilitated. Minor expansion of existing facilities is required.

3.3 COMBINED SEWER OVERFLOW

The Columbus wastewater collection system includes an area of 10.7 square miles that is served by a combined stormwater and wastewater collection system (Figure 3-1). This constitutes approximately 7 percent of the service areas of the two Columbus wastewater treatment plants. Points of combined sewer overflow in the City include 21 regulator chambers, 3 overflow structures and 2 storm tanks. These structures detain and divert wet weather combined sewer flows that would otherwise hydraulically overload the Jackson Pike and Southerly wastewater treatment plants. The locations of CSO are listed in Table 3-10 and shown on Figure 3-6.

Seven of the regulator chambers discharge to the Olentangy River and eleven overflow to the Scioto River. Two of the regulator chambers discharge overflows to storm sewers. One of the regulatory chambers diverts overflows to the Old Main Interceptor while the outfall of the last regulatory chamber (Sullivant Avenue) has been bulkheaded causing local surcharging during wet weather periods.

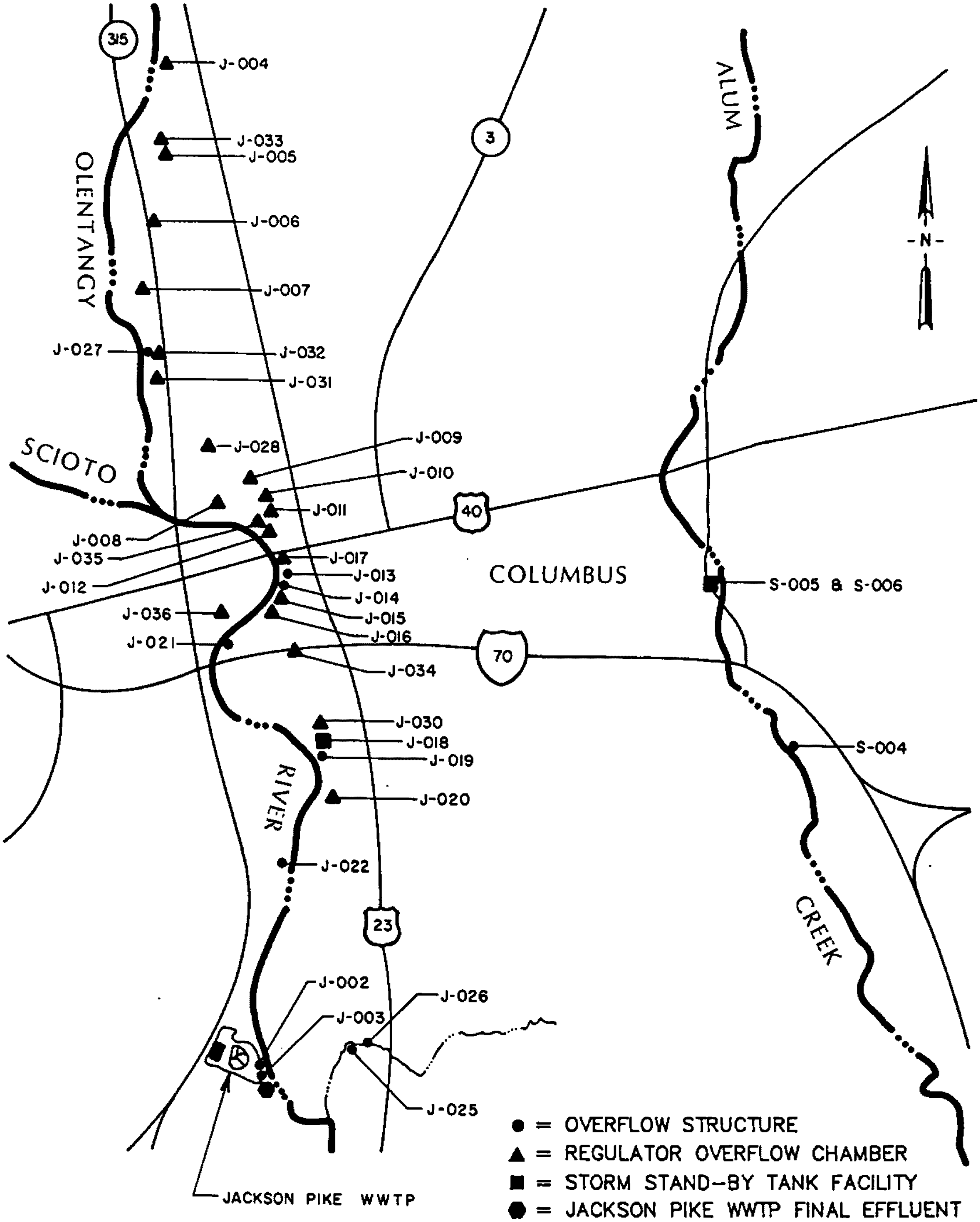
Two of the overflow structures discharge to the Scioto River through 24-inch and 18-inch pipes. The third overflow structure discharges to Alum Creek via a 48-inch storm sewer.

The Whittier Street Storm Detention Tanks, situated south of Whittier Street on the east bank of the Scioto River, were designed to provide relief for wet weather combined sewage flow in the O.S.I.S. The three equal volume, open, reinforced concrete tanks provide a total storage capacity of 4,011,000 gallons. They are capable of acting as a holding system for flows until the flow in the interceptor subsides and they can be bled back into the system and carried to the Jackson Pike WWTP. If the flows exceed the capacity of the tanks, they overflow to the Scioto River. Flows can also be directly bypassed along side the tanks, through an emergency bypass, to the Scioto River.

TABLE 3-10. SUMMARY OF BYPASS AND CSO LOCATIONS IN THE COLUMBUS PLANNING AREA

OUTFALL NUMBER	DECRIPTION - LOCATION	RECEIVING STREAM
	JACKSON PIKE WWTP	
001	Jackson Pike WWTP final effluent	Scioto River
002	Plant raw sewage bypass	Scioto River
003	Plant settled sewage bypass	Scioto River
004	Regulator chamber - Hudson Street	Olentangy River
005	Regulator chamber - Frambes Avenue	Olentangy River
006	Regulator chamber - OSU Water Res.	Olentangy River
007	Regulator chamber - King Avenue	Olentangy River
008	Regulator chamber - Cozzins Street	Scioto River
009	Regulator chamber - West Street	Scioto River
010	Regulator chamber - Chestnut Street	Scioto River
011	Regulator chamber - Spring Street	Scioto River
012	Regulator chamber - Long Street	Scioto River
013	Overflow structure - Capital Street	Scioto River
014	Overflow structure - State Street	Scioto River
015	Regulator chamber - Town Street	Scioto River
016	Regulator chamber - Rich Street	Scioto River
017	Regulator chamber - Broad Street	Scioto River
018	Storm standby tanks - Whittier Street	Scioto River
019	Bypass - Whittier Street standby tank	Scioto River
020	Regulator chamber - Moler Street	Scioto River
021	Sluice gate - Mound Street	Scioto River
022	Overflow - Sewer Maintenance Yard	Scioto River
023	Overflow - Williams Road pump station	Scioto River
025	Overflow - Neff Avenue pump station	Kian Run
026	Overflow - Frank Road - South High Street	Kian Run
027	Sanitary relief - 3rd Avenue	Olentangy River
028	Regulator chamber - Henry Street	Scioto River
029	Regulator chamber - Markinson Avenue	Scioto River
030	Regulator chamber - Whittier Street	Scioto River
031	Regulator chamber - First Avenue	Olentangy River
032	Regulator chamber - Third Avenue	Olentangy River
033	Regulator chamber - Doe Alley	Olentangy River
034	Regulator chamber - Peter's Run	Scioto River
035	Regulator chamber - Spring & West Street	Scioto River
036	Regulator chamber - Sullivant Avenue	Scioto River
	COLUMBUS SOUTHERLY WWTP	
001	Southerly WWTP final effluent	Scioto River
002	Plant raw sewage bypass	Scioto River
003	Plant settled sewage bypass	Scioto River
004	Overflow structure - Roads End	Alum Creek
005	Alum Creek storm standby tank	Alum Creek
006	Alum Creek storm standby tank	Alum creek
007	Ash lagoons	Scioto River

Source: Central Scioto River Mainstem CWQR - 1985



SOURCE: CENTRAL SCIOTO RIVER MAINSTEM CWQR-1985

FIGURE 3-6
LOCATIONS OF COMBINED SEWER OVERFLOW

The Alum Creek Storm Tank is situated on the west bank of Alum Creek just south of Main Street. This covered reinforced tank provides a storage capacity of 857,000 gallons before overflows are bypassed to Alum Creek. A sewer separation program is taking place in the portion of the Southerly service area that is tributary to the Alum Creek Storm Tanks (Figure 3-1). It is being undertaken to address localized surface and residential flooding problems. The city expects that the potential for an overflow will be greatly reduced; however, the actual amount of the reduction has not been quantified.

An evaluation of all overflow points from October 1977 to October 1978 is contained in the Combined Sewer Overflow Monitoring Report prepared by Malcolm Pirnie, Inc. This study indicated that over 90 percent of the overflow volume is discharged through the Whittier Street Storm Detention Tanks, 7.5 percent is discharged at the Alum Creek Storm Tank, and the remaining 2.5 percent is discharged through the regulators and other minor points of overflow. Overflows monitored during the Combined Sewer Overflow Monitoring study conservatively estimated overflows from the Whittier Street Storm Detention Tanks, Alum Creek Storm Tank, and all other overflow points at 2200, 184, and 55 million gallons per year, respectively.

Following completion of the Combined Sewer Overflow Monitoring Report, OEPA authorized an evaluation of combined sewer overflow effects on the Scioto River. This study, entitled Combined Sewer Overflow Progress Report - July 1983, asserts that during periods of medium to high stream flow, dissolved oxygen and BOD_5 concentrations in the Scioto River are largely unaffected by loadings from combined sewer overflows. However, during periods of low river flow, the study maintains that the overflow loadings drop the dissolved oxygen concentration of the river slightly below recommended concentration (5.0 mg/l) and cause an increase in stream BOD_5 concentrations.

3.4 SOUTHWESTERLY COMPOSTING FACILITY

The Southwesterly Compost Facility is located approximately 7 miles south of the Jackson Pike Wastewater Treatment Plant and 2 miles due west of the

Southerly Wastewater Treatment Plant. Construction began in May 1980. Composting began on site in July 1980.

The plant uses the extended-pile aeration method of composting and was originally designed to handle 200 wet tons of sludge/day. It was the first facility of its type in the midwest and has attracted considerable attention from a variety of interested groups.

Dewatered primary and waste activated sludge is trucked to the site and mixed with a bulking agent, either previously composted material or woodchips. The mixture is then placed on a 12-inch deep layer of woodchips, in which perforated plastic pipes have been buried. A pile, 10-feet high, 250-feet long, and 8-feet wide, is generated daily. An 18-inch layer of previously composted material is placed over the pile to provide insulation. Air is drawn through the pile by small blowers attached to the buried pipes and exhausted into a deodorizing pile of woodchips and unscreened compost. The composting operation takes approximately 21 days and requires a minimum of three consecutive days with temperatures greater than 55 degrees Centigrade. Following the composting period, the piles are torn down and restacked for a curing period of 30 days. After this period, the mixture is screened and the woodchips recovered for reuse.

This process creates one difficulty for Columbus. Typically, material composted by the aerated static pile method, utilizing low aeration rates, does not dry significantly during the composting or the curing period. Columbus realized, early in their operation, that additional drying was required if they were going to compost 200 wet tons of sludge per day.

Additional drying of compost may be obtained by either a passive solar process or some mechanical method. Passive solar drying consists of spreading composted and cured material on a drying area and continually stirring it with a tractor and harrow while it is dried by the sun and wind. This method requires a large area and is labor intensive. This method would not be sufficient to handle solids generated at Southwesterly. Therefore, the city chose to implement a mechanical method of drying.

A mechanized drying system was recently installed at Southwesterly. The system consists of reactor bins, conveyor belts, and air handling units in a 70 foot by 338 foot building. There are two reactor bins that are 200 feet long by 20 feet wide and 10 feet deep. Front-end loaders carry cured compost into the building and dump it into a bin feeder-hopper. From there it is conveyed onto a 48-inch conveyor belt which delivers the material to the bins utilizing a tripper car and a shuttle conveyor. The material is placed in the bins and will be dried until proper moisture is obtained. The material is turned and eventually withdrawn from the bins by a digging machine. As the material is removed from the bins it is discharged to a conveyor belt, which carries the dried cured compost into the next building for screening.

The drying bins are aerated from beneath by 4 large air handling units. The units are completely self-contained with integral fans, heat exchangers, and monitoring equipment. They transfer heat from water to air for drying compost. Heat collection for the hot water system is accomplished by a solar collection field. On some occasions only ambient air is used for drying.

Biological drying can also occur in the compost under the right conditions. Biological drying occurs as a result of the inherent biological activity in the composted mass. Oxygen is required to maintain this biological activity. Microorganisms generate heat which in turn evaporates moisture in the pile. This biological drying can occur in the aerated curing piles and in the solar drying building where forced air is available.

The mechanized drying system provides an efficient means of drying compost 365 days a year and permits Southwesterly the capability of processing their original design capacity of 200 wet tons of sludge/day. The final product of the composting process, Com-Til, is marketed as a soil conditioner and top soil substitute.

The city owns approximately 200 acres of land at the Southwesterly facility, approximately 15 to 25 percent of which is being used to process and store compost. Table 3-11 shows the quantities of incoming sludge to the compost facility from January 1984 to September 1986. A total of 130,560 wet tons of sludge were processed during that period. This is approximately 129 tons/day, or 30 percent of the total sludge production at Southerly.

TABLE 3-11. SOUTHWESTERLY COMPOST FACILITY OPERATING DATA

	INCOMING SLUDGE (Wet Tons)		
	1984	1985	1986
January	3,929	2,920	3,142
February	5,056	3,062	3,158
March	6,632	3,622	1,470
April	5,630	2,559	4,197
May	6,091	3,878	4,623
June	3,116	4,233	3,926
July	4,179	3,390	3,473
August	4,970	3,498	3,844
September	4,836	3,626	3,531
October	6,446	2,317	--
November	5,502	3,733	--
December	3,517	2,454	--
TOTAL (Wet Tons)	59,904	39,292	31,364
DAILY AVERAGE (Wet Tons/Day)	164	108	115
PERCENT SOLIDS INCOMING SLUDGE	15.8	17.0	17.3
DAILY AVERAGE (Dry Tons/Day)	25.9	18.3	19.9

Source: Plant Operating Reports

CHAPTER 4. EVALUATION OF WASTEWATER MANAGEMENT DESIGN FACTORS

In the facility planning process, once the objectives have been established and base line conditions described, the next major task is identification of reliable design criteria. The establishment of design criteria involved reviewing existing regulations and guidelines and projecting future conditions in the planning area to serve as a base line in evaluating facility needs and alternatives.

The basic design factors described in this chapter are:

- Planning Period
- Population
- Land Use
- Wastewater Flows and Loads
- Combined Sewer Overflows.

Existing and projected wastewater flows and loads are based on a detailed analysis, documented in Briefing Paper No. 1 - Wastewater Flows and Loads, which is contained in Appendix A. Data contained in the facility planning documents was evaluated to develop an accurate picture of existing conditions and to project future conditions.

Currently, the city of Columbus does not have adequate data documenting the quality and quantity of combined sewer overflows (CSO). In the fall of 1987 the city of Columbus began an extensive study of the CSO problem. The USEPA conducted an independent study and literature search of the CSO problem. This study is summarized in this chapter and is described more fully in Appendix E entitled Briefing Paper No. 5 - Combined Sewer Overflows.

4.1 PLANNING PERIOD

The USEPA regulations mandate a 20-year planning period. The planning period established by USEPA for this SEIS is July 1, 1988, through July 1, 2008.

In 1985 the city of Columbus published the Revised Facility Plan Update, which recommended a one-plant approach to meeting Clean Water Act requirements. Previously, the city had promoted upgrading the existing Jackson Pike and Southerly WWTPs. The planning period selected in the update report is 30 years (1985-2015).

The Clean Water Act requires that wastewater treatment facilities be in compliance with final NPDES Permit requirements by July 1, 1988. Construction is presently underway at both treatment plants to meet the final NPDES permit limits. Currently, the city is operating under interim permit limits until 1988.

This description of the determination of the SEIS planning period takes precedence in this chapter because it sets the boundaries for the discussion of design criteria used in this chapter. Existing and projected population, land use, and wastewater flows and loads are based on a 20-year planning period which is different from the planning period used in the facility plan.

4.2 POPULATION

Population is one of the most important parameters used in designing a wastewater treatment facility. Population forcasts are used to project wastewater flows and loads used for design. Approximately 35 percent of the wastewater flow at Jackson Pike and 47 percent of the wastewater flow at Southerly is estimated to be generated from domestic or residential sources. As the planning area's population increases, wastewater flows are also expected to increase.

4.2.1 Existing Population

In order to project future growth, it is necessary to examine the present population levels and past trends. Table 4-1 presents a demographic profile of the Columbus area based on 1980 Census data. It lists 1980 population levels, median age and income, the number of housing units, household size, and the change in population and housing units between 1970 and 1980. This table indicates that the Columbus Metropolitan Statistical Area (MSA) is a high growth area. The population increased by 25 percent, and the number of housing units increased by 32 percent from 1970 to 1980. The area's average family income is higher than the state's. The bulk of the Columbus area population is between the child bearing years of 25 to 35. Three-quarters of the area's housing units are single-family dwellings.

Table 4-1 also lists the percent of the overall population for each county that is included in the Facility Planning Area (FPA). Most of Franklin County (99 percent) and a small pecentage of Delaware (3 percent), Fairfield (1 percent), and Licking Counties (3 percent) are included in the FPA. All of the city of Columbus is included in the FPA. Since the city of Columbus and Franklin County comprise the bulk of the land and population in the FPA, growth in these two municipalities are indicative of growth levels in the FPA.

In Franklin County, the population reached 869,132 in 1980 and 898,345 in 1985. This represents an increase of 6,000 persons per year. In 1984, there were 6,551 building permits issed in Franklin County; 2,875 of which were for apartments and townhouse units. The remaining 3,676 were for single family homes. On the average, 4,000 dwelling units have been built each year since 1980.

TABLE 4-1. 1980 DEMOGRAPHIC PROFILE FOR THE COLUMBUS AREA

	Percent of Population in FPA	Total Persons	Median Age	Persons/ House-hold	Percent Change in Population 1970-1980	1979 Median Family Income	Housing Units	Percent of One-Unit Structures	Percent Owner Occupied	Percent Change in Units 1970-1980	% Vacant
State of Ohio	8	10,797,630	29.9	2.76	1.3	$20,909	4,108,105	70.3	68	18.5	6
Columbus MSA*	75	1,093,310	29.5	2.82	25.8	23,506	426,426	76.6	72	32.9	5.6
City of Columbus	100	564,871	28.1	2.49	25.5	20,882	236,708	55.0	48	25.5	8.2
FPA Counties											
Delaware County	3	53,840	28.9	2.90	25.5	22,202	18,764	78.9	76	41.8	6.1
Fairfield County	1	93,678	30.4	2.92	27.8	20,728	33,530	83.6	77	36.3	5.2
Franklin County	99	869,132	28.1	2.61	14.2	20,970	347,024	62.4	57	28.0	7
Licking County	3	120,981	30.1	2.80	11.6	20,660	44,502	78.0	74	25.9	5.2
Union County	0	29,536	29.7	2.87	24.2	19,704	10,619	80.2	76	32.5	4.6

*The Columbus MSA includes: Delaware, Fairfield, Licking, Franklin, Madison, Pickaway, and Union Counties.

Columbus is experiencing, along with much of the nation, a decline in household size. This trend along with the growth in population has increased the demand for housing. In 1980, Franklin County had a household size of 3.08 persons per household; by 1984 this had decreased to 2.56 persons per household. The major component of this decline in household size is the rise in the number of households headed by a single person. In 1970, 17 percent of the households in Columbus were included in this category; by 1985 that number had increased to 27.9 percent (City of Columbus, 1985).

In the past 25 years, the population in the city of Columbus has increased by 112,406 persons. The number of households has almost doubled in the period betwen 1960 and 1985. (The number of households in 1960 was 142,378; by 1985, this number had grown to 229,804) (City of Columbus, 1985). In smaller suburban communities (Table 4-2) such as Dublin, Gahanna, Westerville, and Worthington, the population between 1960 and 1980 doubled and in some cases more than tripled in that 20-year period. The growth that has occurred in the Columbus area in the last 25 years generally placed unanticipated demands on community services. These services include the local infrastructure; that is roads, water and sewer system as well as public services such as fire and police protection, health and community services, and public education.

4.2.2 Population Projections

Population projections for the Columbus area are available from a number of sources. These include:

- Ohio Data Users Center (ODUC), a division of the Ohio Department of Economic Development
- Ohio Environmental Protection Agency (OEPA)
- Mid-Ohio Regional Planning Commission (MORPC).

TABLE 4-2. POPULATION AND PER CAPITA INCOME BY POLITICAL SUBDIVISION

	Population July 1984	Population 1980	% Change 1980-84	Per Capita Income 1983
Columbus	566,114	564,871	+ 0.2	8,800
Bexley	13,588	13,405	+ 1.4	15,096
Dublin	5,437	3,855	+29.1	18,392
Gahanna	20,222	18,001	+63.1	10,444
Grandview Heights	7,945	7,420	+ 6.6	11,689
Grove City	17,442	16,793	+ 3.7	9,661
Groveport	3,613	3,286	+ 9.1	8,438
Hilliard	8,647	8,008	+ 7.4	8,549
Lockbourne	419	373	+11.0	7,093
Marble Cliff	566	630	+11.3	17,815
Minerva Park	1,691	1,618	+ 4.3	13,987
New Albany	441	409	+ 7.3	10,442
New Rome	68	63	+ 7.4	9,095
Obetz	3,284	3,095	+ 6.1	8,174
Reynoldsburg	22,390	20,661	+ 8.4	10,811
Upper Arlington	36,067	35,648	+ 1.2	18,711
Westerville	24,878	23,414	+ 6.3	10,875
Whitehall	22,754	21,299	+ 6.8	9,677
Worthington	18,721	15,016	+24.7	14,622

SOURCE: Ohio Data Users Center and Columbus Chamber of Commerce.

NOTE: Shawnee Hills is located in the facility planning area; however, data necessary to complete this table were unavailable.

However, each agency uses different parameters: ODUC prepares its projections only on the county level, OEPA prepares its projections by Sewer Service Areas, and MORPC prepares its projections by traffic zones. Although OEPA and MORPC's projections are prepared for smaller areas than ODUC's, they must be certified by the state as agreeing with the most current ODUC projections. In 1985, ODUC updated its projections based on 1980 U.S. Census. Since MORPC and OEPA agree that the 1985 ODUC estimates are the best available projections, these were used as the basis of projections used in this EIS. Table 4-3 lists the ODUC projections for the area.

TABLE 4-3. POPULATION PROJECTIONS FOR THE STATE OF OHIO AND THE COUNTIES IN THE COLUMBUS SERVICE AREA

	1980	1990	2000	2010
Ohio	10,797,630	10,681,863	10,583,083	10,398,338
Delaware	53,840	61,709	71,381	81,164
Fairfield	93,678	98,655	104,033	107,577
Franklin	869,132	924,592	975,013	1,026,008
Licking	120,981	127,390	132,154	136,765

Source: Ohio Data Users Center, 1985.

Although the population in the state of Ohio is expected to decline in the future, the population of all of the counties included in the FPA is expected to increase. The population of Franklin County is expected to increase at an average annual rate of six percent for the next 30 years. These forecasts show the 2010 Franklin County population will exceed 1 million persons.

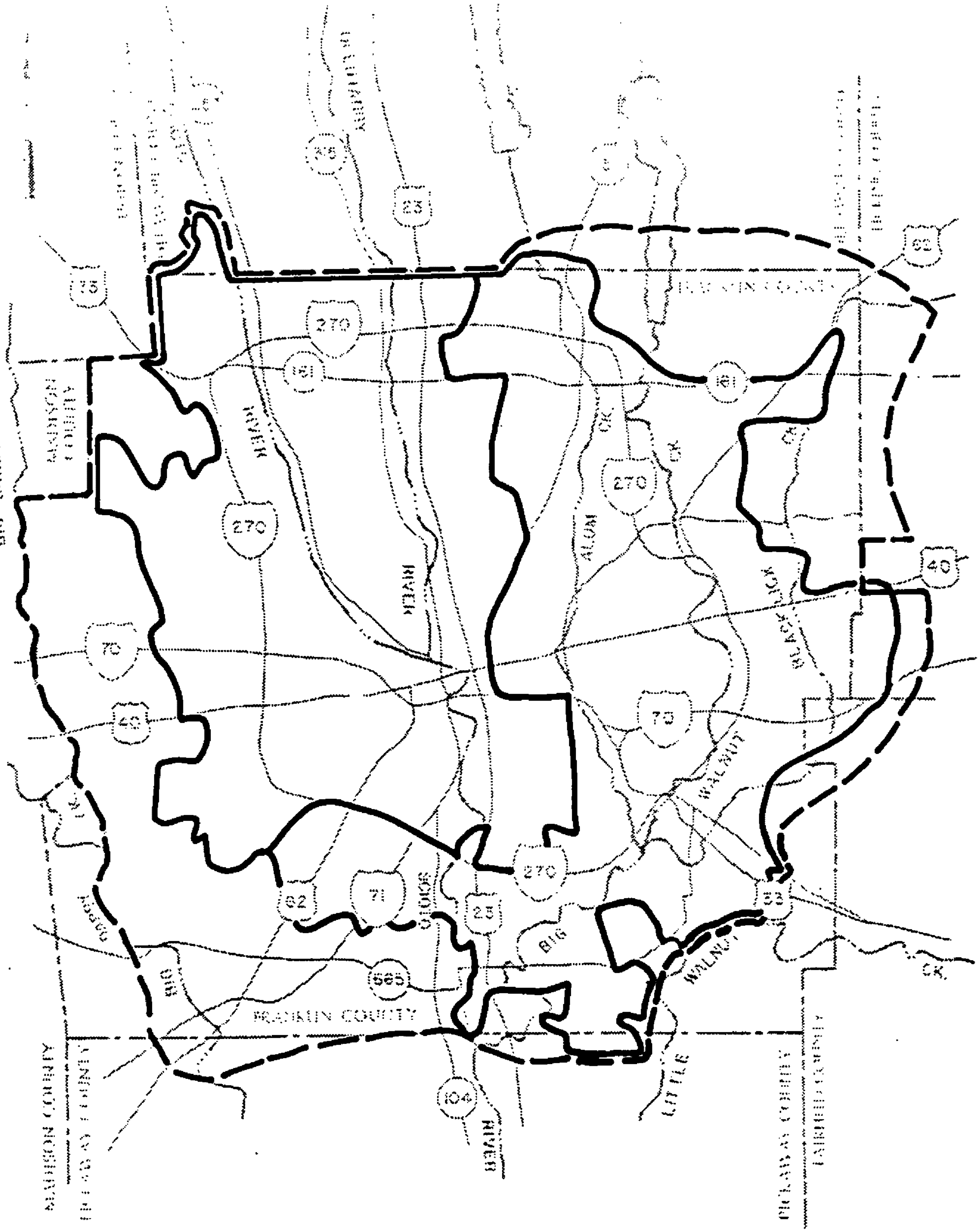
As mentioned earlier, most of Franklin County is included in the Columbus Facilities Planning Area (FPA). The FPA represents the geographic area that could be served by the Columbus sewer system. The FPA is defined by OEPA. OEPA assigns each sewer district an FPA in order to coordinate the planning activities of various sewer authorities. The FPA includes the potential service area. The service area must be located within the FPA boundary. The service area boundary, as shown on Figure 4-1, represents the area presently served as well as those areas most likely to be served during the 20-year planning period or prior to 2008.

Population projections were prepared for use in this Supplemental EIS for both of these areas. These projections were based on the most recent ODUC projections and were prepared for the 20-year planning period starting in 1988. Appendix K details the methodology used to disaggregate the county projections into the 2008 Service Area. Table 4-4 lists these projections for the 2008 design year.

TABLE 4-4. POPULATION PROJECTIONS FOR COLUMBUS

Sub-Area	1988	2000	2008
Planning Area	925,900	982,600	1,018,000
Total Service Area	888,000	941,600	986,000
Jackson Pike Service Area	499,000	529,200	544,600
Southerly Service Area	389,000	412,400	441,400
RFPU Total Service Area Forecasts (11/86)	870,427	951,861	995,159

The above table indicates, the planning area population will increase by 92,100 individuals during the 1988 to 2008 planning period, reaching 1,018,000 persons by 2008. This table also shows the 2008 Service Area population increasing by 98,000 persons during the same period. The Service Area population is shown as reaching 986,000 persons by 2008.



SERVICE AREA BOUNDARY

PLANNING AREA BOUNDARY

FIGURE 4-1
PLANNING AND SERVICE AREA BOUNDARIES

Preparing population projections for small areas requires a good estimate of existing land use, the amount of vacant developable land, and a number of other economic trends. Different forecasting techniques can result in slight variations in small area population projections. The projections prepared for the RFPU vary slightly from those prepared for this Supplemental EIS. The RFPU assumed a slower growth rate between 1980 and 1988 and a higher growth rate between 2000 and 2008 than assumed by ODUC. This resulted in the RFPU presenting a lower initial population and a higher population in 2008 than those shown in Table 4-4. A detailed memorandum explaining the methods used in the RFPU is included as Appendix K.

4.3 LAND USE PATTERN

Land use in Franklin County is controlled by local zoning ordinances. There are 234 incorporated areas and 17 towns in Franklin County that guide growth through zoning. Some of these incorporated areas also have a master plan; most do not. In Franklin County, eleven of the towns have delegated their zoning powers to MORPC--the regional planning agency.

The largest incorporated area in Franklin County is the city of Columbus. They are in the process of developing a comprehensive plan to guide growth. Until a plan is adopted, the city will continue to use over 20 different documents to guide and control growth. Some of these documents are updated on a regular basis, these include the Growth and Development Report and the Capital Improvement Program. Others are updated as the need arises, such as the recently completed plan for the Columbus International Airport. Due to its physical size, large population, and large employment base, the city's policies greatly influence development in the smaller incorporated areas.

Columbus is the state capital and houses several corporate headquarters and a major state university. It has never been known as an industrial town. The city has a densely developed inner core with mixed office space and other services such as hotels and retail stores. Low density research and development and distribution centers have moved from the inner core to the I-270 corridor. This redevelopment has not affected the city's tax base since many of these newer developments have been annexed to the city in order to receive its services.

The city of Columbus provides sewer and water services to city residents and by contract to suburban municipalities. In the past, the city has used water and sewer service as an incentive to developers to annex to Columbus. Twenty communities have contracts with Columbus. Table 4-5 lists the municipalities that have sewer service contracts with the city, and Figure 4-2 identifies suburban communities with **sewer** service contracts **as of 1988.** This service area includes 89 percent of Franklin County. **During the summer of 1987, the county made an administrative review of its sewer service contracts and cancelled those contracts that were considered to be inactive. The contract with New Albany was cancelled at this time. (Cabot 1988)**

In the Columbus area, growth has been influenced by annexation of various incorporated areas, **changes in** school district boundaries, highway construction, and the availability of public water and sewer. Suburban growth, particularly in the northern and western sections of Franklin County is directly related to completion of the interstate highway system (I-270 and I-170). The areas most affected are Dublin, Worthington, Westerville and to a lesser extent Gahanna.

Most of the unincorporated areas are either vacant land or farmland. Some of the smaller incorporated areas mix some industrial and commercial uses with predominantly residential uses. This development has been dominated by the construction of single-family homes. Table 4-6 lists subdivisions filed in the Columbus area between 1980 and 1982. This table confirms that aside from Grove City most of the area's residential development is occurring in the northern sectors. Figure 4-3 presents these high growth areas in a

TABLE 4-5. SEWER SERVICE CONTRACTS FOR THE CITY OF COLUMBUS AS OF MAY 1988

Existing Contracts with Incorporated Cities and Villages.

Bexley[1]	Groveport[2,3]	Upper Arlington[3]
Brice[1]	Hilliard[2,4]	Urbancrest[1]
Dublin[2]	Marble Cliff[1]	Valleyview[1]
Gahanna[2,4]	Minerva Park[1]	Westerville[2,4]
Grandview Heights[1]	Obetz[2,3]	Whitehall[1]
Grove City[2,4]	Reynoldsburg[2]	Worthington[1]
	Riverlea[1]	

Existing Contracts with Franklin County (Unincorporated Subdivisions).

Briarbank Subdivision	Franklin (Sections 1 and 4)	Truro (Section 1)
Brookside Estates	Hamilton Meadows	Worthington Hills
Clinton (Sections 2 and 3)	Mifflin (Section 1)	Timberbrook Subdivision

Existing Contracts with other entities.

Defense Construction Supply Center[3]
Rickenbacker Air Force Base[3]

Pending Contracts with Franklin County (Unincorporated Subdivisions).

Briar Wood Hills	Franklin County Landfill	Windsor Subdivision
Forest Ridge	Ridgewood Subdivision	

Contracts under negotiation with Incorporated Cities.

New Albany

Contracts under negotiation with Franklin County.

Century Acres	Oakhurst Knolls	Windrush Creek
Enchanted Acres	Taylor Estates	Young Estates
Holton Park	Village Park	

Source: Hunsberger 1988.

(Table continued on Page 4-13)

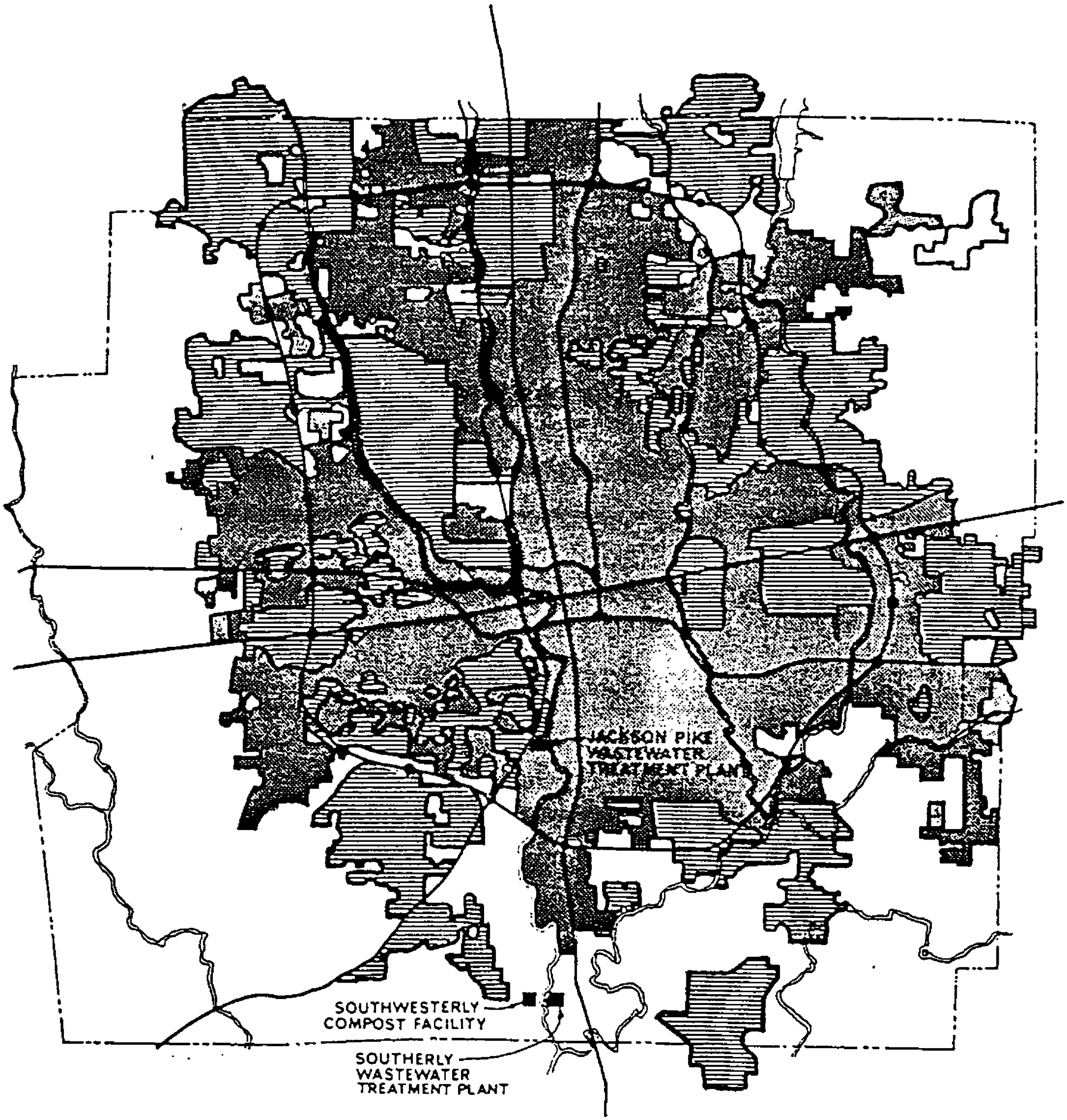
TABLE 4-5. SEWER SERVICE CONTRACTS FOR THE CITY OF COLUMBUS AS OF MAY 1988 (CONT.)

[1]This city or village is entirely surrounded by other incorporated places, and therefore has no opportunity to expand its corporate limits through annexation of adjacent unincorporated areas.

[2]This city or village has a clause in its sewer service contract with Columbus which limits sewer service expansion to the city or village's corporate limits. The contract also clearly defines an area outside the city or village where, if preceded by annexation into the city or village, new sewer service can be offered without prior approval of the City of Columbus' Director of Public Service.

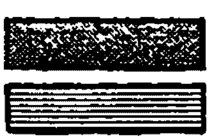
[3]This city or village has a clause in its sewer service contract with Columbus which limits sewer service expansion to the city or village's corporate limits. The contract also clearly defines an area outside the city or village where, if preceded by annexation into the city or village, new sewer service may be offered, only with prior approval of the City of Columbus' Director of Public Service.

[4]This city or village has a clause in its sewer service contract with Columbus which limits sewer service expansion to the city or village's corporate limits. The contract also permits undefined areas outside the city or village to be offered new sewer service as part of annexation into the city or village with prior approval of the City of Columbus' Director of Public Service.



SOURCE: City of Columbus (Scott, March 1988)

COLUMBUS SEWER SERVICE AREA



City of Columbus

Service Contract Areas

FIGURE 4-2
SEWER SERVICE AREAS

TABLE 4-6. RESIDENTIAL PLATS BY MUNICIPALITY OR TOWNSHIP, 1980-1982, FRANKLIN COUNTY

	Year	Plats	Resubdivisions[1]	Acreage	New Acreage[2]	Total Lots	New Lots[3]
Columbus	1980	31	7	368.297	316.359	1659	1567
	1981	23	6	275.110	260.912	965	901
	1982	15	7	93.193	70.879	487	400
	TOTAL	69	20	736.600	648.150	3111	2868
Dublin	1980	3	0	41.389	41.389	83	83
	1981	1	0	7.447	7.447	1	1
	1982	2	0	23.267	23.267	30	30
	TOTAL	6	0	72.103	72.103	114	114
Gahanna	1980	1	0	15.980	15.980	45	45
	1981	4	0	59.613	59.613	181	181
	1982	1	0	7.896	7.896	30	30
	TOTAL	6	0	83.489	83.489	256	256
Grandview* Heights	1980	1	0	4.170	4.170	9	9
	1981	0	0	0.000	0.000	0	0
	1982	0	0	0.000	0.000	0	0
	TOTAL	1	0	4.170	4.170	9	9
Grove City	1980	3	0	48.086	48.086	120	120
	1981	1	0	34.182	34.182	92	92
	1982	1	0	0.596	0.596	3	3
	TOTAL	5	0	82.864	82.864	215	215
Hilliard	1980	1	1	2.074	0.000	10	3
	1981	0	0	0.000	0.000	0	0
	1982	0	0	0.000	0.000	0	0
	TOTAL	1	1	2.074	0.000	10	3
Upper* Arlington	1980	1	0	10.847	10.847	25	25
	1981	2	1	8.904	7.371	28	27
	1982	2	1	4.006	2.149	9	9
	TOTAL	5	2	23.757	20.367	62	61
Westerville	1980	6	0	77.801	77.801	204	204
	1981	1	0	2.115	2.115	11	11
	1982	3	2	37.742	36.119	101	94
	TOTAL	10	2	117.658	116.035	316	309

TABLE 4-6. RESIDENTIAL PLATS BY MUNICIPALITY OR TOWNSHIP, 1980-1982, FRANKLIN COUNTY (CONT.)

	Year	Plats	Resubdivisions[1]	Acreage	New Acreage[2]	Total Lots	New Lots[3]
Worthington*	1980	1	0	3.250	3.250	9	9
	1981	2	0	47.527	47.527	101	101
	1982	2	1	6.601	5.588	19	18
	TOTAL	5	1	57.378	56.365	129	128
Bexley*	1980	0	0	0.000	0.000	0	0
	1981	1	1	1.319	0.000	3	0
	1982	0	0	0.000	0.000	0	0
	TOTAL	1	1	1.319	0.000	3	0
Reynoldburg	1980	0	0	0.000	0.000	0	0
	1981	2	0	13.216	13.216	88	88
	1982	1	0	26.252	26.252	72	72
	TOTAL	3	0	39.468	39.468	160	160
Townships	1980	3	0	68.239	68.239	155	155
	1981	2	0	14.914	14.914	42	42
	1982	2	2	6.263	0.000	10	3
	TOTAL	7	2	89.416	83.153	207	200
Franklin County Total	TOTAL	119	29	1310.296	1206.164	4592	4323

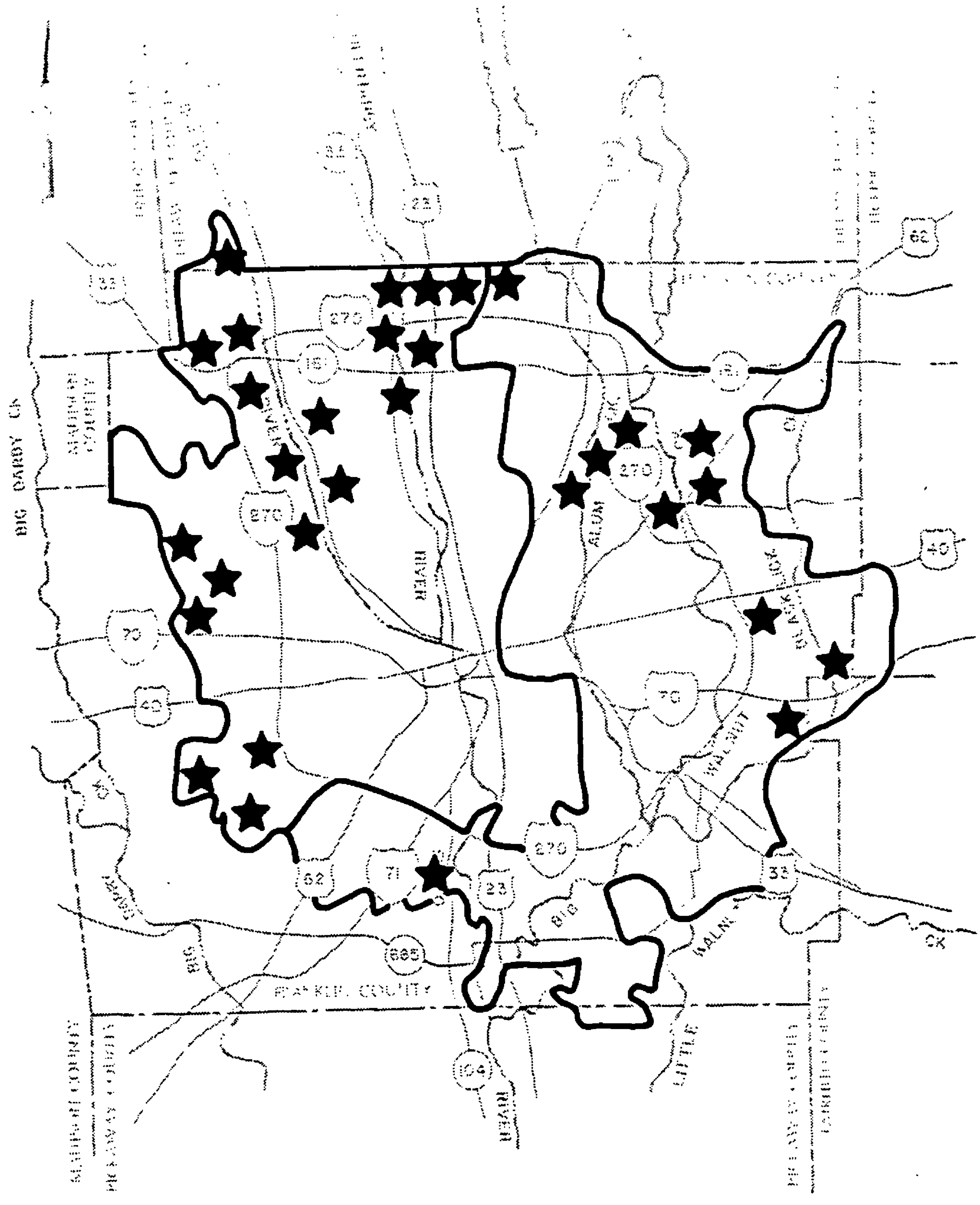
[1]The number of resubdivisions is included in the total plat count. Resubdivision occurs when a large number of undeveloped lots are consolidated under one owner and broken into new lots with different acreages and locations.

[2]New acreage refer to the total platted acreage minus any resubdivided land.

[3]New lots refers to the total platted lots minus those lots created by a resubdivision where previous lots existed. For example, if a resubdivision plat of 4 acreas contained 20 lots and the previous plat for the same 4 acres contained 16 lots, then the resubdivision resulted in no new acreage and 4 new lots.

*Interviews with local officials indicate that less than 10% of the land in the municipalities is available for development.

Source: City of Columbus, 1983.



★ TRAFFIC ZONES WITH PROJECTED INCREASES OF 1,000 PERSONS OR 500 HOMES FROM 1980 TO 2000

SERVICE AREA BOUNDARY

FIGURE 4-3
HIGH GROWTH AREAS

generalized manner. This figure depicts growth according to traffic zones. There are over 800 such zones in the service area. Approximately 30 of these zones are considered to be high growth areas.

Because there are numerous vacant parcels of land adjacent to the city of Columbus and within the service area, it is assumed all of the projected growth can be located within the service area. These parcels of land were not developed during the first wave of suburban expansion. Development of these parcels will be part of an infill process and will require resubdivision of less-attractive parcels. **Given current land use controls and development patterns, projected development is most likely to occur in the suburban areas. In order to keep development in the service area, planning measures could be taken to make these infill parcels more attractive, thereby encouraging a more efficient pattern of development.**

4.4 WASTEWATER FLOWS AND LOADS

The development of average daily and peak daily flow rates and daily loadings of total suspended solids (TSS) and biochemical oxygen demand (BOD) are necessary to evaluate facility planning alternatives. The following sections present the existing flows and loads developed for the Columbus WWTPs from an independent analysis of the 1985 and 1986 plant data, as well as projected flows and loads for the 2008 design year. The detailed documentation for this portion of the report is contained in Appendix A entitled Briefing Paper No. 1 - Wastewater Flows and Loads.

An analysis of existing conditions established the current average day flows. The average day flow is disaggregated into domestic, infiltration, industrial, and commercial flows. Diurnal flows are evaluated, and a diurnal peaking factor is established. A process peaking factor is established to project peak flow rates which will be used for hydraulic sizing of WWTP unit processes. Wet weather flows are discussed briefly with a more detailed discussion included in Section 4.5 - Combined Sewer Overflow. Due to the lack of comprehensive combined sewer overflow (CSO) data, projected design flows were developed independent of CSO.

The analysis also includes a review of existing influent BOD and TSS loads. BOD and TSS loads are used to determine sizings for WWTP unit processes and to aid in the selection of the treatment processes.

Wastewater flows and loads are projected for the design year (2008) using existing per capita flows and loads and 2008 population projections.

4.4.1 Existing Wastewater Flows

Jackson Pike and Southerly Monthly Operating Reports (MORs) and precipitation data for the 1985 and 1986 calendar years were used to establish existing wastewater flows. The MORs are submitted to Ohio EPA in accordance with the NPDES permits.

The Southerly MORs include data on amounts of raw sewage bypassed and settled sewage bypassed as well as treated flow. The Southerly plant has a method of treatment termed Blending of Flows. When incoming flows increase to the point where the biological portion of the plant begins to show signs of potential washout, the flow to the biological part of the plant is fixed. The increase in flow above this fixed flow, but less than the capacity of the primary tanks, is bypassed around the biological portion and blended with the final effluent, thus, receiving only primary treatment and chlorination. These flows are reported on the MORs as settled sewage bypassed. If the primary treatment facilities are operating at capacity, then all excess flows are bypassed directly to the Scioto River through a 108-inch diameter pipe originating in the screen building. These flows are reported on the MORs as raw sewage bypassed. After August of 1986, no blending of flows was recorded on the MORs for the Southerly WWTP, however, bypassing was still reported.

The Jackson Pike MORs provide flow monitoring data for the plant. Jackson Pike does not blend as Southerly does, nor do they bypass raw sewage. The major diversion point for Jackson Pike flows occurs at the Whittier Street Storm Standby Tanks before the flows reach the plant. The tanks are capable of acting as a holding system for the excess flows until the flow in the interceptor subsides and they can be bled back into the system and carried to the Jackson Pike plant. If the flows exceed the capacity of the tanks, they overflow to the Scioto River. Flows can also be directly bypassed along side the tanks, through an emergency bypass, to the Scioto River.

Flow monitoring did not take place at the Whittier Street Storm Standby Tanks until November of 1986. However, hours of operation of the storm tanks were recorded during 1985 and 1986 on the Monthly Report of Operations. The fact that hours of operation were reported does not necessarily mean there was bypassing or overflowing occurring at the tanks. It only means that the gates were open and flows were being diverted into the tanks. In November of 1986, the city began monitoring the overflow but not the bypass. Therefore, the data is still incomplete with respect to determining the total volume of flow entering the Scioto River at the Whittier Street facility.

Dry weather flows were determined through an analysis of 1985 and 1986 flow data. However, only 1986 flow data was used to determine wet weather flows. An analysis of 1985 MORs showed that data on raw and settled sewage bypasses at Southerly were not complete. Up until August of 1985, only a bypass flow rate (MGD) was reported with no duration specified. These bypasses did not always occur 24 hours a day, therefore these rates could not be converted to the volume bypassed during that day. In August of 1985, monitoring of the duration of the bypasses began which provided a more accurate determination of the volume of the bypasses. Therefore, the 1986 calendar year data were used to estimate wet weather flows.

Wet weather total system flow cannot be determined solely based on the volume of flow arriving at the Jackson Pike and Southerly WWTPs. There are numerous points of combined sewer overflow throughout the Columbus Sewer System. The Jackson Pike service area has several regulator chambers and overflow structures in addition to the Whittier Street Storm Standby Tanks discussed previously. The Southerly service area includes an overflow structure at Roads End and the Alum Creek Storm Standby Tank. There is no comprehensive flow monitoring data available for the regulators, overflows, and storm tanks. The city began monitoring some of the points of combined sewer overflow in November of 1986; but according to the MORs, the flow monitoring equipment malfunctioned frequently providing no data. Thus, the only flow data included in the wet weather analysis, other than plant flow data, was that which was reported for the Whittier Street overflow during November and December.

The following paragraphs present the existing average flow, diurnal flow, peak process flow, and wet weather flow as determined from the analysis of available data.

4.4.1.1 Existing Average Flows

USEPA guidelines require WWTP design flows to be determined based on existing dry weather flows and non-excessive I/I. Therefore, the existing average flow was determined through an analysis of dry weather/no bypass flows. The 1985 and 1986 flow record contained 214 dry weather/no bypass days. Analysis of these days showed a combined maximum monthly average of 145 MGD for the Jackson Pike and Southerly WWTPs. This flow was established as the existing average flow. Distributed between the two plants, it is 84 MGD for Jackson Pike and 61 MGD for Southerly.

Infiltration

A current infiltration/inflow report was not available for the Columbus sewer system; therefore, wastewater flow, water use, and precipitation data were utilized to estimate infiltration.

The maximum monthly average dry weather/no bypass flow of 145 MGD occurred in May of 1985. The data base consists of two four-day periods of dry weather/no bypass conditions. This month, which had 3.92 inches of precipitation, had the second highest monthly rainfall recorded during 1985. Therefore, May would represent a high groundwater condition resulting in increased infiltration. November had the highest precipitation with 10.67 inches, but there were no dry weather/no bypass days during that month. Therefore, it was not possible to determine infiltration using November data.

Based on the two years of records evaluated, September of 1985 had the lowest combined (i.e., total for both WWTPs) monthly average dry weather/no bypass flow of 124 MGD; and it had 24 dry weather/no bypass days which occurred in one two-day period and one 22-day period. Due to the extended dry weather period, September was used to represent a low groundwater condition. Water usage vs. wastewater flow data presented in Table 4-7 reinforce May and September as representing high and low groundwater conditions. The month of May has an average water pumpage figure of 120 MGD which is very close to the annual average of 121 MGD. However, it has an average dry weather wastewater flow figure of 145 MGD which is the highest value reported for 1985. The wastewater flow is 20 percent higher than the water pumped suggesting increased infiltration resulting from a high groundwater condtion. September, on the other hand, has the highest water pumpage figure of 142 MGD and the lowest wastewater flow of 124 MGD. In this situation the wastewater flow is 15 percent lower than the water pumpage. This implies that a lot of water is being used for lawn sprinkling due to the dry weather.

The difference of 21 MGD between the high groundwater month (May) and the low groundwater month (September) represents that portion of the total infiltration which is attributable to a high groundwater condition.

However, this is only a portion of the total amount of infiltration occurring since there is also some infiltration occurring during low groundwater conditions. Therefore, the amount of infiltration occurring during low groundwater conditions must be determined and added to the 21 MGD in order to establish a total infiltration rate.

TABLE 4-7. 1985 WATER PUMPAGE VS. WASTEWATER FLOW

Month	Average Water Pumped (MGD)	Average Dry Weather/ No Bypass Flow (MGD)
January	111.23	132.30
February	108.32	139.94
March	109.65	142.55
April	115.60	140.25
May	120.33	144.75
June	128.53	134.03
July	127.15	138.87
August	130.66	127.03
September	141.74	124.02
October	124.88	124.88
November	117.23	No Data
December	116.46	143.16

A common method of estimating total infiltration involves using monthly water records to establish the domestic, commercial, and industrial portion of the wastewater flow. The difference between the water supplied and wastewater collected under dry weather conditions is then taken to be infiltration.

Since September 1985 has been established as a low groundwater month, water usage rates from this month will be used. As reported in Table 4-8, the September 1985 water pumpage rate is 141.74 MGD. Literature states that approximately 60 to 80 percent of water pumped becomes wastewater. The 20 to 40 percent which is lost includes water consumed by commercial and manufacturing establishments and water used for street cleaning, lawn sprinkling, and extinguishing fires. It also includes water used by residences that are not connected to the sewer system as well as some leakage from water mains and service pipes. If it is assumed that 70 percent of the water becomes wastewater, then the return flow for September would be 99.22 MGD. Referring to Table 4-8, the wastewater flow for September is 124.02 MGD. The difference between the actual wastewater flow (124.02) and the expected wastewater flow (99.22) is 24.80 MGD. This value is assumed to represent the amount of infiltration occurring during a low groundwater condition. Thus, the total infiltration occurring during high groundwater conditions is obtained by adding 20.73 MGD to 24.80 MGD. This total infiltration figure of 45.53 MGD, converts to 52 gpcd.

It must be remembered that 52 gpcd is only a rough estimate of infiltration. It is not known if all of the water customers are sewer customers or if all the sewer customers are water customers. Some sewer customers may have their own private wells. In addition, the consumptive use of the brewery and the other industries is unknown.

It is, however, considered to be a non-excessive infiltration rate when compared to infiltration rates in the USEPA document entitled Facility Planning - 1981 Construction Grants Programs. This document states that 2000 to 3000 gpd/inch-diameter mile is considered a non-excessive infiltration rate for sewer systems with lengths greater than 100,000 feet. The Columbus Sewer

System has a total length of 9,975,000 feet or an estimated 32,930 inch-diameter miles. Multiplying the inch-diameter miles by 2000 gpd/inch-diameter mile results in 66 MGD or 76 gpcd. Therefore, 52 gpcd of infiltration would be considered non-excessive.

The Revised Facility Plan Update uses a peak infiltration rate of 72 gpcd. Divided between the two plants, it is 82 gpcd for Jackson Pike and 58 gpcd for Southerly. Assuming more detailed information was available to establish this number for the facility plan and considering 72 gpcd is also a non-excessive infiltration rate according to the USEPA document, it will be used in this briefing paper as the existing infiltration rate. It converts to 22 MGD for Southerly and 40 MGD for Jackson Pike, totaling 62 MGD for the entire Columbus Sewer System.

Industrial and Commercial Flows

Current information on industrial and commercial wastewater flows was not available. Therefore, estimates were made by updating those values presented in the Columbus Industrial Pretreatment Program Report as prepared by Burgess and Niple. The industrial flows presented in the Columbus Industrial Pretreatment Program Report were updated proportional to the increase in population from 1980 to 1985 since they were based on 1980 water consumption records. The 1985 estimates of industrial and commercial flows are presented in Table 4-8.

TABLE 4-8. INDUSTRIAL AND COMMERCIAL FLOW ESTIMATES

	1980 Population	1980 Industrial Flow (MGD)	1980 Commercial Flow (MGD)	1985 Population	1985 Industrial Flow (MGD)	1985 Commercial Flow (MGD)
Jackson Pike	472,503	8.7	4.3	489,000	9.0	4.5
Southerly	368,228	6.7	3.1	381,000	6.9	3.2
TOTAL	840,731	15.4	7.4	870,000	15.9	7.7

Domestic Flows

Domestic flows were estimated simply by subtracting infiltration, industrial, and commercial flows from the maximum dry weather/no bypass flow of 145 MGD. The Jackson Pike domestic flow is 30.4 MGD and Southerly is 28.8 MGD. Table 4-9 presents the breakdown of the existing flow for each plant and the two plants combined.

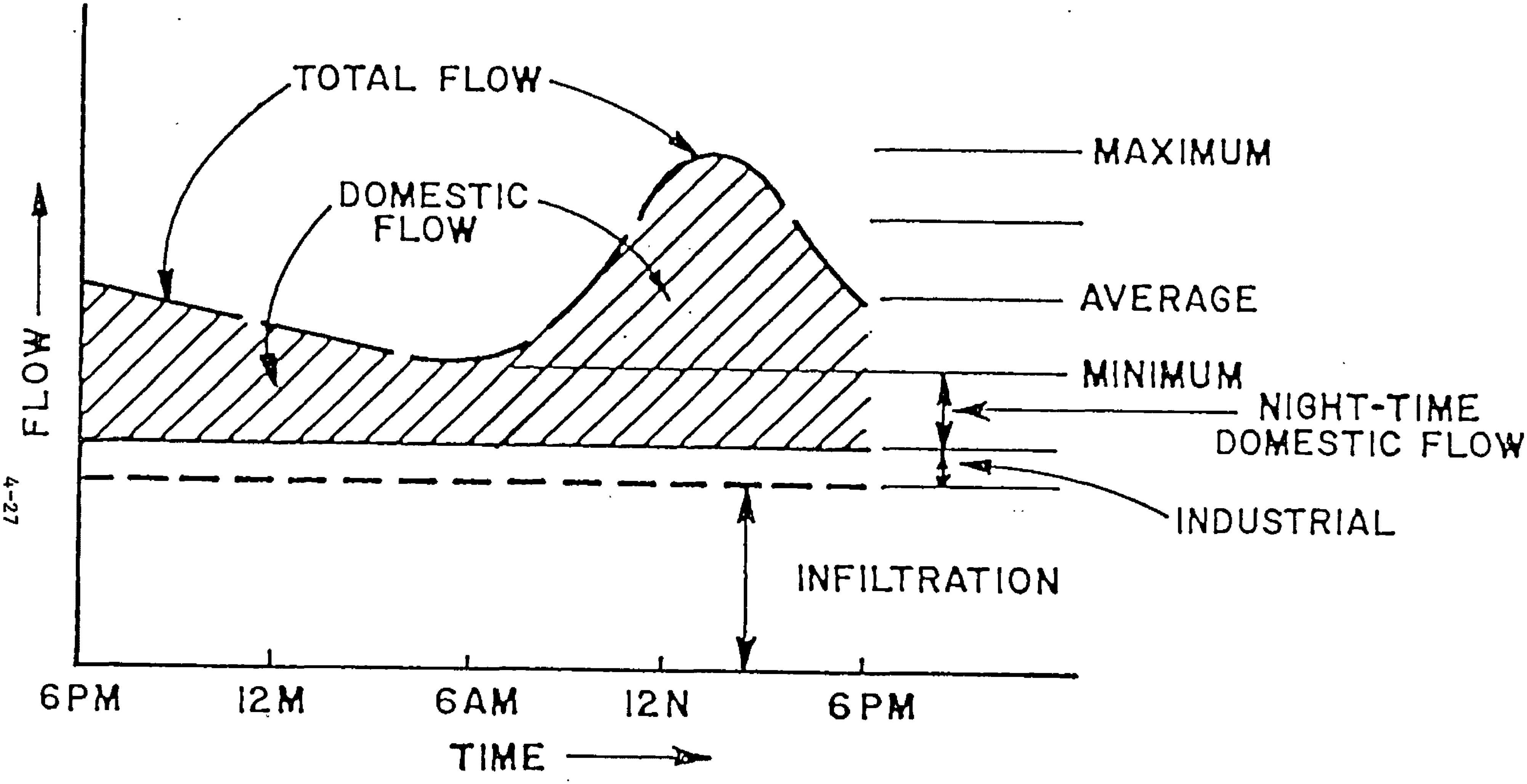
TABLE 4-9. 1985 ESTIMATED FLOWS

	Jackson Pike	Southerly	Total
Design Average Flow (MGD)	84	61	145
• Infiltration	40.1	22.1	62.2
• Industrial	9.0	6.9	15.9
• Commercial	4.5	3.2	7.7
• Domestic	30.4	28.8	59.2

4.4.1.2 Diurnal Flow

Just as demand for water fluctuates on an hourly basis, so do wastewater flow rates. Fluctuations observed in wastewater flow rates tend to follow a diurnal pattern. (See Figure 4-4.) Minimum flow usually occurs in the early morning hours when water use is low. The flow rates start to increase at approximately 6 a.m. when people are going to work, and they reach a peak value around 12 noon. The flow rate usually drops off in the early afternoon, and a second peak occurs in the early evening hours between 6 p.m. and 9 p.m. In general, where extraneous flows are excluded from the sewer system, the wastewater flow-rate curves will closely follow water-use curves. However, the wastewater curves will be displaced by a time period corresponding to the travel time in the sewers.

Diurnal curves are also affected by the size of the community. Large communities with more industrial and commercial flows tend to have flatter curves due to industries that operate on a 24-hour schedule, stores and



SOURCE: Existing Sewer Evaluation and Rehabilitation

Published by the American Society of Civil Engineers (ASCE) and the Water Pollution Control Federation (WPCF), 1983.

FIGURE 4–4
DIURNAL FLOW VARIATIONS

restaurants that are open 24 hours a day, and due to the expansiveness of the collection systems. These 24-hour operating schedules also result in more people working second and third shift, thus altering normal flow patterns. Longer travel times in the collection system dampen peak flows observed at the WWTP.

An existing average flow of 145 MGD was determined in Section 4.4.1. This flow was determined from an analysis of dry weather flows and it is generally used in the design of wastewater facilities to determine quantities of chemicals needed, O&M costs, labor, and energy requirements. However, the peak hourly flow must be used for hydraulic sizing of pumps. Therefore, a diurnal peaking factor must be determined.

Figure 4-5 presents wastewater flow rate curves for the Jackson Pike and Southerly plants compiled from September 1985 dry weather/no bypass days. The diurnal peaking factor was determined for the Jackson Pike and Southerly WWTPs through an analysis of hourly wastewater flows for February and September 1985. These two months represent minimum and maximum water consumption, respectively for 1985. The 1985 months were chosen since the existing average flow occurred in May of 1985. Diurnal peaking factors were calculated by dividing the maximum hourly flow by the average hourly flow for each dry weather/no bypass day during February and September.

The maximum diurnal peaking factor seen at Jackson Pike during this period was 1.40, and at Southerly it was 1.51. Jackson Pike's value of 1.40 occurred several times and was selected as the diurnal peaking factor for Jackson Pike. Southerly's maximum value of 1.51, however, was considered to be excessive. It occurred, only once, on September 21 when the average hourly flow was at a low of 45 MGD. The next peaking factor in the series was 1.37 which is more representative of the maximum diurnal peaking factor seen at the Southerly plant. Thus, 1.4 was chosen as a representative diurnal peaking factor for both plants.

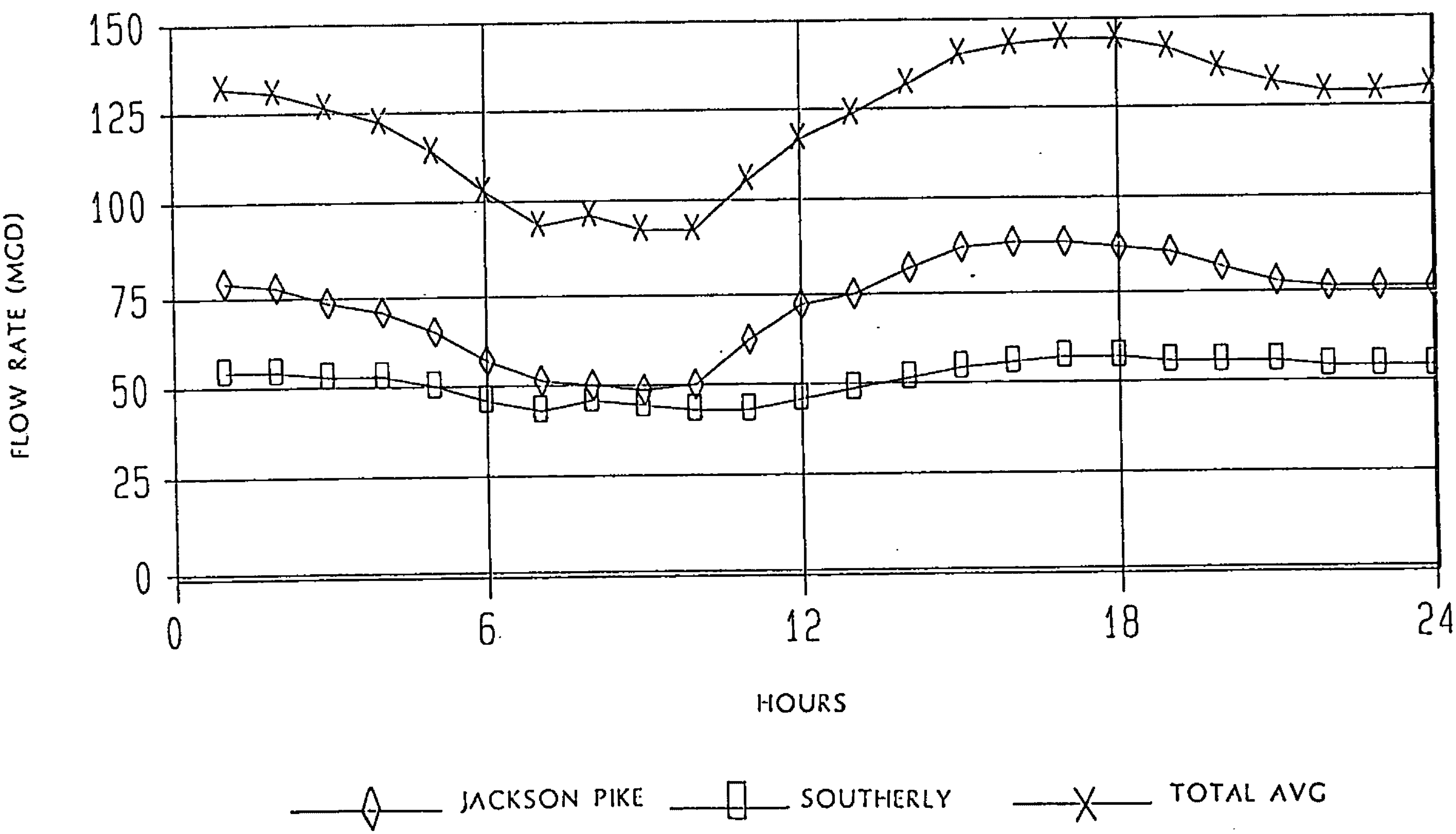


FIGURE 4-5
DIURNAL FLOW VARIATIONS
FOR DRY WEATHER

4.4.1.3 Peak Process Flow

A peak process flow must be developed for use in sizing various processes. This flow establishes the maximum process capability of the wet stream treatment facilities. Flows greater than the peak process flow will cause the treatment facilities to operate beyond their intended design criteria. Sustained operation above the peak process flow may result in a violation of permit limits.

The peak process flow is most reliably established through an analysis of existing flow. This approach was not possible in the Columbus system due to the nature of the flow record. As discussed in Section 2, the flow records for the two Columbus plants provided limited information regarding the amount of sewage bypassed. As a result, a reliable record of the total flow arriving is not available. Furthermore, peak wastewater flows normally include some combined sewage. A combined sewage overflow study, which will define a CSO control strategy, is currently being prepared by the city. The impact of the CSO recommendation on the wastewater treatment facilities will be evaluated at the conclusion of that study.

In the 1979 EIS, the following empirical formula was utilized to develop a peak process flow, due to the absence of a comprehensive flow record:

$$\text{Peak Process Flow} = 1.95\ (\text{Average Daily Flow})^{0.95}$$

Lacking flow information which would substantiate a peak process flow, the 1979 EIS formula provides a reasonable method for developing a peak process flow. Based on the 2008 average design flow of 154 MGD, the formula yields a peak process flow of 233 MGD. This corresponds to a process peaking factor of 1.5.

The 1.5 process peaking factor was evaluated relative to the 1986 flow data to assess the extent of its range. The 1986 flow record includes flows treated at Jackson Pike and Southerly and also the flows which are bypassed at Southerly. The flow record does not include flows which were bypassed at

Whittier Street or any other combined sewer overflows. The 1986 average flow of the two plants was 145 MGD. Applying the 1.5 process peaking factor to this average flow yields a peak process flow of 218 MGD. Comparing this flow with the 1986 record indicated that the daily flow rate of 218 MGD was exceeded only nine days during the year or approximately 2.5 percent of the time. In light of these few exceedances, the 1.5 process peaking factor established by use of the formula in the 1979 EIS provides a reasonable approach to establish a peak process flow.

4.4.1.4 Wet Weather Flow

The maximum monitored wet weather flow as determined from 1986 records is 309.52 MGD. Note that this maximum wet weather flow only includes flow that arrives at the treatment plants. Any flow being bypassed at the various points of combined sewer overflow is not included. This flow occurred on March 14. It includes 95.57 MGD for the Jackson Pike WWTP and 213.95 MGD for the Southerly WWTP. The Southerly flow can be broken down into 78.05 MGD receiving complete treatment, 30.30 MGD receiving primary treatment and chlorination, and 105.60 being bypassed directly to the Scioto River.

4.4.2 Existing Wastewater Loads

Monthly average influent total suspended solids (TSS) and biochemical oxygen demand (BOD) loads were determined for all weather conditions.

The sampling point at Jackson Pike for TSS and BOD concentrations is located at the grit chambers on the O.S.I.S. The O.S.I.S. carries approximately 65 to 70 percent of the flow to Jackson Pike. The remaining flow comes through the Big Run Interceptor. Therefore, the samples are not representative of the flow from the Big Run Interceptor. Plant staff believe that the flow arriving through the O.S.I.S. contains the majority of the industrial flow in the Jackson Pike service area. If this is accurate, then waste loadings established by evaluating this data may overestimate the actual loadings coming into the Jackson Pike plant. The Southerly flow is sampled between the screens and the grit chambers. The samples are representative of 100 percent of the flow entering the Southerly plant.

Only 1985 data were used to determine existing BOD loads because there were insufficient data available for 1986. At Jackson Pike, BOD values were only recorded for 304 days in 1986. There were 341 days of data for Jackson Pike in 1985. Southerly reported BOD values on 362 days in 1986 and 364 days in 1985.

The 1985 annual average BOD load for Jackson Pike is 100,702 lbs/day. The maximum monthly average load is 118,466 lbs/day, and it occurred in January. The ratio of maximum monthly average to the annual average results in a peaking factor of 1.2.

The 1985 annual average BOD load for Southerly is 87,258 lbs/day. The maximum monthly average load, which occurred in October, is 105,446 lbs/day. The peaking factor, as determined by dividing the maximum month average by the annual average, is 1.2.

The 1985 and 1986 data were used to establish TSS loads for Jackson Pike and Southerly. Jackson Pike had 365 and 363 days of TSS data for 1985 and 1986, respectively. There were 364 days of TSS data reported for Southerly for both years.

The average TSS load was obtained by computing the average of the annual averages for 1985 and 1986. The Southerly 1985 and 1986 average is 97,289 lbs/day; and Jackson Pike is 126,006 lbs/day. Peaking factors were established for each year in the same manner as was used for BOD loads. The peaking factors for Jackson Pike are 1.2 and 1.1 for 1985 and 1986, respectively. The higher value of 1.2 was chosen as the Jackson Pike TSS peaking factor. The Southerly TSS peaking factors are 1.1 for both 1985 and 1986. Table 4-10 summarizes the 1985 and 1986 average and peak BOD and TSS loads.

TABLE 4-10. 1985 AND 1986 BOD AND TSS LOADS

	Jackson Pike	Southerly	Total
BOD LOADS			
• Average (lb/day)	100,702	87,258	187,960
• Peak (lb/day)	118,466	105,446	223,912
• Peaking Factor	1.2	1.2	1.1
TSS LOADS			
• Average (lb/day)	126,006	97,289	223,295
• Peak (lb/day)	151,207	107,018	251,925
• Peaking Factor	1.2	1.1	1.1
POPULATION	489,000	381,000	870,000

A summary of the 1985 population figures and historic wastewater flows and loads is presented in Table 4-11. These quantities were used as a basis for projecting flows and loads to the design year.

TABLE 4-11. 1985 FLOWS AND LOADS

	Jackson Pike	Southerly	TOTAL
Total Flow Ave. (MGD)	84	61	145
• Infiltration	40.1	22.1	62.2
• Industrial	9.0	6.9	15.9
• Commercial	4.5	3.2	7.7
• Domestic	30.4	28.8	59.2
BOD Load (lb/day)	118,500	105,400	223,900
TSS Load (lb/day)	151,200	107,000	258,200
Population	489,000	381,000	870,000

4.4.3 Projected Flows and Loads

Table 4-12 presents the flows of Table 4-11 in per capita/connection form. These data support the figures presented in Table 4-11 since they represent reasonable values in agreement with the literature.

Holding infiltration and industrial flows constant and using the existing per capita commercial and domestic flows (Table 4-12) and the population projections for 1988 and 2008, wastewater flows were projected for 1988 and 2008.

There was insufficient information available to disaggregate the industrial loads from the total loads. Therefore, the existing total per capita BOD and TSS loads from Table 4-12 were multiplied by the population projections and the respective peaking factors to obtain the 1988 and 2008 projected loads. In doing so, growth of industrial loads is proportional to residential growth.

Table 4-13 presents the 1988 projected population, flows, and loads; and Table 4-14 presents the projected population and average flows and loads for the 2008 design year.

4.4.4 Comparison of SEIS and Facility Plan Flows and Loads

This section compares the facility plan flows and loads with the flows and loads developed in the preceding sections of this SEIS (Table 4-15). The facility plan flows and loads have been brought back to 2008 for purposes of comparison, and the loads from Whittier Street have been eliminated.

The SEIS average flows are approximately 10 percent lower than the facility plan flows, and the SEIS peak process flows are approximately 20 percent lower than the facility plan flows.

There is a difference in the average flows because the flow projections in the SEIS were developed by holding the infiltration and industrial portions of the flow constant and increasing only the commercial and domestic flows

TABLE 4-12. 1985 PER CAPITA/CONNECTION FLOWS AND LOADS

	Jackson Pike	Southerly	TOTAL
Per Capita Domestic Wastewater Flow (gpcd)	62.2	75.6	68.1
Per Capita Commercial Wastewater Flow (gpcd)	9.2	8.4	8.9
Per Capita Industrial Wastewater Flow (gpcd)	18.4	18.1	18.2
Per Capita Industrial, Commercial, and Domestic Wastewater Flow (gpcd)	89.8	102.1	95.2
Per Capita Infiltration (gpcd)	82	58	72
Per Connection Commercial Wastewater Flows* (gal/connection day)	ND	ND	816.7
Per Connection Industrial Wastewater Flows* (gal/connection day)	ND	ND	62,109
1985 Per Capita Water Pumped Industrial, Commercial, and Domestic (gpcd)	ND	ND	139.1
1985 (Industrial, Commercial, and Domestic) Water Pumped to Wastewater Discharge Factor	ND	ND	.976
Per Capita Average BOD Loads (lb/capita day)	0.206	0.229	0.216
Per Capita Average TSS Loads (lb/capita day)	0.258	0.255	0.257

ND = No Data

* SOURCE: City of Columbus, Division of Sewerage and Drainage, December 1986.

TABLE 4-13. 1988 PROJECTIONS

	Jackson Pike	Southerly	TOTAL
Total Flow Ave. (MGD)	84.8	61.7	146.5
• Infiltration	40.1	22.1	62.2
• Industrial	9.0	6.9	15.9
• Commercial	4.6	3.3	7.9
• Domestic	31.1	29.4	60.5
BOD Load (lbs/day)	123,400	106,900	230,300
TSS Load (lbs/day)	154,500	109,100	263,600
Population	499,000	389,000	888,000

TABLE 4-14. 2008 PROJECTIONS

	Jackson Pike	Southerly	TOTAL
Total Flow Ave. (MGD)	87.9	66.0	153.9
• Infiltration	40.1	22.1	62.2
• Industrial	9.0	6.9	15.9
• Commercial	5.0	3.7	8.7
• Domestic	33.8	33.3	67.1
BOD Load (lbs/day)	134,600	121,300	255,900
TSS load (lbs/day)	168,600	123,800	292,400
Population	544,600	441,400	986,000

TABLE 4-15. COMPARISON OF DESIGN FLOWS AND LOADS

	Facility Plan[a]	SEIS	Percent Difference
Design Average Flow (MGD)			
• Jackson Pike	96	88	-8.3
• Southerly	72	66	-8.3
• Combined	168	154	-8.3
Peak Process Flows (MGD)			
• Jackson Pike	163	132	-19.0
• Southerly	122	99	-18.9
• Combined	285	231	-18.9
Design BOD Load (lb/day)			
• Jackson Pike	141,600	134,600	-4.9
• Southerly	126,600	121,300	-4.2
• Combined	268,200	255,900	-4.5
Design TSS Load (lb/day)			
• Jackson Pike	161,600	168,600	+4.3
• Southerly	121,300	123,800	+2.1
• Combined	282,900	292,400	+3.2

[a] Adjusted to reflect 20-year planning period ending 2008 and to eliminate loads associated with Whittier Street CSO structure.

proportional to the population increase; whereas the flow projections in the facility plan were developed by increasing all the flow, including infiltration and industrial, proportional to the population increase.

Projected increases in infiltration do not appear justified if the population increase is located within the existing service area. The facility plan does not document why an increase in infiltration should be included. Projected industrial increases should be based on documented industrial growth by existing industries and/or policy decisions by the municipality to plan for future undocumented growth. Furthermore, such industrial growth should be an identifiable part of the total design flows since capital cost recovery for the added capacity must be addressed.

The difference in the peak process flows is due to the differences in design average flows and different peaking factors. The peaking factor is 1.5 for this SEIS and 1.7 for the facility plan. The 1.5 peaking factor for the SEIS is consistent with the peaking factor used in the 1979 EIS. The facility plan's peaking factor of 1.7 is based on the maximum hydraulic capability of the conduits between the primary clarifiers and aeration basins in the existing trains at the Southerly WWTP. Since CSO is not a component of this SEIS, it did not seem appropriate to endorse a peaking factor of 1.7.

As a result of the significant differences in average design and peak process flows, the flows developed for this SEIS will be used for further alternative analysis and recommended process sizing.

The SEIS loads, on the other hand, are all within 5 percent of the facility plan loads. Therefore, the 2008 facility plan loads will be accepted as the SEIS loads, and they will be used for further alternative analysis in the SEIS. Table 4-16 summarizes the SEIS recommended **tributary** flows and loads.

TABLE 4-16. 2008 RECOMMENDED TRIBUTARY FLOWS AND LOADS

	Jackson Pike	Southerly	Total
Average Flow (MGD)	88	66	154
Peak Process Flow (MGD)	132	99	231
BOD Load (lb/day)	141,600	126,600	268,200
TSS Load (lb/day)	161,600	121,300	282,900

4.5 COMBINED SEWER OVERFLOWS

The Revised Facility Plan Update (RFPU) and the General Engineering Report and Basis of Design (GERBOD) documents provided a brief analysis of the CSO problem. The analysis was conducted on a limited data base not adequate for planning and design of CSO abatement measures. Consequently, the city is planning to conduct a detailed CSO study. The SEIS briefly reviewed the CSO analysis that was prepared during the facilities plan preparation. Appendix E entitled Briefing Paper No. 5 - CSO provides a review and critique of the city's analysis.

A review of the OEPA Central Scioto River Mainstem Comprehensive Water Quality Report (CWQR) indicates that combined sewer overflows contribute significant pollutant loadings to the Scioto River. The majority of the data reviewed in the CWQR was collected between 1976 and 1982. The CWQR states that "combined sewer overflows, and as previsouly discussed, plant bypasses also contributed significant loadings of BOD, NH_3-N, TSS, and other substances to the Central Scioto River Mainstem." In addition, page 317 states "Reductions in the magnitude and frequency of combined sewer overflow discharges is needed to improve aquatic community function, alleviate aesthetic problems, and reduce risks to human body contact recreation in the segment between Greenlawn Dam and the Jackson Pike WWTP." The particular sources of pollutant loadings discussed in the CWQR are the Whittier Street CSO and the Southerly raw sewage bypass.

The Whittier Street Storm Standby Tanks provide short-term storage and some clarification for flows in excess of the Jackson Pike WWTP's hydraulic capability. The Jackson Pike WWTP is hydraulically limited to 100 MGD. As previously discussed in this chapter, the estimated peak process flow for the Jackson Pike Service Area is 132 MGD. Following completion of the north end of the Interconnector, 32 MGD can be diverted to the Southerly WWTP for treatment. This may alleviate some of the combined sewer overflows occurring at the Whittier Street facility.

Some of the combined sewers in the Southerly Service Area have been separated in recent years. The entire CSO drainage area has decreased from 18.4 square miles to 10.7 square miles. This may have reduced the quantity and frequency of bypasses at the Southerly WWTP and at the overflows within the Southerly Service Area.

In order to assess the magnitude of the combined sewer overflows at the present time, a comprehensive study must be performed using current monitoring data. This study must include a determination of the inflow problem from the separate sewer area. As discussed in the CSO analysis in Appendix E, the volume of inflow from the separate sewer area could be greater than the volume of runoff and inflow from the combined sewer area.

CHAPTER 5. ALTERNATIVES

This chapter presents comprehensive wastewater management alternatives and options for the components that comprise these comprehensive wastewater management alternatives. The comprehensive wastewater management alternatives include the following:

- No action
- Upgrade Jackson Pike and Southerly, provide wet stream treatment and solids handling at both plants
- Upgrade Jackson Pike and Southerly, provide all solids handling at Southerly
- Eliminate Jackson Pike, upgrade and expand Southerly.

Each of the comprehensive wastewater management alternatives includes the following components:

- Interconnector/headworks
- Biological process
- Sludge management.

Options for these components will be presented in this chapter. Options will not be presented for primary treatment and post treatment. It is assumed for all comprehensive wastewater management alternatives that primary treatment will consist of preaeration and primary settling, and post treatment will consist of chlorination and post aeration.

Numerous studies have been completed since the 1979 Environmental Impact Statement (EIS) that have influenced the development of the alternatives and options presented in this chapter. These major studies include:

- 1981 - Segment 2 - Long-Term Solids Handling
- 1984 - DFOT Review of the City of Columbus Facilities Plan and EIS Reports

- 1984 - Feasibility Study for Wastewater Treatment
- 1984 - Facilities Plan Update Report
- 1985 - Revised Facilities Plan Update.

The principal elements of each of these studies, which contribute to the development of alternatives, are summarized in the following sections.

Segment 2 - Long-Term Solids Handling Report (1981)

The objective of the Segment 2 report was to evaluate solids processing and handling at each treatment plant and develop an environmentally acceptable and cost-effective long-term solution for solids treatment and disposal.

The Segment 2 study concluded that the solids treatment process at Jackson Pike and Southerly should include the following components:

- Primary sludge: gravity thickening, anaerobic digestion, centrifuge dewatering, land application, or incineration.
- Waste activated sludge: centrifuge thickening, possible anaerobic digestion, centrifuge dewatering, composting, or incineration.
- Emergency storage for thickened and dewatered sludges, and backup stabilization with lime addition.

A Segment 1 report entitled, "Interim Solids Handling," was also submitted to the OEPA in 1980. This report proposed constructing three new incinerators at Southerly and two new incinerators at Jackson Pike. It also proposed increasing composting at Southwesterly from 200 to 400 wet tons per day. This solution was intended to solve the immediate problem of solids disposal until a long term solution could be developed and implemented under Segment 2. As a result of these recommendations, Southerly is currently installing two new incinerators. These new incinerators have a total capacity of 520 wet tons per day at 20 percent cake solids. The two existing incinerators are rated at 300 wet tons per day at 20 percent cake solids.

This gives a total incineration capacity of approximately 820 wet tons per day.

DFOT Report (1984)

The Design Finalization Overview Team (DFOT) Report, a recommendation of the 1979 EIS, contains an independent design evaluation of wastewater treatment facility improvements for the Jackson Pike and Southerly treatment plants. The primary objective of the DFOT was to review the recommendations and suggested design criteria presented in the facilities plan with respect to the 1979 EIS and to reconcile any differences. The primary recommendations of the DFOT for the Jackson Pike and Southerly Wastewater Treatment Plants are summarized below:

Jackson Pike

- Increase primary clarification capacity slightly more than recommended in the EIS and original facilities plan.
- Adopt facilities plan recommendation for trickling filter capacity.
- Provide approximately 50 percent more intermediate clarifier capacity than recommended by the EIS and original facilities plan.
- Adopt the EIS proposal for activated sludge aeration basin capacity of 31.5 million gallons.
- Increase final settling capacity slightly more than recommended in the facilities plan.
- Adopt original facilities plan proposal for effluent disinfection but add post aeration.
- Perform a trial study of thermal conditioning prior to anaerobic digestion and incineration.
- Design effluent filters and phosphorus removal facilities. These facilities would not be constructed unless their need is verified by water quality studies.
- Adopt the proposal made by the Segment 2 - Long-Term Solids Handling Report for gravity sludge thickeners and centrifuges.
- Use incineration as the preferred means of sludge disposal.

Southerly

- Use a trickling filter/activated sludge treatment system.
- Restrict Anheuser-Busch BOD_5 loads to 45,000 lbs/day.
- Increase trickling filter and intermediate clarifier capacity approximately 40 percent more than the recommendations of the original facilities plan.
- Provide activated sludge aeration basin and final clarifier with capacities less than those proposed in the original facilities plan and EIS.
- Adopt effluent disinfection system as proposed in the original facilities plan.
- Design effluent filters and phosphorus removal facilities. These facilities would not be constructed unless their need was verified by water quality studies.
- Adopt the proposal made by the Segment 2 - Long-Term Solids Handling Report for sludge thickening and digestion.
- Use incineration as the prime sludge disposal system until the market and dependability of composting and land application alternatives are assured.

Feasibility Study for Wastewater Treatment (1984)

This report presents the findings of a preliminary investigation to screen treatment plant site alternatives. The alternatives include various combinations of new plant construction, plant rehabilitation, and plant expansion at the Jackson Pike, Southerly, and Southwesterly treatment plant locations. The Southwesterly plant would be located near the compost facility. The conclusion of this study was that alternatives involving elimination of Jackson Pike and development of a new plant at the Southwesterly site were economically feasible and should be more closely investigated for possible implementation in the Columbus wastewater management program.

Facilities Plan Update Report (1984)

The USEPA asked the city of Columbus to update its facilities plan to conform to the recommendations of the EIS. The Facilities Plan Update Report (FPU) contained a review of numerous combinations of site and treatment process alternatives. Some new wet stream treatment process alternatives were assessed that had not been evaluated in the previous reports. The city also looked at the possibility of constructing a new wastewater treatment plant near the Southwesterly Composting Facility.

The recommendations of the FPU include:

- Elimination of the Jackson Pike WWTP, expansion and upgrading of the Southerly WWTP to handle all flows.
- Construction of a new pump station to transport the flow from the Jackson Pike service area.
- Implementation of an Anaerobic Anoxic Flocculation (AAF) process for biological treatment.
- Effluent polishing by granular media filters, if necessary, to satisfy the proposed NPDES permit requirements. The report recommends that construction of these filters be postponed until operating results for the new wet stream treatment facilities are available.
- Expansion of existing chlorine feeding equipment and new chlorine contact tanks.
- Expansion of the effluent pump station.
- Sludge processing which consists of thickening, digestion, and dewatering.
- Ultimate disposal of sludge by incineration, composting, and land application.

The FPU also recommended that the expanded plant be equipped with distributed automatic monitoring and control systems in each major process area, linked to a centralized monitoring and control station. In addition, a video display terminal should be provided in the Office and Maintenance Building to enable the plant managers to perform routine monitoring tasks.

Revised Facilities Plan Update (1985)

The Revised Facilities Plan Update Report (RFPU) was developed to supplement the FPU. The specific objectives of the document were: (1) to revise the recommendations of previous documents based upon revised design parameters and NPDES permit limits; (2) to present the conclusions and recommendations of planning analyses undertaken since completion of the FPU; (3) to respond to comments by the OEPA relative to the FPU; and (4) develop treatment facilities which will serve the city's needs through the year 2015.

The following basic conclusions and recommendations were presented in the RFPU:

- It is cost effective to expand the existing city of Columbus Southerly wastewater treatment facility to treat all wastewater from the Columbus service area and to phase out the existing Jackson Pike wastewater treatment facility.
- Flows should be diverted from Jackson Pike to Southerly via completion of the North End and expansion of the South End of the Interconnector Sewer.
- Biological treatment should be accomplished through a semi-aerobic process.
- Solids processing consists of gravity and centrifuge thickening, anaerobic digestion, dewatering of nondigested sludge for composting, and land application of digested sludge.
- Maintain current incineration capacity, but land disposal and composting are the preferred sludge disposal methods.

The above paragraphs have summarized the recommendations of previous studies which have contributed to the development of alternatives in this report. The following sections of this chapter provide discussions on options for plant location, conveyance, headworks, biological treatment processes, and sludge management alternatives. These alternatives are subjectively screened in this chapter to eliminate the alternatives which are not suitable for the Columbus facilities. Those alternatives which advance from the subjective screening will be evaluated in greater detail in chapter 6.

5.1 COMPREHENSIVE WASTEWATER MANAGEMENT ALTERNATIVES

The existing wastewater treatment facilities for the Columbus metropolitan area consist of the Jackson Pike and Southerly Wastewater Treatment Plants (WWTP) (See Figure 3-1). Previous planning documents have evaluated other alternatives for treatment plant location. These studies have evaluated continued operation of the existing facilities as well as abandoning the Jackson Pike WWTP and constructing a new Southwesterly plant to handle Jackson Pike flows or expanding the Southerly WWTP to handle all the flow from the Columbus area. None of the previous studies found it to be cost effective to build a new facility at a Southwesterly site. However, the FPU and the RFPU found that expanding Southerly to handle all flows was cost effective. Therefore, this study will evaluate the following alternatives:

- No action
- Upgrade Jackson Pike and Southerly, provide wet stream treatment and solids handling at both plants
- Upgrade Jackson Pike and Southerly, provide all solids handling at Southerly
- Eliminate Jackson Pike, upgrade and expand Southerly.

The following sections discuss these four alternatives and their impacts.

5.1.1. <u>No Action Alternative</u>

The development of a no action alternative is consistent with EPA quidelines for preparing an EIS. A no action alternative cannot be eliminated during a preliminary screening.

Implementation of a no action alternative would involve normal maintenance but no improvement to the existing facilities. Failure to implement procedures to correct wastewater management problems in the Columbus facilities planning area will result in permit violations for the Columbus treatment facilities. The Columbus wastewater treatment plants, without improvements, cannot meet final NPDES permit limits. In accordance with the city's Municipal Compliance Plan, the plants are required to be in compliance with the final permit limits by July of 1988. An inability to meet permit requirements may result in sanctions by OEPA and USEPA that could have adverse social and economic impacts in the facilities planning area.

The no action alternative will be retained and used in chapter 6 as a baseline for comparing and evaluating action alternatives.

5.1.2 Upgrade Jackson Pike and Southerly, Provide Wet Stream Treatment and Solids Handling at Both Plants

This alternative will be referred to as the two-plant alternative. It was the recommendation of the 1979 Environmental Impact Statement. In this alternative the existing treatment plant sites will be maintained. Each plant will be rehabilitated and expanded as necessary to provide advanced wastewater treatment on site for wastewater flows expected through the year 2008. Due to site limitations at Jackson Pike, the wet stream treatment capacity cannot be expanded. However, the existing facilities could be upgraded to provide necessary treatment to meet proposed effluent requirements for an average flow of **70** MGD and a peak flow of 100 MGD. Any excess flow would be diverted to Southerly via the Interconnector Sewer.

The Southerly WWTP would be upgraded and expanded to treat an average flow of **84** MGD and a peak process flow of 131 MGD.

This alternative will be retained as it is consistent with existing operating practice. It will be evaluated in further detail in chapter 6.

5.1.3 Upgrade Jackson Pike and Southerly, Provide All Solids Handling at Southerly

This alternative will be referred to as the two-plant one solids alternative. Under this alternative, both plants would be upgraded to provide wet stream treatment. All solids handling processes would be provided at Southerly. Jackson Pike's solids would be transported to Southerly via sludge pipelines. This alternative was developed because an 8-inch sludge pipeline currently exists between the Jackson Pike and Southerly WWTPs. It will be evaluated in further detail in chapter 6.

5.1.4 Eliminate Jackson Pike, Upgrade and Expand Southerly

This alternative will be referred to as the one-plant alternative. It was recommended by the city in the Facilities Plan Update and the Revised Facilities Plan Update. Under this alternative, Jackson Pike would be phased out and all Jackson Pike flows would be diverted to Southerly via the Interconnector. The existing facilities at Southerly would be expanded and upgraded to treat an average flow of 154 MGD and a peak process flow of 231 MGD. This alternative merits further consideration, and it will be retained for a more detailed evaluation in chapter 6.

5.2 INTERCONNECTOR/HEADWORKS OPTIONS

This section discusses the options for the Interconnector/headworks components under each of the alternatives.

5.2.1 Interconnector

Each of the comprehensive wastewater management alternatives require completion of the north end of the Interconnector (Figure 3-3). The city maintains that, due to site limitations and existing hydraulic constraints within the facility, Jackson Pike is not capable of handling more than 100 MGD. Consequently, the diversion chamber and the Interconnector must be completed to allow flows in excess of 70 MGD under average conditions and 100 MGD under peak conditions to be diverted from Jackson Pike to Southerly.

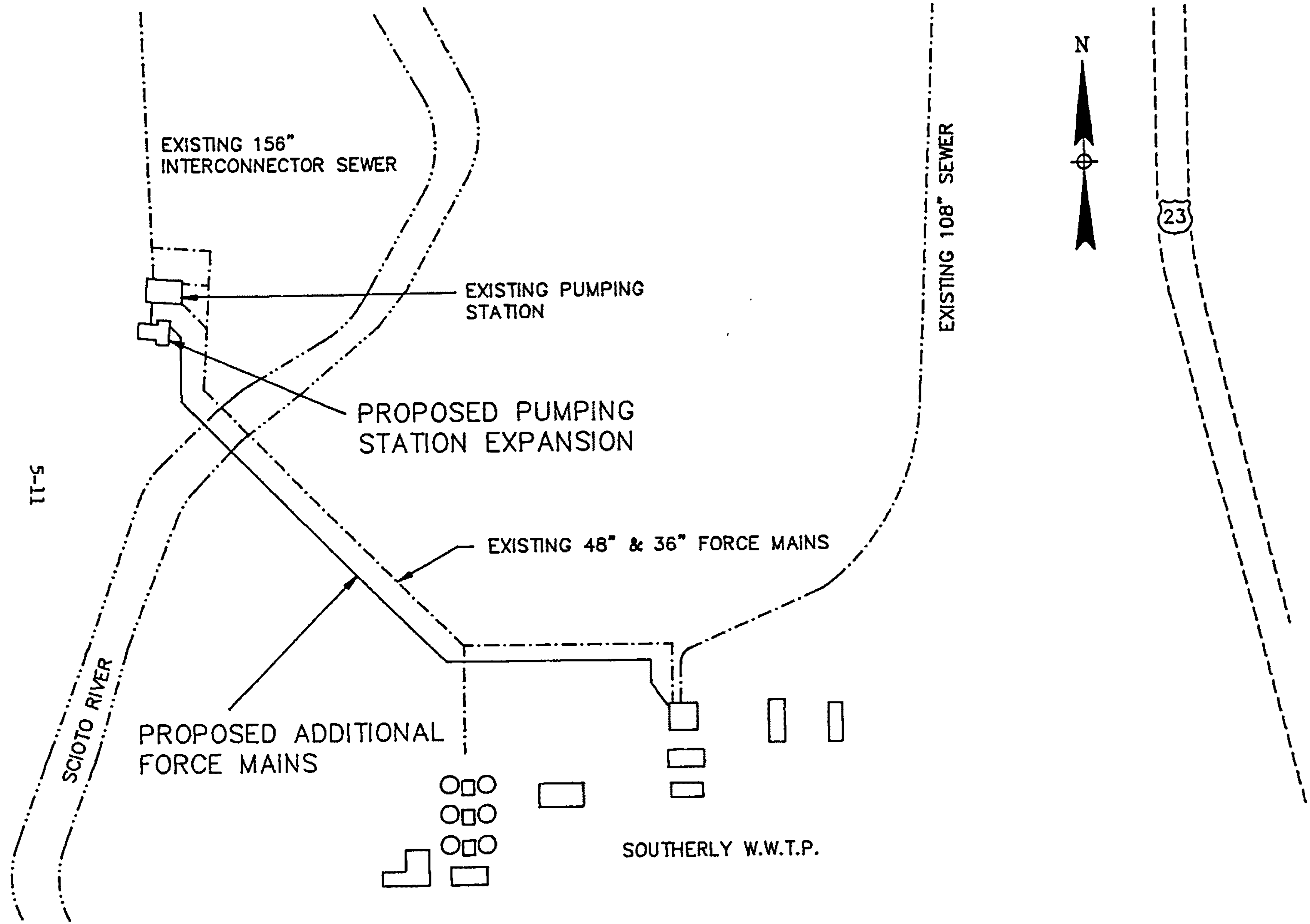
The Interconnector Sewer that is being constructed between Jackson Pike and Southerly is near completion. It runs in a north-south direction along the west side of the Scioto River and it crosses the river on the south end to connect with the Southerly WWTP.

The main section of the Interconnector has a diameter of 156 inches. It connects with a pumping station on the south end. The South End Pumping Station, with a capacity of 70 MGD, pumps the flow across the river to Southerly through a 48-inch force main and a 36-inch force main. The north end of the Interconnector is incomplete. The Municipal Compliance Plan states that it will be in place by May of 1988. It will be constructed along the west and north sides of Jackson Pike (Figure 3-3). A diversion chamber will be built to connect the O.S.I.S. with the Interconnector. This will allow regulation of flows to Jackson Pike and diversion of flows to Southerly.

Based on the flows developed in this document, the pump station and force mains at the south end of the Interconnector are adequate to handle the flow under both two-plant alternatives. The maximum potential flow which will be diverted from Jackson Pike under peak conditions is 32 MGD. Approximately 6 MGD is projected to flow through the Interconnector from a connection at Grove City. This total flow of 38 MGD is within the capabilities of the current pump station and force mains.

The south end of the Interconnector will require some expansion under the one-plant alternative. The sewers must be sized to accommodate flows through the year 2008. The projected peak process flow for Jackson Pike is 132 MGD. The expanded facilities must accommodate this flow in addition to the 6 MGD from Grove City.

The RFPU proposed two options for expansion of the south end of the Interconnector. One option (Option A) involves expansion of the existing Interconnector Pump Station to a capacity of 160 MGD and construction of additional 36-inch and 48-inch force mains (Figure 5-1).



SCALE: 1"=500'
SOURCE: REVISED FACILITY PLAN UPDATE

FIGURE 5-1
SOUTH END INTERCONNECTOR OPTION A

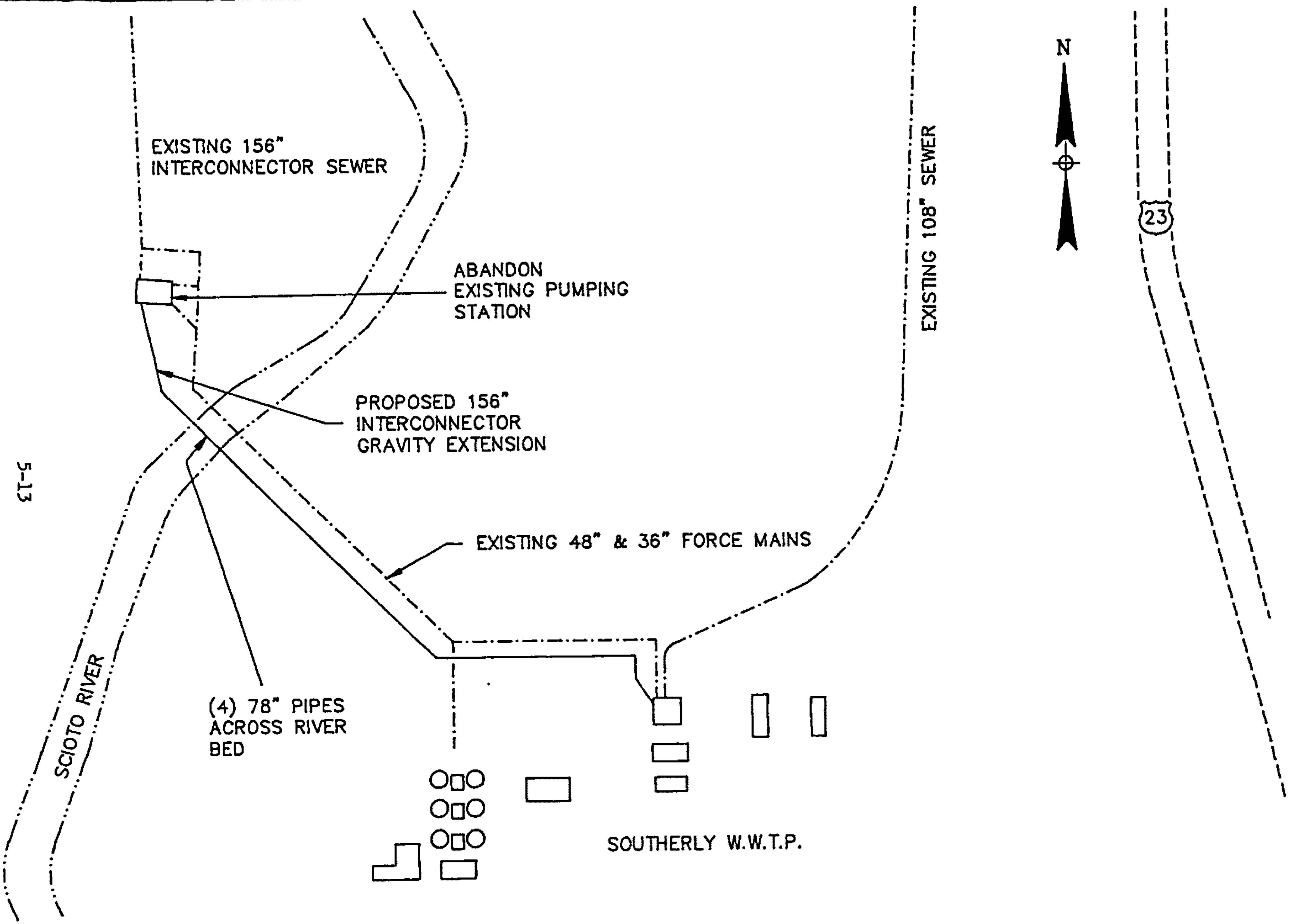
The second option (Option B) proposes abandoning the existing force mains and extending the 156-inch gravity Interconnector to Southerly. Three options were evaluated for the Scioto River crossing. Extending the 156-inch pipe across the river bed would raise the water level of the river by seven feet. Tunneling the 156-inch pipe beneath the Scioto River was also investigated. However, the excessive costs associated with the depth of this pipe and the increased depth of the Southerly headworks prevented this option from being considered economically feasible. The third option requires the installation of four 78-inch pipes across the river bed (See Figure 5-2). This will raise the water level approximately three feet and is the option recommended by the city in the RFPU.

Each of these Interconnector options must be evaluated in conjunction with the headworks option prior to eliminating any of them. Therefore, they will be retained for further consideration. Chapter 6 will evaluate the Interconnector options in detail with the headworks options.

5.2.2 Headworks

5.2.2.1 Jackson Pike

The Jackson Pike headworks are located approximately one mile north of the treatment plant at the Sewer Maintenance Yard on the west bank of the Scioto River. These remote headworks consist of bar screens and aerated grit tanks. The bar screens were originally mechanically cleaned but due to their age and deteriorated condition, manual screen cleaning is now necessary. Flow enters the headworks via the O.S.I.S. The flow that enters the Jackson Pike plant comes from the remote headworks on the O.S.I.S. and the Big Run Interceptor. The combined flow enters a wet well in the pump and blower building where it is screened and pumped to the wet stream treatment facilities. Therefore, flows entering Jackson Pike from the Big Run Interceptor are not subject to grit removal.



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SOURCE: REVISED FACILITY PLAN UPDATE

FIGURE 5–2
SOUTH END INTERCONNECTOR OPTION B

Under the one-plant alternative, the headworks at Jackson Pike would only require necessary maintenance until the plant is phased out in the 1990's. The two-plant alternatives would require entirely new headworks consisting of pumping, screening, and grit removal for Jackson Pike located at the plant, rather than at the sewer maintenance yard two miles away.

5.2.2.2 Southerly

The existing headworks at Southerly consist of bar racks, bar screens, aerated grit tanks, and pumps rated at a capacity of 170 MGD. Flow enters the plant from the Interconnector and from the Big Walnut Sanitary Outfall Sewer which serves the northeast, east, and southeast portions of Columbus and Franklin County.

Under both two-plant alternatives, the Southerly WWTP will be required to treat an average flow of 84 MGD and a peak process flow of 131 MGD. Since the current headworks are rated at a capacity of 170 MGD, no expansion of these facilities is required.

The one-plant alternative requires that Southerly treat an average flow of 154 MGD and a peak process flow of 231 MGD. At these flows, the current headworks are inadequate. The determination of the optimum headworks option (i.e., expand the existing or provide new facilities) is related to the Interconnector option selected. Interconnector Option A, which involves expanding the existing pump station and adding additional force mains, would allow expansion of the existing headworks. Expansion of the existing headworks will be called Option A-1. If Interconnector Option B is selected, the 156-inch gravity sewer extension would enter the Southerly headworks approximately eight feet lower than the Big Walnut Interceptor. This Interconnector option would require separate headworks (Option B-1) to handle the flow from the Interconnector or completely new headworks (Option B-2) to handle the flows from both.

Option B-1 consists of utilizing the existing 170 MGD headworks at Southerly for handling the flows from the Big Walnut Interceptor and constructing new 150 MGD headworks for handling the Interconnector flows. The new Interconnector headworks will be located adjacent to the existing headworks. They will include coarse bar racks, raw pumping, followed by mechanical screening and aerated grit removal; all designed for 150 MGD. Mixing of the Interconnector and Big Walnut flow would follow aerated grit removal.

Option B-2 involves constructing completely new headworks which include a mixing chamber, coarse bar racks, pumping, and aerated grit chambers. The flows from the Big Walnut Interceptor and the Interconnector would combine in a mixing chamber and be conveyed through manually cleaned bar racks. The combined flow will then enter a wet well to be pumped to mechanical bar screens followed by aerated grit chambers. The new headworks will be designed for a peak process flow of 231 MGD.

Based on the subjective screening, all three headworks options merit further consideration. Each of the headworks options will be evaluated in conjunction with the Interconnector options in chapter 6.

5.3 BIOLOGICAL PROCESS OPTIONS

This section presents the options for the biological process component. The current biological process used at both the Jackson Pike and Southerly WWTP's is conventional single-stage activated sludge. This single-stage activated sludge process is preceeded in the wet stream treatment process by preaeration and primary settling and it is followed by chlorination prior to discharge to the Scioto River.

Both plants were designed based on NPDES discharge limitations of 30 mg/l for BOD and TSS. These limits have become more stringent and the plants can no longer successfully treat the original design capacity flows.

Through the course of the facilities planning process for the Columbus wastewater treatment system, other process options were proposed and evaluated. The 1979 EIS recommended a trickling filter process for the Jackson Pike plant. The Facilities Plan Update (FPU) and Revised Facilities Plan Update (RFPU) recommended semi-aerobic treatment processes. In the following sections the semi-aerobic, trickling filter, and conventional activated sludge processes including variations are discussed.

5.3.1 Semi-Aerobic

The semi-aerobic process, being proposed by the city of Columbus, is a modified form of the activated sludge process. The process consists of a non-aerated reaction zone ahead of the aerated activated sludge zone. These non-aerated zones may be anoxic (oxygen concentration less than or equal to 0.3 mg/l and nitrates present), anaerobic (no oxygen or nitrates present) or a combination of anoxic and anaerobic zones. Figure 5-3 provides a schematic of the semi-aerobic process. Figure 5-4 shows the process in three different modes of operation.

The semi-aerobic process employs a high to low food-to-microorganism (F:M) gradient and a high oxygen uptake rate to dissolved oxygen ratio (OUR/DO) in the first two bays of each aeration tank to produce a non-bulking sludge. The semi-aerobic process is physically the same as the conventional activated sludge process with the exception of two additional baffles in the first bay of each aeration tank and an internal sludge recycle system in each tank. The baffles are added to eliminate backmixing. The sludge recycle system provides the ability to denitrify by recycling nitrates from Bay 8 back to Bay 1.

Jet aerators would be installed in the first two bays of each aeration tank to provide the flexibility for aerating or mixing these bays. Normal operation will consist of mixing. However, air will be employed in Bay 2 and Bay 1, if necessary, when the ammonia breaks through Bay 6 or Bay 7. The

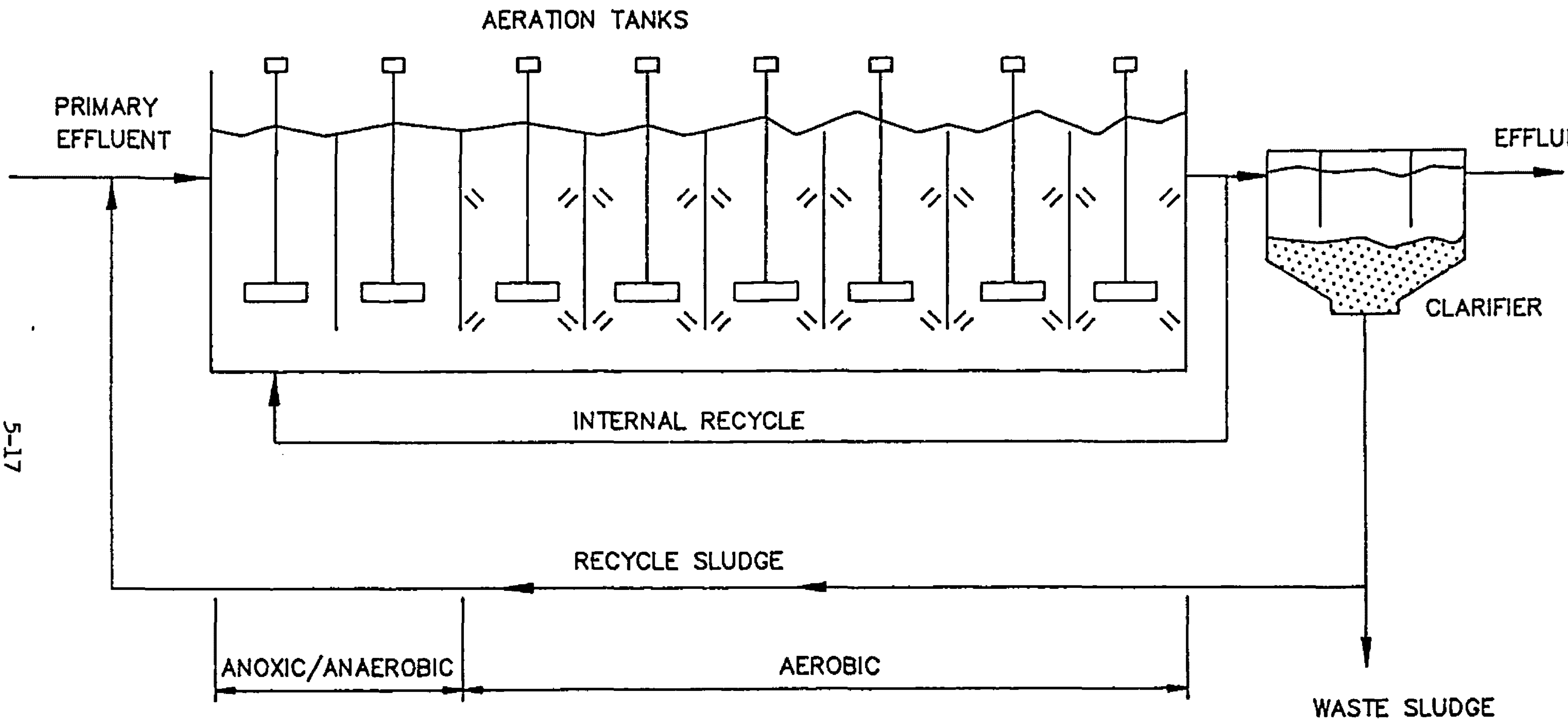
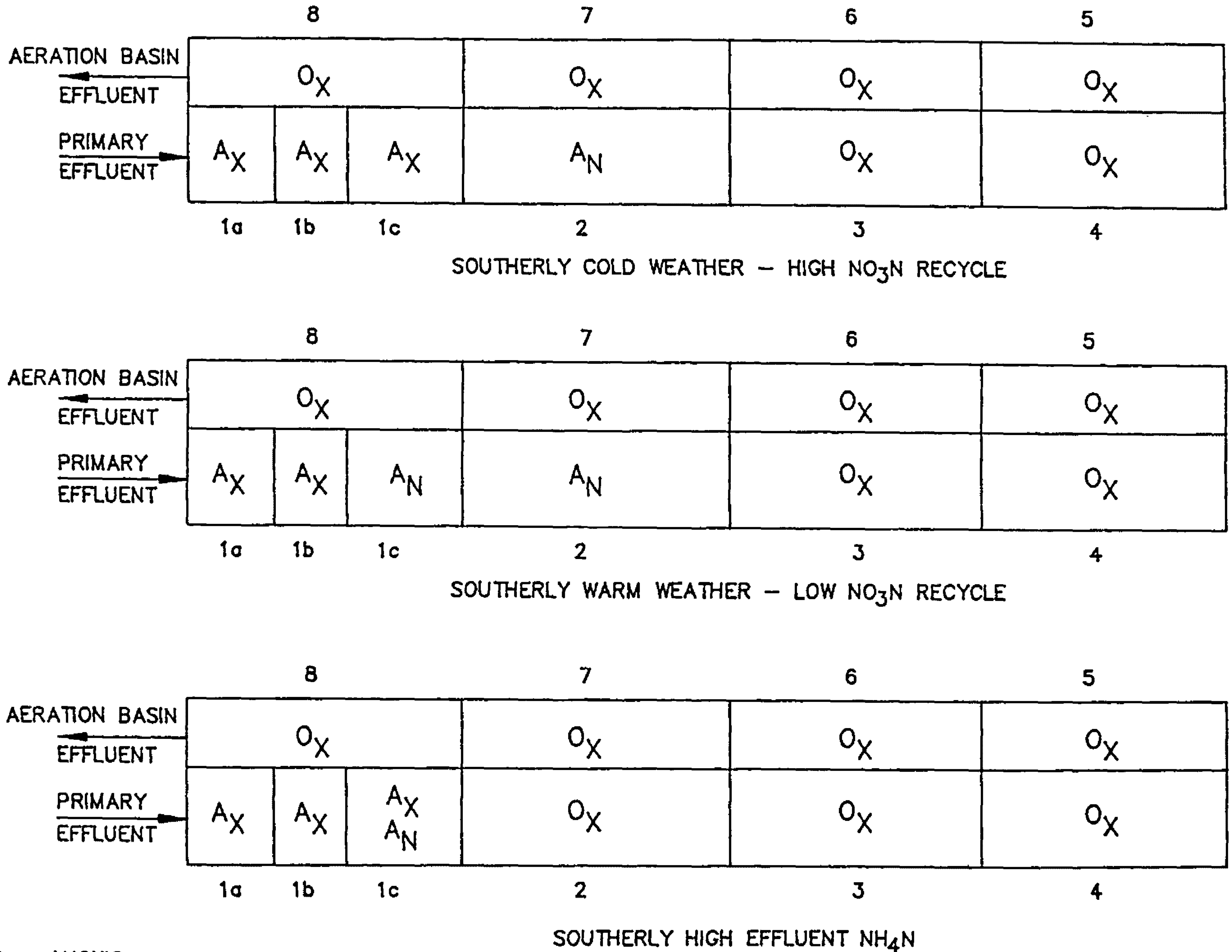


FIGURE 5-3
SEMI-AEROBIC PROCESS



A_X =ANOXIC
A_N =ANAEROBIC
O_X =OXIC

FIGURE 5-4
SEMI-AEROBIC PROCESS
MODES OF OPERATION

remaining six bays of each aeration tank would be equipped with fine bubble diffusers. The semi-aerobic process has the ability to control sludge bulking and to nitrify. It can easily be incorporated into the existing tankage. Therefore, it will be retained for further evaluation in chapter 6.

5.3.2 Trickling Filter Processes

Trickling filter systems are commonly used for secondary treatment of municipal wastewater. Primary effluent is uniformly distributed on a bed of crushed rock, or other media, coated with biological films.

The microbial film on the filter medium is aerobic to a depth of only 0.1 to 0.2 mm. The zone next to the medium is anaerobic. As the wastewater flows over the microbial film, the soluble organics are rapidly metabolized and the colloidal organics absorbed into the surface. Microorganisms near the surface of the bed, where food concentration is high, are in a rapid growth phase, while the lower zone of a bed is in a state of endogenous respiration. Dissolved oxygen extracted from the liquid layer is replenished by reoxygenation from the surrounding air.

Major components of the trickling filter are the filter media, underdrain system, and rotary distributor. The filter media provides a surface for biological growth and voids for passage of liquid and air. The underdrain system carries away the effluent and permits circulation of air through the bed. A rotary distributor provides a uniform hydraulic load on the filter surface.

Two variations of trickling filters have been presented in previous studies. They are:

- Trickling filter/activated sludge (TF/AS)
- Trickling filter/solids contact (TF/SC).

The following sections describe each of these processes.

5.3.2.1 Trickling Filter/Activated Sludge

This trickling filter process option includes trickling filters coupled with activated sludge basins. (See Figure 5-5). The trickling filter treatment units are packed with cross flow plastic media. The filters are designed for approximately 35 percent BOD removal. The aeration tanks that follow the filter remove the remaining BOD_5 and provide the required nitrification.

The activated sludge tanks are sized for the amount of solids generated from the trickling filters and activated sludge tanks. This method utilizes existing aeration tanks. The trickling filter provides a selector mechanism for nonfilamentous bacteria growth in the same manner as the anaerobic zone operates in the semi-aerobic process. Slightly reduced aeration tank capacity and aeration energy is required due to the portion of the BOD_5 removed in the trickling filter process. This process is capable of controlling sludge bulking and performing nitrification; therefore, it will be evaluated further in chapter 6.

5.3.2.2 Trickling Filter/Solids Contact

In this treatment process, trickling filter units are coupled with a solids contact channel prior to secondary clarification (See Figure 5-6). A portion of the sludge which is settled in the secondary clarifiers is recirculated to the influent of the solids contact channel. An aeration time of approximately one half hour is required in the solids contact channel. The contact of the return sludge with the trickling filter effluent in the solids contact channel enhances the BOD removal and suspended solids removal in the secondary clarifiers. Both BOD_5 and ammonia removal are achieved in the trickling filters prior to the solids contact channel. The TF/SC process satisfies the required BOD_5 removal and nitrification, but it also has some disadvantages. An excessive number of trickling filter units are required (approximately 50 for a one-plant scenario), and only one aeration tank is required for use as a solids contact channel. The remaining aeration tanks at

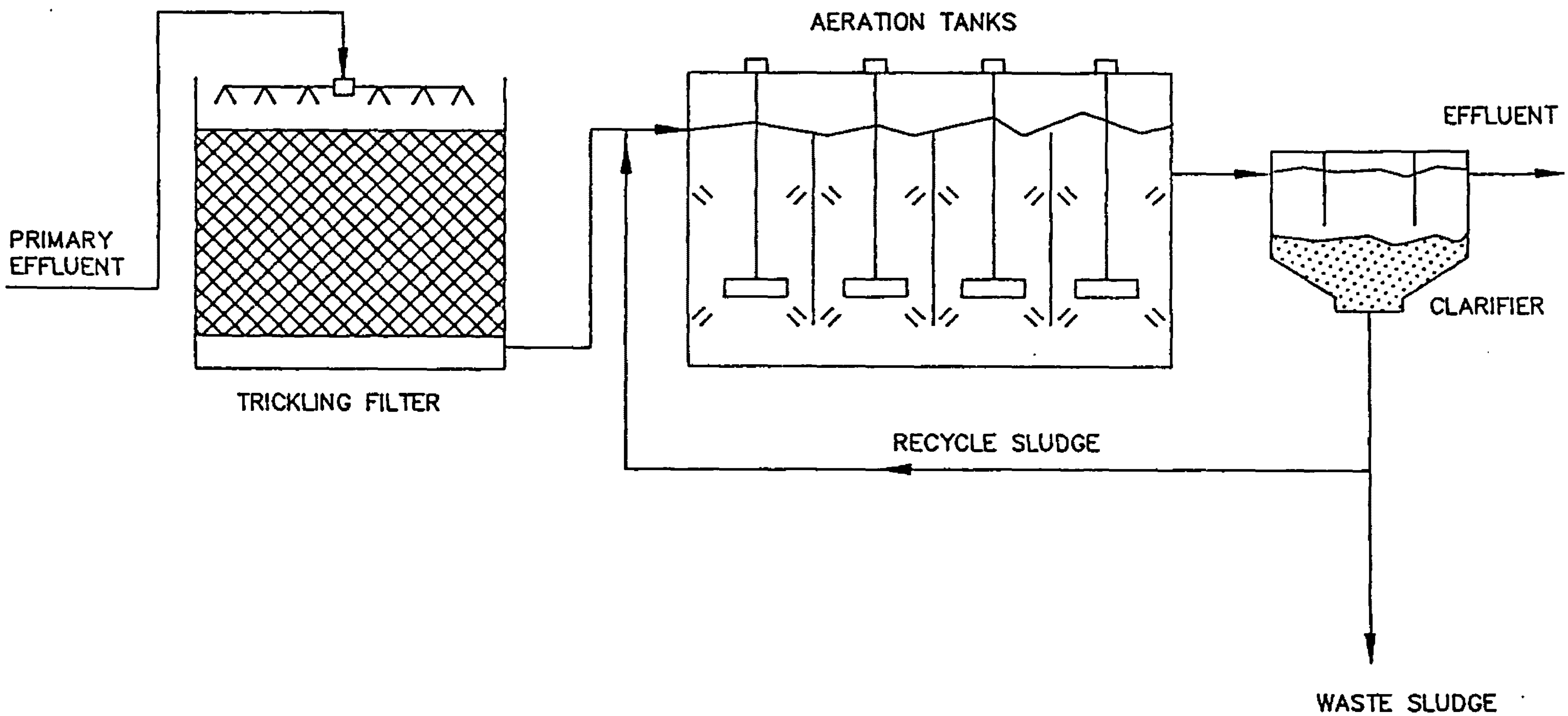


FIGURE 5-5
TRICKLING FILTER/ACTIVATED SLUDGE

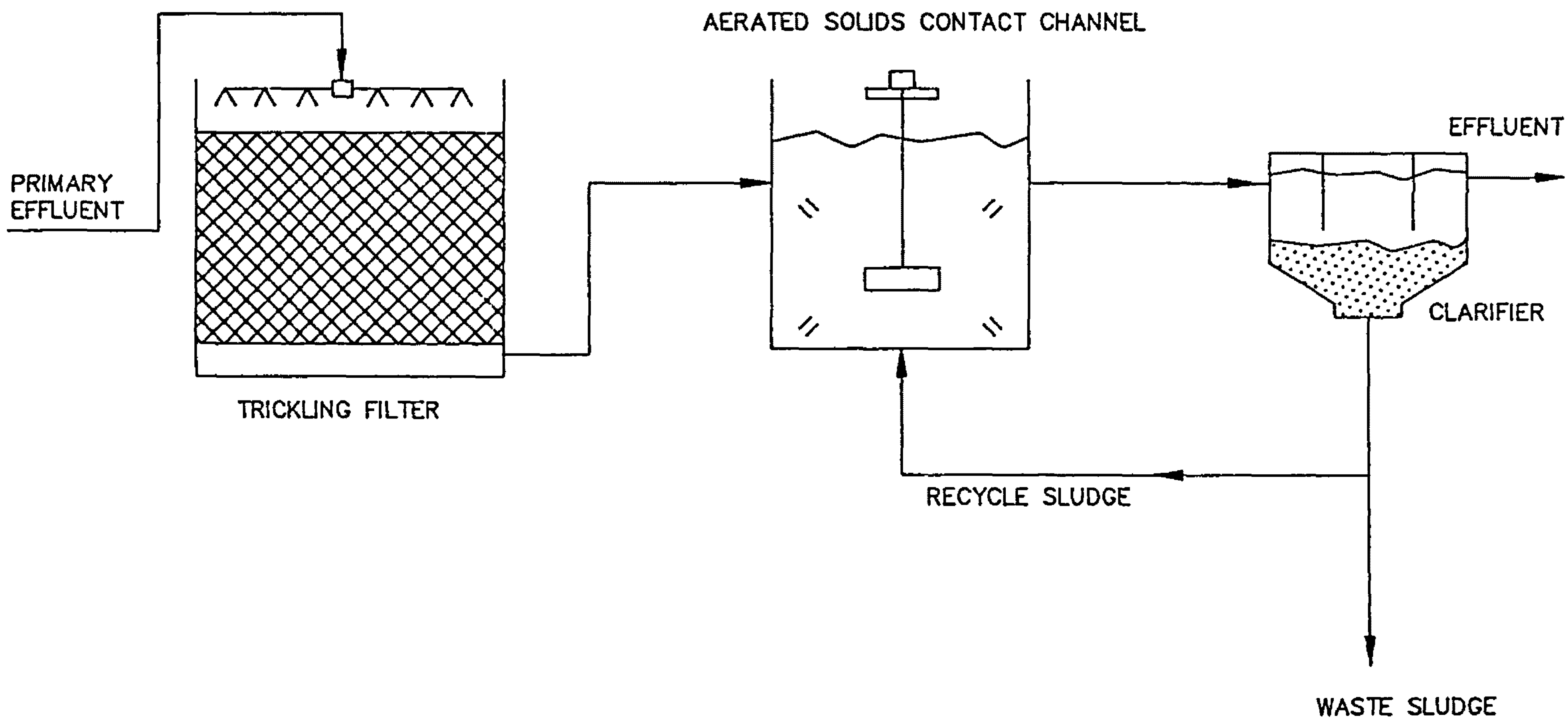


FIGURE 5-6
TRICKLING FILTER/SOLIDS CONTACT

either treatment plant would remain unused. Due to its high capital costs and the fact that it does not make full use of existing facilities, this process alternative is eliminated from further consideration.

5.3.3 Conventional Activated Sludge

The conventional activated sludge process is the current biological method used at both the Southerly and Jackson Pike WWTP's. It consists of rectangular aeration basins with air diffusers to provide aeration and mixing, followed by secondary clarifiers. Settled raw wastewater and return activated sludge enter the head of the tank. The flow proceeds to a clarifier where the solids are settled out.

The activated sludge process consistently removes 85 to 95 percent of the BOD and suspended solids. The amount of nitrogen and phosphorus removed can vary considerably depending on the design and operating parameters of the system.

Two forms of the activated sludge process are being evaluated in this report. They are:

- Single-stage activated sludge
- Two-stage activated sludge.

The following sections discuss these two processes.

5.3.3.1 Single-Stage Activated Sludge

A single-stage activated sludge system consists of an aeration basin followed by a clarifier (Figure 5-7). The aeration basin is typically operated as a plug-flow system. Air diffusers are installed along the length of the tank to provide aeration and mixing. One mode of operation is to taper the air flow along the length of the tank to provide a greater amount of diffused air near the head where the rate of biological metabolism and resultant oxygen demand are the greatest. Another mode of operation, which is

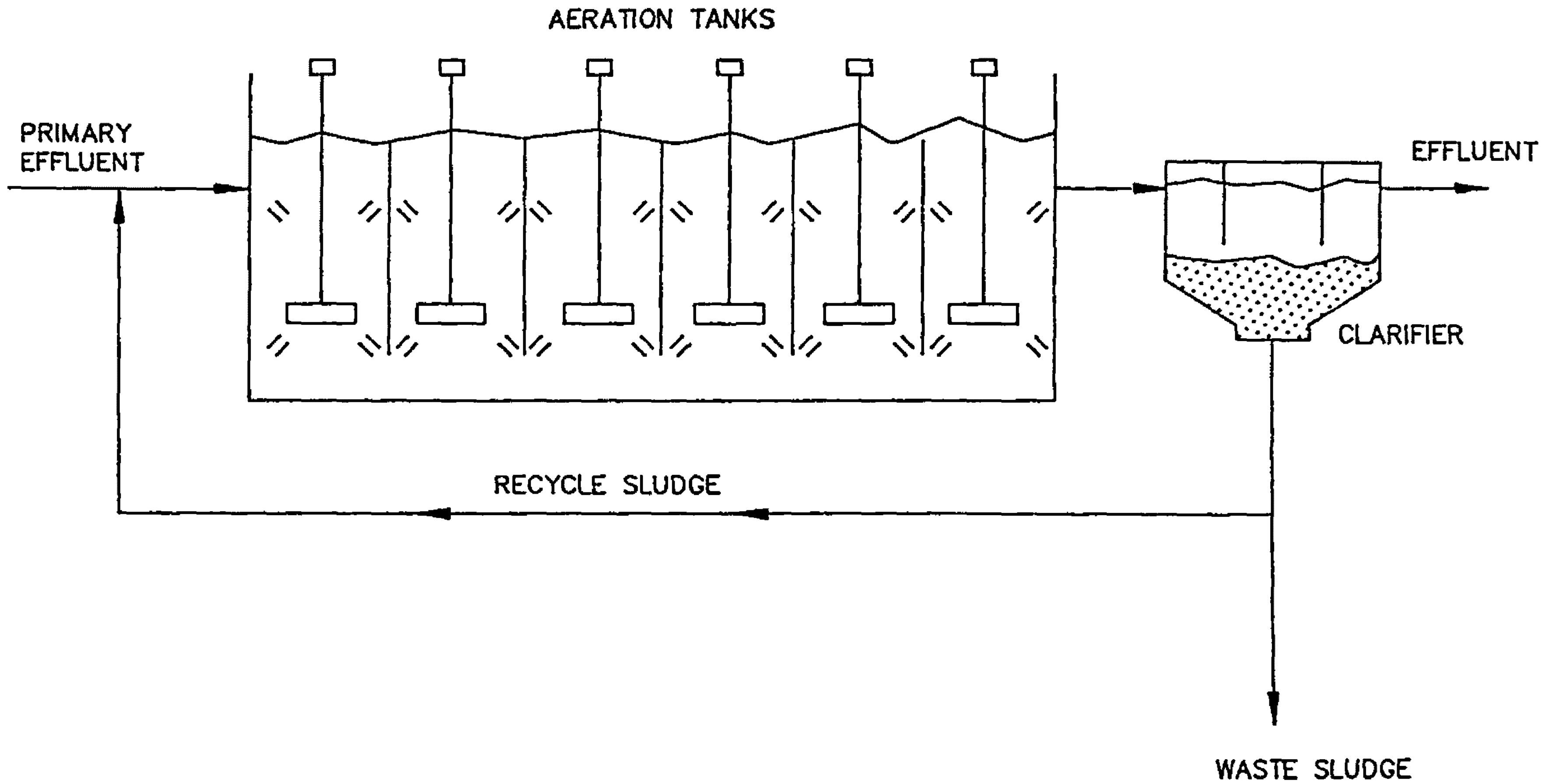


FIGURE 5-7
SINGLE STAGE ACTIVATED SLUDGE

consistent with the mode of operation for the semi-aerobic process, is to reverse taper the air supply to create an anaerobic/anoxic zone at the head of the aeration basin. This anaerobic/anoxic zone acts as a selector mechanism against filamentous organisms, thus it assists in controlling sludge bulking.

Since the semi-aerobic process is simply a modified version of the single-stage activated sludge process, they can be evaluated as one process with operational flexibility. Therefore, the single-stage activated sludge process will be eliminated at this point and the semi-aerobic process will be evaluated in Chapter 6.

5.3.3.2 Two-Stage Activated Sludge

With strong domestic wastewaters, staged treatment may be beneficial and produce a better effluent than the same reactor volume in a single stage. In the first stage, conditions are optimized for carbonaceous removal, while the second aeration basin is optimized to develop the maximum nitrifying population. The disadvantages for this approach include disposal of more waste sludge, the cost of intermediate clarification units, as well as those costs for separating the reactor basins of the two stages and possible costs for additional lime for pH control. Controlling the loss of second-stage solids is also critical. To maintain sufficient aeration solids for cell synthesis it is sometimes necessary to bypass a portion of the influent flow to the second stage, add return sludge from the first stage to the second stage, or bypass, in part, the intermediate settling basin. A two-stage activated sludge system is shown in Figure 5-8. Due to the additional capital cost associated with adding intermediate clarifiers and difficulties associated with process control, this option does not merit further evaluation.

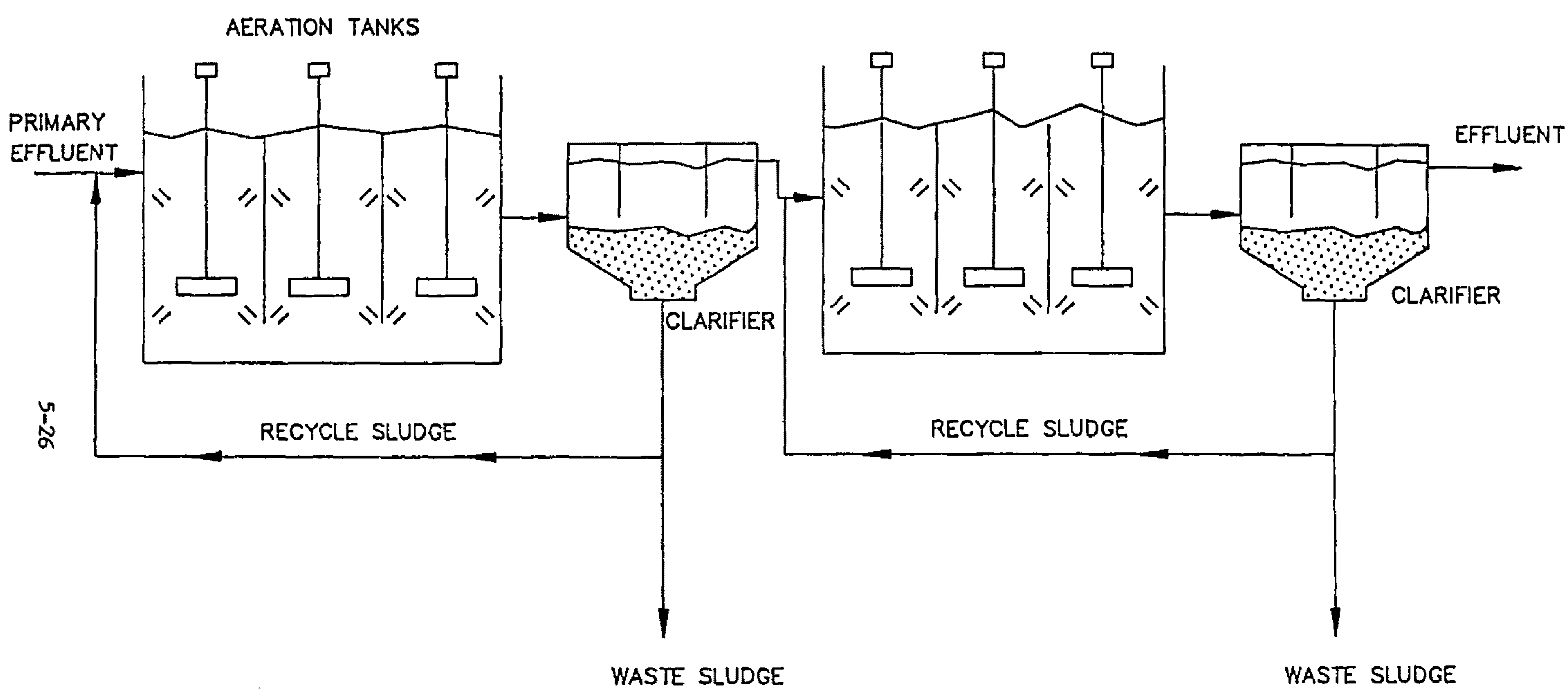


FIGURE 5-8
TWO-STAGE ACTIVATED SLUDGE

5.4 SOLIDS HANDLING

Combinations of physical, chemical, and biological processes are employed in handling the solids (sludge) generated during the wastewater treatment process. The objective of processing sludge is to stabilize the organic material, to extract water from the solids, and dispose of the dewatered residue. The sequence of the various processes is critical to the ultimate performance of the facility.

This section will discuss sludge production and available sludge processing methods and then present feasible combinations of these methods for evaluation as sludge management options.

Both plants current sludge processes (Figures 5-9 and 5-10) include centrifugal thickening and dewatering. Jackson Pike also utilizes anaerobic digestion and heat treatment. Southerly has digesters, but they are not currently operational. Incineration, landfill, and land application are used at Jackson Pike for ultimate disposal. Southerly disposes of their solids via incineration, landfill, or composting. The solids handling capacity at both plants is limited by either inadequate equipment or poor performance due to aging equipment.

5.4.1 Sludge Production

The Jackson Pike WWTP currently produces 230 to 250 wet tons per day of dewatered sludge at a cake solids concentration of about 17 percent. On a dry weight basis, approximately 50 dry tons per day (dtpd) of dewatered solids are produced for ultimate disposal. Based on recent operating records, approximately 50 percent of the dewatered sludge is incinerated and 50 percent is land applied.

The Southerly WWTP currently produces 350-400 wet tons per day of dewatered sludge at a cake solids concentration of about 17 percent. On a dry weight basis, approximately 64 dry tons per day (dtpd) of dewatered solids are produced for ultimate disposal. Based on recent operating records,

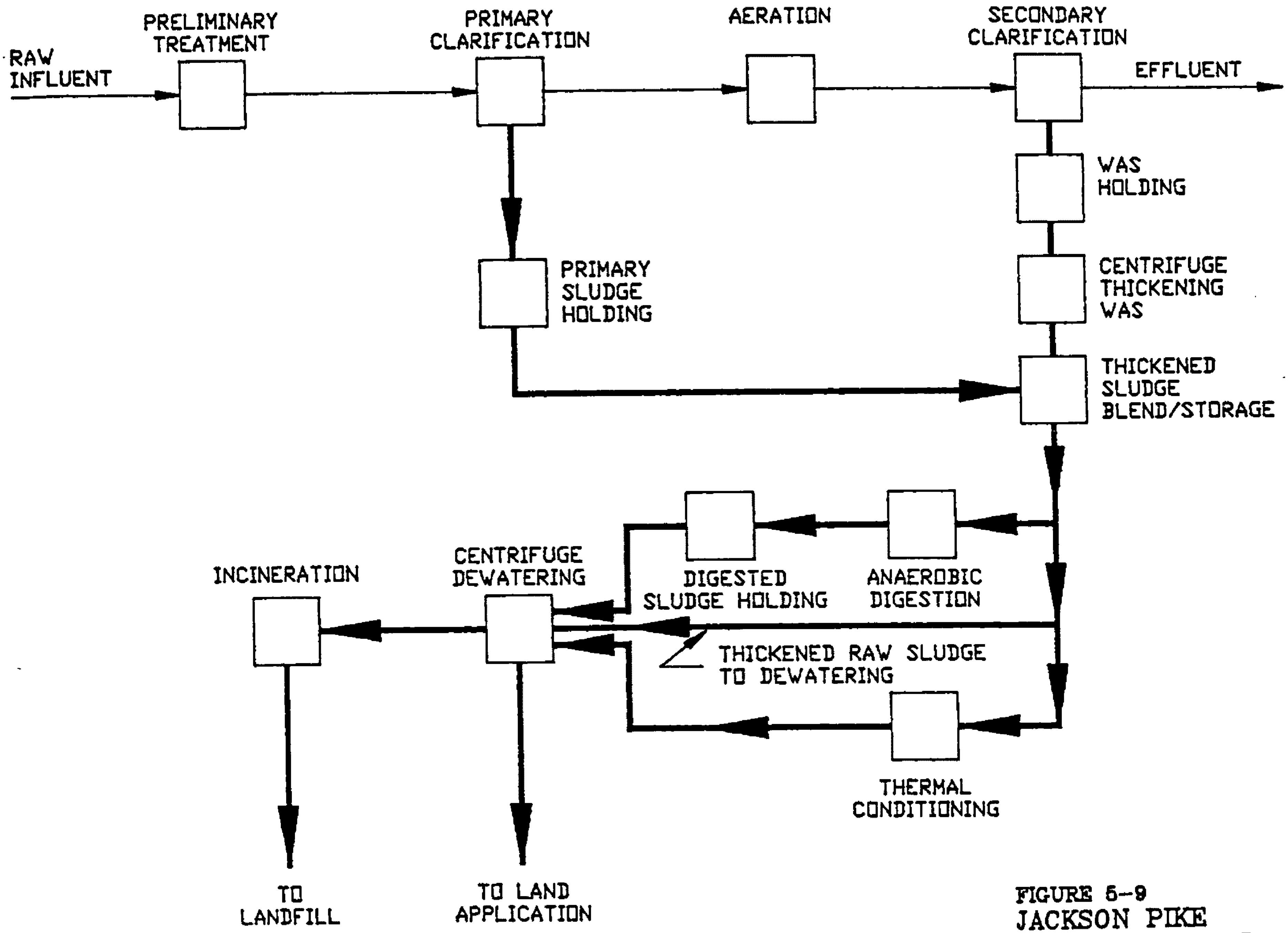


FIGURE 5-9
JACKSON PIKE
EXISTING SLUDGE
MANAGEMENT SCHEMATIC

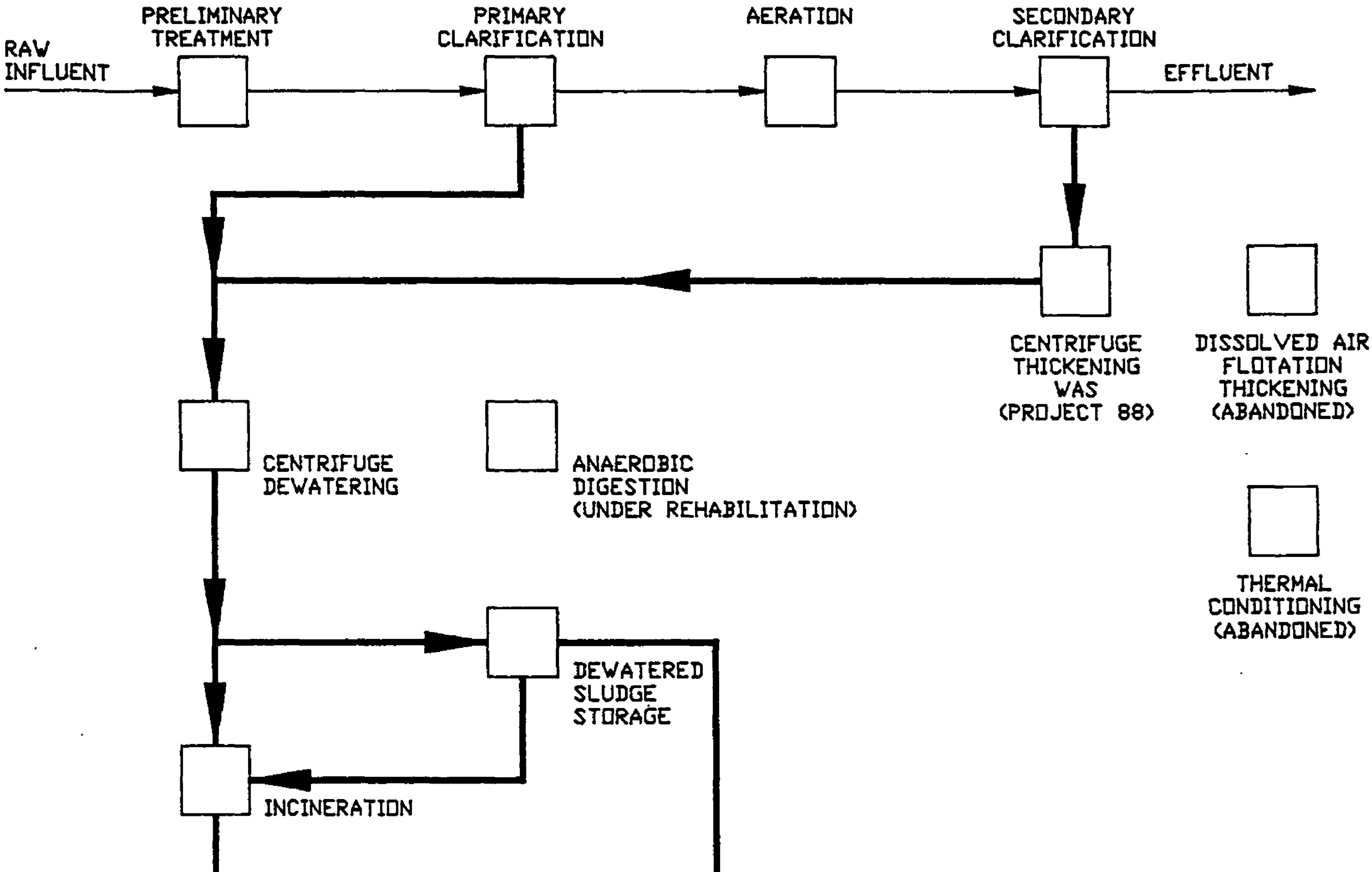


FIGURE 5-10
SOUTHERLY
EXISTING SLUDGE
MANAGEMENT SCHEMATIC

approximately 70 percent of the dewatered sludge is incinerated and the remaining 30 percent is composted.

The anaerobic digestion process is mainly responsible for the smaller quantity of dewatered solids at Jackson Pike. Digestion breaks down organic matter in two phases. In the first phase complex organic substrate is converted to volatile organic acids. In this phase little change occurs in the total amount of organic material in the system. The second phase involves conversion of the volatile organic acids to methane and carbon dioxide. Anaerobic digestion results in a decrease in the amount of solids.

Table 5-1 presents data on the amount of metals present in the processed sludge at Southerly and Jackson Pike. Zinc, cadmium, and lead concentrations are important factors to be considered in evaluating the land application and composting programs. Jackson Pike sludge has significantly higher metal concentrations than Southerly. This could impact a one-plant alternative because the combination of Jackson Pike and Southerly sludge could change the compost classification.

5.4.2 Unit Processes

The following sections present each of the solids handling processes being considered in this report. The unit processes are limited to those alternatives which have been presented in previous Columbus facility planning studies. They include:

- Sludge Thickening
- Anaerobic Digestion
- Thermal Conditioning
- Dewatering
- Lime Stabilization
- Incineration
- Composting
- Land Application

TABLE 5-1. SOLIDS ANALYSES

METALS (mg/kg TS)

	CADMIUM	CHROMIUM	COPPER	LEAD	NICKEL	ZINC
SOUTHERLY*						
1985						
September	16	184	258	218	36	1940
October	12	193	233	240	28	1700
November	18	153	223	230	27	1750
December	18	140	194	162	32	1480
1986						
January	15	111	178	143	31	1400
February	14	164	166	202	36	1086
March	17	152	197	212	45	1167
April	10	149	211	149	31	859
May	--	--	--	--	--	--
June	6	140	249	168	56	789
July	8	110	258	250	53	843
August	5	119	240	175	53	788
AVERAGE	13	147	219	195	39	1255
JACKSON PIKE**						
1985						
September	50	796	686	358	134	5500
October	49	820	652	392	162	5175
November	38	685	713	398	173	4250
December	50	680	613	565	303	3900
1986						
January	36	565	565	315	125	3925
February	40	608	539	386	125	3559
March	44	577	559	319	147	3184
April	--	--	--	--	--	--
May	32	480	643	332	128	2485
June	30	462	640	376	144	2357
July	30	478	658	375	113	2575
August	26	473	608	358	110	2800
AVERAGE	39	602	625	379	151	3610

* To Compost Facility
** To Land Application
-- No Data Available

5.4.2.1 Sludge Thickening

Thickening is a common practice for concentrating sludge. It is employed prior to subsequent sludge processes to reduce the volumetric loading and to increase the efficiency of the downstream processes. At present, there are no facilities for thickening primary sludge (PS) at the Southerly or Jackson Pike treatment plants. Waste activated sludge (WAS) is thickened at both plants by centrifuges. They were installed in recent years to replace the dissolved air flotation units. Rehabilitation costs of the dissolved air flotation units dissuaded the city from their continued operation. The following paragraphs will discuss gravity, and centrifugal thickening.

Gravity thickening is the simplest process for concentrating sludges. Gravity thickeners are applied principally for thickening of primary sludge, lime sludges, combinations of primary and waste activated sludges, and to a lesser degree, waste activated sludge. Gravity thickening is a sedimentation process which is similar to that which takes place in all settling tanks. Solids settle by gravity to the bottom of the basin forming a sludge blanket with a clearer liquid (supernatant) above. The supernatant is removed from the basin over weirs located near the top of the tank. A scraper arm rotates at the bottom of the tank gently stirring the sludge blanket. This aids in compacting the sludge solids and releasing the water from the mass, as well as scraping the sludge toward a center well where it can be withdrawn by pumping. Thickener supernatant is usually returned to either the primary or secondary treatment process.

Centrifugal thickening can have substantial maintenance and power costs, but it is very effective in thickening waste activated sludge. The centrifuge is essentially a dewatering device in which the solids-liquid separation is enhanced by rotating the liquid at high speeds. The centrate stream is usually returned to the plant influent. Centrifuges have been used for both sludge thickening and dewatering.

Conditioning prior to thickening provides improved thickening and solids capture. The thickening process makes primary and waste activated sludge difficult to blend together. Therefore, a mechanical mixing device is needed in sludge holding tanks.

The RFPU recommendation for the one-plant scenario included gravity thickening of PS and centrifugal thickening of WAS.

5.4.2.2 Anaerobic Digestion

Biological digestion of sludge from wastewater treatment is widely practiced to stabilize and break down the organic matter prior to ultimate disposal. Anaerobic digestion is used in plants employing primary clarification followed by either trickling filter or activated sludge secondary treatment. The end products of anaerobic digestion are methane, unused organics, and relatively small amounts of cellular protoplasm. Anaerobic digestion is basically a destructive process, although complete degradation of the organic matter under anaerobic conditions is not possible.

The Columbus treatment facilities currently have primary and secondary digesters. However, the digesters at Southerly have been out of service since 1979. Upgrading and possible expansion at both plants may be required. The areas of contention in previous studies were whether primary solids, secondary solids, or both should be digested; if post thickening is necessary; and what the volume requirements should be.

Anaerobic digestion provides a stabilized solids product that is suitable for land application. Digestion is generally not considered conducive to composting. The reduction in volatile solids would generally reduce the bio-activity in the composting piles, which is considered essential to generate heat in the piles.

5.4.2.3 Thermal Conditioning

Thermal conditioning in the form of heat treatment consists of grinding the sludge first and then heating it between 350°F and 450°F under pressures of 150 and 300 psi in a reactor. Under these conditions, the water contained in the solids is released. Sludge is fed from a reactor to a settling tank where the solids are concentrated. Heat treatment releases water that is bound within the cell structure of the sludge and thereby improves the dewatering and thickening characteristics of the sludge. Heat treatment improves the production rate and the cake solids content of the dewatering process. Heat treatment has an added advantage in that it also stabilizes the sludge. It destroys pathogenic organisms and successfully disinfects the sludge. A disadvantage of the heat treatment process is that it ruptures the cell walls of biological organisms, releasing not only the water but some bound organic material. It returns to solution some organic material previously converted to particulate form and creates other fine particulate matter. The breakdown of the biological cells as a result of heat treatment converts these previously particulate cells back to water and fine solids. This process aids the dewatering process, but creates a separate problem of treating this highly polluted recycle stream.

Treatment of this water or liquor requires careful consideration in design of the plant because the organic content of the liquor can be extremely high. It may require a separate treatment system.

The Jackson Pike treatment plant currently operates thermal conditioning (heat treatment) units. They are operated approximately six months of the year. The Revised Facilities Plan Update does not recommend operating heat treatment equipment at Southerly under the one-plant alternative. However, in the two-plant alternative, they do recommend continuation of the operation at Jackson Pike where the operation is well established.

5.4.2.4 Dewatering

This process is generally necessary for all options. Basically, the reduction in volume of solids is critical to incineration, land application, and composting.

The three most common systems currently specified for mechanical sludge dewatering are centrifugation, belt filter presses, and diaphragm plate and frame filter presses.

Centrifugation causes the mechanical dewatering of sludge through centrifugal force. The centrifugation process was previously described under the sludge thickening section. Pretreatment such as chemical conditioning or thickening is recommended prior to centrifugal dewatering to increase solids dewatering capacity.

The belt filter press utilizes two porous mono-filament polyester cloth belts which dewater the sludge in three zones; gravity zone, the wedge and low pressure zone, and the shear and high pressure zone. The dewatered cake with high solids content is discharged after the high pressure zone. The water removed by the belt filter press is captured in trays where it is ultimately returned to the wet stream process.

Diaphragm plate and frame (DPF) filter presses used for sludge dewatering consist of a series of plates, recessed or with frames, mounted in a framework consisting of head supports connected by two heavy horizontal and parallel bars on an overhead rail. Sludge dewatering using this treatment approach consists of a gradual thickening, dewatering, and compression stage brought about by subjecting the sludge to high pressures, thus causing solid-liquid separation. The use of chemicals such as lime, ferric chloride, and polymers for conditioning is generally required for sludges to aid in coagulation of the solids and release of the absorbed water. This allows for better filtration times and assists in cake-cloth disengagement.

Centrifuges are presently used to dewater mixtures of primary and waste activated sludge at the Jackson Pike and Southerly WWTP's. The RFPU recommended additional centrifuges for dewatering. A recent report entitled Preliminary Design Evaluation of Sludge Dewatering recommended replacing the existing centrifuges with DPF presses.

5.4.2.5 Lime Stabilization

The addition of lime, in sufficient quantities to maintain a high pH between 11.0 and 11.5, stabilizes sludge and destroys pathogenic bacteria. Lime stabilized sludges dewater well on sandbeds without odor problems if a high pH is maintained. Sludge filterability can be improved with the use of lime; however, caution is required when sludge cake disposal to land is practiced. Disposal in thick layers could create a situation where the pH could fall to near 7 prior to the sludge drying out, causing regrowth of organisms and resulting in noxious conditions. Essentially, no organic destruction occurs with lime treatment. The key factor in assuring a proper stabilization process is to maintain the pH above 11.0.

5.4.2.6 Incineration

Sludge incineration is usually preceded by sludge thickening and dewatering. It requires an incinerator feed system, air pollution control devices, ash handling facilities, and the related automatic controls. Two major incineration systems employed in the United States are the multiple-hearth furnace, the rotary kiln, and the fluidized-bed reactor. The multiple-hearth unit has received widest adoption because of its simplicity and operational flexibility. The Columbus facilities employ these furnaces for incineration, but they also rely on land application and composting for sludge disposal.

A primary consideration in the cost-effectiveness of sludge incineration is the effect of sludge feed composition on auxiliary fuel requirements. Heat yield from a given sludge is a function of the relative amounts and elemental composition of the contained combustible elements. Primary sludges are higher in heating value than biological sludges because of their higher grease content. It is more economical to burn undigested solids than digested solids since digestion significantly reduces the heat content of the remaining solids. Therefore, critical design factors for any wastewater sludge incineration system are heating value and moisture content of the sludge, excess air requirements, and the economics of heat recovery.

Another significant consideration for incineration is its relative stability in regard to environmental and aesthetic factors. The state of the art of incineration is such that various controls and equipment modifications are possible to meet a variety of potential environmental standards above and beyond those currently in place. These potential modifications are costly, but at least the basic advantage exists that the ultimate control is within the facilities operation and not as subject to the variations in raw sewage composition as other ultimate disposal processes such as land application and composting.

5.4.2.7 Composting

Composting is an aerobic biological process designed to biologically stabilize organics, destroy pathogenic organisms, and reduce the volume of waste. The Southwesterly Composting Facility in Columbus uses the aerated static pile method to process unlimed, raw sludge. The final product from the composting process, Com-Til, is marketed as a soil conditioner.

The aerated static pile process involves mixing dewatered sludge with a bulking agent, such as wood chips, followed by active composting in specially constructed piles. Typically, both recycled bulking agent and new bulking agent are used for mixing. Induced aeration, either positive (blowing) or negative (suction), is provided during active composting and sometimes during curing and/or drying.

Temperature and oxygen are monitored during active composting as a means of process control. The active composting period lasts at least 21 days, following which the piles are torn down and restacked for a curing period of following which the piles are torn down and restacked for a curing period of 30 days. After this period, the mixture is screened and the wood chips recovered for reuse.

The issues of concern in composting are the odor problem and a market demand for the final product. The RFPU recommended composting in addition to land application as the preferred means of solids disposal with incineration as a back-up. The FPU recommended additional incineration due to the tenuous nature of composting and land application.

5.4.2.8 Land Application

Following the recommendations of the original EIS, the city of Columbus has developed a program for land application of sludge. A benefit of the process results from the nutrient value of nitrogen and phosphorus in the sludge, which reduces the quantities of chemical fertilizer necessary on the agricultural land. The key factors in considering land application as an alternative in sludge disposal are haul distance, climate, and availability of land. Environmental concerns regarding land application include surface water and groundwater pollution, contamination of soil and crops with toxic substances, and transmission of human and animal disease.

Although nitrogen is a plus in this process, it is also a limiting factor in considering the amount of sludge which can be safely applied. Adding excess nitrogen to the soil involves the risk of polluting the groundwater with nitrates. High nitrate concentrations are toxic to humans and livestock.

Cadmium concentrations in sludge are also a limiting factor in the application rate. Cadmium is taken up by plants and enters the human food chain. The primary chronic health effect of excessive dietary intake of cadmium is damage to the kidneys.

To keep excessive amounts of cadmium, nitrate, and other toxic substances from entering the soil, monitoring of the sludge, soil, and crops should be done during utilization. Aquifers should also be monitored for potential nitrate pollution.

Only stabilized sludge should be spread on farmland. Sludge can be stabilized by aerobic or anaerobic digestion, lime, or thermal conditioning. Farmers are usually advised to allow six weeks or more after sludge application before harvesting crops or allowing animal grazing. Preferred vegetation is non-food-chain crops like cotton. Feed grains for animal consumption are also commonly fertilized by tilling sludge solids into the soil before planting the crops.

Sludge can be applied on the surface if local regulations permit, or it can be injected into the subsurface. Subsurface injection is the most environmentally desirable since it eliminates exposure of the sludge to the atmosphere. Surface application can be done by spreading or spraying. Spraying through irrigation nozzles can only be practiced where insects and odor are not a problem.

The continued use of land application as a preferred means of sludge disposal is mainly dependent on the available land for application and the cost of transporting the sludge.

5.4.3 Sludge Management Options

Sludge management options were formulated in light of several goals and objectives. These goals and objectives included the following:

- The sludge management options must consist of processing and disposal methods that will provide for environmentally sound processing and ultimate disposal of sludge.
- The option must provide a reliable means for future processing and disposal.
- The options should offer some flexibility allowing the city to modify the processing and disposal methods to relieve pressures created by equipment failures or temporary loss of the ultimate disposal methods.

The options developed should consider, to the extent possible, optimizing the reuse of the existing facilities thus minimizing implementation costs.

This preliminary evaluation identified options for the two-plant scenario, where Jackson Pike and Southerly would be operated independently; for the two-plant one solids scenario, where Southerly and Jackson Pike are upgraded for wet stream treatment and Southerly is expanded to provide all the solids handling facilities; and for the one-plant scenario, where Southerly is expanded to handle the projected flows and loads and the Jackson Pike facility is abandoned. Under the two-plant two solids scenario, three sludge management options were identified for Jackson Pike, and six sludge management options were identified for Southerly. For the two-plant one solids and one-plant scenarios the sludge management options which were identified for the Southerly two-plant scenario were considered appropriate to evaluate.

5.4.3.1 Jackson Pike Sludge Management Options

Three potential sludge management options were identified for the Jackson Pike WWTP. Each option is discussed separately in the following paragraphs.

Jackson Pike Sludge Management Option JP-A

Figure 5-11 presents the sludge managment schematic for option JP-A. The option would involve the following sludge processes:

- Gravity thickening of PS
- Centrifuge thickening of WAS
- Thickened sludge storage and blending
- Stabilization by anaerobic digestion
- Dewatering.

Dewatered digested sludge would strictly be land applied in an agricultural reuse program.

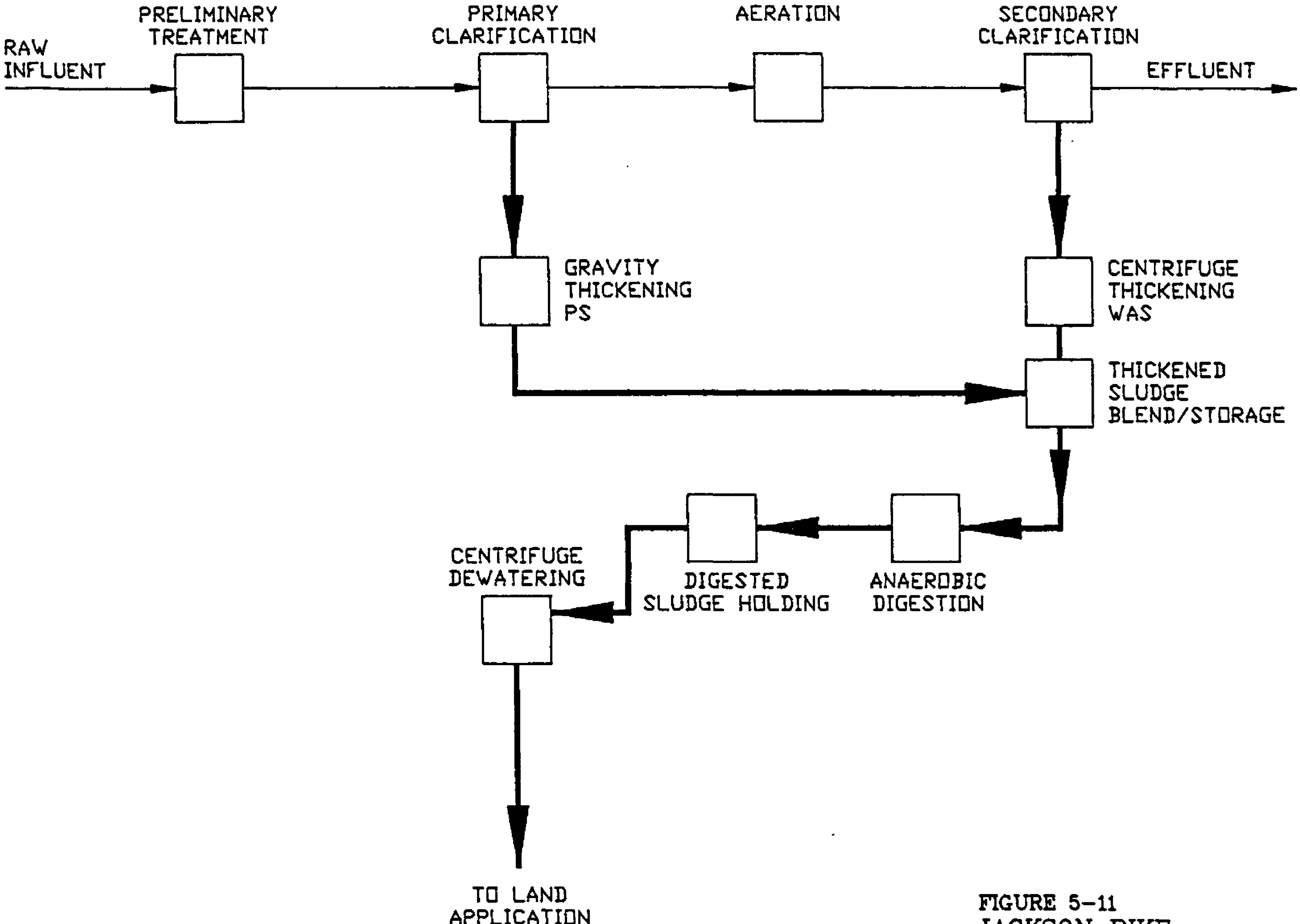


FIGURE 5-11
JACKSON PIKE
OPTION JP-A SLUDGE
MANAGEMENT SCHEMATIC

Based on the subjective review of this management option, it was eliminated from further consideration. Relying strictly on land application, for ultimate disposal of the projected sludge quantities, lacks the flexibility critical to maintaining a successful disposal program. This lack of flexibility would require an increased degree of conservatism in design and implementation to ensure plant performance during an interruption of the disposal process. Furthermore, the seasonal nature of the agricultural application program would require substantial sludge storage facilities. Normally, such storage facilities experience community relation difficulties associated with aesthetics and odors.

Jackson Pike Sludge Management Option JP-B

Figure 5-12 presents the sludge management schematic for option JP-B. This option would consist of the following sludge processes:

- Gravity thickening of PS
- Centrifuge thickening of WAS
- Thickened sludge storage and blending
- Stabilization by anaerobic digestion
- Dewatering
- Incineration.

Dewatered sludge would be disposed of as follows:

- 50 percent of the dewatered sludge would be incinerated and the ash product landfilled.
- 50 percent of the dewatered sludge would be land applied.

The 50:50 ratio is approximately consistent with current Jackson Pike disposal practices. In this brief analysis, a comprehensive review of alternate ratios to determine an optimum ratio was not performed. Since land application is not a limiting factor and the incinerators at Jackson Pike require some rehabilitation, a split equal to current practices appears appropriate.

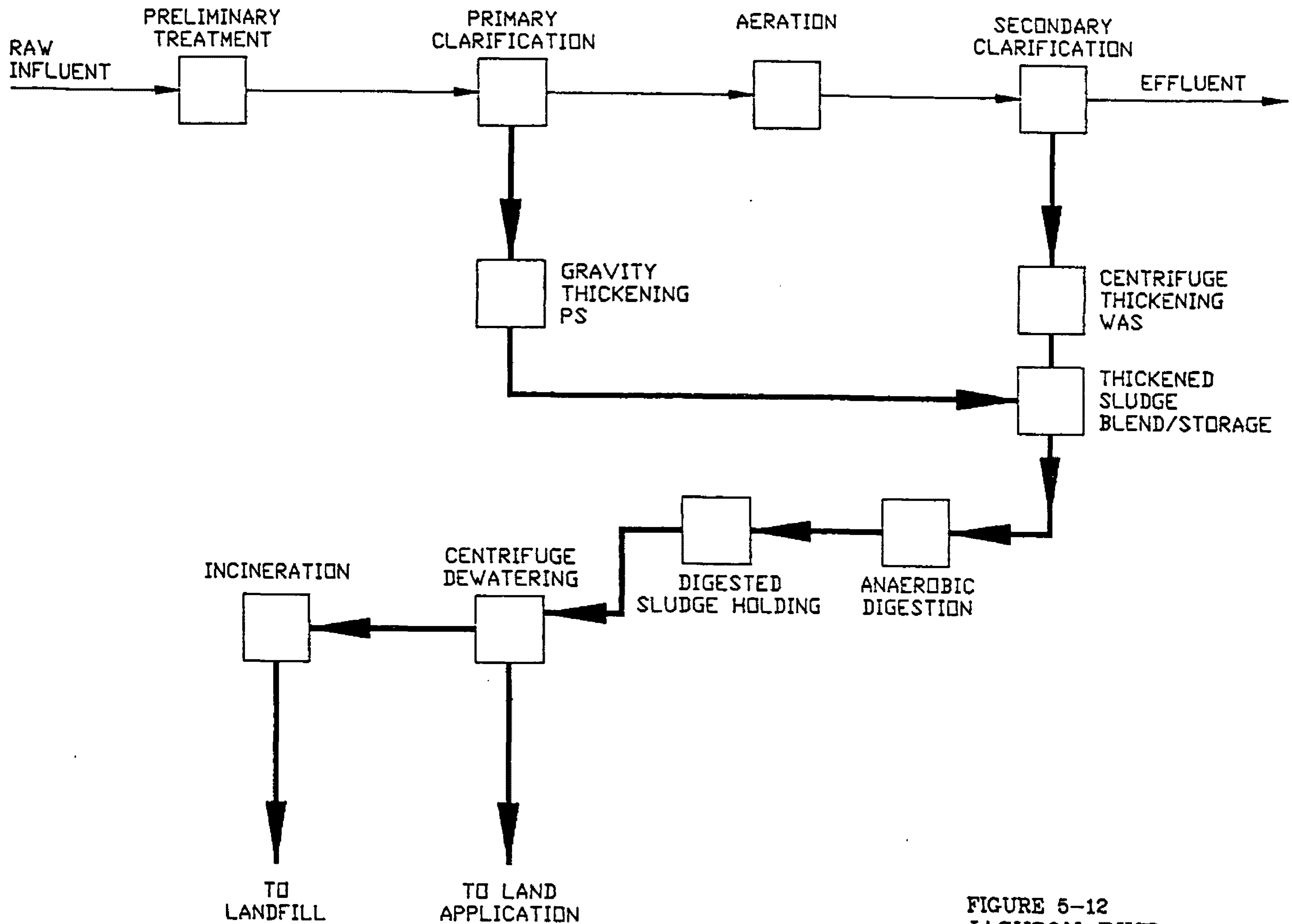


FIGURE 5-12
JACKSON PIKE
OPTION JP-B SLUDGE
MANAGEMENT SCHEMATIC

Subjective screening of JP-B indicated that the option adequately addressed the goals and objectives. Therefore, it will go through a more detailed evaluation in chapter 6.

Jackson Pike Sludge Management Option JP-C

Figure 5-13 presents the sludge management schematic for option JP-C. This option would consist of the following sludge processes.

- Gravity thickening of PS
- Centrifuge thickening of WAS
- Thickened sludge storage and blending
- Stabilization by anaerobic digestion
- Stabilization by thermal conditioning
- Dewatering
- Incineration.

Dewatered sludge would be disposed of as follows:

- 50 percent of the dewatered sludge would be incinerated and the ash product landfilled.
- 50 percent of the dewatered sludge would be land applied.

As previously discussed, the 50:50 disposal ratio is consistent with current practice. The stabilization processes would each handle 50 percent of the thickened sludges produced under normal operating conditions. The dewatered, thermally conditioned sludge would be incinerated while the dewatered, digested sludge would be land applied.

Sludge management option JP-C was also determined by the subjective screening to merit more detailed consideration. It will be evaluated further in chapter 6.

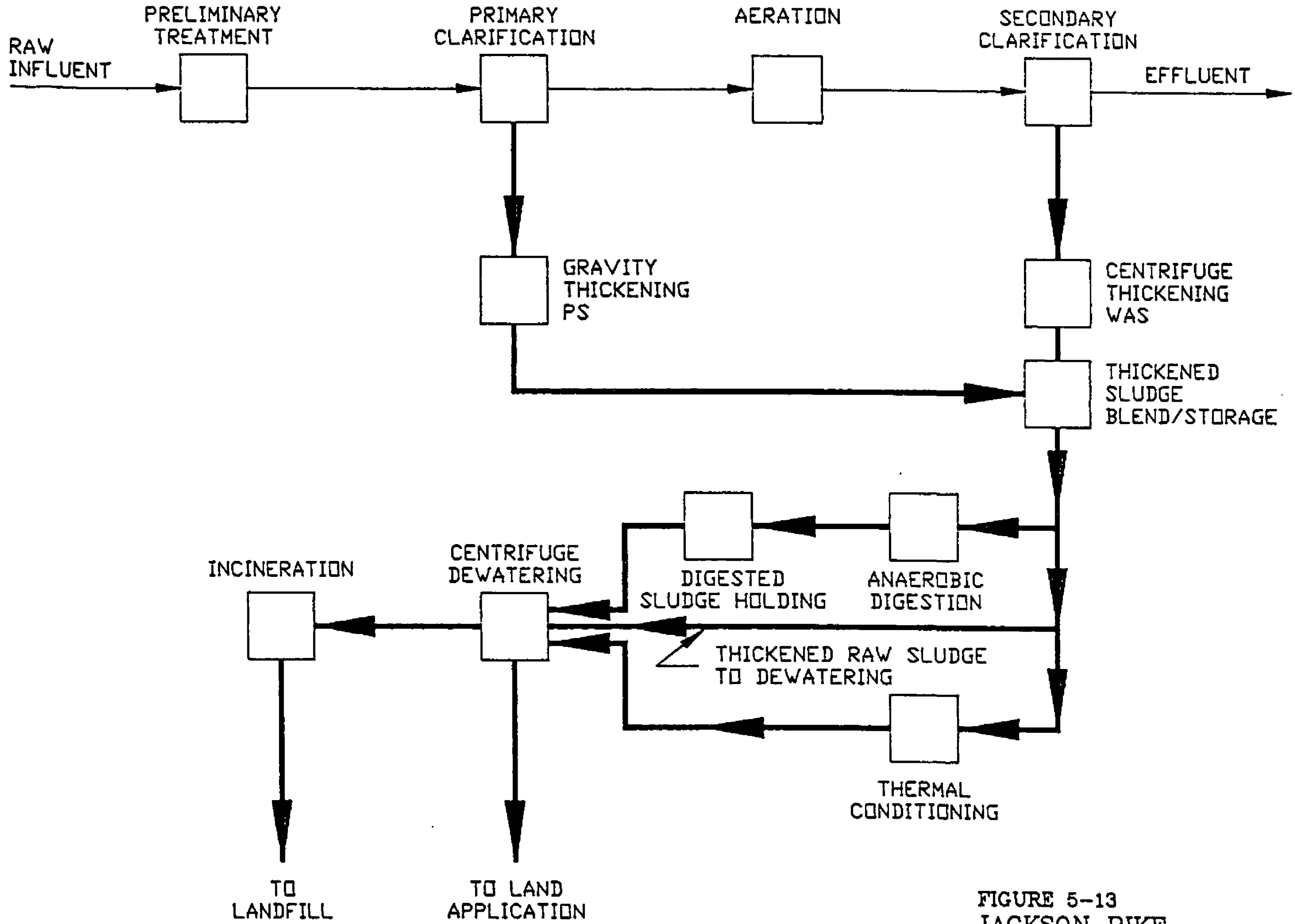


FIGURE 5-13
JACKSON PIKE
OPTION JP-C SLUDGE
MANAGEMENT SCHEMATIC

5.4.3.2 Southerly Sludge Management Options

Six potential sludge management options were identified for the Southerly WWTP. Each option is discussed separately in the following paragraphs.

Southerly Sludge Management Option SO-A

Southerly sludge management option SO-A is graphically depicted by the schematic presented in Figure 5-14. Option SO-A would utilize the following sludge processes:

- Gravity thickening of PS
- Centrifuge thickening of WAS
- Thickened sludge storage and blending
- Stabilization by anaerobic digestion
- Dewatering
- Incineration.

Dewatered digested sludge would be incinerated and landfilled.

Option SO-A was eliminated from further consideration for two basic reasons. First, the option proposes to abandon the existing compost operations. Such a move would forfeit the substantial investment the city has placed in the relatively new facilities and would substitute disposal of all of the sludge product by landfilling in lieu of the current practice which reuses a portion of the sludge as soil conditioner. Second, option SO-A lacks the flexibility needed to allow the city to modify disposal operations subject to equipment failures or external pressures such as public dissatisfaction or regulatory requirements.

Southerly Sludge Management Option SO-B

Figure 5-15 presents the sludge management schematic for option SO-B. The option would feature the following sludge processes:

- Gravity thickening of PS

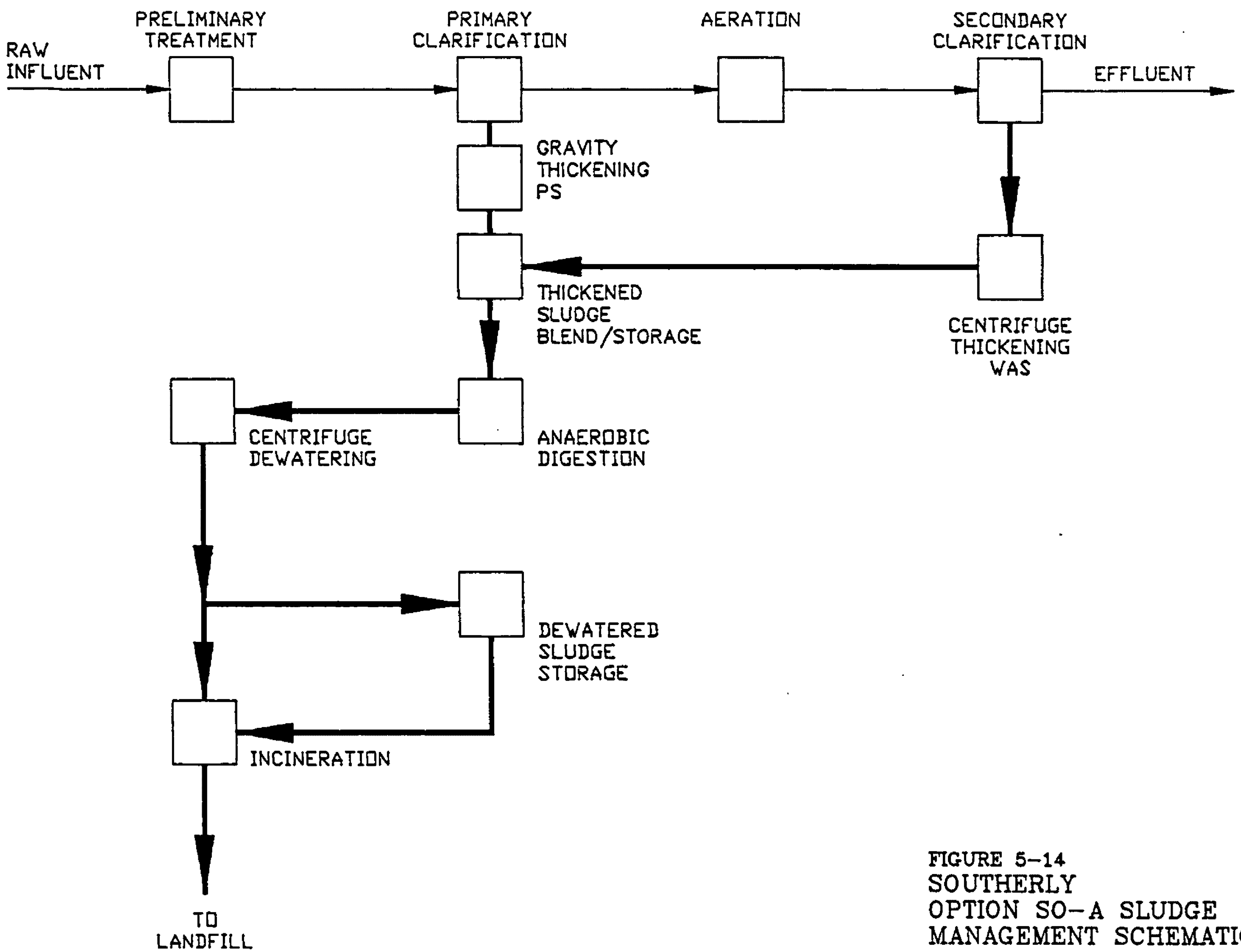


FIGURE 5-14
SOUTHERLY
OPTION SO-A SLUDGE
MANAGEMENT SCHEMATIC

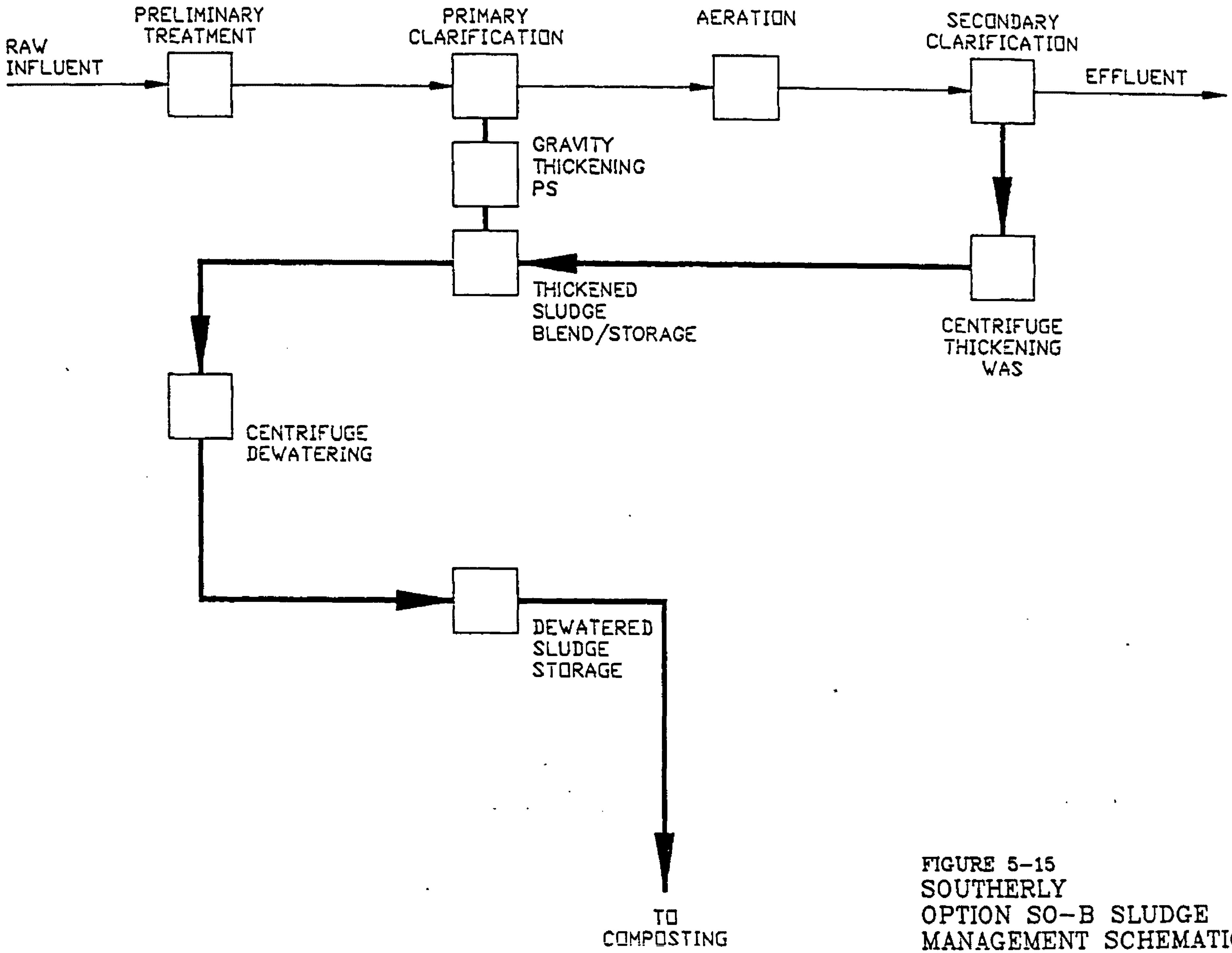


FIGURE 5-15
SOUTHERLY
OPTION SO-B SLUDGE
MANAGEMENT SCHEMATIC

- Centrifuge thickening of WAS
- Thickened sludge storage and blending
- Dewatering
- Composting.

Ultimate sludge disposal would be accomplished through the marketing and distribution of compost as a soil conditioner.

The subjective evaluation eliminated option SO-B from further consideration. Flexibility to alter disposal operations was the critical factor in the evaluation. Composting the entire volume of dewatered sludge would mean a 2 to 3 fold increase in compost product over current conditions. If Southerly were operated in a one-plant scenario, 5 to 6 times the current compost product would be produced. An aggressive and successful marketing program would be mandatory to locate and maintain sufficient receptors for the compost. The long-term reliability of an option which relies solely on distribution of compost was not considered adequate to merit more detailed development and evaluation.

Southerly Sludge Management Option SO-C

The sludge management schematic for option SO-C is presented in Figure 5-16. Southerly sludge management option SO-C would consist of the following sludge processes:

- Gravity thickening of PS
- Centrifuge thickening of WAS
- Thickened sludge storage and blending
- Stabilization by anaerobic digestion
- Dewatering
- Composting
- Incineration.

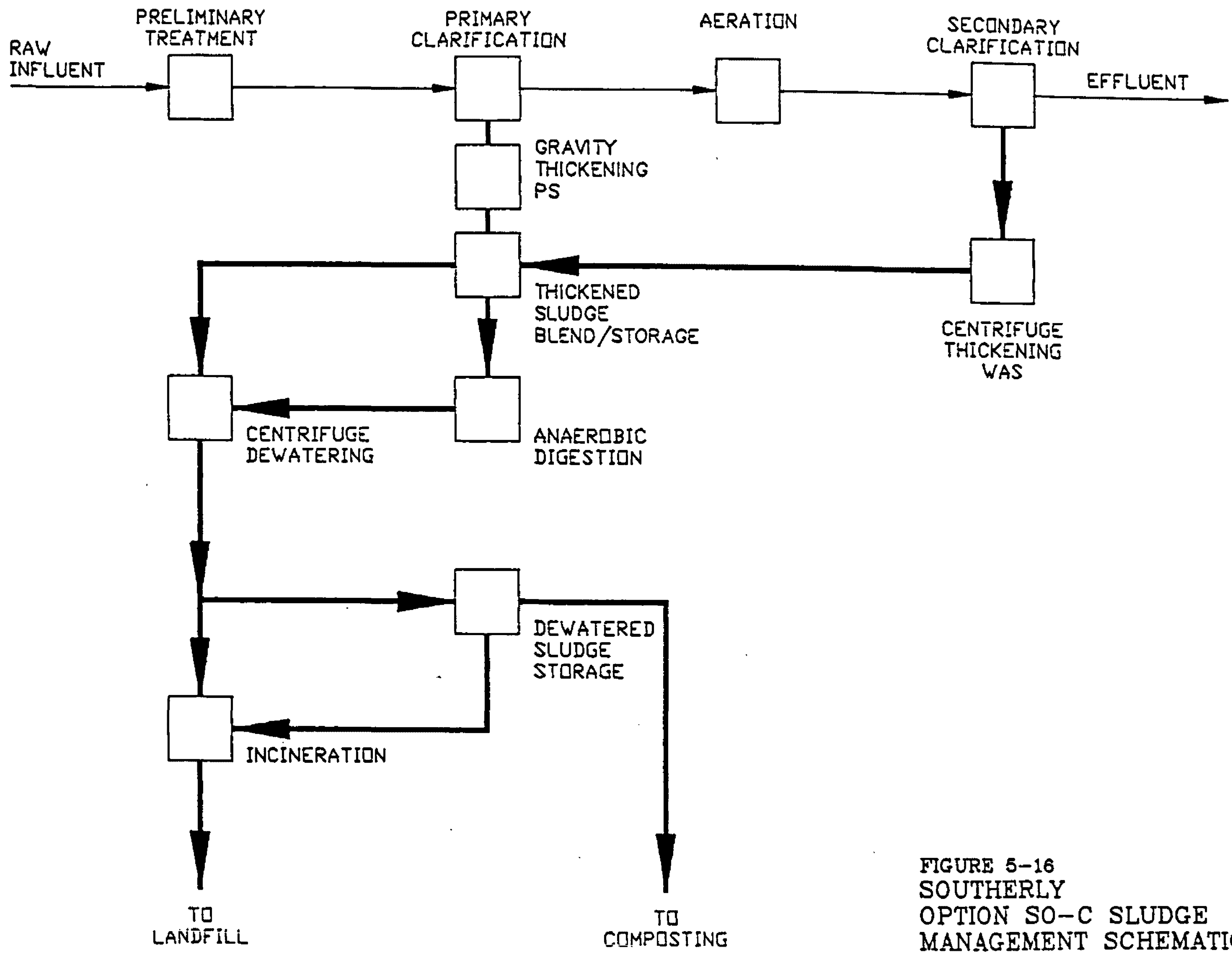


FIGURE 5-16
SOUTHERLY
OPTION SO-C SLUDGE
MANAGEMENT SCHEMATIC

Dewatered sludge would be disposed of as follows:

- 75 percent of the dewatered sludge would be incinerated, and the ash product would be landfilled.
- 25 percent of the dewatered sludge would be composted and the compost would be distributed as a soil conditioner.

The 75:25 ratio is approximately consistent with current Southerly disposal practices. The digestion facilities would be sized to process that portion of the sludge that would be incinerated. The portion of the sludge that would be composted would not receive stabilization prior to dewatering.

Option SO-C represents current practice at Southerly when the digestion facilities are operational. Therefore, subjective screening concluded that the option merits more detailed development and evaluation in chapter 6.

Southerly Sludge Management Option SO-D

Southerly sludge management option SO-D is graphically depicted by the schematic presented in Figure 5-17. Option SO-D would utilize the following sludge processes.

- Gravity thickening of PS
- Centrifuge thickening of WAS
- Thickened sludge storage and blending
- Stabilization by anaerobic digestion
- Dewatering
- Composting
- Incineration.

Ultimate disposal of the sludge would be accomplished through the following disposal methods:

- 25 percent of the sludge would be dewatered, composted, and distributed as a soil conditioner.

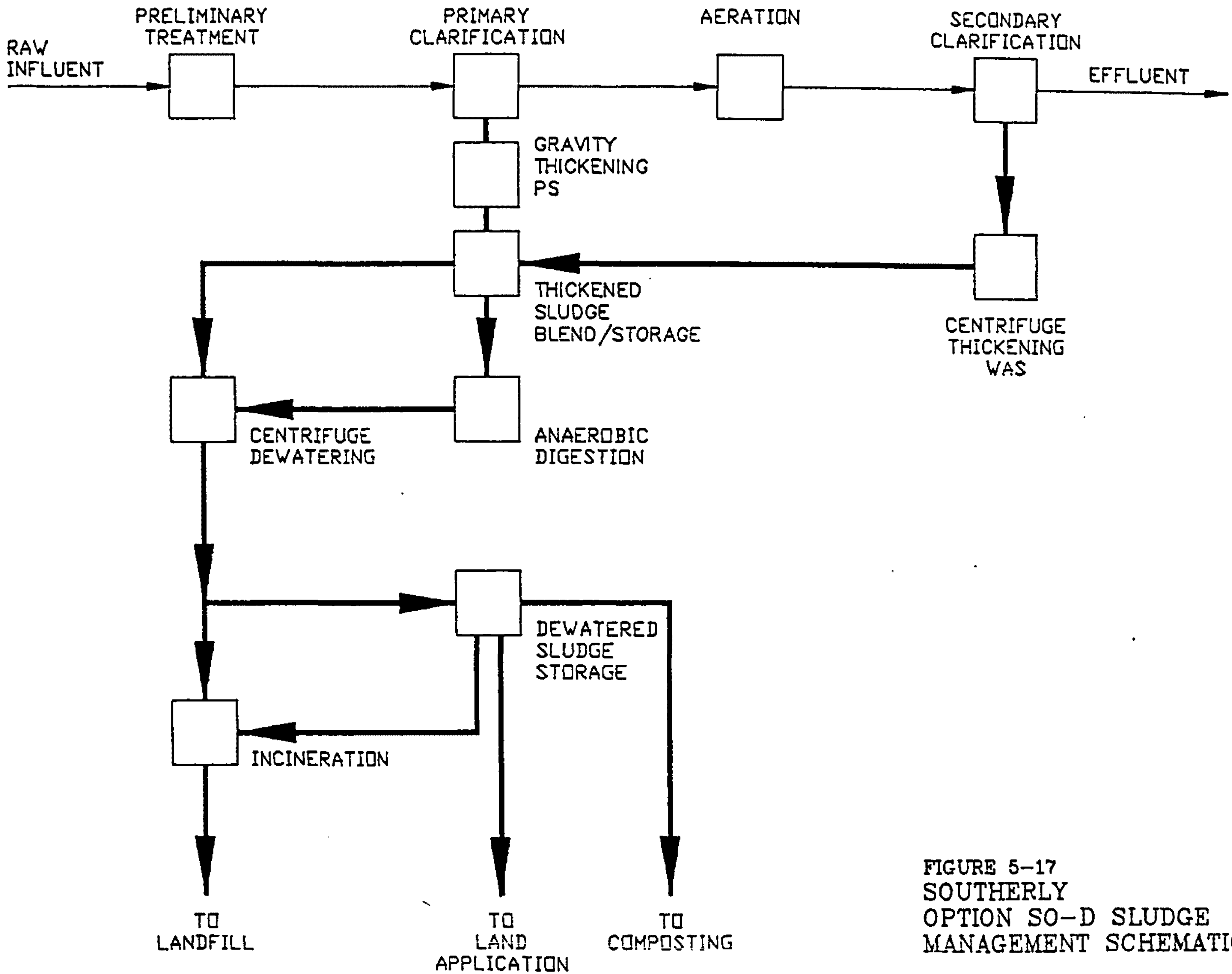


FIGURE 5-17
SOUTHERLY
OPTION SO-D SLUDGE
MANAGEMENT SCHEMATIC

- 25 percent of the sludge would be digested, dewatered, and land applied.

- 50 percent of the sludge would be digested, dewatered, incinerated, and landfilled.

Option SO-D meets the goals and objectives of the subjective screening. The option offers continuation of the existing incineration and composting processes at Southerly and introduces land application as a disposal process. The city has indicated there is adequate acreage suitable for land application within an economically feasible distance of the plant. Option SO-D was advanced for further development and evaluation in chapter 6.

Southerly Sludge Management Option SO-E

Figure 5-18 presents the sludge management schematic for Option SO-E. Southerly sludge management option SO-E would consist of the following sludge processes:

- Gravity thickening PS
- Centrifuge thickening of WAS
- Thickened sludge storage and blending
- Stabilization by anaerobic digestion
- Dewatering
- Composting.

Dewatered sludge would be disposed of as follows:

- 50 percent would be composted and distributed as a soil conditioner. Sludge sent to compost would not go through the digestion process.

- 50 percent would be land applied as a fertilizer to agricultural acreage within a reasonable distance from the plant.

Based on the subjective evaluation option SO-E was eliminated from further consideration. The reliability of utilizing only compost distribution and land application as ultimate disposal options did not appear reasonable.

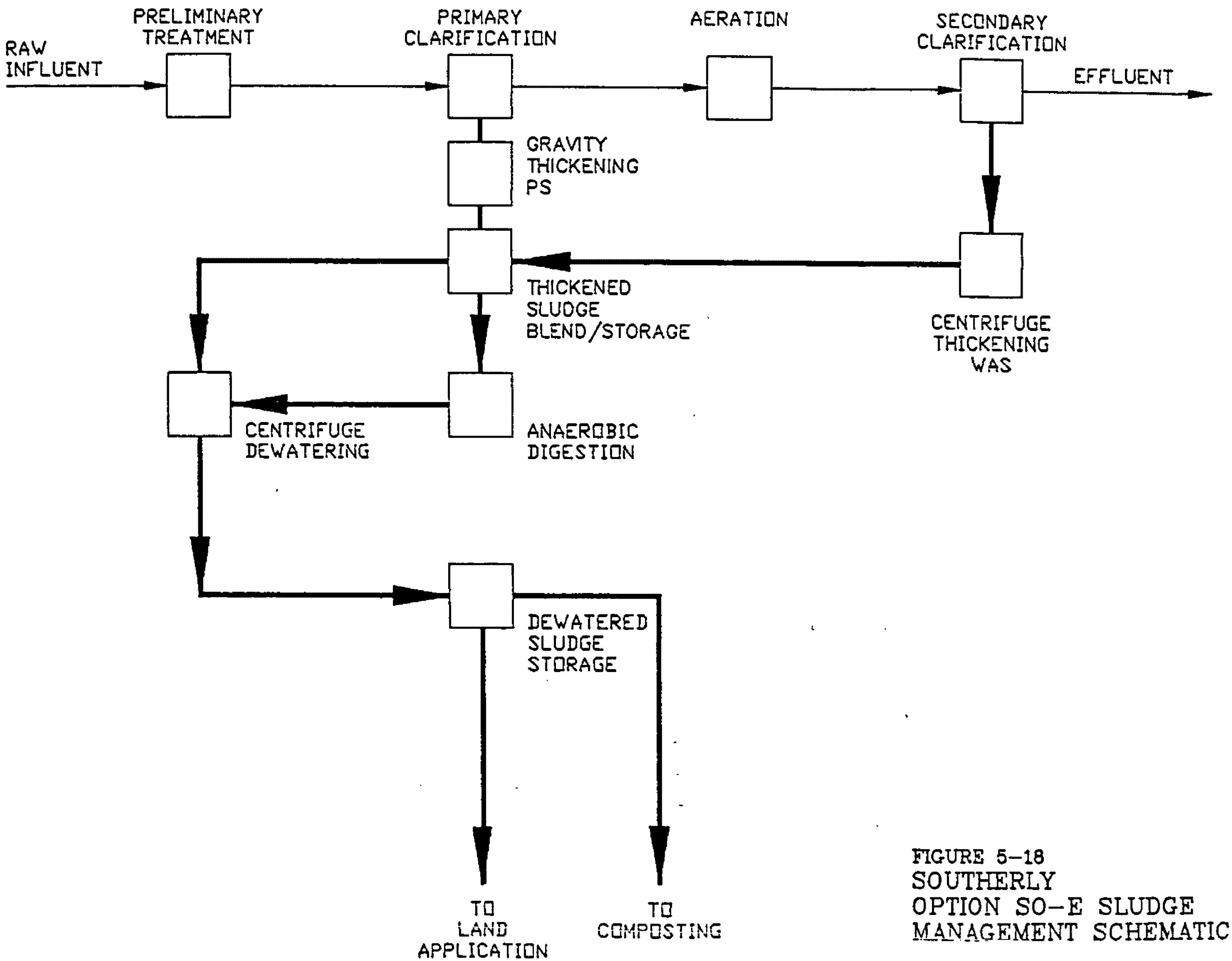


FIGURE 5-18
SOUTHERLY
OPTION SO-E SLUDGE
MANAGEMENT SCHEMATIC

The plant currently practices incineration and relies heavily on incineration and landfilling of the ash for disposal. Furthermore, it is critical that the plant have a disposal method that is completely within their control, i.e., not influenced by sludge quality, weather, market demand, public perception or other external pressures.

Southerly Sludge Management Option SO-F

Figure 5-19 presents the sludge management schematic for Option SO-F. Ths sludge management system would consist of the following processes:

- Gravity thickening PS
- Centrifuge thickening WAS
- Thickened sludge storage and blending
- Dewatering
- Composting
- Incineration.

Ultimate disposal of the sludge would be accomplished through one of the following disposal methods:

- 50 percent would be composted and distributed as a soil conditioner.
- 50 percent would be incinerated and landfilled.

Option SO-F is similar to option SO-C with the exception that digestion is not provided. The evaluation of option SO-F was prompted due to the fact that digestion prior to incineration has normally not proven to be cost-effective. Although digestion diminishes the amount of solids to be handled in subsequent processes, the heat content of digested sludge is significantly reduced. Furthermore, digested sludge tends to be more difficult to dewater than combined raw sludges. These factors cause digested sludge to be more difficult, and consequently more expensive on a unit basis (i.e. dollars per dry ton), than raw sludges to incinerate. Since the Southerly plant has a portion of the required digestion facilities and adequate incineration

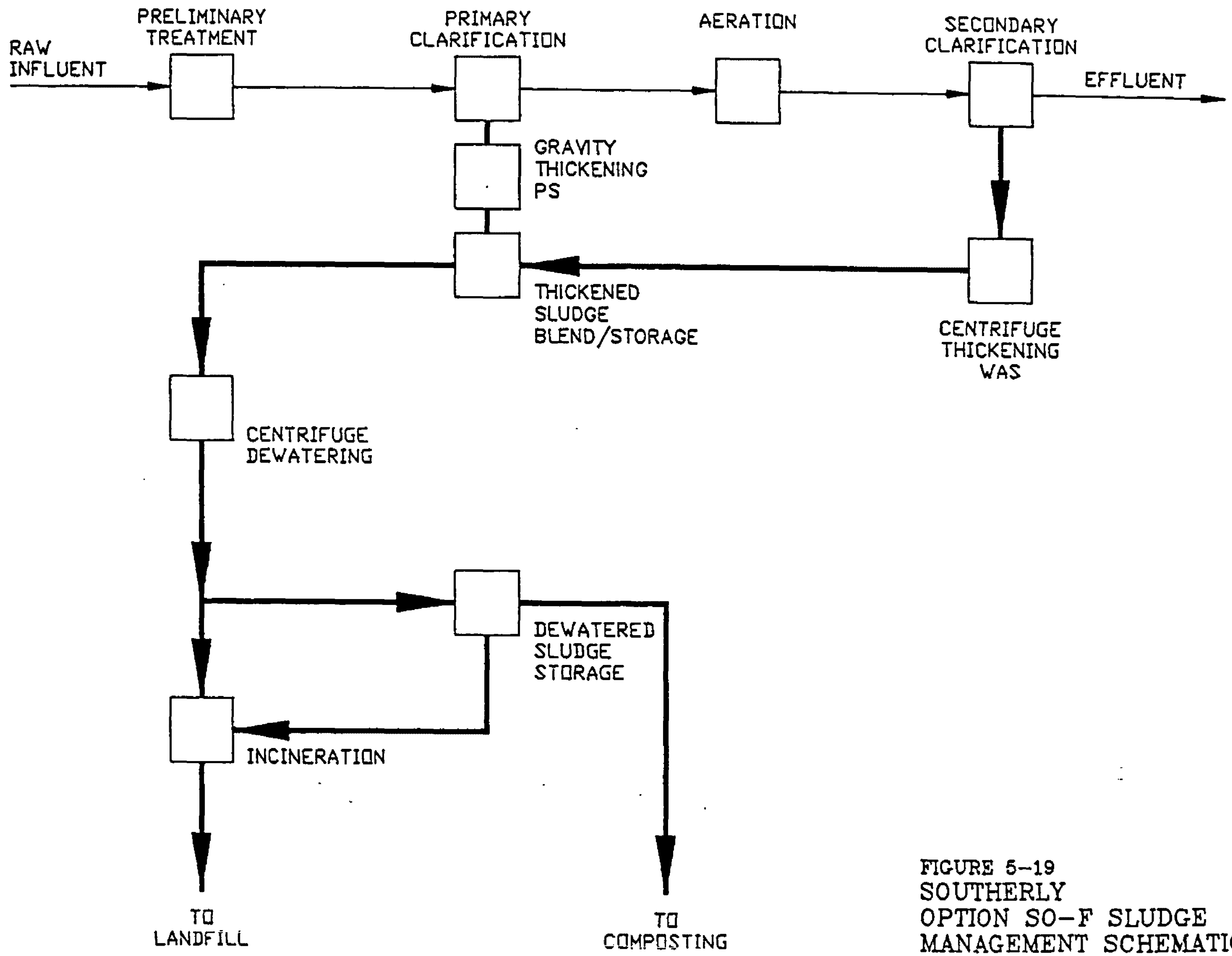


FIGURE 5-19
SOUTHERLY
OPTION SO-F SLUDGE
MANAGEMENT SCHEMATIC

facilities in place, the cost effectiveness of digestion prior to incineration is less dependent on capital cost than an evaluation where these facilities are not in place. This option will be evaluated further in chapter 6.

5.5 SUMMARY OF ALTERNATIVES AND OPTIONS

Alternatives for comprehensive wastewater management that have advanced for further evaluation in chapter 6 include the following:

- One-plant (all treatment at Southerly)
- Two-plant (solids handling at Jackson Pike and Southerly)
- Two-plant (all solids handling at Southerly)

The following options for treatment plant components have been advanced for further evaluation in chapter 6.

- Interconnector/Headworks
  - A/A-1 (additional pumping, force mains, and headworks)
  - B/B-1 (extension of gravity sewer and separate headworks)
  - B/B-2 (extension of gravity sewer and entirely new headworks)

- Biological Processes
  - Semi-aerobic
  - Trickling Filter/Activated Sludge (TF/AS)

- Sludge Management
  - JP-B (PS thickening, WAS thickening, anaerobic digestion, dewatering, land application, and incineration/landfill)
  - JP-C (PS thickening, WAS thickening, anaerobic digestion, thermal conditioning, dewatering, land application, and incineration/landfill)
  - SO-C (PS thickening, WAS thickening, anaerobic digestion, dewatering, composting, and incineration/landfill)
  - SO-D (PS thickening, WAS thickening, anaerobic digestion, dewatering, composting, land application, and incineration/landfill)
  - SO-F (PS thickening, WAS thickening, dewatering, composting, and incineration/landfill)

Table 5-2 summarizes each of the wastewater management alternatives with their respective component options.

TABLE 5-2 SUMMARY OF ALTERNATIVES AND OPTIONS

WASTEWATER MANAGEMENT ALTERNATIVE	COMPONENT	OPTION
ONE-PLANT	INTERCONNECTOR/HEADWORKS	A/A-1 B/B-1 B/B-2
	BIOLOGICAL PROCESS	SEMI-AEROBIC TF/AS
	SLUDGE MANAGEMENT	SO-C SO-D SO-F
TWO-PLANT	BIOLOGICAL PROCESS	SEMI-AEROBIC TF/AS
	SLUDGE MANAGEMENT	SO-C SO-D SO-F JP-B JP-C
TWO-PLANT ONE SOLIDS	BIOLOGICAL PROCESS	SEMI-AEROBIC TF/AS
	SLUDGE MANAGEMENT	SO-C SO-D SO-F

CHAPTER 6. DETAILED ANALYSIS OF ALTERNATIVES

This chapter presents a detailed evaluation of the two comprehensive wastewater management alternatives: the one-plant and two-plant alternatives. Section 6.1 describes the engineering evaluation, while Sections 6.2 through 6.5 present the environmental evaluations. In Section 6.6, the engineering and environmental evaluations of the one-plant and two-plant alternatives are summarized, and a recommended comprehensive alternative is identified.

Previously in chapter 5 three basic components of the comprehensive alternatives were identified. These three components are:

- Interconnector/headworks
- Biological process
- Solids handling.

Also in chapter 5, the feasible options that fulfill the components were identified and subjected to a preliminary screening. In Section 6.1 - Engineering Evaluation, the options for the basic components that advanced from the screening in chapter 5 are evaluated with respect to technical criteria consisting of cost, reliability, flexibility, implementability, and operational convenience. The optimum option which fulfills each component is selected for both the one-plant and two-plant alternatives. After the optimum options for each component are identified, the comprehensive one-plant and two-plant alternatives are defined and evaluated with respect to the technical evaluation criteria.

The environmental evaluation addresses the comprehensive system alternatives. This evaluation considers physical, biological, and human environmental criteria. These criteria were derived from the data collection effort documented in chapter 2. Physical criteria include: water, air quality, and prime agricultural land. Biological criteria include: terrestrial and aquatic biota as well as threatened and endangered species.

The human or man-made environmental criteria include: land use, noise, energy, economics, transportation, and historic and archeologic resources. Indirect environmental consequences such as induced growth are also discussed.

6.1. ENGINEERING EVALUATION

In the engineering evaluation, technical criteria are applied to evaluate the options for the components that formulate an alternative, as well as to evaluate comprehensive alternatives. First, the technical evaluation is applied to identify the optimum options for the components. Then, components are assembled into the one-plant and two-plant comprehensive alternatives and a second technical evaluation is performed.

In evaluating planning alternatives, it is usually necessary to evaluate the comprehensive alternatives due to the interrelationships between the components which formulate the alternatives. For example, where options for the biological process component produce substantially different quanities of sludge, the solids handling evaluation must be coupled with the biological process evaluation to determine the optimum alternative. However, based on the options for the components that have been advanced from chapter 5 such an evaluation process is not necessary. Selection of the optimum option for the Interconnector/headworks does not influence the subsequent liquid and sludge treatment components. The biological process options that have been advanced will yield approximately the same quantity of sludge. Similarly the solids handling options remaining under consideration do not exhibit significantly different impacts on other components. Consequently, the individual components will be evaluated independently and an optimum option for each component will be identified for both the one- and two-plant alternatives.

The technical criteria applied in the engineering evaluation are identified and defined below.

- Cost - The lowest total present worth cost.
- Reliability - Ability to treat the projected wasteload and continuously discharge an effluent capable of meeting NPDES permit standards.

- Flexibility - Ability to change and meet differing conditions.
- Implementability - Ease of implementation.
- Operational Convenience - Ease of operation and maintenance.

Cost is an objective criteria with the differences in total present worth establishing the ranking of component options and comprehensive alternatives. The remaining four criteria are subjective criteria. A brief narrative discusses how the component options and alternatives compare with the subjective criteria.

6.1.1 Interconnector/Headworks Component

This section provides an evaluation of the Interconnector and headworks components of one-plant and two-plant alternatives.

6.1.1.1 One-Plant

As discussed in chapter 5, no work would be required at the Jackson Pike headworks under the one-plant alternative because the plant would be phased out of service and the flow tributary to Jackson Pike would be diverted to the Southerly WWTP via the Interconnector Sewer. Completion of the north end of the Interconnector would be required to convey the flows from Jackson Pike to Southerly.

The one-plant alternative also requires that the capacity of the south end of the Interconnector Sewer and the Southerly headworks be expanded. Chapter 5 presented two options for expanding the south end of the Interconnector and three options for expanding the capacity of the Southerly headworks. Due to the interrelationship between the headworks and the Interconnector the headworks options were developed based on the Interconnector options. Three potential Interconnector/headworks combinations are identified and described below. They include the following:

- Option A/A-1 - Increase the capacity of the south end of the Interconnector from 70 MGD to 160 MGD by constructing a new pumping facility and by installing one new 48-inch and one new 36-inch force main from the pumping facility to the Southerly headworks. Increase the capacity of the existing Southerly headworks from 170 MGD to 231 MGD by adding additional pumps, screens, and grit chambers.

- Option B/B-1 - Extend the 156-inch gravity Interconnector Sewer to the Southerly WWTP. Use four 78-inch pipes for the Scioto River crossing. Construct new 150 MGD headworks which include pumping, screening, and grit removal for the Interconnector flows. Use the existing headworks for preliminary treatment of flow from the Big Walnut Interceptor Sewer.

- Option B/B-2 - Extend the 156-inch gravity Interconnector Sewer to the Southerly WWTP. Use four 78-inch pipes for the Scioto River crossing. Construct entirely new headworks rated at a capacity of 231 MGD for preliminary treatment of flows from the Interconnector Sewer and the Big Walnut Interceptor Sewer. The new headworks will include a mixing chamber, screening, pumping, and grit removal. Demolish the existing headworks.

Table 6-1 presents capital, annual O&M, and total present worth costs for each of the options.

TABLE 6-1. INTERCONNECTOR/HEADWORKS COSTS

	Capital	Annual O&M	Total Present Worth
Option A/A-1	$15,239,000	$1,771,000	$31,064,000
Option B/B-1	$19,282,000	$1,289,000	$30,279,000
Option B/B-2	$25,382,000	$1,169,000	$34,928,000

Option B/B-1 exhibits the lowest present worth cost. However, practically speaking the present worth of A/A-1 is equal to B/B-1. The gravity sewer options (B/B-1 and B/B-2) are more reliable than the force main option (A/A-1) since there is less chance that the gravity sewer will rupture. Furthermore, failure of the gravity sewer normally results in infiltration to the conduit, while a rupture of the force mains would cause exfiltration to the environment. In addition, the gravity sewer does not rely on the operation of a pumping facility to perform. The pumping facility causes the force main option to be considered more difficult to operate and maintain and also somewhat less reliable due to the dependency on its pumps.

With respect to flexibility to adapt to higher flows both the gravity sewer and the pump station/force main are considered similar. Both would be sized to handle the projected peak flows and would require modifications to increase capacity.

The force mains, on the other hand, will not require as deep of an excavation as the gravity sewer; and therefore, may be easier to implement. Also, the force main option (A/A-1) and the gravity option (B/B-2) only have one headworks which would be easier to operate and maintain than the two separate headworks as proposed under option B/B-1.

Based on the cost and reliability of the gravity sewer, Option B/B-1 is the recommended Interconnector/headworks component for the one-plant alternative.

6.1.1.2 Two-Plant

The existing Jackson Pike headworks provide screening and pumping only. Preliminary screening and grit removal facilities are located at the Sewer Maintenance Yard upstream of the Jackson Pike headworks on the O.S.I.S. These facilities, however, provide pretreatment only for flows entering the plant through the O.S.I.S. Interceptor.

Due to the fact that flows from the Big Run Interceptor are not provided with grit removal and due to the age of the existing equipment, it is recommended that entirely new headworks be constructed at Jackson Pike under the two-plant alternative. The new headworks would include screening, pumping, and aerated grit removal, and they would be located on the Jackson Pike plantsite.

As discussed in chapter 5, the peak flow to the Jackson Pike WWTP will be limited to 100 MGD. The 2008 projected peak process flow tributary to Jackson Pike is 131 MGD. Therefore, the north end of the Interconnector would require completion under the two-plant alternative to allow flows in excess of 100 MGD to be transported to the Southerly WWTP.

The pumping station and force mains at the south end of the Interconnector Sewer (i.e. tributary to Southerly) are rated at a capacity of 70 MGD. These facilities are adequate to handle the 2008 flows from the Grove City connection which are projected to be 6 MGD as well as the 31 MGD that would be diverted from Jackson Pike under peak conditions. Therefore, no expansion of the conveyance system is required.

The existing Southerly headworks, rated at a capacity of 170 MGD, is capable of handling the 31 MGD from Jackson Pike in addition to Southerly's projected peak flow of 99 MGD. Therefore, no expansion is required at the Southerly headworks under the two-plant scenario.

6.1.2 Biological Process Component

This section provides an evaluation of the semi-aerobic and trickling filter/activated sludge biological process options for the Jackson Pike and Southerly WWTPs under the one-plant and two-plant alternatives. The detailed documentation of the biological process evaluation is contained in Appendix C entitled Briefing Paper No. 3 - Biological Process Selection.

6.1.2.1 One-Plant

The semi-aerobic and trickling filter/activated sludge processes were evaluated for biological treatment at the Southerly WWTP under the one-plant alternative.

The semi-aerobic process is similar to the conventional activated sludge process which currently exists at the Southerly WWTP. Existing basins could be modified to operate in the semi-aerobic mode by installing two additional baffles in the first bay of each aeration basin and by installing an internal mixed liquor recirculation system in each basin. In addition to modifying the existing basins, two new basins would be added to the Center Train, and a new East Train would be built with nine basins.

The trickling filter/activated sludge process would utilize the existing aeration basins in the West and Center Trains. Four trickling filters would be needed for the existing West and Center Trains; and a new East Train would be constructed with two trickling filters and four aeration basins.

Circular clarifiers are recommended for the Southerly WWTP under either biological process option to provide the capability of rapid sludge return to maintain a high mixed liquor suspended solids concentration (MLSS - 3500 mg/l); and due to the historic rising sludge observed as denitrification occurred in the rectangular final clarifiers. The existing rectangular clarifiers and associated sludge removal equipment cannot maintain the necessary mixed liquor concentrations in the return sludge or provide the proper sludge removal rate. Circular clarifiers provide more rapid sludge removal than rectangular clarifiers, thereby lessening the potential for denitrification in the final clarifier. New circular clarifiers would be equipped with helical scraper arm sludge removal mechanisms to ensure high rate sludge removal without denitrification.

Under the one-plant alternative, six new clarifiers would be required for the existing Center and West Trains and four new circular clarifiers would be required for the new East Train.

Table 6-2 provides the capital, annual O&M, and total present worth costs for the trickling filter/activated sludge and semi-aerobic process options under the one-plant scenario.

TABLE 6-2. ONE-PLANT BIOLOGICAL PROCESS COSTS

	Capital	Annual O&M	Total Present Worth
Trickling Filter/Activated Sludge	$87,462,000	$2,773,000	$109,571,000
Semi-Aerobic	$81,995,000	$3,148,000	$107,958,000

The semi-aerobic process exhibits the lowest total present worth cost. However, practically speaking the present worth cost of the trickling filter/activated sludge process is equal to the present worth cost of the semi-aerobic process.

From a reliability standpoint, the semi-aerobic process is more reliable than the trickling filter/activated sludge process. Both processes have the ability to select against filamentous organisms which cause bulking and both processes are capable of providing nitrification. However, the semi-aerobic process is considered more reliable due to the fact that more process control flexibility is inherent in the process. The ability to maintain the initial bays of an aeration basin in either an anaerobic, anoxic, or aerobic conditions through mixing and aeration and the ability to return mixed liquor through a recycle loop enhance the process' ability to perform and meet effluent limits.

The trickling filter/activated sludge process would be subject to an adverse environmental review due to its resultant odor and pests. Trickling filters have been cited in odor complaints particularly under conditions of high organic loadings. In addition, fly larvae and flies breed on these filter media resulting in nuisance complaints. Control of odors and flies requires covering the trickling filters, installing a positive ventilation system, and scrubbing the off-gases. This would add significant capital and

O&M costs to the system and may result in reduced efficiency during the summer months.

The trickling filter/activated sludge process would also be very difficult to implement in that it would require major restructuring of the conduits between the existing primary clarifiers and aeration basins. There is inadequate area between these two processes for the trickling filters. Therefore, they would have to be located some distance from the preceeding and subsequent treatment process, and primary effluent flows would have to be pumped to them.

Due to the fact that there is increased reliability with the semi-aerobic process and due to the problems associated with implementing the trickling filter/activated sludge process, the semi-aerobic process is recommended as the preferred biological process for the Southerly one-plant alternative.

6.1.2.2 Two-Plant

The semi-aerobic and trickling filter/activated sludge processes were evaluated for Southerly and Jackson Pike under the two-plant alternative. Table 6-3 presents the capital, O&M, and total present worth costs for these processes under the two-plant alternative.

TABLE 6-3. TWO-PLANT BIOLOGICAL PROCESS COSTS

	Capital	Annual O&M	Total Present Worth
Southerly			
Trickling Filter/Activated Sludge	$38,732,000	$1,491,000	$ 51,034,000
Semi-Aerobic	$32,805,000	$1,638,000	$ 46,808,000
Jackson-Pike			
Trickling Filter/Activated Sludge	$41,140,000	$1,804,000	$ 56,311,000
Semi-Aerobic	$31,193,000	$1,794,000	$ 46,766,000

The semi-aerobic process exhibits the lowest total present worth cost for Jackson Pike and Southerly under the two-plant scenario. The cost difference between the semi-aerobic process and trickling filter/activated sludge process is approximately 10 percent for the Southerly plant and 20 percent for the Jackson Pike plant. The evaluation with respect to the reliability and implementatiblity previously discussed under the one-plant analysis holds true in comparing the options for the two-plant alternative.

Since the semi-aerobic process is 10 to 20 percent less costly and is considered more reliable than the trickling filter option, the semi-aerobic process is selected as the optimum biological process option for Jackson Pike and Southerly under the two-plant alternative.

Six circular clarifiers are required for the Southerly WWTP under the two-plant scenario. Circular clarifiers are recommended for Southerly under the two-plant scenario for the same reasons that were given for the Southerly one-plant scenario. These reasons include the need to rapidly return activated sludge to increase nitrification rates, and the need to **maintain a high mixed liquor suspended solids concentration** and to maintain a minimum sludge blanket in the final clarifiers to prevent denitrification.

At Jackson Pike the required mixed liquor suspended solids concentration is lower due to higher observed nitrification rates and because overpumping of the final clarifiers is not necessary since rising sludge has not been a problem. Therefore, the continued use of the existing rectangular clarifiers is recommended along with the addition of two new rectangular clarifiers for final settling.

6.1.3 Solids Handling

This section presents an evaluation of the sludge management options developed in chapter 5 for the one-plant and two-plant alternatives. Appendix B entitled Briefing Paper No. 2 - Solids Handling, provides detailed documentation of the evaluation.

The evaluations performed for the sludge management alternatives in the following sections are based on the use of centrifuges for dewatering. The Revised Facility Plan Update (RFPU), prepared in September of 1985, recommended the continued use of centrifuges for dewatering. Subsequently, in a document prepared in December of 1986, entitled Preliminary Design Evaluation of Sludge Dewatering, the city recommended installing diaphragm plate and frame presses (DPF) for dewatering. Following the review of the planning and preliminary design documents, an evaluation of sludge dewatering was performed as part of the SEIS.

The results of the SEIS evaluation (Appendix B) concluded that centrifuges were the cost-effective dewatering option. In the SEIS evaluation, the total present worth cost of the centrifuge option is 7 percent lower than the cost of the DPF option. The conclusions reached in this evaluation differed from those developed in the planning and preliminary engineering documents for several reasons:

- A higher capacity rating for the centrifuges was utilized.
- The operating costs associated with the dewatering options and the incineration process differed.
- A nominal cost for ash disposal was incorporated in the analysis.

Consequently, the following evaluation of sludge management options is based on the continued use of centrifuges for dewatering.

6.1.3.1 One-Plant

Under the one-plant alternative (all treatment at Southerly) three options were retained from chapter 5. They include the following:

- SO-C - PS thickening, WAS thickening, digestion, dewatering, composting, and incineration/landfill.
- SO-D - PS thickening, WAS thickening, digestion, dewatering, composting, land application, and incineration/landfill.

- SO-F - PS thickening, WAS thickening, dewatering, composting, and incineration/landfill.

Table 6-4 presents the capital, annual O&M, and total present worth costs for each option.

TABLE 6-4. COST COMPARISON OF SLUDGE MANAGEMENT OPTIONS (Southerly One-Plant)

	Capital	Annual O&M	Total Present Worth
Option SO-C	$45,770,000	$6,080,000	$89,590,000
Option SO-D	$45,770,000	$6,230,000	$90,710,000
Option SO-F	$40,700,000	$7,110,000	$92,440,000

All options exhibit approximately the same present worth costs, with SO-F the highest present worth being only 3 percent higher than SO-C which has the lowest present worth cost.

Option SO-D with composting, land application, and incineration provides more flexibility and reliability in final disposal options than SO-C and SO-F. Option SO-C and SO-D provide more flexibility and reliability than SO-F with respect to stabilization of the sludge through digestion since option SO-F does not include digestion. Based on reliability and flexibility, SO-D is the recommended option for Southerly under the one-plant alternative.

6.1.3.2 Two-Plant

The three sludge management options retained from chapter 5 for Southerly under the two-plant alternatives are the same as those which were retained under the one-plant alternative. Table 6-5 provides the capital, annual O&M, and total present worth costs of SO-C, SO-D, and SO-F under the two-plant alternative.

TABLE 6-5. COST COMPARISON OF SLUDGE MANAGEMENT OPTIONS
(Southerly Two-Plant)

	Capital	Annual O&M	Total Present Worth
Option SO-C	$15,220,000	$3,260,000	$39,080,000
Option SO-D	$15,220,000	$3,340,000	$39,680,000
Option SO-F	$14,570,000	$3,940,000	$42,770,000

Similar to the costs for the one-plant alternative, options SO-C and SO-D can be considered equal. However, SO-F is approximately 9 percent higher than SO-C.

As with the Southerly one-plant alternative, option SO-D is recommended as the preferred Southerly two-plant sludge management scheme. Option SO-D provides three reliable disposal paths and adequate flexibility.

Two options were retained from chapter 5 for Jackson Pike under the two-plant alternative. They include the following:

- JP-B - PS thickening, WAS thickening, anaerobic digestion, dewatering, land application, and incineration/landfill.
- JP-C - PS thickening, WAS thickening, anaerobic digestion, thermal conditioning, dewatering, land application, and incineration/landfill.

Table 6-6 provides the capital, annual O&M, and total present worth costs for these options.

TABLE 6-6. COST COMPARISON OF SLUDGE MANAGEMENT OPTIONS
(Jackson Pike Two-Plant)

	Capital	Annual O&M	Total Present Worth
Option JP-B	**$19,727,000**	$3,070,000	**$41,827,000**
Option JP-C	**$21,307,000**	$3,770,000	**$48,597,000**

Option JP-B, which provides for digestion, dewatering, and a 50:50 split of sludge to land application and incineration/landfill, has the lowest total present worth cost. This option is approximately 16 percent less costly than JP-C which proposes to retain the thermal conditioning units for processing a portion of the sludge.

Option JP-C provides more flexibility in that sludge can be stabilized through digestion or thermal conditioning. However, the thermal conditioners are more costly and difficult to operate and maintain than the digesters.

Due to the lower present worth cost of option JP-B and the greater ease of operation and maintenance of digestion, option JP-B is the recommended sludge management scheme for Jackson Pike.

6.1.3.3 Two-Plant Liquid Treatment/One-Plant Solids Treatment

A third system configuration which was conceptually identified in the SEIS involved providing liquid treatment facilities at two plants (i.e., Southerly and Jackson Pike) and consolidating solids processing facilities at one-plant (i.e., Southerly). Currently, a single 8-inch sludge transfer pipeline links Jackson Pike and Southerly. This sludge transfer pipeline prompted the identification of the two-plant liquid treatment/one-plant solids treatment alternative.

The two-plant liquid treatment/one-plant solids treatment alternative was eliminated from consideration following the analysis of the one- and two-plant solids options. In the previously presented section, the recommended one-plant solids option, SO-D, was shown to have a present worth cost of $90,710,000. Similarly, the recommended two-plant solids options (i.e., Southerly SO-D and Jackson Pike JP-B) exhibited a total present worth cost of $81,507,000. Based on these present worth costs, it is approximately 11 percent less costly to maintain solids processing operations at both Southerly and Jackson Pike if both facilities are providing liquid treatment.

The 11 percent difference is based strictly on required facilities for processing and disposal. This margin would widen if an appropriate level of reliability and redundancy in the sludge conveyance system is added to the analysis. The existing, single 8-inch pipeline would not be sufficient to allow consolidation of sludge processing operations. At a minimum, a second parallel pipeline would be necessary to provide redundancy. Potentially a third pipeline may be appropriate, allowing one dedicated pipeline for transfer of primary sludge, one dedicated pipeline for transfer of waste activiated sludge, and one dedicated stand-by pipeline. Providing the necessary redundancy in the sludge conveyance system would cause the option for consolidating sludge processing at Southerly to be from 15 to 20 percent more costly than maintaining separate facilities at each plant. As a result, the two-plant liquid treatment/one-plant solids treatment alternative was eliminated from further consideration.

6.1.4 One-Plant vs. Two-Plants

This section summarizes the recommended component options for the one-plant and two-plant alternatives based on the evaluations previously presented. After defining the recommended components for the one-plant and two-plant alternatives, a technical evaluation is conducted.

6.1.4.1 Required Facilities

The previous sections evaluated options for Interconnector/headworks, biological process, and solids management components. Recommendations on these components were made for each plant alternative based on cost, reliability, flexibility, implementability, and operational ease.

The recommendations for the Southerly One-Plant Alternative include the following:

- Complete the north end of the Interconnector Sewer. Construct a flow diversion chamber.
- Extend the 156-inch gravity Interconnector Sewer to the Southerly WWTP. Use four 78-inch pipes for the Scioto River crossing.

- Construct new 150 MGD headworks at Southerly to handle the flows from the Interconnector. Use the existing 170 MGD headworks for the Big Walnut Interceptor flows.

- Adopt the semi-aerobic process as the method of biological treatment.

- Upgrade and expand the solids handling facilities to include gravity thickening of PS, centrifuge thickening of WAS, anaerobic digestion, centrifuge dewatering, incineration/landfill, composting, and land application.

Figure 6-1 provides a site layout, and Table 6-7 presents the sizes of the required facilities for the Southerly One-Plant Alternative.

The recommendations for the Southerly Two-Plant Alternatives include the following:

- Adopt the semi-aerobic process as the method of biological treatment.

- Upgrade and expand the solids handling facilities to include gravity thickening of PS, centrifuge thickening of WAS, anaerobic digestion, centrifuge dewatering, incineration/landfill, composting, and land application.

Figure 6-2 provides a site layout of the Southerly Two-Plant Alternative, and Table 6-8 presents the sizes of the required facilities.

The recommendations for the Jackson Pike Two-Plant Alternative include the following:

- Complete the north end of the Interconnector Sewer. Construct a flow diversion chamber.

- Construct new headworks rated at a capacity of 100 MGD which include screening, pumping, and grit removal.

- Adopt the semi-aerobic process as the method of biological treatment.

- Upgrade and expand the solids handling facilities to include gravity thickening of PS, centrifuge thickening of WAS, anaerobic digestion, incineration/landfill, and land application.

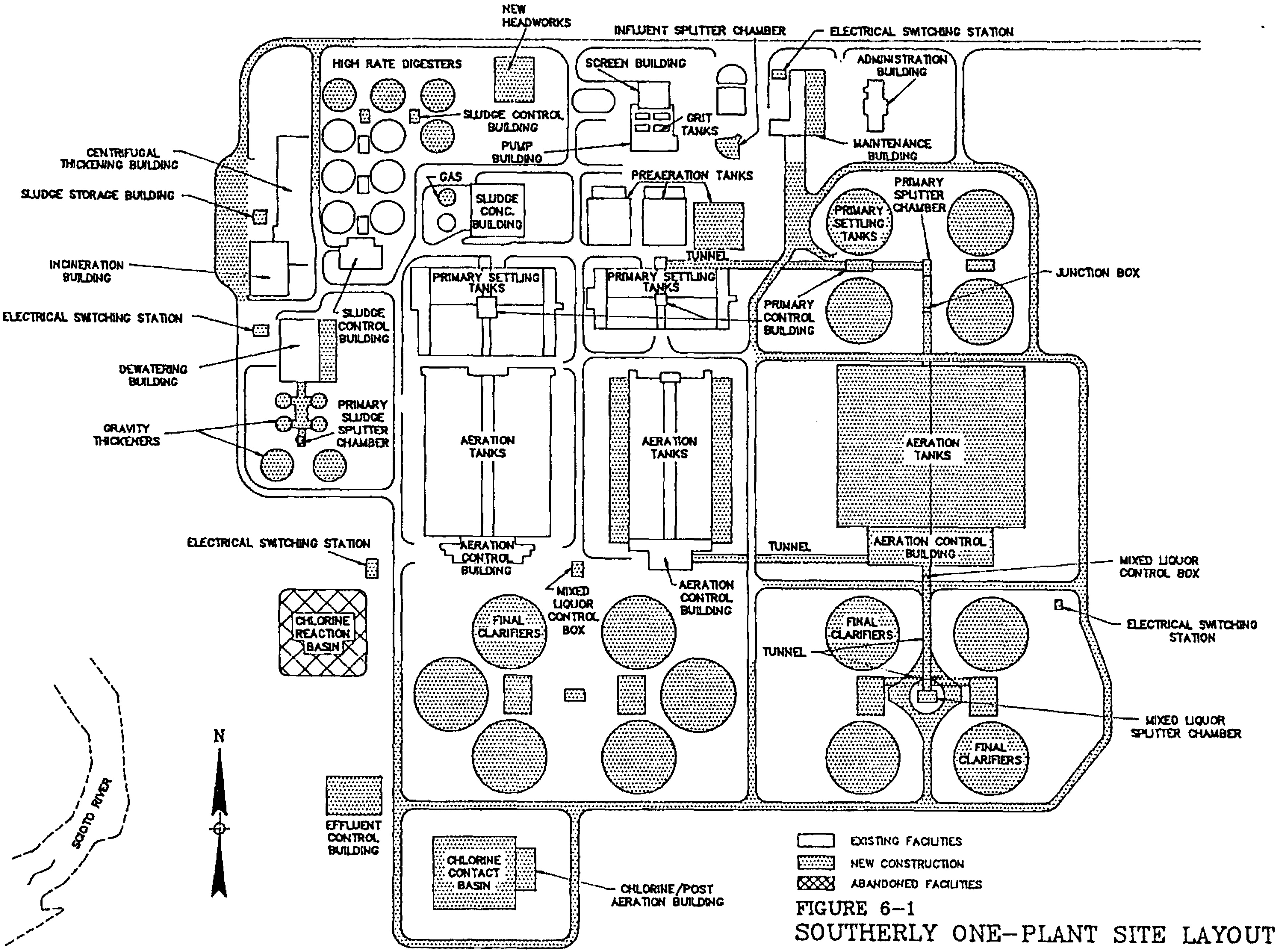


FIGURE 6-1
SOUTHERLY ONE-PLANT SITE LAYOUT

TABLE 6-7. SOUTHERLY ONE-PLANT REQUIRED FACILITIES

Component	Existing Facilities	Required Facilities
INTERCONNECTOR	7 miles of 150-156 inch gravity sewer. 70 MGD pump station, 48-inch force main, and 30-inch force main connecting the south end of the gravity sewer to Southerly.	Complete north end to connect with Jackson Pike. Extend 156-inch interceptor to Southerly. Use four 78-inch pipes for river crossing. Abandon existing pump station and force mains.
HEADWORKS	170 MGD screening, pumping, and grit removal.	Use existing 170 MGD headworks for Big Walnut flows. New 150 MGD screening, pumping, and grit removal for Interconnector flows.
PREAERATION	Eight tanks at 112.7 ft x 26 ft x 15.5 ft SWD	Four new tanks at 112.7 ft x 26 ft x 15.5 ft SWD; Rehab existing eight tanks.
PRIMARY SETTLING	Four tanks at 80 ft x 165 ft x 10 ft SWD Four tanks at 100 ft x 170 ft x 10 ft SWD	Four new tanks at 150 ft dia. x 15 ft SWD; Rehab existing eight tanks.
AERATION	Ten tanks at 26 ft x 900 ft x 15 ft SWD	Eleven new tanks at 26 ft x 900 ft x 15 ft SWD; Rehab existing ten tanks.
FINAL SETTLING	Four tanks at 89 ft x 170 ft x 12.5 ft SWD Four tanks at 104 ft x 180 ft x 10.5 ft SWD	Ten new tanks at 200 ft dia. x 15 ft SWD; Demolish existing eight tanks.
CHLORINATION	One earthen chlorine contact basin at 260 ft x 260 ft x 7 ft SWD	Two tanks at 81 ft x 200 ft x 10 ft SWD; to include mixers, chlorinators, evaporators, and sulfinators. Abandon existing basin.
POST AERATION		Final pass of chlorine contact tanks; Fine bubble diffusers.
EFFLUENT PUMPING	Effluent control building with pumping capacity of 170 MGD.	New effluent control building with pumping capacity of 231 MGD. Demolish existing building.

TABLE 6-7. SOUTHERLY ONE-PLANT REQUIRED FACILITIES (CONT.)

Component	Existing Facilities	Required Facilities
GRAVITY THICKENING PS		Two new units at 85 ft dia. x 10 ft SWD; Modify four decant tanks at 45 ft dia. x 17 ft SWD.
CENTRIFUGE THICKENING WAS	Four at 250 gpm, 1250 lb/hr	Four new at 250 gpm, 1250 lb/hr and utilize four existing units.
ANAEROBIC DIGESTION	Six 85 ft dia. x 25 ft SWD units	Four new units at 85 ft dia. x 25 ft SWD; Rehab existing six units.
CENTRIFUGE DEWATERING	Six 1000 lb/hr units	Nine new units at 1000 lb/hr; Modify existing six units.
DEWATERED SLUDGE STORAGE	One 400 cy bin	One new a 400 cy bin plus material handling facilities. Utilize existing bin.
COMPOSTING	Facility - 120 wet ton/day at 20% solids	Utilize existing facility.
INCINERATION	Two units at 150 wet ton/day each. Two units at 260 wet ton/day each.	Rehab two 150 wet ton/day units. Utilize two 260 wet ton/day units.

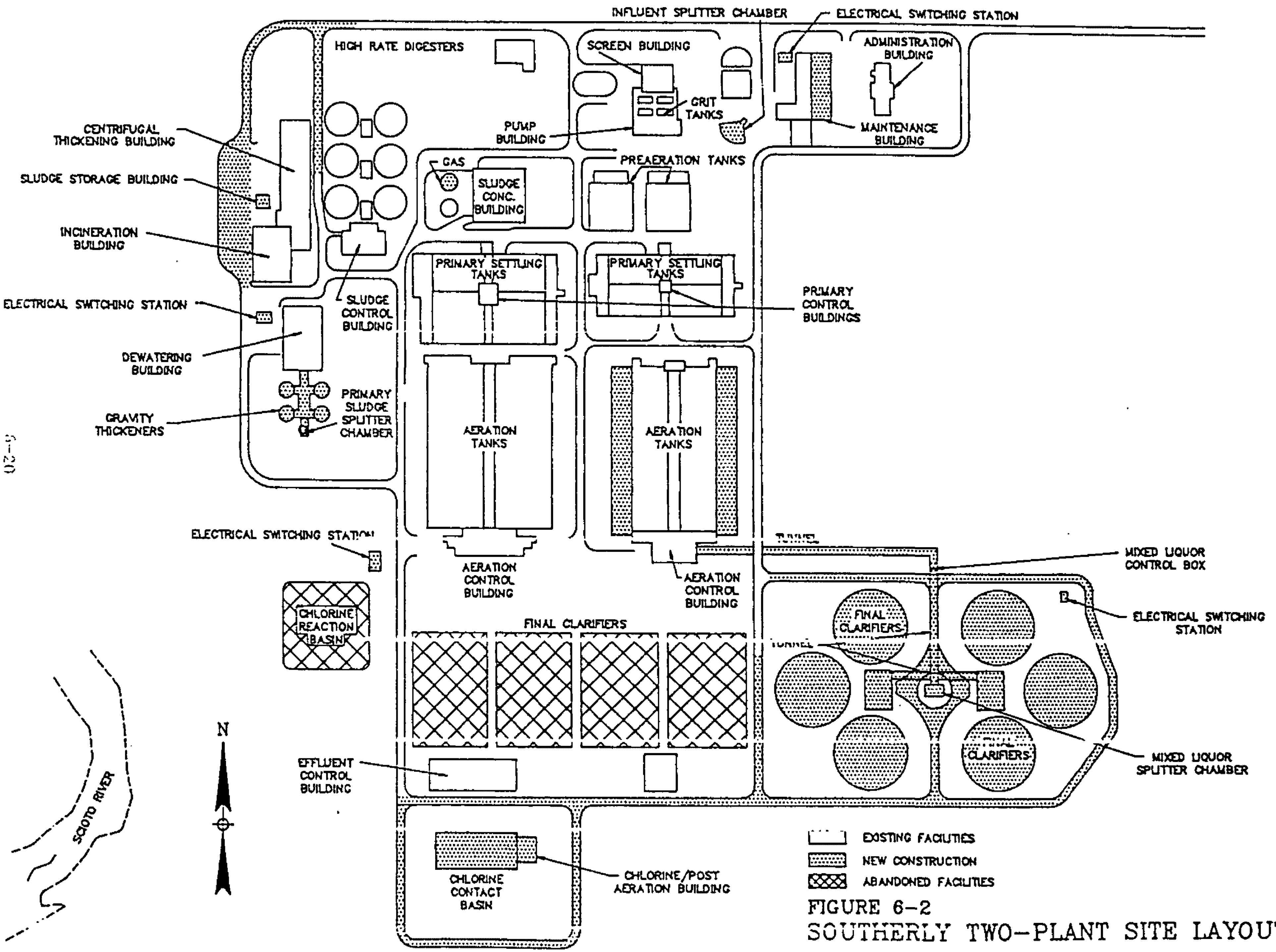


FIGURE 6-2
SOUTHERLY TWO-PLANT SITE LAYOUT

TABLE 6-8. SOUTHERLY TWO-PLANT REQUIRED FACILITIES

Component	Existing Facilities	Required Facilities
INTERCONNECTOR	7 miles of 150-156 inch gravity sewer. 70 MGD pump station, 30-inch force main, and 48-inch force main connecting the south end of the gravity sewer to Southerly.	Pump station and force mains have adequate capacity for the south end.
HEADWORKS	170 MGD facility which includes screening, pumping, and grit removal.	Existing 170 MGD facility is adequate.
PREAERATION	Eight tanks at 112.7 ft x 26 ft x 15.5 ft SWD	Rehab existing eight tanks.
PRIMARY SETTLING	Four tanks at 80 ft x 165 ft x 10 ft SWD Four tanks at 100 ft x 170 ft x 10 ft SWD	Rehab existing eight tanks.
AERATION	Ten tanks at 26 ft x 900 ft x 15 ft SWD	Two new tanks at 26 ft x 900 ft x 15 ft SWD; Modify existing ten tanks
FINAL SETTLING	Four tanks at 89 ft x 170 ft x 12.5 ft SWD Four tanks at 104 ft x 180 ft x 15.5 ft SWD	Six new at 200 ft dia. x 15 ft SWD; Abandon existing tanks.
CHLORINATION	One earthen chlorine contact basin at 260 ft x 260 ft x 7 ft SWD.	Two tanks at 150 ft x 64 ft x 10 ft SWD including mixers, chlorinators, evaporators, and sulfinators. Abandon existing basin.
POST AERATION		Final pass of chlorine contact tanks Fine bubble diffusers
EFFLUENT PUMPING	Effluent control building with pumping capacity of 170 MGD.	Existing facility is adequate.
GRAVITY THICKENING PS		Modify four 45 ft dia. x 17 ft SWD decant tanks.
CENTRIFUGE THICKENING WAS	Four at 250 gpm, 1250 lb/hr	Four existing units. One new unit at 250 gpm, 1250 lb/hr

TABLE 6-8. SOUTHERLY TWO-PLANT REQUIRED FACILITIES (CONT.)

Component	Existing Facilities	Required Facilities
ANAEROBIC DIGESTION	Six 85 ft dia. x 25 ft SWD units	Rehab six existing units.
CENTRIFUGE DEWATERING	Six at 1000 lb/hr	Two new at 1000 lb/hr Modify existing six units.
DEWATERED SLUDGE STORAGE	One bin at 400 cy	One new bin at 400 cy plus material handling. One existing 400 cy bin.
COMPOSTING	Facility rated at 120 wet ton/day	Utilize existing facility.
INCINERATION	Two units rated at 260 wet ton/day each. Two units rated at 150 wet ton/day each.	Two 260 wet ton/day units.

Figure 6-3 provides a site layout of the Jackson Pike Two-Plant Alternative and Table 6-9 presents the sizes of the required facilities.

6.1.4.2 Technical Evaluation

Table 6-10 presents the capital, annual O&M, and total present worth costs for the one-plant and two-plant alternatives. These costs include the costs for facilities which are common to the respective one-plant and two-plant alternatives (i.e. preaeration, primary clarification, chlorination, post aeration).

TABLE 6-10. ALTERNATIVE COST SUMMARY

	Capital	Annual O&M	Total Present Worth
One-Plant [Southerly]	268,711,000	16,849,000	436,911,000
Two-Plant [So. and JP]	**207,076,000**	19,078,000	**397,016,000**
Difference From One-Plant	**-61,635,000**	+2,229,000	**-39,895,000**
Percent Difference	**-30**	+13	**-10**

NOTE: These costs are based on a 2008 average flow of 154 MGD and a peak flow of 231 MGD. Present worth costs are in 1988 dollars.

Detailed cost estimates prepared during the facilities planning process by the Turner Construction Company were utilized in preparing the capital costs. These detailed cost estimates were reviewed and considered reasonable facility planning estimates. These costs were adjusted in the SEIS evaluation to account for differences in facility requirements due to different flow projections and sizing criteria. Operation and maintenance costs were developed independent of the analysis presented in the facility plan. Details on the development of the costs are included in Appendix D entitled Briefing Paper No. 4 - O&M and Capital Costs.

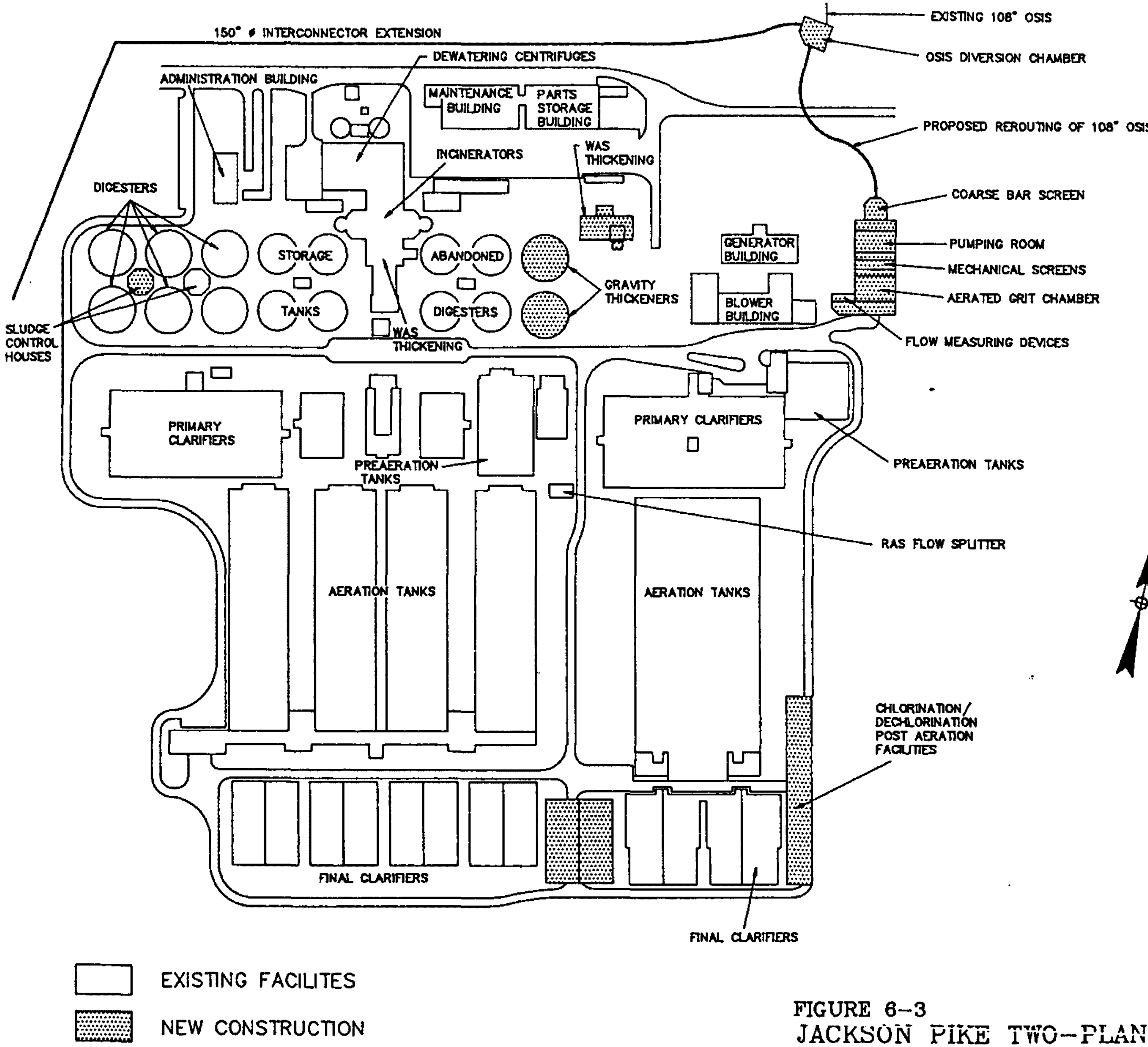


FIGURE 6-3
JACKSON PIKE TWO-PLANT SITE LAYOUT

TABLE 6-9. JACKSON PIKE TWO-PLANT REQUIRED FACILITIES

Component	Existing Facilities	Required Facilities
INTERCONNECTOR		Complete north end. Construct diversion chamber.
HEADWORKS	165 MGD facility which includes screening and pumping.	New 100 MGD facility which includes screening, pumping, and grit removal.
PREAERATION	Two tanks at 180 ft x 26 ft x 15 ft SWD Two tanks at 113 ft x 26 ft x 15 ft SWD	Rehab existing four tanks.
PRIMARY SETTLING	Four tanks at 150 ft x 80 ft x 10 ft SWD Four tanks at 150 ft x 80 ft x 10 ft SWD	Rehab existing eight tanks.
AERATION	Eight tanks at 900 ft x 26 ft x 15 ft SWD Four tanks at 900 ft x 26 ft x 15 ft SWD	Rehab and modify existing twelve tanks.
FINAL SETTLING	Twelve tanks at 153 ft x 60 ft x 12.5 ft SWD	Two new tanks at 153 ft x 60 ft x 12.5 ft SWD; Rehab existing twelve tanks.
CHLORINATION		Two new tanks at 100 ft x 75 ft x 10 ft SWD to include mixers, chlorinators, evaporators, and sulfinators
POST AERATION		Final pass of chlorine contact tanks. Fine bubble diffusers.
EFFLUENT PUMPING		New effluent control building with a pumping capacity of 100 MGD.
GRAVITY THICKENING PS		**Modify two existing anaerobic digesters.**
CENTRIFUGE THICKENING WAS	Two 500 gpm units	One new 500 gpm unit. Utilize two existing units.

TABLE 6-9. JACKSON PIKE TWO-PLANT REQUIRED FACILITIES (CONT.)

Component	Existing Facilities	Required Facilities
ANAEROBIC DIGESTION	Six units at 85 ft dia. x 23.5 ft SWD Four units at 70 ft dia. x 27.5 ft SWD	Rehab **six** existing units. **Modify two existing units for gravity thickening.** **Utilize extra units for sludge holding.**
CENTRIFUGE DEWATERING	Six at 1200 lb/hr	Modify existing six units.
INCINERATION	Two units at 170 wet tons/day total	Rehab two existing units.

The two-plant alternative exhibits a total present worth cost approximately 10 percent lower than the one-plant alternative.

Both the one-plant and two-plant alternatives are equal with respect to their reliability in meeting the final effluent limits. However, the two-plant is considered more reliable with respect to shock loads. Under the one-plant alternative, a plant upset at Southerly could result in a significant loss of biological treatment capacity and may cause a serious water quality problem. However, if the shock and/or toxic load can reach only one of the two plants, the impact may not be as severe.

The two-plant alternative is judged more flexible than the one-plant alternative. With both facilities operational, the city would have more flexibility to adapt to increased future flow, to meet more stringent effluent limits, and to address combined sewer overflows. The two-plant alternative would leave more land available at Southerly for expansion. The two-plant alternative would improve and upgrade Jackson Pike to provide a solid 100 MGD treatment capacity. The two-plant alternative would allow for future expansion of the Interconnector system to divert more flow to Southerly while optimizing the use of the Jackson Pike facility.

The two-plant alternative is considered easier to implement since the majority of the facilities already exist. Most of the construction would consist of rehabilitation of existing facilities. No expansion of the conveyance system between the plants is required under this alternative.

The one-plant alternative is considered easier to operate and maintain since all facilities would be consolidated at one location.

6.1.5 User Costs

The Columbus Department of Public Utilities and Aviation owns and operates the Jackson Pike and Southerly WWTPs. This department finances most of its capital improvement projects through revenue bonds and has the power to assess user charges. User charges are assessed to finance both capital construction costs and O&M costs of operating public facilities. Columbus has operated wastewater facilities for some time and has a proven financial capability. The city has earned an AA bond rating, and has accumulated a large cash reserve with established procedures for assessing and raising required revenues.

Currently, Columbus uses a combination of methods to assess appropriate user charges to its customers. These methods include annual user charges (regular fees based on usage) and permits and connection charges (one-time fees). Annual service charges for processing standard strength effluent are applied to all users. Additional service charges for processing extra-strength effluent are applied to industrial users. Inspection and permit fees are applied to new and rehabilitated units, both commercial and residential. House connection and front footage fees are applied primarily to new users. System capacity charges are assessed according to either the size of the pipe installed for residential users or the size of the structure for commercial and industrial users. System capacity charges are designed to recoup the costs of capital construction by assessing an appropriate fee on new users (City of Columbus Code, Chapter 1147). Table 6-11 presents estimated additional annual user charges for the one-plant and two-plant alternatives.

Due to the uncertainty as to the amount and time of current and future grants of Federal funds, it is useful to present estimated user costs in a range for both alternatives from assuming no Federal funds available vs. assuming a 55 percent grant for all capital construction. This approach is presented in Table 6-11 and shows the full range of possible additional annual user charges for the one-plant alternative ($42 to $76) and the two-plant alternative ($40 to $66).

TABLE 6-11. SERVICE CHARGE ESTIMATES

	One-Plant Alternative	Two-Plant Alternative
Estimated Capital Costs (Present Worth)		
• With 55% Federal Funds	$120,829,950	$ 93,094,200
• Without Federal Funds	268,511,000	206,876,000
Annual Amortized Grant Fundable Capital Costs*		
• With 55% Federal Funds	$14,192,041	$10,934,810
• Without Federal Funds	31,539,201	24,299,577
Annual Operation & Maintenance (O&M) Costs	16,849,000	19,078,000
Anticipated Annual Revenues from Sewer Service Hook-up Fee		
• Residential User	4,400,000	4,400,000
• Commercial & Industrial User	500,000	500,000
Annual Extra-Strength Processing Charge Revenues	4,000,000	4,000,000
Annual Costs to be Recovered through Annual Service Charge		
• With 55% Federal Funds	22,141,641	21,112,810
• Without Federal Funds	39,488,201	34,477,577
Estimated Dwelling Units (DUs)	370,000	370,000
Equivalent Dwelling Units (EDUs) (Comercial & Industrial Users)	152,576	152,576
Estimated Number of Users (Total DUs and EDUs)	522,576	522,576
Additional Annual Service Charges per User for the SEIS Alternatives		
• With 55% Federal Funds	$ 42	$ 40
• Without Federal Funds	76	66
1985 Annual Service Charge Per User		
• Residential Users	108	108
Projected Annual User Charges	$150-184	$148-174

* Assumes a 20-year bond with an interest rate of 10%.

As of the most recent Columbus budget, $117,730,000 has been obligated toward construction to meet 1988 water quality limits at the Jackson Pike and Southerly WWTPs. Annual residential user fees in Columbus have been increased since 1985 to reflect the obligation of those funds. For this reason, user fees in 1985 are combined with new costs for the alternatives to estimate future residential costs. User fee increases for costs to complete either the one-plant or two-plant alternatives are estimated to result in future annual residential user fees of $150 to $184 for the one-plant alternative and $148 to $174 for the two-plant alternative.

Median family income is often used to assess the affordability of increases in user charges to average residents. As shown in Table 6-12, Franklin County, which includes most of the service area, had median family incomes over $17,000 in 1979. Based on EPA guidelines, an annual user charge of $367 would not be considered excessive for this income category. Based on these guidelines, none of the estimated additional user charges will make total user charges excessive.

TABLE 6-12. MEDIAN FAMILY INCOME FOR THE UNITED STATES, OHIO, FRANKLIN COUNTY, AND COLUMBUS IN 1969 AND 1979

Place	Median Income 1969	Median Income 1979
United States	9,586	19,917
Ohio	10,309	20,909
Franklin County	10,579	20,970
Columbus	9,729	18,612
SMSA	10,282	20,882

Source: Bureau of Economic Analysis, April 1986.

6.2 ENVIRONMENTAL CONSEQUENCES - PHYSICAL ENVIRONMENT

6.2.1 Surface Water Quality

The principal variable in the Supplemental Environmental Impact Statement (SEIS) alternatives, with respect to surface water quality, is the location of effluent discharge. Functionally, only two alternatives exist.

- Effluent discharge at two locations (Jackson Pike and Southerly)
- Effluent discharge at a single location (Southerly).

Comparable levels of treatment will be achieved prior to effluent discharge, with each one-plant or two-plant alternative.

Raw effluent entering the wastewater treatment plants (or plant) will receive biological treatment for substantial reduction in the concentration of biodegradable components of the wastestream, prior to discharge. Nevertheless, the treated effluent will contain residual amounts of biodegradable contaminants, which will undergo final decay in the receiving water. In this final decay, dissolved oxygen will be consumed, exerting an oxygen demand in the Scioto River. The extent of this oxygen demand is a consequence of the loading rates of oxygen-consuming pollutants in the effluent, and is expressed as 5-day carbonaceous biological oxygen demand, $CBOD_5$. The $CBOD_5$ loading rates are defined by the National Pollutant Discharge Elimination System (NPDES) permits. In addition to $CBOD_5$, nitrogen decay also creates an oxygen demand in the receiving water. Nitrogen limits in the NPDES permit are expressed as ammonia nitrogen (NH3-N).

In the Scioto River, $CBOD_5$ and NH3-N decay will result in a temporary reduction in dissolved oxygen (DO) downstream of the outfall(s). The extent of the DO reduction, and the length of the river affected, is governed by physical, chemical, and biological parameters in the receiving water. These parameters define the rates at which oxygen-demanding residual constituents in the effluent are decayed (assimilative capacity). The NPDES effluent limits established for the Jackson Pike and/or Southerly Wastewater Treatment Plants (WWTPs) one- or two-plant scenarios are intended to preserve a minimum DO level in the receiving water (5.0 mg/l mean and 4.0 mg/l minimum), by carefully matching loading rates of oxygen-consuming pollutants with the assimilative capacity of the receiving water.

To assist in selecting the appropriate NPDES discharge limits, the Ohio Environmental Protection Agency (OEPA) developed an empirical model of the Scioto River, which provides a mathematical simulation of the river's assimilative capacity. This model (QUAL2) was used as the basis for wasteload allocations and subsequent effluent limits in the draft Scioto River Comprehensive Water Quality Report (CWQR) (OEPA 1983). The original QUAL2 model was updated by the city of Columbus. The updated model (QUAL2E) was used by OEPA as the basis for modified wasteload allocations and related permit limits as contained in an amended CWQR (OEPA 1986a). Although the amended CWQR has not been approved by the USEPA, the NPDES permit limits have been accepted and are the basis of the facilities planning decisions evaluated in this SEIS.

In developing this SEIS, the QUAL2E model was evaluated. This evaluation concluded that a number of technical assumptions used in the model (including steady state conditions, benthic oxygen demand, phytoplankton, organic nitrogen demand, and flow/depth/velocity relationships) were questionable. Collectively, these assumptions put in question the reliability of the wasteload allocations, permit limits, and related DO predictions for the receiving water.

The results of the QUAL2E model evaluation are summarized in Appendix L. The USEPA Water Quality Branch has reviewed the QUAL2E model evaluations and has concurred that model calibration and verification could be improved. However, the USEPA has concluded that the error margin in the existing QUAL2E model is acceptable and that the permit limits based on this model are reliable and would achieve DO and NH_3 water quality standards. Based on the results of the QUAL2E model and professional judgement, the USEPA Region V Water Quality Branch has "... endorsed the two-plant analysis" (Fenner, 1987). The results of the USEPA review of the QUAL2E model evaluations are included in Appendix M. Consequently, the following discussion of water quality impacts reflects the conclusion that proposed permit limits are sufficient to meet minimum water quality standards under either the one-plant or two-plant alternative.

Based on existing data in the CWQR and as previously discussed in chapter 2, the biological quality of the mainstem Scioto River is primarily impacted by discharges from the two Columbus treatment plants. This section of the river has been well-studied, and the historic data indicate that significant improvements have occurred in water quality and the fish community structure during the past decade. However, water quality continues to be degraded from the confluence of the Scioto and the Olentangy to just upstream of Circleville. The CWQR states that "the principal chemical/physical water quality problem in the central Scioto River mainstream has been, and continues to be, low dissolved oxygen." The low dissolved oxygen conditions are caused by discharges from Jackson Pike, Southerly, and from the Whittier Street Combined Sewer Overflow (CSO).

Effluent monitoring data collected by the city of Columbus at their Jackson Pike and Southerly WWTPs show that neither facility can consistently meet its final water-quality-based NPDES permit limitations. The Jackson Pike and Southerly WWTPs are required to be in compliance with these final limits by July 1, 1988. Jackson Pike data for 1985 show that the plant usually exceeded the $CBOD_5$ and NH^3-N limits in the summer and occassionally violated these limits in the winter. The effluent did not achieve the minimum required DO concentration of 7 mg/l. The 1985 performance at Southerly indicates that this facility could normally achieve the minimum required $CBOD_5$ limit, but exceeded final ammonia limits in the summer.

The preceding discussion of effluent quality at Jackson Pike and Southerly only concerns flow which is treated. The Southerly plant has a raw sewage bypass at the WWTP and the Jackson Pike plant has the capability to bypass flows at Whittier Street.

During periods of low flow, algal metabolism can influence DO levels in the Scioto River (OEPA 1986a). The impact of algal metabolism on DO is evident in the data collected by OEPA on July 19-22 and September 1982, for water quality modeling of the Scioto between Jackson Pike and Circleville. DO levels below 5 mg/l are seen along the entire river reach studied.

Fecal coliform data from facility self-monitoring reports, the CWQR, and EPA's STORET system show elevated counts of bacteria along the Scioto River throughout the Columbus area. Data contained in the CWQR show occasional high numbers of fecal coliform bacteria even upstream of the discharge from the Whittier Street CSO. According to the CWQR, 31 percent of the fecal coliform data collected by the OEPA exceed the primary recreation standard of 2,000 counts/100 ml. Sixty percent of the data collected by the city of Columbus, as part of their cooperative program with the state, exceed the standard. The elevated levels are likely caused by combined sewer overflows and bypasses and by urban runoff.

6.2.1.1 No Action Alternative

The no action alternative assumes no improvements to the existing facilities, although normal maintenance would continue (see Section 5.1.1). Because the no action alternative does not provide for the rehabilitation or upgrading of the existing facilities, violations of the final discharge limits may occur. The aquatic environment of the Scioto River in the Facilities Planning Area (FPA) is degraded, largely as a result of current inadequacies in wastewater treatment. The no action alternative will result in a perpetuation of the current water quality/aquatic ecology impairments (see chapter 2). Generally, depressed DO conditions and reduced aquatic biota will exist from Columbus to Circleville.

As the existing facilities age and the wastewater loads to the exisitng facilities increase (through growth in the sewered population), the frequency and duration of permit violations and degree of impact on the receiving water is also expected to increase, under the no action alternative. These increases will have two effects. First, water quality in the already impacted section of the Scioto River will deteriorate, displacing the less tolerant of the already reduced aquatic species inhabiting this area. Second, the zone of impact will expand downstream as the length of river needed to assimilate a growing residual effluent wasteload increases. Based on currently available water quality data, it is probable that the zone of impact would reach Circleville within a number of years. Under these conditions, the Scioto River below Circleville no longer would be capable of fully assimilating the residual effluent oxygen demand from the Circleville POTW, and a second zone of water quality/aquatic biota impairment would result. This scenario could result in an inability of the Circleville POTW and industrial NPDES dischargers in the Circleville area to meet water quality standards at current treatment levels.

6.2.1.2 Two-Plant Alternative

The two-plant alternative will result in signficant water quality improvements in the Scioto, particularly in DO levels. The upgraded Jackson Pike and Southerly plants will be capable of consistently meeting final limits, and few violations of the DO standard would be expected in the river. However, since only limited nutrient removal would accompany the plant upgrades, algal metabolism would likely continue to affect dissolved oxygen, expecially during periods of low flow.

Effluents from the Jackson Pike and Southerly WWTPs will contain a residual DO demand which will be assimilated by the Scioto River, resulting in a DO sag downstream of each plant. The DO sag below either plant will not exceed the in-stream DO standards. The critical point in the sag below Southerly will occur approximately 12 miles downstream of the WWTP outfall, near the confluence of Walnut Creek.

Improvements in riverine DO levels resulting from the two-plant alternative will be partially masked by continued discharges from the Whittier Street CSO. Although the city is currently studying the CSO problem, no CSO corrections are included in the current facilities planning efforts. According to the CWQR, "on an annual basis, the Whittier Street CSO contributed nearly as much BOD_5 loading (32.7 percent) in 1982 as did the Jackson Pike WWTP (38.8 percent)" (OEPA 1986a). Although the loadings are highest during the spring and winter, some discharge does occur during periods of low flow and high temperature when the river is most sensitive to depressed DO.

Field data collected for a report on CSOs by Malcolm Pirnie, Inc. (1983) show that the Whittier Street inputs can depress in-stream DO levels below the standard during periods of low flow. Therefore, although the proposed discharge limits will protect in-stream DO standards based on the Jackson Pike and Southerly WWTP effluents, occassional violations of the standards may continue to occur resulting from other sources. However, the section of the Scioto River exhibiting continued depressed DO levels will be reduced significantly under the two-plant alternative and will be essentially constricted to an area below Whittier Street. Consequently, downstream areas (near and below Southerly) of the Scioto River will exhibit the greatest overall improvement in DO conditions under the two-plant alternative, while improvements in upstream areas, closer to Whittier Street and Jackson Pike, will be reduced.

Although the two-plant alternative will significantly reduce loadings of certain oxygen-consuming pollutants (e.g. BOD_5), resulting in improvements to in-stream DO levels, nitrogen compounds in the effluent will continue to exert a DO demand. The existing modeling does not provide a reliable basis for evaluating the DO impact of ammonia, nitrite/nitrate, organic nitrogen, and TKN. However, because background sources of these nitrogen compounds tend to be concentrated in the urban areas of the watershed, nitrogen-related DO impacts will be greatest in the area of the Scioto River immediately downstream of Columbus.

Treatment processes at Jackson Pike and Southerly will prevent any significant fecal coliform loading to the Scioto River. However, fecal coliform discharges will continue from the Whittier Street CSO and other urban sources in the Columbus metropolitan area. Although significant fecal coliform loading to the Scioto River does not presently occur from the two WWTPs, excess chlorine discharged from the Jackson Pike and Southerly plants produces a measurable decrease in in-stream fecal coliform levels below the two plants. Under the two-plant alternative, the total residual chlorine limits in the discharge permits (JP - 19 ug/l, SO - 26 ug/l) will result in little or no in-stream fecal coliform kill, and future fecal coliform numbers may exceed present levels under certain flow conditions. Because most remaining fecal coliform sources (after implementation of the two-plant alternative) will be concentrated in the urbanized areas near the confluence of the Olentangy and Scioto Rivers, the area of continued water quality impairment (relative to fecal coliforms) will be concentrated in this zone.

6.2.1.3 One-Plant Alternative

The one-plant alternative provides for the complete elimination of the Jackson Pike WWTP with all flows routed to Southerly. The Jackson Pike flow will be conveyed to Southerly through the existing gravity Interconnector Sewer. This Interconnector Sewer will be extended to the Southerly plant. Four 78-inch pipes will cross the Scioto River in the alignment of the existing force mains.

The water quality impacts of the one-plant alternative are similar to those of the two-plant alternative for many parameters as discussed in the preceding section. Consequently, the following discussion focuses only on those impacts that are not common to the one-plant and two-plant alternatives.

Under the one-plant alternative, critical low flows in the upper Scioto River, between Jackson Pike and Southerly, would be significantly reduced. The city of Columbus is authorized to remove 100 percent of Scioto River flows at the Dublin Dam water intakes. Consequently, Scioto River flows may drop to essentially zero below the Dublin Dam during critical low flow periods, at which time river flow is sustained by Olentangy River discharges.

Flows in the lower Olentangy River are regulated by the Delaware Dam during low flow periods. The guaranteed minimum release is 5 cubic feet per second (cfs) from the Delaware Dam. Although the actual measured minimum is 11 cfs in the lower Olentangy River, the observed minimum for the 7-day/10-day critical low flow period is 13 cfs. Assuming a 13 cfs low flow discharge from the Olentangy River, a zero low flow over the Dublin Dam, a correction factor for groundwater recharge which is cited as insignificant (Francis, 1987a), seepage under or around the Dublin Dam, and miscellaneous industrial direct dischargers; the minimum low flow immediately above Jackson Pike is estimated at approximately 20 cfs.

The average daily dry weather discharge at Jackson Pike is approximately 78 MGD, or 121 cfs, based on 1985-1986 flow records. This effluent flow is six times the estimated 20 cfs flow rate in the Scioto River, upstream of Jackson Pike, during critical low flow periods. Consequently, removal of Jackson Pike flows will reduce present flows in the upper Scioto River, between Jackson Pike and Southerly, by as much as 86 percent during critical low flow periods. (Current low flows below Jackson Pike are the sum of 20 cfs from upstream flow and 121 cfs from Jackson Pike.) This decrease in flows will result in more pronounced pooling and longer riffle areas between pools. The surface areas of the riffles will increase as a function of length, but the wetted area will be laterally constricted.

The city of Columbus has compared flow versus depth for Scioto River cross sections between Jackson Pike and Southerly, comparing the one-plant versus two-plant alternatives. For nine cross sections affected by the one-plant alternative, flow depth would be reduced by an average of 39 percent, with a range of 13 to 72 percent. In three cross sections (QUAL2E stream reaches 3, 4, and 8), flow depth will be less than 1 foot (0.15 foot, 0.84 foot, and 0.35 foot, respectively). Because the flow calculation component of the available modeling is not considered reliable, the true nature of the low flow impact cannot be determined.

Elimination of the Jackson Pike effluent will remove a major source of water quality impact on the Central Scioto River. However, it is important to realize that other sources (e.g., general urban runoff and the Whittier Street CSO) also exert a major water quality impact (the calculated BOD_5 loading from the Whittier Street CSO approximates the current loading from Jackson Pike and has been shown to result in violations of in-stream DO standards). Consequently, the impacts of the one-plant alternative will be different on the stretch of the Scioto between Jackson Pike and Southerly and the stretch between Southerly and Circleville. In the following discussion, the stretch betweeen Jackson Pike and Southerly is referred to as "below Jackson Pike" and the stretch between Southerly and Circleville is referred to as "below Southerly".

Below Jackson Pike, the impacts of the one-plant alternative will be strongly flow-dependent. Under most flow conditions, elimination of the Jackson Pike effluent loading will result in improved water quality conditions, to the extent that this effluent affects water quality. However, for the one-plant alternative, it is possible that water quality in the upper Scioto River would deteriorate under certain flow conditions.

Under critical low flow conditions water quality in the Scioto River below Jackson Pike will be dominated by wasteload sources not affected by the one-plant alternative, including the Whittier Street CSO and general urban runoff. Under these flow conditions, removal of the Jackson Pike effluent may result in diminished water quality and aquatic biota conditions below Jackson Pike, for the following reasons: 1) the Jackson Pike effluent represents 86 percent of Scioto River flow under low flow conditions, 2) this effluent would meet water quality standards, and 3) the other wasteload sources entering the Scioto River near Jackson Pike (CSO and urban runoff) contribute pollutant loads equal to or greater than Jackson Pike. For these reasons, elimination of the Jackson Pike effluent may remove a beneficial dilution effect which would be present under the two-plant alternative.

Below the Southerly WWTP, no change in river flows will occur as a result of the one-plant alternative. Downstream water quality conditions are expected to generally improve with respect to DO, residual chlorine, and $CBOD_5$. However, an oxygen demand will remain in the effluent, in the form of residual BOD_5, nutrients, and various nitrogen compounds. This residual demand will result in a DO sag downstream of Southerly. Although this sag would occur under either the one- or two-plant alternative, the severity of the sag and length of river affected is expected to be greater under the one-plant alternative. This is a result of all residual effluent wasteload from Columbus being released to the river at a single location with no increase in river flows or other parameters affecting assimilative capacity.

Water quality modeling has determined that final effluent limits for the Southerly WWTP will protect in-stream DO standards below Southerly, under the one-plant alternative (see Appendix M). While the critical point in the DO sag will occur at essentially the same location under either the one-plant or two-plant scenario (approximately 12 miles downstream of the Southerly WWTP), the severity of the sag is greater under the one-plant alternative (i.e., downstream DO levels are higher under the two-plant alternative) based on the QUAL2E model results. Although the stream standard will not be contravened by the one-plant alternative, the DO sag resulting from the residual wasteload demand of the Southerly WWTP effluent will affect a longer stretch of the river than would occur under the two-plant alternative and may affect a longer stretch than is impacted by the present DO sag. In addition, the increased nutrient release associated with the one-plant discharge may further impact downstream DO due to increased algal metabolism, which has been shown to have a significant impact on in-stream DO levels at low flow. Any increase in the length of river affected by the expanded DO sag will be in a downstream direction. Therefore, the one-plant alternative represents a greater probability of interfering with other downstream dischargers, because the severity and length of the sag would be extended downstream. The QUAL2E model does not extend far enough downstream to assess this possible impact.

Under current conditions, the critical point in the DO sag from Southerly is located much closer to Circleville than Southerly and water quality at Circleville reflects residual BOD_5 from the Southerly effluent discharge. Under the one-plant alternative, the increased wasteload discharged at Southerly will result in a greater probability that the DO sag, residual BOD_5, ammonia, and other pollutants will impact Circleville. This impact could impair the ability of the river to assimilate oxygen-consuming wastes from existing dischargers in the Circleville area of the Scioto (e.g., Container Corporation at RM 99.6; Circleville POTW, and DuPont at Rm 95.9). The existing water quality modeling is inadequate to assess this potential impact, and the OEPA has recommended that "...all discharges maintain their current NPDES permit limitations" in that portion of the Scioto River, from just above Circleville (RM 99.2) to river mile 77.7 "...due to the uncertainty regarding this segment" (OEPA 1986a).

Finally, the one-plant alternative will require placement of four 78-inch gravity sewer pipes across the Scioto River. The crossing will occur parallel to the existing force mains in the immediate vicinity of the Southerly plant site. **If pipes are buried in the stream bed, short-term increases in turbidity and sedimentation downstream of the construction area will occur. Because this stream crossing poses a number of significant impacts, a variety of mitigative measures have been proposed by USEPA, OEPA, and the city of Columbus. These measures concentrate on construction techniques which should minimize the impact.** These include timing of construction in the fall when river flows are low; isolation of the in-stream construction zone to prevent river water from flowing through the disturbed streambed area during construction, replacement of the natural streambed materials following pipe placement; and stabilization of the cut bank areas during and after construction. These mitigating measures are described in Table 6-13.

A list of conditions and specifications designed to limit the environmental impacts of this interconnector should be included with the final site plan and agreed to by the contractor. This list should include the recommendations

TABLE 6-13. MITIGATION ON SEWER LINE
(Interconnector)

Construction Activities	Attributes	Mitigative Measures
1. Sewer on Flood Plain		
a. Pre-clearing	Existing Vegetation	Clearly mark construction easement. Mark trees to be saved and identify stockpile areas, **locations of hay bales, jute mesh, silt barriers, rip rap, and other erosion control measures. Detailed inserts showing proper construction techniques for these various erosion controls should also be included.**
b. Clearing and Grading	Slight Slopes	Begin in low precipitation month.
	Drainageways	Staked hay bales and/or mesh of jute.
	Daily Maintenance	**The contractor shall backfill and rough grade all trenches at the end of each workday. The disturbed area over the trenches shall be graded, seeded, and mulched within 72 hours after backfilling. The contractor shall maintain all seeded and mulched areas in accordance with the specifications until final acceptance of the work.**

TABLE 6-13. MITIGATION ON SEWER LINE (cont.)
(Interconnector)

Construction Activities	Attributes	Mitigative Measures
b. Clearing and Grading (cont.)		The clean-up and disposal of cleared materials shall be done as soon as practical after laying of the pipe and as the resident project engineer may direct. However, clean-up work shall not fall behind the pipe laying more than 600 feet. Should the contractor not keep his clean-up work within the aforementioned distance, the contractor shall be required to cease further pipe laying until such clean-up work is accomplished. If work on this project is suspended for any reason, the contractor shall maintain the soil erosion and sedimentation control facilities in good condition during the suspension of work. Also, when seasonal conditions permit and the suspension of work is expected to exceed a period of one month, the contractor shall place topsoil, fine grade, seed, fertilize, and mulch all disturbed areas left exposed when work is stopped.

TABLE 6-13. MITIGATION ON SEWER LINE (cont.)
(Interconnector)

Construction Activities	Attributes	Mitigative Measures
c. Excavation of Trench	Excavated Material	Stockpiled upslope from trench. Separate top soil from subsoils. Cover stockpile with plastic if not returned immediately to trench. Expose only small lengths of sewer at a time.
d. Restoration (after final grading)	Exposed Topsoil	Final grade with stockpiled topsoil; seed with naturally occurring grasses during spring or fall planting season. Use hydroseeding or air-seeding at a rate of 3.5 lb. of seed/1,000 square feet. Mix fertilizer and mulch per manufacturer.
Restoration	Established Vegetation	Maintain sediment barriers until vegetation is established. **A maintenance contract for all landscaping (trees and grass) should include immediate revegetation for two years after the initial planting.**
e. Final Landscaping	Existing Flora Damage	Prune trees as required if root damage occurred and replace trees as directed by owner.
2. Sewer on Stream Bank (only one bank at a time)		
a. Pre-clearing	Water Quality and Soil	Low stream flow.

TABLE 6-13. MITIGATION ON SEWER LINE (cont.)
(Interconnector)

Construction Activities	Attributes	Mitigative Measures
b. Clearing and Grading	Stream and Bank	Establish dry area at interface between bank and stream and use hay bales or steel sheetings to catch any sediment. **Clearing and grading shall not begin prior to July.** **Clearing shall be done in stages near the river to avoid vast exposure of bare soils.** **Tree removal shall be minimized along the river banks.**
c. Excavation	Stream and Bank	Maintain dry area interface and remove excess sediment as required.
d. Restoration	Sloped Area	Restore existing grade, place rip-rap at water line, reseed and cover with mesh or jute or net to stabilize bank, maintain silt barrier until vegetation has been established, ground cover to be used where shade may prevent grass from being established or compatible with existing vegetation.
3. Sewer in Streambed		
a. Pre-construction	Aquatic Habitats and Water Quality	Low flow established (timing). Obtain Army Corps of Engineers Section 10 and 404 permits. Establish minimum construction easement. Keep to permanent easement if possible.

TABLE 6-13. MITIGATION ON SEWER LINE (cont.)
(Interconnector)

Construction Activities	Attributes	Mitigative Measures
3. Sewer in Streambed (cont.)		**No construction in or near the Scioto River shall be permitted during the spring spawning months.**
b. Excavation	Aquatic Habitats and Water Quality	Block only one-half to one-third of the stream at a time. Remove streambed and stockpile separate from sub-bed material. Keep area dewatered. Collect discharge water and separate silt. Place all excavated material upland from stream with sediment catchbasin around stockpile area. No material to be placed in river outside of dry construction area.
c. Restoration	Aquatic Habitats and Water Quality	Backfill above sewer with substream material. Place excavated streambed material to final elevation. Fill area with stream water slowly to prevent washout. Remove any excess excavated material to upland disposal site as shown on plans.

made in a Phase III Archaeologic Survey, current best management practices, construction easement restrictions, and other state and local erosion and sedimentation requirements.

6.2.1.4 Conclusions

The principle variable affecting surface water quality under any alternative is the location of wastewater discharge. Comparable levels of treatment will be provided under either the one-plant or two-plant alternatives, and either alternative will protect stream standards for DO and ammonia.

Regardless of the one-plant or two-plant alternative, the treated effluent will contain a residual wasteload, which will be assimilated by the river, resulting in a downstream DO sag. The severity of the sag, and the extent of the river affected, vary between alternatives.

Under the no action alternative, no improvement in the degraded water quality conditions in the Scioto River will occur. With projected future growth in the sewered population (and corresponding increases in wastewater flows), age-related deterioration of the existing WWTPs and increases in urban non-point runoff due to continued urban growth, further deterioration in current water quality conditions is expected. Under these conditions, more frequent water quality standards violations can be expected and the impacted zone of the Scioto River below Southerly may be extended to Circleville, interferring with other point source dischargers.

The two-plant alternative will release the residual effluent DO demand to the Scioto River at two locations (Jackson Pike and Southerly). Two DO sags will therefore result, however, neither sag will result in contravention of water quality standards. Significant improvements to in-stream DO conditions will result from this alternative. Because significant pollutant loads will continue to enter the Scioto River upstream of Jackson Pike (from urban runoff and CSOs from Whittier Street), the degree of water quality improvement below Jackson Pike will be less complete than below the Southerly WWTP. Under certain flow conditions, DO levels below the 5.0 mg/l standard may occur below Jackson Pike, related to CSO loadings. However, the presence of Jackson Pike effluent during low flow events may lessen the DO impacts of CSOs and upstream urban runoff.

The impacts of the one-plant alternative are variable for the river reach between Jackson Pike and Southerly, depending on background river flow conditions. At average river flow levels, water quality will be improved by the elimination of Jackson Pike effluent. However, under critical low flow conditions, elimination of the Jackson Pike effluent will reduce Scioto River flows by nearly 90 percent while a large background pollutant load will remain in the form of urban runoff and CSO loading. This situation will result in a significant reduction in the river's wasteload assimilative capacity due to reductions in flow volume, velocity, and reaeration. Decay of pollutants from upstream sources could therefore result in severe water quality deterioration in slow, shallow pools during warm weather, low flow events.

Downstream of the Southerly WWTP, the DO sag resulting from the one-plant alternative will be more severe and will affect a longer stretch of the river, when compared with the two-plant alternative. This situation results from the release of the entire residual wastewater DO demand from Columbus at a single point in the river, creating a greater assimilative demand. In addition, the increased nutrient release under the one-plant alternative will further stimulate algal biomass below Southerly which may depress low flow DO below in-stream standards due to algal metabolism. The combination of these factors results in a possibility that the one-plant alternative may impact the Circleville area, interfering with other point source dischargers near Circleville.

Based on these considerations, the two-plant alternative is considered preferable over the one-plant alternative with regard to water quality impacts.

6.2.2 Surface Water Flow

Current construction activities at the Southerly WWTP should have little or no impact on the 100-year floodplain. Construction at the Southerly WWTP location includes increasing the plant's foundation and building berms around the facility. Both of these construction activities would tend to increase the flood boundary during a 100-year flood compared to preconstruction conditions. These activities are similar under either system alternative. To minimize potential flood increases, Columbus was able to have the flood fringe redefined by the Federal Emergency Management Agency (FEMA) by guarantee that portions of the land bordering the Scioto River that would be inundated during the 100-year flood, and that could feasibly be developed, would not be developed. This land is either owned by the city or is in the process of being purchased. The city's study was reviewed, approved, and printed for public release by FEMA. The new 100-year flood elevation, after redefining the flood fringe, is at most about one-fourth foot higher than before.

6.2.2.1 No Action

By taking no action, no significant changes are expected in the flows observed in the Scioto River. The volume of surface water Columbus currently removes from the Scioto River is about the maximum possible limit, especially during the critical low flow months of summer and fall. Therefore, no future manmade reductions in the volume of flows in the Scioto River are expected around the Columbus area. Because the stretch of the Scioto River affected by the Jackson Pike WWTP is small, and because the river bed is believed to be at least partially sealed by industrial and WWTP sludges, little or no impact upon the groundwater system by changes in surface water quality is expected.

6.2.2.2 Two-Plant Alternative

The two-plant alternative will discharge flows from the Jackson Pike WWTP at about the same levels as currently occur. For this reason, impacts from the two-plant alternative are not expected to significantly alter the physical parameters of Scioto River surface water between the Jackson Pike and Southerly WWTPs.

Another factor affecting Scioto River flows is **the O'Shaughnessy hydroelectric power plant (dedicated in 1987) which was built as part of an upgrading of the existing dam.** At present, flows through the O'Shaughnessy Dam are based on the downstream needs of the Griggs Reservoir/Dublin Road Water Treatment Plant (DRWTP). Following construction of the new power plant, flows may be released more quickly to the Griggs Reservoir, but not above the Griggs Reservoir capacity (Bell 1987). However, the expected effect of this power plant on Scioto River flows is uncertain. There may be an increase in the number of days when low-flow conditions occur. The latter condition may occur if the O'Shaughnessy Reservoir retains more water than in the past to provide maximum hydraulic head (maximum potential water elevation) to power the hydroelectric turbines. Some of the buildup of hydraulic head would occur during periods when the Scioto River flow might normally pass the DRWTP. **Since the power plant is an auxiliary unit, it is likely that operations at this plant would be suspended during low flow conditions (Bowman 1988).**

6.2.2.3 One-Plant Alternative

The Jackson Pike WWTP discharges a daily mean flow of 130 cubic feet per second (cfs), or 85 million gallons per day (MGD), into the Scioto River. The USGS surface water gauge at Jackson Pike WWTP (003227500) records a daily mean flow of 1,390 cfs, as shown in Table 6-14. The removal of Jackson Pike WWTP discharges, as proposed under the one-plant alternative, will result in an average flow reduction of less than 10 percent. This reduction will have a negligible effect during average flow conditions and no effect at flood conditions. However, at low-flow conditions, the effects will be significant. The 7Q10 low-flow used for environmental reasons, as discussed in chapter 2, is 13 cfs. At this background flow, removal of Jackson Pike WWTP discharge will result in a reduction of Scioto River flows, between the Jackson Pike and Southerly WWTPs, of more than 90 percent. The Scioto River flow regime along this stretch will become slower, shallower, and narrower during low-flow conditions. Pools will receive less mixing (and have an increased flushing

TABLE 6-14. SURFACE WATER FLOWS* IN THE OLENTANGY AND SCIOTO RIVERS AT COLUMBUS, OHIO

Duration/Recurrence	Olentangy Flows[1] in Cubic Feet per Sec.	Scioto Flows[2] in Cubic Feet per Sec.
7 consecutive day mean low	21.4	118.0
7Q10 low	11.1	65.8
3Q10 low	10.0	62.4
1Q10 low	9.1	59.6
1 day mean low	17.4	102.8
1Q2 low	14.9	95.6
1Q5 low	10.6	70.0
1 day mean high	4660	18800
1Q2 high	4230	17300
1Q5 high	5150	25300
3Q10 high	5080	23000
7Q10 high	4640	16400
1Q50 high	8610	41500
1Q100 high	10100	46000
daily mean	457.0	1390

*These values were obtained using a log Pearson type II analysis of USGS WATSTORE data bases.

[1]River gauge #003226800 on the Olentangy River below the Delaware Dam.

[2]River gauge #003227500 on the Scioto River at Jackson Pike WWTP.

time), while riffles may have reduced turbulence. If the discharge structure is designed and constructed properly, erosion of the river bed and banks, the most potentially deleterious effect, will be prevented.

6.2.2.4 Conclusions

The no action and two-plant alternatives will have little or no impact on surface water flows in the Scioto River. The one-plant alternative will cause significant reductions in flows in the Scioto River during low-flow periods in the eight mile reach between the Jackson Pike and Southerly WWTPs. Impacts of this change are reviewed in Section 6.2.1, 6.2.3., 6.3 and 6.4.7.

6.2.3 Groundwater

Beginning in the early 1980's, groundwater became one of the sources of raw water for Columbus' municipal drinking water system. All public water supplies downstream of Columbus along the Scioto River and all private and industrial water consumption in Columbus relies on groundwater sources. Columbus' growing water demands exceeded the available surface water supplies at the Dublin Road Water Treatment Plant (DRWTP) and the Morse Road Water Treatment Plant (MRWTP), particularly during summer months, leaving groundwater as the next available water source. In response, the Parsons Avenue Water Treatment Plant (PAWTP) was constructed to mine groundwater from the Teays aquifer, a buried glacial braided river system in southern Franklin County.

Data on bacterial levels in Columbus area groundwater are not available. Tests are needed to determine the bacterial content of groundwater taken from wells close to area streams, since these streams and buried valley aquifers are usually hydraulically connected. Also, the infiltration of Scioto River water, a significant portion of which is WWTP effluent, could have a negative impact on the groundwater quality. However, groundwater pollution is most likely to occur in areas using shallow aquifers and in such recharge sites as eskers, Kames, and outwash gravel terraces. These aquifers lying close to streams or beneath inadequate septic tanks are highly susceptible to contamination.

Various studies of the Teays aquifer were performed to determine safe yields. Safe yield is the volume of groundwater that can be withdrawn from an aquifer without exceeding the ability of natural recharge (from surface water and other groundwater sources) to keep the water table constant over a given timeframe, typically 1 year. The city of Columbus contracted with a private firm to install radial wells with a safe design yield of approximately 30 MGD. Four wells were eventually installed and 7-day, long-term pump tests were performed to determine the safe rate of withdrawal (Francis 1987). From the available data, safe design yields for the four wells were estimated to range from 8.5 to 14.5 MGD, for a total withdrawal of 46 MGD (Hughes 1987). The PAWTP is designed to handle roughly 150 MGD (Francis 1987), allowing for future expansion of the well system as needed.

Because of the importance of the Teays aquifer and the lack of available data, the USGS is currently studying that portion of the southern Franklin County aquifer that is directly affected by the reach of the Scioto River between the Jackson Pike and the Southerly WWTPs. This study is intended to encompass groundwater quality from the Southerly WWTP to the PAWTP. Areas under investigation include groundwater quality, surface water quality, and the impact of Scioto River water on the aquifer (Shindle and Childress 1987). This study should provide information on surface water impacts to the groundwater, recharge rates, safe yields, and the physical parameters necessary to predict the cone of depression created by a pumping source, as well as the movement rate and chemical fate of groundwater contaminants.

Although there is some evidence that sections of the Lower Scioto River may be sealed by industrial and WWTP sludges and that these sludges may interrupt the natural flow of water between the Scioto River and the Teays aquifer, recent tracer dye test indicate that this blockage is insignificant and/or nonexistent. These tests prove that the effect of Scioto River water upon groundwater quality and water table elevations may be greater than previously believed. Since future increases in Columbus' water demands will have to be met by groundwater pumping, **the relationship between the quality**

and quantity of the water in the Scioto River to the Teays Aquifer and the level of recharge contamination with respect to the safe groundwater yield, are important in considering the one- and two-plant alternatives for Columbus' WWTP options.

At this point, no significant impacts to groundwater resources are anticipated from any of the alternatives. A draw-down of groundwater elevations and drinking water wells occurred in 1986 to the town of Shadeville, a suburb of Columbus. This was caused by a dry spell, construction dewatering at the Southerly WWTP, and groundwater pumping from the PAWTP. This caused the water table to drop about 8 feet leaving many of Shadeville's wells inoperational. To mitigate this problem, Columbus has extended water distribution mains to the Shadeville area.

6.2.3.1 No Action

The no action alternative, maintaining the status quo in the Columbus area, should have no significant impacts on groundwater. Even if the USGS groundwater study currently underway establishes there is a more direct connection between the Scioto River and area groundwater, current groundwater quality at the city's wells remains good, even after several decades of potential influence from the Jackson Pike WWTP.

6.2.3.2 Two-Plant Alternative

The two-plant alternative is not expected to cause significant impacts to area groundwater resources, since WWTP discharge levels and any associated impacts will remain similar to current practices.

6.2.3.3 One-Plant Alternative

Under the one-plant alternative, the Jackson Pike WWTP effluent will be diverted downstream, leaving river water elevations during low-flow periods between the Jackson Pike and Southerly WWTPs drastically lower than under the two-plant and no action alternatives. These low-flow conditions will occur during dry summer and fall months at the same time that groundwater elevations are lowered by the reduction in recharge from precipitation (surface water infiltration), other groundwater sources, and surface water sources (impoundments, wetlands, and streams).

If connections between the Scioto River and the Teay aquifer are more direct than currently believed, groundwater elevations may become lower than they currently are and they may even become critically low during extended drought conditions, requiring the PAWTP wells to be pumped above safe design yields. Since any additional drinking water supplies required to meet Columbus' growing needs will be drawn from groundwater sources, long-term impacts on the radial well system could include an increase in capital and O&M costs as safe design yields of individual wells are reduced during dry periods, and additional wells are required to meet demands.

Groundwater quality was not closely monitored by Columbus until groundwater was used as a component of the municipal drinking water supply. A monitoring system to sample well water on a periodic basis is projected to be in place by 1987 or 1988 (Button 1986). Raw groundwater quality is superior to raw surface water sources used for drinking water purposes in Columbus; however, some non-health hazard problems are present according to data analysis of two PAWTP well samplings. Levels of hydrogen sulfide, iron, and manganese are near or above water quality standards. This is one reason lime soda ash softening is required to treat raw water to meet drinking water standards.

Ranney field is located on a parcel of land known as Hartman Farm. A number of legal agreements have been negotiated between Columbus and the affected property owners on this six hundred acre tract in order to protect the city's drinking water supply (Briegel 1987). Although various agencies have recommended land use controls such as drainage retention basins that would include a five to twenty-five square mile area surrounding Ranney field, the city of Columbus has not adopted any well head protection laws (Kelly 1987).

6.2.3.4 Conclusions

When the USGS groundwater study mentioned above is completed in 1988, better data on the groundwater system will be available. A more definitive evaluation should then be possible of future impacts from the one- and two-plant alternatives. When water quality data become available at the end of 1987 or in 1988, these data compared to the USGS findings will provide an indication of industrial and Scioto River water impacts upon groundwater quality.

6.2.4 Air Quality/Odor

Air quality impacts do not differ significantly among the various alternatives. The most significant long-term impact to air quality will result from the operation of the incinerators as a primary method for ultimate solids disposal. The current practice, which would continue under the no action alternative, consists of incineration of approximately 25 dry tons per day (dtpd) of dewatered solids at Jackson Pike and 45 dtpd at Southerly.

Both the one- and two-plant alternatives would result in a decrease in the total amount of solids incinerated due to the fact that anaerobic digestion would be practiced and also because the quantity of sludge land applied would increase. The engineering evaluation developed the one-plant and two-plant alternatives to optimize utilization of the sludge reuse options. The Southwesterly Compost Facility was assumed to process 24 dtpd on an annual average under both alterantives. Under the one-plant alternative, 25 dtpd would be land applied. Under the two-plant alternative, 38 dtpd would be land applied, approximately 25 dtpd from Jackson Pike and approximately 13 dtpd from Southerly.

The two-plant alternative would decrease the amount of solids incinerated at Southerly by about 70 percent and the level of incineration at Jackson Pike would remain approximately the same. The one-plant alternative will phase out all operations at Jackson Pike and Southerly incinerators will be used to incinerate about 17 percent more (to account for the current amount incinerated at Jackson Pike) than current demands. Current estimates of pollutants generated per ton of sludge incinerated are listed in Table 6-15a. Projected air pollutant emissions associated with the no action, two-plant, and one-plant alternatives are listed in Tables 6-15b, c, and d respectively.

Portions of Franklin County are designated as non-attainment of the National Ambient Air Quality Standards (NAAQS) for particulate matter. In particular, the Jackson Pike WWTP is located in an area that is designated as non-attainment of the secondary standard, and regions north of the facility are designated as non-attainment of the primary standard. Figure 6-4 illustrates the pattern of NAAQS non-attainment areas.

All six incinerators (two operating incinerators at both Jackson Pike and Southerly, and two permitted incinerators in start-up at Southerly) are equipped with wet scrubbers designed to reduce particulate matter emissions to meet the emission control standards imposed by the State of Ohio and the Federal New Source Performance Standards for municipal sludge incinerators.

Odor problems have historically plagued southern Franklin County, with frequent complaints of burnt ash sewage odors attributable to the incinerators, earthy raw sewage odors characteristic of Southwesterly composting operations, and a septic sewage odor attributed to the primary clarifiers and/or anaerobic digesters at the Southerly WWTP (McCarthy 1986, Bonk 1986, and Maxwell 1986). Based on the available data, it appears that the Southwesterly Composting Facility is the major cause of the odor problems in Southern Franklin County. Other odors may be due to a variety of industrial and agricultural-related sources, as identifed in Table 6-16 and Figure 6-5. This figure also identifies the residential areas that have registered the majority of complaints to local, state, or Federal agencies.

Several odor control-related procedures or design improvements have been put into operation at Southwesterly. However, complaints are still received. Design changes recently completed at the Southwesterly composting facility include addition of a pug mill designed to achieve a better mix of wood chips and raw sludge and a solar drying facility to control moisture content. Additional improvement in the sludge may be seen with the implementation of the recommended additions to the solids handling at the Southerly WWTP.

TABLE 6-15a. ESTIMATES OF POLLUTANTS GENERATED PER TON OF SLUDGE INCINERATED

	Estimated Emission Rate in lb/ton Dry Solids	
	Jackson Pike	Southerly
Particulate Matter	1.1	1.1
Oxides of Sulfur	0.102	0.074
Oxides of Nitrogen	2.18	2.18
Cadmium	0.011	0.013
Lead	0.037	0.028
Mercury	0.0065	0.0087
Zinc	0.327	0.24

Emission estimates are based on the following:

Particulate matter emissions are limited to the Ohio EPA standard. Other pollutants are estimated from the difference in the pollutant concentration in the sludge and ash of Jackson Pike and Southerly incinerators prior to emission controls. However, oxides of nitrogen and sulfur oxides rates have been decreased by 80 and 50 percent, respectively, to account for the removal efficiency of the wet scrubbers. Values for other heavy metals, organic matter, and pathogenic organisms are not available. Source: USEPA 1978

TABLE 6-15b. PROJECTED AIR POLLUTANT EMISSIONS ASSOCIATED WITH THE NO ACTION ALTERNATIVE

	Estimated Emissions (lb/day) No Action Alternative	
	Jackson Pike	Southerly
Particulate Matter	27.5	49.28
Oxides of Sulfur	2.55	3.3152
Oxides of Nitrogen	54.5	97.664
Cadmium	0.275	0.5824
Lead	0.925	1.2544
Mercury	0.1625	0.3898
Zinc	8.175	10.752

Values are based on current production of 64 dtpd of dewatered solids and 70 percent incineration at Southerly, and 50 dtpd dewatered solids and 50 percent incineration at Jackson Pike.

TABLE 6-15c. PROJECTED AIR POLLUTANT EMISSIONS ASSOCIATED WITH THE TWO-PLANT ALTERNATIVE

	Estimated Emissions (lb/day) Two-Plant Alternative		
	Jackson Pike	Southerly	Total
Particulate Matter	28.6	15.4	44.0
Oxides of Sulfur	2.652	1.036	3.688
Oxides of Nitrogen	56.68	30.52	87.2
Cadmium	0.286	0.182	0.468
Lead	0.962	0.392	1.354
Mercury	0.169	0.1218	0.2908
Zinc	8.502	3.36	11.862

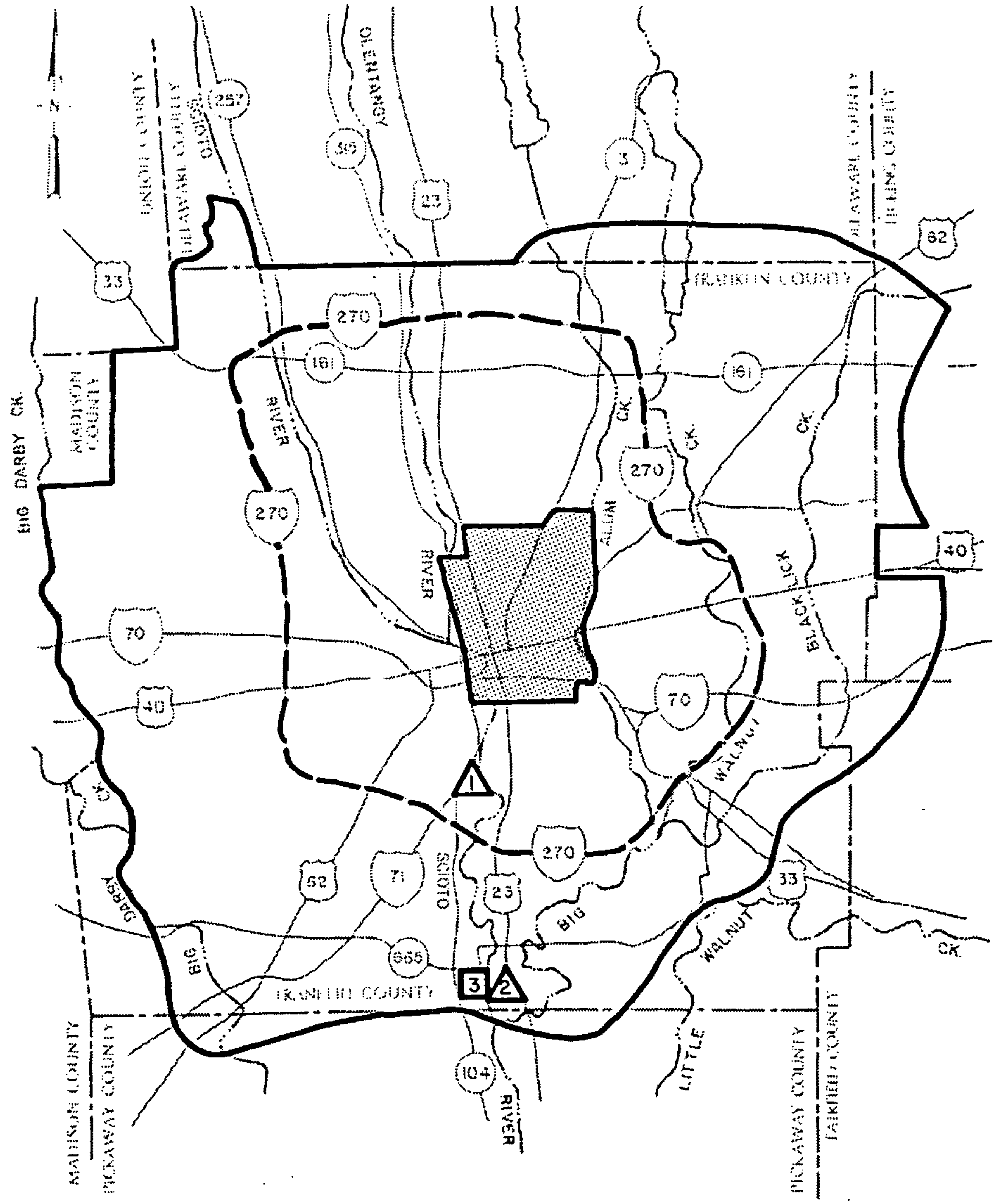
Values are based on projected incineration of 26 dtpd of dewatered solids at Jackson Pike and 14 dtpd of dewatered solids at Southerly. Values for Southerly will be higher when handling overflows from Jackson Pike.

TABLE 6-15d. PROJECTED AIR POLLUTANT EMISSIONS ASSOCIATED WITH THE ONE-PLANT ALTERNATIVE

	Estimated Emissions (lb/day) One-Plant Alternative		
	Jackson Pike	Southerly	Total
Particulate Matter	0	58.3	58.3
Oxides of Sulfur	0	3.922	3.922
Oxides of Nitrogen	0	115.54	115.54
Cadmium	0	0.689	0.689
Lead	0	1.484	1.484
Mercury	0	0.4611	0.4611
Zinc	0	12.72	12.72

Values are based on the projected incineration of 53 dtpd of dewatered solids at Southerly.

NOTE: The one-plant alternative would generate a greater total amount of emissions per day than the two-plant alternative due to a greater quantity of solids being sent to incineration and a smaller quantity of solids being sent to land application.



JACKSON PIKE WWTP

SOUTHERLY WWTP

SOUTHWESTERLY COMPOST FACILITY

PLANNING AREA BOUNDARY

DENOTES PRIMARY NON-ATTAINMENT AREA FOR TOTAL SUSPENDED PARTICULATE MATTER

ALL AREAS INSIDE THE INTERSTATE 270 LOOP ARE DESIGNATED AS NON-ATTAINMENT OF THE SECONDARY STANDARD FOR TOTAL SUSPENDED PARTICULATES.

FIGURE 6-4
NON-ATTAINMENT AREAS FOR TOTAL SUSPENDED PARTICULATES

TABLE 6-16. POTENTIAL ODOR SOURCES IN SOUTHERN FRANKLIN COUNTY, OHIO

1. Franklin County Replacement Landfill: 3851 London-Groveport Road

   Size: 118 acres
   Types of Waste: municipal, commercial, industrial
   Opened: August 1985
   Unaware of any odor problems

2. Model Landfill: 3299 Jackson Pike

   Size: approximately 100+ acres
   Types of Waste: municipal, commercial, industrial
   Closed: August 1985. Adequate cover.
   Odors are noticeable. Methane gas recovery is proposed.

3. Jackson Pike Landfill: 2460 Jackson Pike

   Size: approximately 30-40 acres
   Types of Waste: municipal, commercial, industrial
   Operated from 1969 to 1978. Adequate cover.
   In 1979 sludge from the Jackson Pike Sewage Treatment Plant was stored on top. Three to four feet of sludge remains and is potential source of odors.

4. Columbus Municipal Refuse Electric Plant - 2500 Jackson Pike

   Six 238 million BTU input coal or refuse derived fuel steam generating boilers.
   Air emissions control equipment include cyclones with electrostatic precipitators.
   Refuse composition varies between summer and winter.
   Short-time storage of refuse may allow odors to become apparent.

5. Sloter's Demo Site: South of Southview Park, East of I-71.

   Size: 10 acres
   Types of Waste: demolition
   In operation.
   A potential source of odor as material was dumped into water.

6. Cowan's Demo Site: South of Southview Park, East of I-71.

   Size: 15 acres
   Types of Waste: demolition
   In operation.
   A potential source of odor as material was dumped into water.

TABLE 6-16. POTENTIAL ODOR SOURCES IN SOUTHERN FRANKLIN COUNTY, OHIO (CONT.)

7. Craig's Demo Site: South of Southview Park, East of I-71.

   Size: 15 acres
   Types of Waste: demolition
   In operation.
   A potential source of odor as material is being dumped into water.

8. Scott's Demo Site: 1377 Harmon Road

   Size: approximately 100+ acres
   Types of Waste: demolition
   In operation.
   A potential source of odor as material is being dumped into water.

9. J & B Mining: 3041 Jackson Pike

   Size: approximately 20 acres
   Types of Waste: demolition
   Opened in 1982 and is in operation today.
   Low odor potential.

10. Loewendick's Demo Site: 715 Frank Road

    Size: approximately 50+ acres
    Types of Waste: demolition
    In operation. Adequate cover.
    Low odor potential.

11. Southerly Waste Water Treatment Plant - Portsmouth Cols. Road

    2 municipal sludge incinerators
    2 additional incinerators currently under construction
    Incinerators may result in odors.

12. Southwesterly Composting - East of SR 104, south of SR 665.

    200 wet tons/day steady-state capacity
    300 wet tons/day short-term capacity
    Composting processes may result in odors.

13. Jackson Pike Waste Water Treatment Plant - Jackson Pike Road

    2 municipal sludge incinerators
    Incinerators and digested sludge used in land application and may cause odors.

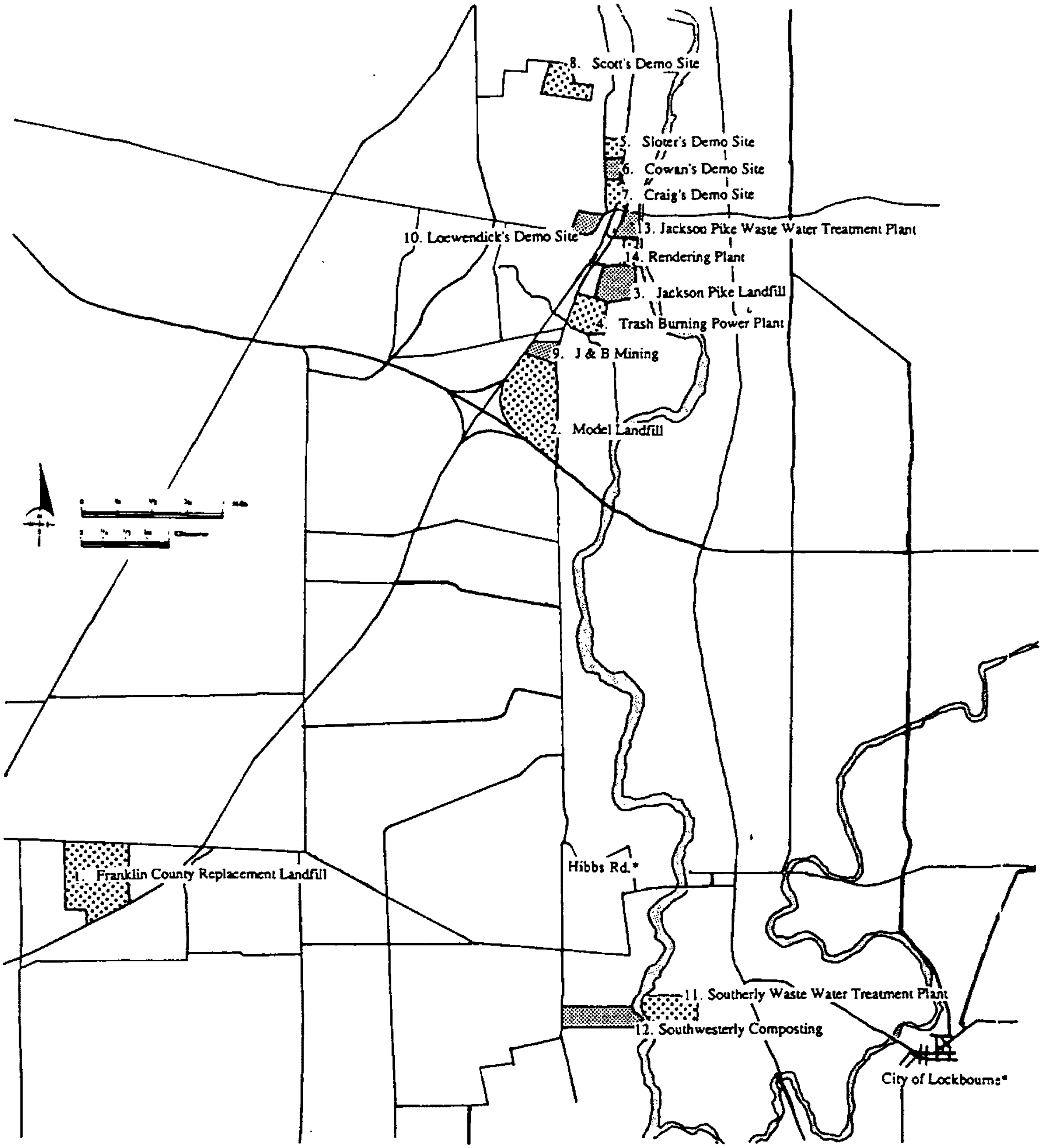
TABLE 6-16. POTENTIAL ODOR SOURCES IN SOUTHERN FRANKLIN COUNTY, OHIO (CONT.)

14. Inland Products, Inc. Rendering Plant - Frank Road and Scioto River

Rendering process/product, tallow storage.
Air emissions control equipment include air evaporator cooler with non-condensibles transferred to boilers for incineration, and chlorine scrubbing of all fugitive emissions.
Typical processing time: 3 pm to midnight, 6 days per week.
Control malfunctions may allow odors to escape.

Other regional potential odor sources include Columbus and S. Ohio Electric Boilers in Pickaway County, Container Corporation Paper Plant in Circleville, Mead Paper Plant in Chillicothe, and locations of various agricultural activities.

Source: McCarthy, 1986.



* SITE OF NUMEROUS ODOR COMPLAINTS

SEE TABLE 6-16 FOR ADDITIONAL INFORMATION ON POTENTIAL SOURCES.

FIGURE 6-5
LOCATIONS OF POTENTIAL ODOR SOURCES IN SOUTHERN FRANKLIN COUNTY

Recently the city has designated an Odor Control Committee comprised of city employees, chemists, and local residents. The Committee has designed an odor control action plan, which involves the employment of an independent consultant to conduct a qualitative study of the problem, with specific efforts aimed at correlating odor complaints with plant operations and meteorological conditions. It is expected that with the results of these and other proposed studies, the odor source(s), including individual processes within a facility, will be identified. This knowledge can then be used to establish feasible control measures designed to alleviate or substantially reduce the odor levels. This may be accomplished through decreasing the emissions of odorants and/or enhancing the dispersion potential of the source.

6.2.4.1 No Action Alternative

The no action alternative will result in continued use of both the Jackson Pike and Southerly WWTPs, with only normal maintenance.

Air quality impacts of the no action alternative, excluding odors, are essentially neutral in that they do not degrade present ambient air quality. However, this alternative does not provide for further progress toward achieving compliance with ambient air quality standards for particulate matter. Odor impacts from the no action alternative would be represented by a continuation of current problems.

6.2.4.2 Two-Plant Alternative

Direct air quality impacts associated with the two-plant alternative will include short-term, adverse air quality impacts experienced during the construction phase of the project, with the generation of fugitive dust and increased vehicular exhaust. These impacts will be concentrated in the locale of both the Jackson Pike and Southerly facilities. Project specifications will include provisions for minimizing such impacts through the use of practical mitigating measures, such as watering of haul roads and exposed soil.

Operation of the two-plant alternative is not expected to result in any long-term deleterious impacts on air quality. Based on current operating records, the operations at Southerly produce approximately 64 dtpd of dewatered solids, of which 45 dtpd are incinerated. The two-plant alternative substantially decreases the amount of solids processed through the incinerators at Southerly due to the incorporation of anaerobic digestion in the processing scheme. An approximate 70 percent reduction in the amount of dewatered sludge incinerated compared with current conditions would be observed. Consequently, a corresponding reduction in air pollutant emissions from the Southerly incinerators would result. The two-plant alternative would require sludge incineration at Jackson Pike consistent with current practice and does not provide for further progress toward achieving the NAAQS for particulate matter. Table 6-15 provides an estimate of emissions from incineration associated with the two-plant alternative as well as the one-plant and no action alternatives.

Odor impacts will not occur as a direct impact of the construction phase. However, operation of the two-plant alternative should result in a reduction in ambient odor due to the reduction in the usage of the incinerators at Southerly which should reduce to some extent the occurrence of nuisance odors, which are characteristic of burnt sewage odors. The 25 percent increase in the amount of solids composted will result in increasing the odor potential, which may or may not be offset by process changes, renovations, and the installation of new units, which are expected to reduce the occurrence of earthy sewage odors characteristic of this facility through the reduction of moisture and maintenance of optimum temperature, pH, and oxygen content through improvements to aeration and dewatering at the Southwesterly Composting. However, the potential for odorous emissions from the operation of the incinerators and solids handling facilities to impact local residents is dependent on meteorology. Therefore, expected impacts of these changes on the potential for emissions from these facilities to result in nuisance odors cannot be quantified without further analysis.

6.2.4.3 The One-Plant Alternative

Direct air quality impacts associated with the one-plant alternative will include short-term, adverse air quality impacts experienced during the construction phase of the project, with the generation of fugitive dust and increased vehicular exhaust. These impacts will be concentrated in the locale of the Southerly WWTP and Southwesterly Composting Facility. Project specifications will include provisions for minimizing such impacts through the use of practical mitigating measures, such as watering of haul roads and exposed soil.

Direct impacts associated with the long-term operation of this alternative will include a decrease in pollutant loading similar to that of the two-plant alternative, and a local redistribution of pollutants. The phasing out of the Jackson Pike facility and diversion of all flows to Southerly will result in the following impacts to air quality:

- The increased activity at Southerly will result in higher local levels of ambient pollutants due to the increased quantity of sludge incinerated. The Southerly incinerators would be handling an estimated 53 dtpd of dewatered solids instead of the current value, 45 dtpd. This 18 percent increase in the volume of sludge incinerated at Southerly would result in an increase in air pollutant emissions. Likewise, there would be minor increases in emissions of hydrocarbons, carbon monoxide, oxides of nitrogen, and particulate matter from increased vehicular activity.
- Local air quality near the Jackson Pike facility would improve due to the reduction of emissions from the incinerators.

Because the Jackson Pike WWTP is located in a more industrial locale, and in a region that exhibits a higher ambient level of particulate matter than that of the Southerly WWTP, it may be concluded that implementation of the one-plant alternative may result in a benefit to local air quality by more widely distributing the industrial sources of particulates and providing for further achievement toward compliance with ambient air quality standards for particulate matter. However, without an in-depth modeling analysis, this cannot be reliably predicted.

Ambient odor impacts associated with the long-term operation of the one-plant alternative are not readily discernible. The increase in the quantity of sludge incinerated may be associated with a higher incidence of nuisance odors (characteristic of a burnt sewage odor); however, it is expected that the operation of two new incinerators, which will be on-line at Southerly in the near future, will provide further process control and result in a lessening of nuisance odor generation.

Similarly, an increase in the amount of waste composted may be associated with a higher incidence of nuisance odors; however, proposed process changes, renovations, and the installation of new units in conjunction with this alternative should alleviate to some extent the potential for the generation of nuisance odors. In particular, the reduction of moisture and maintenance of optimum temperature, pH, and oxygen content through improvements to aeration and dewatering at the Southwesterly Composting Facility will reduce the occurrence of earthy sewage odors characteristic of this facility. However, the potential for odorous emissions from the operation of the incinerators and solids handling facilities to impact local residents is dependent on meteorology; therefore, expected improvements, or the expected decrease in the potential emissions from these facilities to result in nuisance odors, cannot be quantified without further analysis.

At Jackson Pike, it is clear that the phasing out of operations will result in reduced emissions of odorous compounds from the incinerators and associated facilities; however, this area has not been associated with a majority of the recorded odor complaints.

6.2.4.4 Conclusions

Air quality impacts do not differ significantly between the various alternatives. Pollutants generated through incineration of sludge will not cause violations of NAAQS beyond those currently found in the Columbus area. Odor problems should decrease under either of the action alternatives and may increase slightly under no action.

6.2.5 Soils/Prime Agricultural Land

The physical and chemical characteristics of local soils will govern the extent of impacts from two segments of the proposed improvements to the Southerly and Jackson Pike WWTPs. First, the direct impact of soil disturbance during the construction of new facilities and the removal of existing facilities will result in exposure and accelerated erosion within the limits of the project site. Second, the land application of anaerobically digested waste activated sludge to agricultural lands will modify the composition of the existing soils. The impact of both segments of the project will involve areas that have been designated, based on soil classification, as "prime agricultural" lands.

The land application of anaerobically digested waste activated sludge is a well-known and accepted method of solids management. Potential adverse impacts of land application include heavy metal contamination, nutrient overloading, and pathogenic contamination of soils; however, if properly regulated and implemented, these impacts are minimal and easily controlled. Potential benefits to the affected lands include increased productivity and enrichment of existing soils. In general, the benefits greatly outweigh the adverse effects.

The OEPA provides oversight to the land application program, which follows the guidelines presented in their Land Application of Sludge Manual (OEPA 1985b). Under this program, the application rate is based on both the concentration of cadmium contained in the sludge and the physical and chemical capacity of a given soil to assimilate this applied volume of sludge. The assimilative capacity is soil specific; thus, it is impossible to quantify accurately the acreage of land required for future land application needs. The prime agricultural lands involved in this practice will have two short-term restrictions placed on their potential uses. First, lactating dairy animals should not be grazed on these lands for one year. Second, vegetable crops that may be eaten raw should not be grown on these lands for 1 year.

6.2.5.1 No Action Alternative

This alternative would involve the continuation of current practices. No new construction would occur, therefore, no additional soil erosion would occur due to construction. The current solids management program at Jackson Pike includes land application of roughly half of the sludge produced (25 dtpd). This practice has proven successful, and no contamination or adverse human health problems have been reported. None of the sludge produced by the Southerly WWTP is land applied.

6.2.5.2 Two-Plant Alternative

Under the two-plant alternative, there will be no additional land **outside the current site boundary** required for construction of the proposed upgrading of the Southerly **or Jackson Pike** WWTP.

Under this alternative, roughly 38 dtpd of sludge will be land applied, 13 dtpd from Southerly and 25 dtpd from Jackson Pike. Based on 1985-1986 cadmium concentration figures and a range of soil assimilative capacities typical for this region, an application rate of 3.4 to 5.1 dry tons per acre per year can be estimated. This results in an annual land requirement of 2,755 to 4,133 acres per year. Comments from OEPA and Columbus indicate that site lives will be limited to 16 years because of zinc concentrations. Based on the city's estimate of 200,000 acres available for land application within 40 miles, site availability should not be a problem. As explained above, current land application operations have proven successful with no reported contamination or adverse health effects; this performance should continue based on current guidelines.

6.2.5.3 One-Plant Alternative

Under the one-plant alternative, the quantity of sludge to be land applied is estimated at 25 dtpd. As explained earlier, based on 1985-1986 cadmium concentration figures and a range of soil assimilative capacities typical for this region, it is estimated that the application rate will be limited to 3.4 to 5.1 dry tons per acre per year. Based on these application rates, the one-plant alternative will require 1,832 to 2,748 acres per year. Based on the city's estimates of site availability and estimated quantity of solids to land application, no significant impacts are anticipated.

No significant impacts are forecast to area soils or prime agriculture land under any of the alternatives.

6.3 ENVIRONMENTAL CONSEQUENCES - BIOLOGICAL ENVIRONMENT

6.3.1 Terrestrial and Wetland Biota/Habitat

6.3.1.1 No Action

Implementation of the no action alternative and continued operation of the Columbus wastewater facilities should not create substantial impacts to terrestrial biota. However, some minor impacts may occur on vegetation along the Scioto River banks. Nutrient enriched waters may support higher growth rates of plants that are flooded periodically by the river, thereby increasing the food supply of wildlife feeding on these plants. The Scioto River is used heavily by waterfowl, most of which feed on plants. These animals would benefit from nutrient enriched waters (Watts 1987). Waterfowl also use Scioto River waters for breeding and to escape predators, and these activities would not be affected by degraded water quality from the unimproved treatment facilities (Watts 1987). The no action alternative will not impact wetlands.

6.3.1.2 Two-Plant Alternative

No impacts to previously undisturbed terrestrial habitat are expected under the two-plant alternative. The two-plant alternative will not impact wetlands.

6.3.1.3 One-Plant Alternative

Impacts to terrestrial habitat and biota under the one-plant alternative will result from: 1) extension of the Interconnector across the Scioto River and part of the flood plain and 2) elimination of the discharge from the Jackson Pike WWTP.

Construction of the river crossing will have locally significant impacts on terrestrial biota, primarily vegetation. The local fauna will be displaced, but should be able to find refuge in similar habitats nearby.

The banks of the Scioto River in the vicinity of the river crossing are lined with trees indicative of riparian habitat. Observation of the site in January 1987 indicated the dominant tree species were red maple (Acer rubrum), box elder (Acer negundo), and poplar (Populus tremuloides). Less common species were sycamore (Platanus occidentalis) and hackberry (Celtis occidentalis).

The stands of trees on the east and west banks differ in several respects. Trees on the east bank form a swath about 10 feet wide bordering the river like a ribbon. The stand on the west bank is much wider, extending about 400 feet back from the bank at the site of the crossing. The floodplain on the west bank is broad and rises in elevation gradually with distance from the river. The east bank is steep and resembles a levee or the cut bank side of a meander. The trees on the east bank are considerably smaller in diameter and height than those on the west, and understory growth is denser on the east side, indicating the east stand is younger than the west. Aerial photography of the proposed crossing site, taken April 6, 1976, shows an absence of trees on the east bank and a fairly dense stand on the west bank. This confirms the youth of the east bank stand.

It is possible that the land near the banks of the Scioto at the site of the river crossing could be classified as wetland. The area is subject to flooding of short duration (primarily from October to June); however, the soils are not listed as typical of those that support wetland plants or animals, in the Franklin County Soil Survey (Soil Conservation Service 1980a). The west bank more strongly resembles a forested floodplain than the east because it has larger trees with little understory growth or ground cover. Evidence of overbank flooding on the east bank was apparent during the January 1987 site visit because the shrubs and grasses were uniformly flattened within approximately 20 to 60 feet of the bank. The east bank has been disturbed recently by clearing and farming and is possibly in a transitional state. Areas to the north and south of the east bank river crossing bear a stronger resemblance to a typical forested wetland and have apparently not been disturbed as recently as the crossing zone.

Based on soils classifications and direct site observations, the specific areas to be directly impacted by the one-plant alternative are not considered to be wetlands. Therefore, the one-plant alternative, as proposed, will have no significant impacts on wetlands.

Construction on the west bank will destroy trees of substantial age and size and disrupt a mature forest habitat. **Such action reduces the amount of suitable habitat for the Indiana Bat and increases the threat to this federally endangered species.** Regrowth to the present state will take decades. Construction on the east bank will have a less severe impact on habitat because the trees are younger and the stand is much narrower. Regrowth to the present state, based on the aerial photography mentioned earlier, should require approximately 10 years. However, the east bank is much steeper than the west and will be subject to more severe erosion problems until vegetative cover is re-established.

It is advisable to retain the maximum amount of vegetation possible on both banks to reduce erosion. When construction is completed, efforts should be made to restore the river banks to their present slopes. This will ensure that a similar forest community will revegetate the area (see Table 6-14 for additional mitigating measures proposed for the one-plant alternative.)

In addition to crossing the Scioto River, pipes carrying flows from the Interconnector sewer will traverse a field, located to the north of the Southerly WWTP, in order to connect with proposed headworks. The field, covering about 120 acres, is owned by the city of Columbus, Division of Sewerage and Drainage, and is currently leased to a farmer for crop production. The field is considered prime agricultural land, but was not planted during 1986. A site visit in January 1987 determined vegetation in the field to be dominated by rapidly growing grasses and woody shrubs. The condition of vegetation just behind the river bank indicated the field recently had been flooded. Vegetation was flattened in a range of 20 to 60 feet from the river bank. Conversation with Southerly WWTP personnel during the site visit indicated flood waters may exceed that distance during storms and that such flooding was not uncommon.

Proposed activities in the field will result in removal of vegetation over the trench and construction easements. Because the vegetation is only 1 to 2 years old, it will be easily replaced after construction is completed. Similar fields exist nearby and wildlife in the area will not be forced long distances to find suitable habitat. Tree lines will be left intact.

Erosion of soil poses a potential threat to area habitat. Construction should be undertaken during the summer when rainfall and river flow are lowest. The field should be reseeded before the weather becomes too cold to prevent rapid regrowth of vegetation. Clearing the field in portions would be preferable to clearing the entire field at once. Recommendations of the city of Columbus for mitigative measures pertaining to this part of construction are listed on page one of Table 6-14.

The impacts on terrestrial habitat and agricultural land from Interconnector construction are considered minimal and can be easily mitigated (see Table 6-14). Any additional localized impacts resulting from headworks expansion of Southerly are also considered minimal and easily mitigated. Construction of the new headworks will occur on the existing plantsite.

Elimination of Jackson Pike WWTP may affect birds near the plant. A wide variety of bird species, including several rare species, have been observed at the plant and it has been noted as a good birding site in Ohio (Thomson 1983). Great Blue Herons and Belted Kingfishers have been known to visit the ponds and settling basins at the Jackson Pike site and the brushy edge vegetation surrounding the ponds provides habitat for a variety of songbirds. The sludge ponds are visited by shorebirds from April through October. Rare shorebirds sighted here include the Piping, Lesser Golden, and Black-bellied Plovers, Red-necked Phalaropes, and the Long-billed Dowitcher. A pond adjacent to the sludge pond attracts waterbirds, including the Blue-winged Teal, Wood Ducks, and American Coots. This pond also attracts shorebirds when the water level is low.

Effluent from the plant also provides river habitat for waterfowl during the winter months when the reservoirs north of Columbus become frozen. It keeps the river water warm, making it a source of food and protection to migrating stocks (Watts, 1987). Closing Jackson Pike would eliminate this habitat. Because the Scioto is a major migration route, the passage of birds is not likely to change; however, their distribution along the river probably will change. The distribution probably will become more dispersed. Visits of rare birds to the area will decrease to the extent that they are presently attracted by open water habitat provided during the winter. Depending on habitat requirements of rare species, they may find suitable habitat elsewhere or suffer mortalities. The removal of open water habitat in the Scioto River during winter, through elimination of Jackson Pike effluent, will diminish waterfowl visits in general.

6.3.2 Aquatic Biota/Habitat

6.3.2.1 No-Action

Water quality in the Scioto River, between Columbus and Circleville, is degraded by point source and general non-point runoff from the metropolitan areas. The key water quality problem is considered to be low DO. Although the low DO problem is clearly related to discharges from the Jackson Pike and Southerly WWTPs (degraded fish populations have been associated with the DO sags resulting from these two point sources), other sources contributing to the problem include the Whittier Street CSO and general urban runoff.

Implementation of the no-action alternative will result in continuation of the current DO problems and related aquatic habitat degradation in the Scioto River below Columbus. Impacts will be most severe in the summer, as the Jackson Pike plant is currently unable to meet summer ammonia limits and unable to consistently meet summer $CBOD_5$ limits. Under this alternative, any significant changes in DO conditions in the Scioto River below Columbus will be more directly related to possible changes in the nature and amount of Whittier Street CSO and urban non-point loadings (the other principal sources presently contributing to the current DO problem). Because the city of Columbus is currently studying the CSO problem with the objective of decreasing the CSO related pollutant loadings to the Scioto River, DO conditions in the Scioto River may improve in the future, due to factors unrelated to the Jackson Pike WWTP. However, improvements in DO conditions related to diminished CSO loadings may be at least partially offset by increased urban non-point loadings associated with projected future population growth in the Columbus area.

Implementation of the no-action alternative will also result in a continuation of the current problems related to the impacts of high residual chlorine in the WWTP effluents since Jackson Pike and Southerly have no dechlorination facilities. In the event that CSO loadings from Whittier Street are decreased and DO levels increase in the Scioto River independently of the treatment plants, the impacts of the continuing high chlorine loadings from Jackson Pike and Southerly would represent a locally significant obstacle to recovery of the aquatic habitat.

Under the no-action alternative, pollution intolerant species will continue to be excluded from the affected reach of the Scioto River due to mortality, lowered reproductive success, and/or avoidance (OEPA 1986a). The aquatic community will continue to be dominated by a reduced number of tolerant species. If water quality conditions deteriorate further (as could result from no change in either the Jackson Pike WWTP or Whittier Street CSO, but a general increase in the Columbus area population), pollution tolerant species will suffer a loss of biomass followed by a loss in density (OEPA 1986a). The more sensitive of the tolerant species which would be lost first, under a scenario of deteriorating water quality conditions, including the round bodied catostomidae, basses, crappies, freshwater drum, and catfishes (these species have increased their numbers in the Central Scioto over the past five to seven years, reflecting gradually improving water quality conditions during this time period). Certain pollution tolerant species may increase in biomass and density with gradual deterioration of water quality, including gizzard shad, carp and goldfish, and the deep bodied suckers. Increased hybridization would also be experienced under the conditions of biological stress resulting from a decline in water quality. This effect, combined with the loss of less tolerant species and an increase in tolerant species, would be reflected in a general decline in the biotic index.

The benthic community will respond to the scenarios of no change or gradual deterioration in water quality in patterns similar to those discussed for the fish community. Mollusk species are extremely sensitive to wastewater effluent and will not be able to recolonize the affected segment of the Scioto River under the no-action alternative.

6.3.2.2 Two-Plant Alternative

Upgrading both treatment plants will result in no effluent-related water quality violations and subsequent water quality improvements. Such action will have a favorable impact on aquatic biota and habitat. Sensitive species that currently inhabit the area should persist and increase in abundance. New species may move into the area and increase community diversity.

Decreased turbidity will create a more favorable habitat for turbidity-sensitive species. These species, such as darters, which now inhabit Scioto River tributaries, may begin to move into the Scioto mainstream in greater numbers.

Although violations in DO standards will not occur under the two-plant alternative, residual wasteloads in the effluents from both WWTPs will continue to exert a DO demand in the receiving water, and a reduced DO sag will persist below both treatment plants. As a result, fish communities will continue to show some degradation as oxygen levels are depressed downstream. These effects will be most noticeable in the sections of the river where the residual DO sags are most critical (i.e., where DO levels approach 5.0 mg/l). Effects of degradation in fish communities include increased numbers of omnivorous fish relative to insectivorous fish, increased hybridization, (lowered biotic index) and decreased diversity. In all fish surveys conducted on the Scioto River from 1979 to 1986, degradation of fish communities occurred in the vicinity of the DO sags associated with discharges from the Jackson Pike and Southerly WWTPs. Although the structure of the benthic community will also improve under the two-plant alternative, benthic communities will continue to exhibit decreased abundance and diversity in areas experiencing the oxygen sag.

Over the past 6 years, the fish community in the Central Scioto has improved. The two-plant alternative will result in a continuation and acceleration of this trend. Although significant improvements will occur, the collective, continuing impacts of WWTP effluents, general urban runoff, and the Whittier Street CSO will prevent free biological recovery in the Central Scioto, when compared with comparatively unimpacted segments upstream of Columbus and downstream of Circleville.

6.3.2.3 One-Plant Alternative

Aspects of the one-plant alternative that will impact aquatic habitat and biota are the following: 1) elimination of Jackson Pike WWTP; 2) upgrading and expansion of Southerly WWTP; and 3) construction at Southerly WWTP.

Between Jackson Pike and Southerly, the impacts of the one-plant alternative will be strongly flow-dependant. Under most flow conditions, elimination of the Jackson Pike effluent loading will result in improved water quality conditions, to the extent that this effluent affects water quality. These improvements will result in favorable aquatic community responses, as discussed under the two-plant alternative.

However, under low flow conditions, pollutant loadings from background sources (Whittier Street CSO and urban runoff) will persist, while the capacity of the river to assimilate this wasteload will be sharply diminished, through the elimination of nearly 90 percent of river flows. Therefore, under low flow conditions, it is hypothesized that elimination of the Jackson Pike effluent will result in degraded water quality conditions (see Section 6.2.1) and negative impacts on aquatic biota. Although these impacts will likely be short-term, dependant on the length of any critical low flow conditions during summer months, the impacts could be severe. Because flow will be significantly reduced, aquatic species forced to retreat to pools will be especially susceptible to impaired water quality conditions which may develop at low flow.

A significant loss of benthic habitat area will result from the reduction in river flows. Under critical low flow conditions, riffle areas will be reduced, significant areas of benthic habitat will be exposed to drying and pools could become very shallow and still due to the reductions in water levels associated with the elimination of Jackson Pike flows (see Section 6.2.2). These conditions could disrupt spawning, feeding, and migratory activities of fish and water levels. Depending on the length of time that the benthos is exposed and on the capability of individual species to withstand such impacts, significant reductions in benthic productivity could occur in selected riffle areas of the Scioto River between Jackson Pike and Southerly under the one-plant alternative.

Downstream of Southerly, the impacts on the one-plant alternative on aquatic fauna are difficult to assess because expected changes in water quality have not been clearly described. Because the level of wastewater treatment will be improved under this alternative, concentrations of BOD and, to a lesser extent, NH_3 will be lower in the effluent. However, by routing all flows to Southerly, the entire residual wastewater DO demand from Columbus will be released to the river at a single location. Because reductions in nutrient concentrations in the effluent (other than ammonia) will be minimal, and because the total volume of wastewater released at Southerly will be significantly increased, without any increase in river flows below Southerly, a proportionate increase in residual wastewater DO demand from Southerly will result. This residual DO demand will be assimilated by the river, and a DO sag will be evident in that portion of the river where the DO demand is assimilated. Although the 5.0 mg/l DO standard will not be contravened, the length of river affected by the sag will be increased. Because no changes will occur in flows, the area of the river affected by the DO sag will be extended in the downstream direction.

Degradation of aquatic communities can be expected in the vicinity of the DO sag and in the additional portion of the river that will become exposed to a higher level of water pollution. Effects of degradation have been discussed under the no action alternative and include reduced diversity, higher percentage of omnivorous species relative to insectivorous species, and increased hybridization (depressed biotic index). It is possible that the Circleville Riffle will be exposed to higher levels of pollution. Currently, the aquatic community in the vicinity of the riffle is considered to be in very good condition. It supports a high diversity of species. In the 1960s and 1970s it was seriously degraded and has only recently recovered in the early 1980s. These factors indicate the community may be sensitive to habitat degradation. It is possible that this community will experience degradation under the one-plant alternative, reversing the recent trend of improved conditions.

Construction across the river bed of the Scioto may have a localized, short-term but severe impact on aquatic habitat and biota. Impacts will stem primarily from increases in sediment transport and deposition downstream of the construction site. Fish will suffer fewer short-term impacts than benthos as they can avoid the construction site, but stresses and mortalities should be expected. Localized populations may be reduced if riffles used for feeding and spawning become covered with sediment. Increased turbidity will also temporarily damage habitat of species which use pools, due to lowered oxygen levels caused by organic loads associated with eroded soils. The distance affected and the degree of stress depend on the amounts of sediment which will ultimately enter the water; however, mitigation techniques proposed for this project alternative (see Table 6-13) should minimize these impacts.

To minimize damage to aquatic biota, construction will be scheduled when river flow is low. Also, construction during springtime will be avoided not only because of potential high flows, but also because most, if not all, fish in the Scioto spawn at that time (Yoder 1987b). These and other mitigative measures proposed by the city of Columbus as part of the one-plant alternative are listed on pages 2 and 3 of Table 6-13.

6.3.3 Endangered Species/Habitat

6.3.3.1 No Action

Terrestrial endangered species should not be affected by the no action alternative. However, the aquatic endangered species habitat will suffer due to continued degradation of water quality. Several federal and state designated endangered and rare fish have been sighted in the Central Scioto River mainstem within the past 5 to 7 years and those species are most likely to be disturbed. The species are the river redhorse, mooneye, goldeye, and Tippecanoe darter. Poor water quality will exclude them from the affected portions of the Scioto River through avoidance, lowered reproductive success, and/or mortality. The degraded habitat will prevent their populations from growing in the affected areas. The shortnosed gar, lake chubsucker, and paddlefish have been sighted in the Central Scioto, but generally favor a habitat type not well-developed in the Scioto River. This species probably would not establish a population in the river even under natural conditions (Yoder 1987b).

Small populations of other endangered or rare fish live on tributaries to the Scioto River where water quality is better. The Central Scioto River mainstem potentially could provide habitat for these species, if water quality was improved. Continued degradation of water quality will decrease the chances for these fish to expand their ranges into the Scioto River. The restriction of available habitat will prevent populations from increasing in numbers. These species include the bluebreast darter, slender head darter, spotted darter, and blacknose shiner.

The only federally listed endangered fish in the area is the Scioto River madtom. The fish was last sighted in Big Darby Creek in 1957, although efforts to find it were made as recently as 1981. Implementation of this alternative will probably not have a direct impact on the fish, if it still exists in Big Darby Creek, but it will preclude any potential for the expansion of the present habitat.

Several state endangered mollusks may inhabit Big Darby Creek and the Circleville Riffle of the Scioto River. They are native to the Central Scioto River, but are highly sensitive to pollution from WWTP effluent (Stansbury 1986). Continued degradation of the Scioto River below the WWTPs will depress the potential for these species to re-enter their former habitat. Based on surveys conducted from 1955 to 1970, species that may currently live in the region are the cob shell, Simpson's shell, northern riffle shell, fragile heelsplitter, and ridged pocketbook (Stansbury 1986, 1987). Although there have been no recent surveys of the Scioto River, a survey of Big Darby Creek conducted within the past 3 years identified the following species: smooth minishell, smooth cob shell, northern club shell, fragile heelsplitter, and northern riffle shell. A few endangered mollusks have occasionally been sighted in the Scioto River in earlier surveys.

6.3.3.2 Two-Plant Alternative

Endangered aquatic species should benefit from implementation of this alternative. Improvements in water quality should allow the fish species that have been captured in the Scioto River (river redhorse, mooneye, gold eye, and Tippecanoe darter) to increase in abundance and allow those species inhabiting tributaries (bluebreast darter, slenderhead darter, spotted darter, and blacknose shiner) to expand their ranges. Specific information on the tolerances of these species to turbidity and lowered DO is not available, preventing an assessment of the conditions under which these species would establish permanent breeding populations. Increased habitat for feeding, however, should benefit populations. Improved water quality in the Scioto River may increase potential for the Scioto madtom population to expand its numbers and range.

Mollusk populations should benefit from this alternative because it could offer them an expanded habitat and therefore the opportunity to increase in abundance. Because they are sensitive to WWTP effluent, they would most likely move into areas further downstream from outfalls. As larvae, the unionid mollusks are carried to new environments on gills of fish. Little information is available on suitable fish species, but freshwater drum is believed to be one such species (Stansbury 1987). Freshwater drum is a pollution sensitive species. The potential for increased numbers of freshwater drum in response to improved water quality also may play a role in the migration of mollusks.

6.3.3.3 One-Plant Alternative

Long-term impacts of this alternative stem from: 1) modified water quality below Jackson Pike and Southerly, and 2) reduction in flow between the Jackson Pike and Southerly WWTPs. Short-term impacts stem from construction at the Southerly WWTP site.

Below Jackson Pike, water quality will be somewhat improved under most flow conditions. These improvements may encourage rare, threatened and endangered aquatic fauna to increase in range and abundance, entering the Scioto River from tributaries or less impacted river areas further downstream. Species most likely to migrate from downstream areas include the river redhorse, mooneye, goldeye, and Tippecanoe darter. Species most likely to move into the river from tributaries include the bluebreast slenderhead and spotted darters, and the blacknose shiner. **(Although some of these species have already been observed is this area, current migration patterns could be affected.)**

Under the one-plant alternative, however, the critical low flow condition will be the limiting factor on re-colonization of the Upper Scioto River (between Jackson Pike and Southerly) by rare, threatened, and endangered species. Because of the nearly 90 percent reduction in river flows which will result from this alternative during low flow conditions, residual DO demands from other upstream sources (urban runoff and the Whittier Street CSO) will result in degraded water quality in shallow, still pools during warm weather. Under these conditions, the sensitive species will be reduced or eliminated, cancelling the benefits to water quality which will occur under higher flow conditions.

The nearly 90 percent reduction in river flows between Jackson Pike and Southerly under low flow conditions, will exert additional negative impacts on aquatic fauna due to the physical effects of reduced flows and diminished habitat area. Of the species mentioned above, the river redhorse is thought to be particularly sensitive to slow and intermittent flows. Reduced velocities associated with low flow could stress this species and possibly limit its range. Because many of the species feed in riffles, drying out of riffles also could hinder the movement of these species into the affected river segment. Unionid mollusks favor riffle habitats and require shallow to medium depth, fast flowing water for feeding. Should mollusks move into the area, a dryout could cause mortalities and stress the population. Reproduction of mollusks is dependent on swift currents and fertilization occurs in fall. It is possible that low flow conditions could prevent permanent expansion of the mollusk population into this reach of river.

Construction at the Southerly WWTP may threaten endangered terrestrial and aquatic fauna. The loss of trees along the Scioto's banks may damage potential habitat for the federally endangered Indiana Bat. The bat nests in shaggy barked trees, preferably the shaggy barked hickory, along river banks in summer. Because the bat has been sited recently in nearby Pickaway County, precautions should be taken to protect its nesting habitat. Tree removal associated with implementation of the one-plant alternative, if selected, should be timed to avoid the May through August (Multerer 1986) nesting periods. Because this alternative would result in an insignificant incremental reduction in habitat area available to this species throughout its range, this potential impact is considered minimal.

Endangered fish with the greatest potential to be effected by construction at Southerly include those most recently found in the area: river redhorse, mooneye, and goldeye. These species are all highly sensitive to turbidity. It is likely that individuals will be able to avoid the area, but if not, they may be stressed or suffer mortalities. The Tippecanoe darter may be at risk if substantial quantities of sediment are carried as far downstream as the Circleville Riffle. However, this darter has not been sighted above Circleville for the past 5 to 7 years. Should sediment concentrations increase markedly in lower Big Walnut Creek, the resident population of slender-head darters might be disturbed, as these darters are also highly sensitive to turbidity. Because most of the endangered fish spawn in spring, construction should not be scheduled at this time. Mitigative measures outlined by the city of Columbus indicate construction will proceed during a low flow period, which should not coincide with spawning. The impact of construction on fish should be temporary and should not prevent these species from expanding their ranges and numbers once the habitat recovers (Yoder 1987b).

Because no mollusks are believed to live in the Scioto River near the Southerly WWTP, construction should not be problematic. In surveys conducted between 1955 and 1970, mollusks were found on the Circleville Riffle and in the banks of lower Big Darby Creek. The riffle is known to support populations of rare, threatened, or endangered fish and may support some unionid mollusks (Stansbury 1987). Should sediment be transported down to the riffle, mollusk populations may be harmed by increased turbidity. Estimates of sediment transport associated with construction are not available; however, it is considered unlikely that any signficant impact would be felt in the Circleville Riffle.

6.3.4 Conclusions

No impacts to terrestrial and wetlands biota/habitat will occur as a direct result of either the no action or two-plant alternatives. Under the one-plant alternative, minimal impact will occur for potential habitat of the Indiana Bat **and piping plover, both** endangered species. Wetlands habitat is not impacted by any alternative.

The one-plant alternative will require removal of a narrow band of forested area on both sides of the Interconnector crossing of the river. This impact will remove mature trees on the west bank and younger specimens on the east bank. Although the removal of forest habitat is signficant and long term locally, the increment is quite small regionally and the overall impact is considered minimal.

Direct impacts associated with construction of the one-plant alternative **would require mitigation.** The city of Columbus has proposed an array of mitigation measures which will minimize the potential impacts of construction.

Elimination of the Jackson Pike WWTP under the one-plant alternative will remove a localized area of attraction to waterbirds, shorebirds, and songbirds, including several rare species. These birds are presently attracted by the ponds and settling basins, the brushy edge vegetation habitat, and the open water of the Scioto River, which is prevented from freezing during winter by the warm effluent. The Jackson Pike site is popular as a birding site due to the variety of species which may be observed at this location.

No significant additional changes in aquatic biota/habitat will occur under the no action alternative, although little recovery of the currently degraded conditions is expected.

Under the two-plant alternative, improvements in aquatic biota/habitat will occur below Jackson Pike and Southerly. Because of the impacts from remaining pollutant sources upstream of Jackson Pike (urban runoff and CSOs), the greatest improvements in aquatic biota/habitat will be realized below Southerly.

The one-plant alternative will improve water quality below Southerly, compared to the no action alternative, but to a lesser extent than the two-plant alternative. This comparatively reduced beneficial impact results from a greater residual wasteload demand discharged at Southerly under the one-plant alternative and the enlarged resulting DO sag, compared to the one-plant alternative. It is possible that this enlarged sag may extend to Circleville and interfere with existing point source dischargers in the Circleville area.

Below Jackson Pike, water quality would be improved under most flow conditions, resulting in an average improvement in aquatic habitat/biota. However, under critical low flow conditions, the continuation of extreme low river flows, resulting from the loss of the Jackson Pike effluent and the remaining background loadings of pollutants (urban runoff and CSOs) may result in short term but severe water quality stress. This stress will result in critical impairment of aquatic habitat/biota and will be the dominating factor in the riverine ecology between Jackson Pike and Sourtherly during the critical warm weather season.

The reductions in river flows, resulting from elimination of Jackson Pike effluent under the one-plant alternative, will further limit aquatic biota/habitat below Jackson Pike through removal of physical habitat. Because critical low flow in the river below Jackson Pike will be reduced by nearly 90 percent under the one-plant alternative, aquatic habitat will be impaired through exposure to drying and reductions in the volume of remaining aquatic habitat. These impacts will be especially severe in shallow riffle areas.

Generally speaking, it is believed that impact to the biological environment would be more significant under the one-plant alternative than under the two-plant alternative. Therefore, the two-plant alternative is preferred.

6.4 ENVIRONMENTAL CONSEQUENCES - HUMAN ENVIRONMENT

6.4.1 Planning and Land Use

6.4.1.1 No Action Alternative

Under this alternative, use of the Jackson Pike and Southerly WWTPs would continue with only minor maintenance. No land acquisition or zoning changes would be necessary and, therefore, no impact would be anticipated.

6.4.1.2 Two-Plant Alternative

No land acquisition or zoning changes will be required under this alternative. Under this alternative, a smaller portion of the Southerly site would be used for wastewater facilities than under the one-plant option. As previously explained this land has already been purchased and disturbed during construction to meet compliance with water quality standards by 1988. In addition, there will be **no expansion outside the current site boundary** of the existing Jackson Pike facility.

6.4.1.3 One-Plant Alternative

No land acquisition or zoning changes will be required under this alternative. Under the one-plant alternative, a larger portion of the Southerly site would be used for wastewater treatment facilities than under the two-plant option. The land required for these facilities already has been purchased by the city and was disturbed and graded as the city pursued construction to meet compliance by 1988. The one-plant alternative will require expansion of the river crossing. The necessary land is already owned by the city and was previously disturbed. Upgrading of these facilities may disturb day-to-day farming activities of several farms located on Route 665; however, these effects will be short-term and minimal.

6.4.2 Noise

6.4.2.1 No Action Alternative

The no action alternative would not involve new construction or its associated noise impacts. Noise from the regular operation of the Jackson Pike and Southerly WWTPs would continue at current levels. These are not considered a nuisance at this time.

6.4.2.2 Two-Plant Alternative

Ambient noise levels near both treatment plants will increase during construction activities. As mentioned above, construction specifications will minimize these effects. Operational noise is not expected to be a nuisance.

6.4.2.3 One-Plant Alternative

Ambient noise levels in the area will increase during construction. The one-plant alternative will result in the concentration of construction activities at Southerly and therefore increase noise levels at that location. However, project construction specifications will include provisions for minimizing these short-term impacts, and, in accordance with standard practice, all construction activities will be performed during regular working hours and all vehicles will be equipped with mufflers. Noise associated with operation of the improvements to wastewater treatment facilities at the Southerly WWTP will occur due to the operation of the machinery and traffic serving the facilities. These increases are not expected to be a nuisance to nearby residents.

6.4.3 Public Health

Adequate disinfection of the effluent from sewage treatment facilities is **required** for the protection of public health **during warm weather months.** Untreated effluent can result in the release of pathogenic microorganisms capable of causing widespread outbreaks of disease. Current disinfection practices at both the Southerly and Jackson Pike WWTPs are successfully controlling the release of pathogenic microorganisms to the Scioto River, as evidenced by low effluent fecal coliform counts. Treatment levels are expected to improve slightly with the upgrading of facilities under either the one- or two-plant alternatives.

Land application of anaerobically digested sludge is a widely practiced method of sludge disposal. The primary public health concern regarding this disposal method is the entrance into the food chain of contaminants contained in the applied sludge. The state of Ohio has issued strict guidelines regulating this practice in order to protect public health interests. Adherence to these regulations under either the no action, one-plant, or two-plant alternatives is expected to protect the public from any adverse health effects.

6.4.4 Energy Use

The energy requirements associated with the upgrading of facilities at Jackson Pike and/or Southerly WWTPs include:

- Gasoline and diesel fuel for construction equipment and for hauling of solids to landfill, land application, or composting.
- Electric power for the operation of pumps, aerators, miscellaneous plant equipment, and heating and cooling.
- Methane gas (produced by anaerobic digestion) for use as an energy supplement within the plants.

The impact of these energy requirements is not projected to deplete local reserves significantly. Current requirements will increase slightly under the two action alternatives as flows increase. The one-plant alternative is estimated to require 10 to 20 percent less energy than the two-plant alternative due to efficiencies of scale.

6.4.5 Economics and Employment

Employment levels at the two treatment plants under the no action alternative would remain constant at approximately 212 persons. Employment requirements are estimated at 135 people for the one-plant alternative and 191 people for the two-plant alternative. The two-plant alternative requires less personnel than the no-action due to more efficient computerized control equipment. Employment requirements are the least under the one-plant option due to economies of scale. These differences are reflected in annual operation and maintenance (O&M) estimates.

The economic impact in the Columbus area of combined capital and O&M expenditures would be roughly similar under the one- and two-plant options. The no action alternative would not provide economic benefits from these expenditures. Quantification of indirect economic benefits cannot be performed at the current level of project planning and financial analysis.

6.4.6 Historic/Archaeologic Resources

Neither the no action nor the two-plant system alternatives will have direct impacts on known historic resources. However, the one-plant option could impact an archaeologic site at the point of the river crossing.

Archaeologic surveys were performed in 1985 by Dr. John Blank in order to evaluate impacts from site work planned by Columbus to meet 1988 compliance with water quality criteria. During Dr. Blank's Phase I and Phase II survey, four sites **of some significance** were identified within the boundaries of the Southerly WWTP site. Dr. Blank recommended a further (Phase III) archaeologic survey. However, at a meeting in March of 1986 the Ohio Historic Preservation Officer (OHPO) approved the initiation of site work necessary to build improvements to comply with water quality limits at the Southerly WWTP; this work has since been completed. Additional construction under the one-plant alternative may still require a further (Phase III) investigation. The OHPO has been contacted to determine the need for this work. At this time, no significant impacts are expected. **Since documentation and recovery of these sites will mitigate potential impacts, a complete Phase III study should be completed before any further expansion occurs.**

6.4.6.1 No Action

The no action alternative will not involve new construction at either WWTP. No impacts to known or unidentifed archaeologic resources are anticipated.

6.4.6.2 Two-Plant Alternative

Impacts to archaeologic resources at the Southerly WWTP under the two-plant option will be minimal. During 1985 Dr. Blank, Professor of Archaeology at Cleveland State University, surveyed the Jackson Pike WWTP site. Dr. Blank estimates that Jackson Pike was built on approximately 20 feet of fill material, isolating any archaeologic resources below from disturbance. For this reason the two-plant alternative should have no direct impact on archaeologic resources at Jackson Pike.

6.4.6.3 One-Plant Alternative

Construction at the Southerly WWTP under this alternative is not expected to disturb archeologic resources identified during surveys in 1985.

The one-plant alternative involves extending four 78-inch gravity sewers across the Scioto River. This may directly impact at least one known archaeologic site. The Ohio State Historic Preservation Officer recommends an archaeologic survey of the site to determine if this site is eligible for the National Register of Historic Places. Since Dr. Blank's original survey uncovered previously unknown sites at the Southerly WWTP site, it is probable that construction activities associated with the extension of the gravity Interconnector Sewer may also disturb unknown resources in the area. An archaeologic investigation of all potential construction areas, including temporary roads and rights-of-way, within the path of the gravity sewer should be undertaken to ensure that these activities do not adversely impact unknown archaeologic resources since these are predicted to occur frequently in this area.

6.4.7 Recreation

Direct impacts on recreational use of the Scioto River are expected to be minimal under either of the system alternatives. Under the one-plant alternative, discharges currently returned to the river at the Jackson Pike WWTP will be shifted to the Southerly WWTP and discharged downstream. Watershed models indicate that this change in discharge location only will affect the water elevation of the river during low-flow periods. The lower section of the Scioto is generally shallow, slow-flowing, and lacking in aesthetic and other qualities that promote recreational use on the northern section of the river. Minor impacts on water elevation will not change the current uses of this area. These include mostly duck hunting and fishing. Boating in this area is largely limited to infrequent canoeing due to water depths, which average 3 feet. None of the alternatives are expected to alter these patterns of use significantly. Fishing on this section of the river, while not as frequent as in areas north of the Greenlawn Dam, is directed toward species adapted to the aquatic ecosystem existing here. The one-plant alternative, while occasionally lowering the river elevation minimally, is not expected to cause so prolonged or significant an impact as to alter the basic ecology of the area and thereby affect recreational use of the Scioto River.

Neither of the project alternatives will affect the park acquisition and conservation easement program, which the city of Columbus is undertaking on the lower Scioto River in accordance with the "Watercourse Plan for Columbus and Franklin County.

6.4.8 Transportation

Direct impacts of the proposed project alternatives on vehicular transportation in the Columbus area will involve short-term effects on traffic flow due to construction.

6.4.8.1 No Action Alternative

The no action alternative will not produce short- or long-term primary impacts, leaving circulation patterns in their current status.

6.4.8.2 Two-Plant Alternative

Under the two-plant alternative, short-term construction impacts can be expected at both the Southerly and Jackson Pike facilities, related to construction vehicles and employees. These effects will be marginally greater at the Jackson Pike site due to the more congested traffic patterns in the downtown area. In neither case will impacts be significant enough to affect the level of service in the area. Under the two-plant alternative, no off-site construction is anticipated that would impact vehicular flow.

6.4.8.3 One-Plant Alternative

Transportation impacts of the one-plant alternative will be concentrated at the Southerly plant during the construction process. Short-term increases in traffic may occur, but are unlikely to affect the level of service on State Route 23, which is currently functioning well.

Some disruption of traffic flows along State Route 23 and intersecting roads may occur as connections are made from the Jackson Pike WWTP to the Southerly WWTP, but the use of proper traffic management should minimize this over the affected period.

6.4.9 Conclusions

None of the alternatives are anticipated to cause significant impacts to planning or land use. No land acquisition or zoning changes will be necessary. With the one-plant alternative, the land necessary for a river crossing is already owned by the city of Columbus.

Ambient noise levels near the Jackson Pike and Southerly WWTPs will increase during construction. The one-plant alternative will result in a concentration of construction activities and related noise at Southerly. Operational noise is not expected to be a problem.

Both the one-plant and two-plant alternatives will provide for the adequate disinfection of wastewater. The no action alternative would prove slightly less reliable than either action alternative. No significant public health impacts are expected.

All alternatives will result in energy usage, however, no alternative is projected to deplete local reserves signficantly. Construction equipment will use gasoline and diesel fuel, while electric power is necessary to operate plant equipment. The one-plant alternative should require less energy due to efficiencies of scale. However, it is not possible to qualify this at the facility planning stage.

The city currently has approximately 212 employees operating its wastewater treatment plants. Under the no action alternative, these employment levels would remain constant. Employment levels are reduced to 191 employees under the two-plant alternative due to the proposed installation of computerized control equipment. The one-plant alternative has the lowest manpower requirements (135 employees) due to efficiencies of scale.

The three system alternatives will not have direct impacts on known historic resources. However, the one-plant option could impact an archaeologic site at the point of the river crossing. Additional survey work is suggested for all construction areas to ensure construction activities do not disturb archaeologic resources.

Direct impacts on recreational use of the Scioto River are expected to be minimal under a one-plant or two-plant option. None of the alternatives are expected to alter present patterns of river use.

Direct impacts of the proposed project alternatives on vehicular transportation in the Columbus area will involve short-term effects on traffic flow due to construction.

6.5 ENVIRONMENTAL CONSEQUENCES - SECONDARY IMPACTS/INDUCED GROWTH

6.5.1 Secondary Impacts: Growth and Development

Sustained growth in the Columbus metropolitan area is projected through 2008. Upgrading existing wastewater facilities will accommodate this growth. This discussion centers on secondary impacts projected to occur as part of forecast growth. Secondary impacts are defined as indirect or induced changes in population and economic growth or land use as well as other environmental impacts resulting from these changes (USEPA 1975a; USEPA 1975b). Secondary impacts from induced growth include: 1) increased demand for public services; 2) increases in non-point source pollution and erosion and runoff created by disturbances of stable areas; and 3) increased fiscal outlays required to mitigate other secondary impacts, that is, provide additional services.

6.5.1.1 No Action Alternative

Market demand for housing in the Columbus area, demonstrated by low vacancy rates, increased housing and office space costs, as well as a large number of subdivision and building permit requests are expected to remain high. This demand for residential, commerical, and industrial uses is concentrated in the parts of Columbus that already have water and sewer service. Local planners feel that this demand will continue well into the future. Since federal law mandates compliance with provisions of the Clean Water Act by 1988, the no action alternative is not considered a viable option.

6.5.1.2 One-Plant and Two-Plant Alternatives

Although some interceptor sewers in the Columbus area are nearing full capacity and future growth could be restricted in some service areas, this EIS cannot assess the capacity or potential for growth inducement of these lines, since plans for suburban interceptor expansion are not yet finalized. However, some of the growth projected in the northwest section of Franklin County may not occur if interceptor lines do not improve.

In general, during past studies of growth inducement, in those areas of the country where no sewer service existed or expansion of trunk or sewer interceptor lines increase service areas, the act of providing sewer service, the location and size of treatment plants, as well as sewer interceptor routes was found to potentially induce growth or redirect development. However, since the Columbus area already has sewer service provided by two major treatment plants and 3,735 miles of sewer lines, and locations and sizes of new interceptors are not finalized, the secondary impacts of upgrading both of the existing treatment plants or phasing out one plant in order to expand the other will be limited. For these reasons, growth projections, dispersement of the projected population, and the size of the future service area will not be affected by the one- or two-plant alternatives.

Several factors have influenced growth and development in the Columbus area over the past 20 years. These include the following growth determinants:

- In-place linkages to interstate transportation systems: railroads, highways, and major airports
- Availability of public facilities, primarily water and sewer
- Public policies encouraging economic growth and development
- Public policies regarding public land use regulation and taxation (fiscal) policies
- Public perception of suburban amenities, such as schools and parks.

As long as the Columbus economy is strong and continues to expand, and as long as vacant land is available, the northern suburbs of Columbus will continue to grow (see chapter 4). Developers and local residents find this section of the county to be most attractive because of its readily available recreation resources, existing public services, fine public schools, and close proximity to the Columbus central business district (CBD). Although some infilling has occurred, the city is also expanding its boundaries through annexation in the northwest sector of the county. This is an area where the incorporated areas of Dublin and Hilliard are also expanding their boundaries.

Although State law limits annexation to contiguous parcels of land (land adjacent to the established corporate limits of a city or village) the political boundaries of the city of Columbus are not compact. The city has a checkerboard pattern of annexation. Other incorporated areas in Franklin County have similar disjointed municipal boundaries. Most of these municipalities use annexation to gain the fiscal benefits of new commercial, industrial, and residential developments. In the city of Columbus, developers usually negotiated for water and sewer service. In these cases, water and sewer service was withheld until proposed developments were annexed into the city.

This reactive method of providing essential services has resulted in an inefficient pattern of development. The Office of Strategic Planning recognizes these inefficiencies and is encouraging infilling. Infilling is the process of developing vacant parcels of land that are surrounded by developed parcels of land. Most of the growth projected for the planning period can be accommodated by these vacant parcels of land located near the Columbus city limits. Table 6-17 shows that this type of infill annexation has already started to occur.

One community most likely to absorb secondary impacts from upgrading of existing facilities is New Albany. This community is inside the future service area, but outside areas presently served by water and sewer. As discussed in chapter 2, strict septic system requirements are limiting growth in this area to single homes on large lots of approximately 1 acre or more. Once water and sewer is available, the average residential development in the area will probably shift to one-quarter acre lots. This will reduce both housing and development costs. Columbus has no plans to extend sewer interceptor lines into the rural areas adjacent to New Albany (Joyce 1987).

The most obvious impacts of continued forecast growth will be degradation in air and water quality and the increased demand for public services together with the increased taxes and user fees required to finance these

TABLE 6-17. ANNEXATIONS THAT HAVE OCCURRED IN COLUMBUS 1984-1986

Number of Annexations	Townships		Acres Annexed By Townships
	1984		
	Franklin TWP		.98 Acres
	Mifflin		8.4 Acres
2	Perry		125.451 Acres
	Norwich		4.260 Acres
1	Sharon		212.662 Acres
3	Plain		111.8 Acres
4	Jackson		23.157 Acres
	Violet, Fairfield Co.		4.86 Acres
	Blendon		.13 Acres
	Clinton		4.9 Acres
	Praire		2.09 Acres
		1984 Total:	493.837 Acres
	1985		
1	Perry		340.63 Acres
4	Sharon		73.436 Acres
	Franklin		18.188 Acres
	Blendon		15.902 Acres
2	Norwich		250.001 Acres
	Praire		1.65 Acres
3	Plain		200.00 Acres
		1985 Total:	899.807 or 892.961 Acres
No. of Acres Annexed by TWP	**1986**		
	Franklin		6.6 Acres
	Sharon		12.92 Acres
3	Perry		40.57 Acres
1	Clinton		983.197 Acres (940.8 Ohio State University)
	Blendon		12.79 Acres
	Mifflin		5.18 Acres
	Praire		2.167 Acres
2	Norwich		156.57 Acres
4	Plain		37.618 Acres
	Truro		.528 Acres
		1986 Total:	1256.81 Acres

services. Section 6.5.4 discusses the impacts of growth on community facilities. These facilities include transportation, public utilities, police and fire protection, and public education.

6.5.2 Secondary Impacts: Air Quality/Climate

This section presents an assessment of the impact of anticipated population and related commercial and industrial growth on the ambient air quality and climate in the Columbus area.

6.5.2.1 Secondary Impacts: Air Quality

Since portions of Franklin County have been designated as non-attainment for total suspended particulates, the impact of projected growth on future ambient particulate concentrations was assessed. Overall population increases in the study area, with or without improved wastewater treatment facilities, are not forecast to differ significantly. The analysis presented, therefore, reflects impacts from overall population growth, rather than any incremental increases due to the proposed project.

Growth forecasts (see chapter 4) show a 10 percent growth rate for the period 1988 to 2000, and a 20 percent increase from 1988 to 2015. This population growth will be accompanied by increases in particulate generating activities such as residential and commercial fuel combustion, automotive exhaust, tire and brake wear, and solid waste burning. The effect of the increased particulate loading will depend primarily upon the local meteorological conditions; however, in order to estimate impacts it may be assumed that these growth rates would be accompanied by a corresponding increase in particulate emissions.

The Ohio EPA (OEPA) operates several monitoring sites for total suspended particulates throughout Columbus and the metropolitan area. The monitoring sites closest to the two wastewater treatment plants are located at Woodrow Avenue, about 1.5 miles northeast of the Jackson Pike WWTP, and Dennis Lane in Grove City, about 5 miles west-southwest of Jackson Pike.

The monitoring locations closest to the high growth areas as outlined in Figure 4-3 are Maple Canyon in the northeast, South Hamilton Road in the east-northeast, Dennis Lane, Grove City in the southwest, and Cranston Drive in the northwest. Assuming for simplicity that each of these high growth areas will experience one-fourth of the expected increase in population and an associated increase in ambient particulate matter levels, and furthermore, that the Woodrow Avenue area would experience a like increase in particulate matter levels, yields the following:

TABLE 6-18. CURRENT AND PROJECTED LEVELS OF TOTAL SUSPENDED PARTICULATES DUE TO POPULATION GROWTH (ug/m^3)

Monitoring Station	Avg. Time	1985	1988	2008
Maple Canyon	24-hr	131	133	135
	Annual	49.3	50.0	50.7
So. Hamilton	24-hr	92	93	94
	Annual	47.0	47.7	48.3
Monitoring Station	Avg. Time	1985	1988	2008
Cranston	24-hr	74	75	76
	Annual	36.8	37.4	37.8
Grove City	24-hr	93	94	96
	Annual	38.6	39.2	39.7
Woodrow	24-hr	132	134	136
	Annual	49.5	50.3	50.9

All values are well below the secondary standards of 60 ug/m^3 for the annual period and 150 ug/m^3 for the 24-hr average. Therefore, it is expected that air quality impacts due to project-related growth will not contribute to the exceedance of any air quality standards, add to the local non-attainment areas, or inhibit progress toward achieving ambient air quality standards.

In reality, however, it is not expected that particulate matter levels will increase at the rates estimated above. Data compiled by Ohio EPA (1985a) for the years 1976 to 1985 have shown a significant reduction in the levels of suspended particulates throughout Ohio. Percent improvements are shown in Table 6-19 below. Data have been grouped according to whether an area is considered urban or rural, and population- or source-oriented, indicating the presence or absence of nearby major pollutant sources.

TABLE 6-19. PERCENT IMPROVEMENTS BY SITE CATEGORY

Site Category	% Improvement
Urban/Source-Oriented	39
Urban/Population-Oriented	38
Non-Urban/Source-Oriented	36
Non-Urban/Population Oriented	31

Similar levels of improvement have been monitored at sites near the service area.

6.5.2.2 Secondary Impacts: Climate

Since the population growth and development are expected to change the result in 24 hour or annual average air quality only slightly, it is very unlikely that growth will contribute to changes in the climate of the area.

6.5.3 Secondary Impacts: Water Quality

To the extent that growth in the Columbus area can be related to the proposed project, secondary impacts on water quality in the FPA can be expected. However, the project is not projected to change the specific locations and levels of local growth because the location of new or expanded interceptors is presently unspecified.

Based on the current pattern of population distribution and growth trends, generalized areas within the FPA have been identified where future growth is probable. These generalized areas are depicted as "High Growth Areas" in Figure 4-3. These growth areas can be grouped into four general zones, based on watersheds, for the purpose of indirect water quality impacts discussions. Moving clockwise around Columbus, the four general growth impact zones are the Big Walnut Creek basin, including Blacklick Creek and Alum Creek; a small area draining directly to the lower Scioto River, southeast of Grove City, in Jackson Township; the Big Darby Creek basin; and the upper Scioto River, including the Olentangy River.

6.5.3.1 Secondary Impacts: Water Quality - Big Walnut Creek

Growth projected for this drainage basin occupies the northeastern and eastern fringes of the Columbus metropolitan area, roughly following the Route 270 corridor (see Figure 4-3). This growth will directly affect the headquarters of Big Walnut Creek, Blacklick Creek, and Alum Creek. Water quality impacts will include those typical of urbanization:

- Modified hydrograph (higher peak flows, lower base flows) and bank erosion
- Elevated turbidity, dissolved solids, and sedimentation
- Elevated water temperatures
- Increased organic load (higher BOD, COD, TOC, and nutrients) and decreased DO
- Elevated levels of non-point toxics (pesticides, herbicides, and complex organic compounds)
- Increased coliform bacterial levels.

The extent of these impacts will be dependent on the rate and degree of urbanization actually realized and on the extent to which stream management practices are integrated with this growth.

Current information is inadequate to determine either the quantities of particular pollutants, or the specific impacts of these pollutants. However, all three streams comprising the Big Walnut Creek system are already subject to water quality deterioration due to urban point sources and non-point source loadings (see Section 2.3.5.2). The projected growth pattern in this stream system will aggrevate existing DO, ammonia, and fecal coliform problems. Although existing water quality degradation in the upper portions of the Big Walnut Creek system will be exacerbated by projected growth, the lower sections of this stream system are not projected to experience high growth rates (Figure 4-3). Consequently, some water quality improvement will occur (from natural wasteload assimilative capacity in the stream) before Big Walnut Creek enters the Scioto River. The extent of this improvement, and the degree of possible impacts on the Scioto (resulting from any residual wasteload in Big Walnut Creek discharge) cannot be quantified with the currently available data base.

6.5.3.2 Secondary Impacts: Water Quality - Lower Scioto

A small area east of Interstate 71, north of Route 665, south of Interstate 270, and west of the Scioto is projected for high growth (Figure 4-3). This area drains directly to the Scioto through a series of small streams, including Grant Run and other unnamed permanent and intermittent drainages. Although the streams will be severely impacted by the same generic water quality effects of urbanization cited in the preceding discussion, these small streams are not known to represent significant aquatic habitats within the FPA.

Because of the proximity of this area to the mainstem Scioto, little natural wasteload assimilation will occur prior to the release of any urban pollutants to the river; therefore, caution should be exercised during development of these areas to control non-point runoff. The current data base is not adequate to quantify potential impacts on the Scioto from this area.

6.5.3.3 Secondary Impacts: Water Quality - Big Darby Creek

High growth rates are predicted to occur on the west and southwest fringes of the Columbus metropolitan area, outside of Interstate 270, north of Interstate 70, and south of Interstate 40 (see Figure 4-3). Generic water quality impacts will be as cited for Big Walnut Creek.

This growth zone is concentrated in the Hellbranch Run subdrainage basin of Big Darby Creek. Hellbranch Run occupies a predominantly north/south orientation, approximately midway between Interstate 270 and the mainstem of Big Darby Creek, discharging to Big Darby Creek at the Interstate 71 bridge (immediately north of the Franklin County/Pickaway County Line), north of Harrisburg.

Because most of the growth in this zone will be captured by the Hellbranch Run subbasin, impacts on Big Darby Creek upstream of the confluence of Hellbranch Run will be minimal. However, Hellbranch Run will be directly impacted by the projected growth in this zone. Due to the projection of high growth along much of the stream's length, water quality in Hellbranch Run is expected to exhibit significant deterioration over time.

Big Darby Creek currently exhibits "exceptional" water quality (see Section 2.3.5.2). Upstream of the confluence of Hellbranch Run, little change is expected based on the current projection of growth in this zone. However, Big Darby Creek will be impacted by gradually deteriorating water quality discharges from Hellbranch Run due to the small flow from Hellbranch Run, in comparison with Big Darby Creek, and the high water quality in Big Darby Creek, the severity of impact should be small. After the confluence of Hellbranch Run, Big Darby Creek flows more than 25 miles before discharging to the Scioto River. Therefore, Big Darby Creek water quality is expected to recover from the impacts of future growth in Hellbranch Run before joining the Scioto River and little or no impact will be evident in the Scioto itself.

6.5.3.4 Secondary Impacts: Water Quality - Scioto/Olentangy Rivers

High growth is predicted for the north and northwest fringes of the Columbus metropolitan area along the Scioto and Olentangy river mainstems (Figure 4-3). General water quality impacts will include those cited previously for Big Walnut Creek. Because this growth is predicted to occur in the immediate proximity of the Scioto and Olentangy mainstems, urban pollutants will enter these streams with little if any attenuation.

Water quality in the sections of the Scioto and Olentangy affected by growth in this zone exhibit some degree of urban pollution; however, conditions have improved in recent years (see Section 2.3.5.1). The degree to which growth impacts will arrest or reverse this trend or the degree to which water quality impacts will carry to more critical downstream areas in the Scioto cannot be accurately determined with the currently available data base.

6.5.4 Secondary Impacts: Community Facilities

In rapidly growing metropolitan areas such as Columbus there are two requirements in providing adequate community services. The first involves maintenance of the existing facilities; the second involves expansion of these services to meet increasing demands.

There are a number of ways to finance facilities to meet increased service needs. These include:

- Increasing existing fees and charges
- Increasing income and property taxes
- Assessing impact fees on developers
- Assessing new fees and taxes for special districts
- Issuing bonds for capital improvements
- Coordinating service delivery among local municipalities
- Expanding the tax base.

One of the primary methods used to finance services in the Columbus region has been expansion of the tax base via annexations. While expanding the tax base, new growth in these areas places demands on existing services. If fees or taxes are inadequately assessed, the supply of community facilities is adversely affected. Older facilities and services may not be properly maintained or supported, and the demand for new facilities and services may not be provided for in a timely manner.

In the Columbus area, demand for services has increased as each community has expanded its boundaries. Many services are currently at capacity and are showing signs of deterioration or stress. The services and resources with the greatest potential for impacts from sustained growth are listed below:

- Public water and sewer
- Roads and highways
- Public schools
- Fire and police protection
- Cultural resources.

6.5.4.1 Secondary Impacts: Community Facilities - Public Water and Sewer

The city of Columbus provides water and sewer service to most of Franklin County. Parts of this system were installed as early as 1935. The Columbus Infrastructure Report included in Appendix N lists the location of sewer and water lines along with associated problems with each system. Almost 4,000 miles of sewer and water lines must be maintained throughout the Columbus system. Although developers usually pay for the installation of sewer interceptors, the city must include operation and maintenance charges in its rate structure. As the system ages and its size increases, operation and maintenance costs also increase. Projected growth will increase the number of system users. The impacts of maintaining other operations are discussed in the Columbus Infrastructure Report. This report indicates that each community will have significant funding shortfalls and that new revenue sources must be tapped in order to maintain this system. The report urges an increase in user charges and assessment fees to cover operation and maintenance costs.

Aside from maintaining a system of water lines, the city is also responsible for maintaining adequate water supply reserves. Columbus currently draws 95 percent of its drinking water from surface water supplies. As mentioned in the water quality section (Section 6.5.3), increased recreational use and development heightens the potential for runoff into these waterways. As described in the city's watercourse plan, providing a buffer will limit the impacts of future development.

A recently completed water supply study prepared by the State of Ohio for Columbus (Witlatch & Martin 1985) confirms that the city can meet its water supply needs through the early 1990's. This study recommends, however, that additional sources be found. The city has four deep water wells. In order to meet growth demands, the city may need to add more wells in the future.

6.5.4.2 Secondary Impacts: Community Facilities - Transportation

No secondary impacts on transportation are anticipated as a result of this project under any of the alternatives. As previously described, the Columbus area is active and growing. Road capacity problems currently exist in several areas; some will be addressed under planned and/or programmed transportation improvements. Future growth and development will aggravate existing traffic capacity problems. However, none of the proposed alternatives will result in growth that is more extensive or earlier than that currently anticipated.

The level of service provided by the Columbus area highway system appears to be adequately meeting current needs of the system, although some roads in some communities are approaching capacity. While data were not available to precisely quantify the levels of service, experts as well as previously referenced documents (see chapter 2) indicate that level of service capacity has been reached in some communities and is approaching capacity in others. Qualitative conclusions as to level of service are summarized in Table 6-20.

Table 6-20 identifies a poor level of service for highways in Westerville. A major factor contributing to this over-capacity condition is limited east/west access to I-71 from the entire community, resulting in severe traffic congestion. This traffic condition is reported to occur even during non-rush hour periods. As indicated in Table 6-20, Dublin also is experiencing traffic congestion. Dublin is a relatively small community with a recent history of rapid growth where road systems are not adequate to handle the increased traffic. New Albany is projected to experience the same type of growth as Dublin, and it is reasonable to expect that the same type of traffic congestion experienced in Dublin will occur in New Albany as development proceeds.

In looking at the general results of levels of service estimates, it seems reasonable to conclude that in many cases highway/road capacity has been reached without regard to additional growth anticipated in the future. It is also clear that growth is anticipated to continue and that the proposed project is only one factor in determining the magnitude of that growth. It does not appear from the available information that the implementation of the project will increase growth beyond that already projected.

6.5.4.3 Secondary Impacts: Community Facilities - Public Education

Franklin County has 17 independent school districts including Columbus. Each district operates its own schools and raises the funds to finance these schools through local property taxes. Most of the schools in high growth areas such as Dublin, Westerville, Worthington, and Hilliard are at capacity and will require expansion in the near future.

These areas may be forced to increase their property taxes in order to pay for new schools. Added to other public improvement needs the tax rate may need to be increased, or taxpayers may be forced to decide between school improvements or roadway improvements. One method of limiting educational costs that is being considered by the city of Columbus would be to request that developers dedicate parcels within new developments for future neighborhood schools. Table 6-21 lists the enrollment figures, existing capacity, and other parameters for each school district.

TABLE 6-20. CURRENT LEVELS OF SERVICE*

Incorporated Area[4]	Highway (federal, state, and interstate)	County Road
Dublin	D - E	D - E
Westerville	F	E - F
New Albany	C - D	C - D
Hillard	D - E	D - E
Reynoldsburg	D - E	D - E
Pickerton	D - E	-
Gahanna	D - E	D - E

*Levels of Service Definitions:

Definition

A - Highest quality of service that represents free traffic flow, indicates no restrictions on operating speed.

B - Stable traffic flow with few restrictions on operating speed.

C - Stable flow with high traffic volume and more restrictions on speed and lane changing.

D - Approaching unstable flow with little freedom to maneuver.

E - Unstable flow, lower operating speeds than level D, short headway, and accident potential high.

F - Forced flow operations where highway acts as a storage area and there are many stoppages.

Source: Institute of Traffic 1976.

TABLE 6-21. SCHOOL DISTRICT INFORMATION 1985-1987

School Districts	1985/86 Enrollment	1986/87 Enrollment	No. of Schools Currently at Capacity	Student Teacher Ratio	Opened New Facility or Re-opened Old Facility in 1986	Number of Leased Classrooms 1986/87	New Facilities Planned	Under-utilized Facilities	Recently Issued or Pending Bond Issue	No. of Elementary Schools	No. of Middle Schools	No. of High Schools	Vocational or Special Education
*Bexley	2,072	2,058	0	15:1	-	-	-	-	-	3	1	1	-
Canal Winchester	954	990	0	18:1	0	0	0	X	-	1	-	1	-
Columbus	66,823	66,158	-	20:1	Reopened-6	-	-	X	-	80	26	15	8
Dublin	4,363	5,181	All 7	24:1	1-Under Construction	1 School 14 temp.**	3 1988 Bldgs.	-	X	5	1	1	-
*Gahanna-Jefferson	5,223	5,306	4	23:1	-	-	-	-	-	5	2	1	1
Grandview Heights	1,216	1,224	0	15:1	-	-	-	X	-	2	1	1	-
Groveport-Madison	5,969	6,024	0	20:1	1-Reopened	-	-	-	-	6	2	2	1
Hamilton	2,077	2,127	0	24:1	-	-	-	X	-	2	1	1	-
Hilliard	4,342	4,523	All 9	19:1	0	-	1 1988 Bldg.	-	X				
*Pickerington	3,513	3,709	2	25:1	-	-	-	-	-	3	1	1	-
Plain	882	849	0	18:1	0	0	0	X	-	1	1	1	-
*Reynoldsburg	4,445	4,474	All 7	22:1	-	-	1 1990 Expansion	-	X	4	2	1	-
South Western	16,035	15,931	15	19:1	-	-	-	-	-	15	5	3	2
Upper Arlington	5,053	5,106	2	21:1	-	-	-	X	-	4	2	1	-
Westerville	11,034	11,440	All 16	25:1	-	20 temp.**	1 Expansion 3 Bldg. 1988 2 Ex. 1987	-	X	12	2	2	1
Whitehall	3,378	3,400	0	22:1	-	-	-	X	-	4	2	1	-
Worthington	7,841	8,336	All 12	24:1	2 New	-	2 Bldg. 1988 1 Planning Stage	-	X	8	3	1	1

*Currently working on saturation studies and/or projected enrollment figures developed by SAIC personal interviews.

**In most cases a temporary structure is a portable classroom.

6.5.4.4 Secondary Impacts: Community Facilities - Fire and Police Protection

In 1977, MORPC prepared two reports: one addressing police protection and the other addressing fire protection (Mid-Ohio Regional Planning Commission 1977b). Neither of these studies have been updated. Both of these reports indicated that providing adequate police and fire protection for the Columbus area would require increased coordination of services and additional manpower. These reports found that the inconsistent pattern of annexation by Columbus disrupted the delivery of these services. The problems referred to in these reports have not been directly addressed in the intervening 10 years.

Some efforts have been made to mitigate problems. Columbus is currently recruiting and training new police and fire fighters, and has plans to open four new fire stations in the next three years. These stations will be located in the northern sections of Columbus where most of the new service demands associated with rapid growth have occurred. In addition, Franklin County plans to make 911 service available by the end of 1987. However, as these efforts have gone on, new problems have arisen. In order to cut the costs of increased service demands, some smaller communities have dropped their police forces without making contractual arrangements with Franklin County for protection. Although this does not leave a community unprotected, it does change the type of service provided. A comprehensive community services plan, sound financial planning, and increased coordination of services to the various communities would lessen the negative impacts of such changes in service.

6.5.4.5 Secondary Impacts: Community Facilities - Cultural Resources

Secondary impacts on historic resources could occur as a result of changes in land use and zoning patterns as well as changes in the evolution of neighborhoods during the growth process. Historic resources have been inventoried in the study area. Land use changes may affect historic properties adversely in numerous ways without stringent zoning codes, zoning enforcement, containment of strip commercial and zoning map changes.

As communities grow and expand outwards from the central core, neighborhoods lying between the commercial business core and new suburban communities often go through a period of decline. Many of these older homes, particularly in the midwest, are of historic significance. Examples of historically significant communities are areas of American bungalows and neighborhoods of turn-of-the-century catalog homes. During the cycle of neighborhood decline there is a tendency for greater absentee ownership, and lack of basic maintenance and repair. Moreover, without stringent zoning enforcement, neighborhood integrity can decline as former dwelling units are turned into marginal business locations. In addition, during new suburban development, many older estates or farms are sold to developers. Without the capacity within the local community to inventory significant farms or estates of historic interest, many of the original estate/farm homes will be demolished to make way for suburban progress.

To minimize loss of historic resources, Federal Community Development Block Grant Funds could be applied to inventory older neighborhoods of indigenous American architecture and draft public policies for preserving these resources. Ohio Historic Inventory Districts that may be impacted the most by induced growth are districts: 1-4, 8-10, 15-17, 20, and 22.

As described in chapter 2, archaeologic sites have been found to be nearly continuous along the floodplain and on adjacent bluffs along the Scioto River in the area of the Southerly WWTP. Since insufficient data have been collected and inventoried, knowledge of prehistoric culture along the Scioto River and within the study area is not complete.

Increased urban development along the Scioto River in the vicinity of the Southerly plant may increase the disturbance of unknown sites. As part of the recreation plan for the Scioto River, conservation of the southern Scioto riverbanks is recommended as a means of mitigating secondary impacts on these resources.

6.5.5 Conclusions

Growth forecasts show a 10 percent growth rate for the period 1988 to 2000 and a 20 percent overall increase from 1988 to 2015. This population growth will be accompanied by increases in particulate generating activities such as residential and commercial fuel consumption, automotive exhaust, tire and brake wear, and solid waste incineration. Calculations were made based on the project growth rates. Based on this analysis, it is expected that air quality impacts due to project related growth will not contribute to the exceedence of any air quality standards, add to the local non-attainment areas, or inhibit progress toward achieving ambient air quality standards.

Since the population growth and development are not expected to result in a violation of ambient air quality standards, it is unlikely that growth will contribute to changes in the climate of the area.

Based on the current pattern of population distribution and growth trends, four generalized areas have been identified where future growth is probable. These growth areas are grouped in four zones based on watersheds for the purpose of water quality analysis. Water quality improvement is anticipated to occur in the Big Walnut Creek before it enters the Scioto. Little natural wasteload assimilation will occur in the lower Scioto prior to the release of any urban pollutants to the river, therefore, caution should be exercised during development of these areas to control non-point runoff. Big Darby Creek currently exhibits exceptional water quality upstream of the confluence of Hellbranch Run and impacts from development in Hellbranch Run will be mitigated prior to Big Darby joining the Scioto River. Development along the Scioto/Olentangy mainstems will result in urban pollutants entering the streams with little if any attenuation.

In the Columbus area, demand for community services has increased as each community has expanded its boundaries. Many services are currently at capacity and are showing signs of deterioration and stress. Local reservoirs must be protected from the negative impacts of increased development and additional drinking water sources should be located. No secondary impacts on transportation are anticipated as a result of this project under any of the alternatives. Most of the schools in high growth areas such as Dublin, Westerville, Worthington, and Hilliard are at capacity and will require expansion in the future. Fire and police protection will continue to face problems from expanded urban development.

6.6 CONCLUSIONS ON ALTERNATIVES

The previous sections of this chapter presented evaluations of the one-plant and two-plant alternatives based on engineering criteria and environmental impacts. Table 6-22 provides a comparison of the one-plant and two-plant alternatives based on the environmental impacts. Table 6-23 provides a comparison between the one-plant and two-plant alternatives based on engineering criteria and major environmental issues.

The two-plant alternative is recommended over the one-plant based on the following:

- The two-plant alternative has a **ten percent** lower present worth cost than the one-plant alternative.
- The two-plant alternative will be more reliable than the one-plant with respect to shock loads of pollutants to the sewer system.
- The two-plant alternative will provide more flexibility to adapt to increased future flow, to adapt to more stringent effluent limits, and to address combined sewer overflows.
- The two-plant alternative will be easier to implement since the majority of the facilities at each plant already exist.
- The two-plant alternative will result in more positive impacts with regard to the quality of surface water flows (Scioto River).
- The two-plant alternative will not result in any negative impacts with regard to the volume of surface water flows in the Scioto River between Jackson Pike and Southerly.
- The two-plant alternative will result in more positive impacts on aquatic biota and endangered species.

TABLE 6-22. ONE-PLANT/TWO-PLANT IMPACTS COMPARISON

Criteria	One-Plant	Two-Plant
Ann. User Costs	m – $42-76 add'l user charges (new total: $150-184) <$500/yr = not excessive	m – $40-66 add'l user charges (new total: $148-174) <$500/yr = not excessive
Sur. W. Qual.	M – Impaired upstream water quality	m + minor improvement in WQ at LF
	M – WQ impaired @ normal flow	m + WQ improvement at normal flow
	M – Enlarged downstream DO sag	m + Downstream DO sag minimized
	M – Potential for conflicts w/downstream dischargers	m + Potential for downstream conflicts minimized
	M – Short-term constr. impacts due to river x-ing	m o no impacts
Air/Odors	m – Sludge incineration impacts – no addtl. violations of standards	m – [Repeat of one-plant]
Soils/1° Ag	m – Construction-related erosion – easily mitigated	m + Construction-related erosion minimized – easily mitigated
GW	m – Possible reductions in GW recharge along upper Scioto	m o No impacts
Proj. 88:GW	M – Wells dewatered due to constr.	M – [repeat of one-plant] @ Southerly – mitigated
Surface Flows	M – Low flow reduction (86%) in upper Scioto	m o No change in current low flow conditions
Terr. Bio.	m – Habitat loss due to constr. at Southerly (incl. river x-ing; greater on W. bank)	m o No impact
	m – Reduction in open-water habitat @ J.P. in winter	m o No impact
Aq. Bio.	M – Habitat reduction and impairment @ LF between J.P. and Southerly	m o No change
	M – Habitat impairment below Southerly @ LF	m + Minor habitat improvement below Southerly
	m – Short-term habitat disruption due to river x-ing	m o No impact

Key:

Issue	Impact
M = Major	– = Negative
m = Minor	+ = Positive
	o = Neutral

TABLE 6-22. ONE-PLANT/TWO-PLANT IMPACTS COMPARISON (CONT.)

Criteria	One-Plant	Two-Plant
Endangered Sp.	m – Impaired habitat below J.P. at LF	m + Minor improvement in habitat at LF
	m – Loss of bird habitat at J.P.	m o No change at J.P.
	m – Reduction in Indiana BAT habitat due to river x-ing (greater on W side); easily mitigated	m o No Impact
	M – Impaired habitat below Southerly	m + Minor improvement below Southerly
Plann./L.U.	m – Poten. short-term disruption of farming (easily mitigated)	m o No impact
	———	m o Expansion of SE corner of J.P.
Noise	m – Short-term constr. increase/ long-term O&M increase: both easily mitigated	m – [repeat of one-plant]
Pub. Health	———	———
Energy Use	m + Slightly less (10-20%) energy use due to economies of scale	m – Slightly higher (10-20%) energy use due to less economics of scale
Econ./Employ.	m + Construction expenditures: $269 million Annual employment: 135	m + Construction expenditures: $215 million Annual employment: 191
Hist./Arch.	m – Potential disrupt. of 2-3 non-eligible sites; can be mitigated through recovery (Phase III)	m – [repeat of one-plant]
	m – Potential disrupt. of one possibly eligible known site and other unknown sites @ Scioto River crossing	m o No impact
Recreation	m – Water level reductions during LF; attenuated by low use levels of affected areas during LF	m o No change

Key:

Issue	Impact
M = Major	– = Negative
m = Minor	+ = Positive
	o = Neutral

TABLE 6-22. ONE-PLANT/TWO-PLANT IMPACTS COMPARISON (CONT.)

Criteria	One-Plant	Two-Plant
Transportation	m – Short-term constr. impacts on roads near Southerly	m – Short-term constr. impacts on roads near both WWTPs
2^o:Develop.	M o Accommodates future growth; distribution of growth tied to future local development plans	M o [repeat of one-plant]
2^o:Air Qual.	———	———
2^o:Water Qual.	M – Non-point WQ deterioration (long-term); worst in Hellbranch Run	M – [repeat of one-plant]
Pub. Water/Sew.	M – Increased O&M costs/potential funding shortfalls in surrounding communities	M – [repeat of one-plant]
Transportation	M – Declining levels of service in suburban communities (New Albany, Westerville, Dublin)	M – [repeat of one-plant]
Pub. Education	M – Increased crowding in 17 Franklin Co. school districts; possible property tax increases	M – [repeat of one-plant]
Fire/Police Prot.	m – Potential service level/coverage problems	m – [repeat of one-plant]
Cultural Res.	m – Potential losses of hist. structures and arch. sites due to incomplete inventories and limited ability to require preservation and/or recovery	m – [repeat of one-plant]

Key:

Issue	Impact
M = Major	– = Negative
m = Minor	+ = Positive
	o = Neutral

TABLE 6-23 ONE-PLANT/TWO-PLANT COMPARISON

CRITERION	ONE-PLANT	TWO-PLANT
PRESENT WORTH COSTS		X
RELIABILITY		X
FLEXIBILITY		X
EASE OF IMPLEMENTATION		X
EASE OF OPERATION AND MAINTENANCE	X	
SURFACE WATER QUALITY		X
SURFACE WATER FLOWS		X
AQUATIC BIOTA		X
ENDANGERED SPECIES		X

X = PREFERRED ALTERNATIVE

CHAPTER 7. PREFERRED PLAN

7.1 DETAILED DESCRIPTION OF PREFERRED PLAN

Based on the engineering and environmental evaluations presented in chapter 6, the two-plant alternative is recommended as the preferred alternative. This alternative involves upgrading Jackson Pike and Southerly to provide wastewater treatment for the Columbus area through 2008. Figure 7-1 presents a flow diagram of the two-plant alternative. Figures 7-2 and 7-3 present flow schematics of the Jackson Pike and Southerly WWTPs, respectively. The following sections describe the required facilities.

7.1.1 Interconnector/Headworks

Under the two-plant alternative, the north end of the Interconnector (i.e. tributary to Jackson Pike) would require completion to allow diversion of excess Jackson Pike flows to the Southerly WWTP. The north end of the 150-inch diameter Interconnector Sewer would be constructed along the west and north sides of the Jackson Pike WWTP. A diversion chamber would be installed on the O.S.I.S. ahead of Jackson Pike at the intersection of the O.S.I.S. and the Interconnector Sewer.

New headworks are required at the Jackson Pike WWTP. The new headworks would include:

- Four coarse bar racks
- Four 35 MGD raw sewage pumps
- Four mechanically cleaned bar screens
- Four aerated grit chambers.

The south end of the Interconnector (i.e. tributary to Southerly) would not require expansion or modification under the two-plant alternative. The existing pump station and force mains are adequate to convey projected flows. The existing Southerly headworks are also capable of processing projected flows.

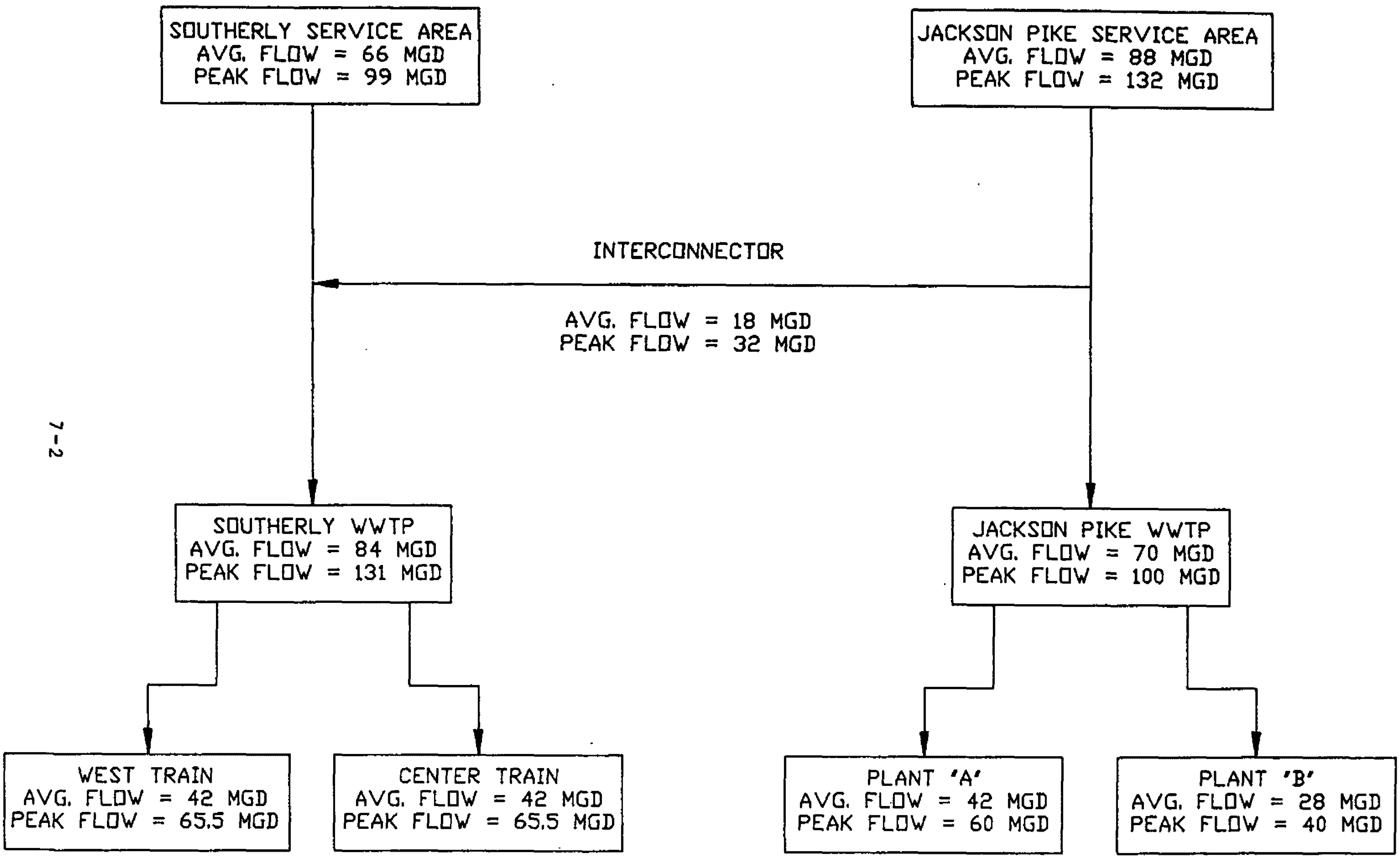


FIGURE 7-1
TWO-PLANT ALTERNATIVE
FLOW SCHEMATIC

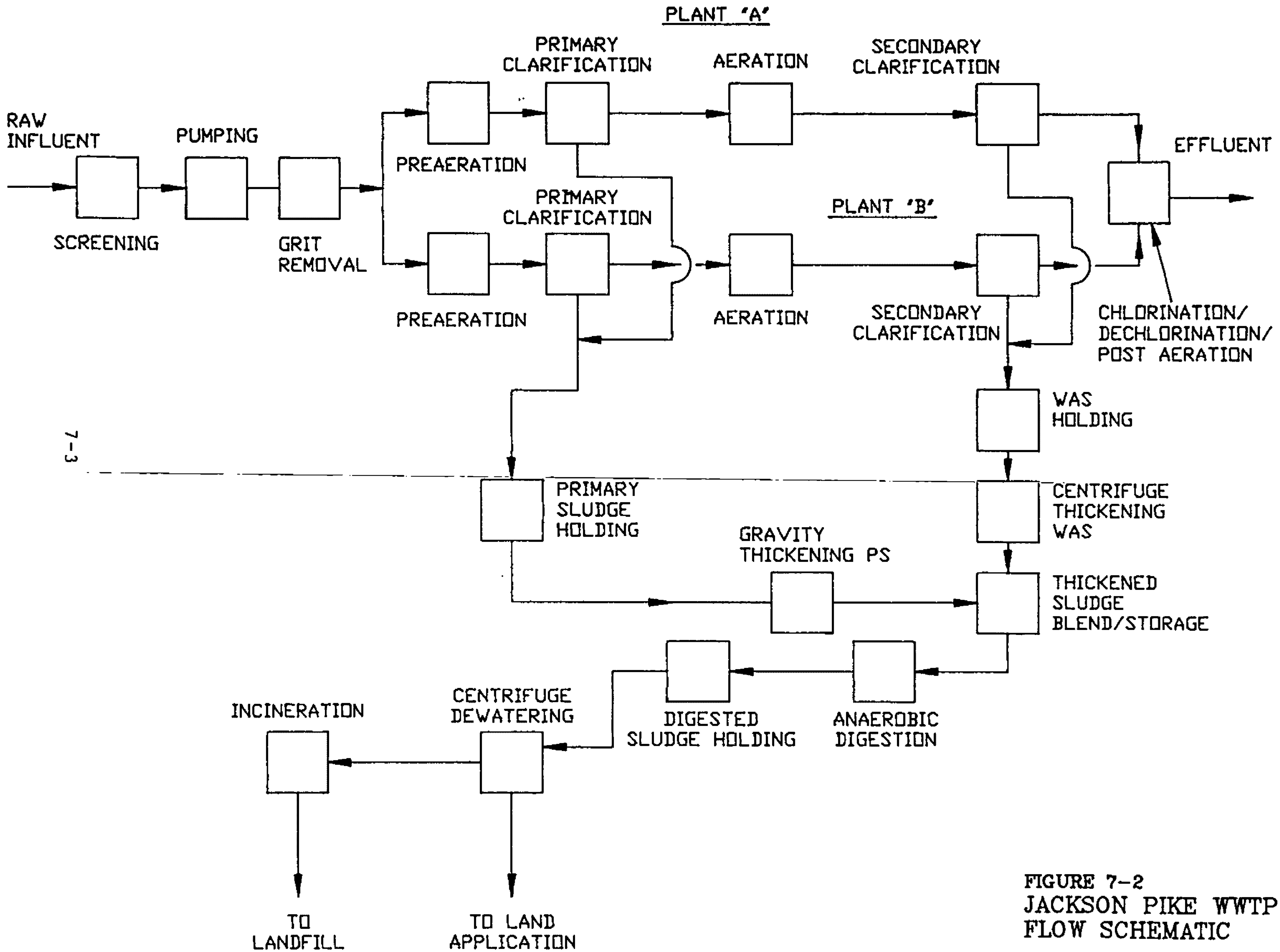


FIGURE 7-2
JACKSON PIKE WWTP
FLOW SCHEMATIC

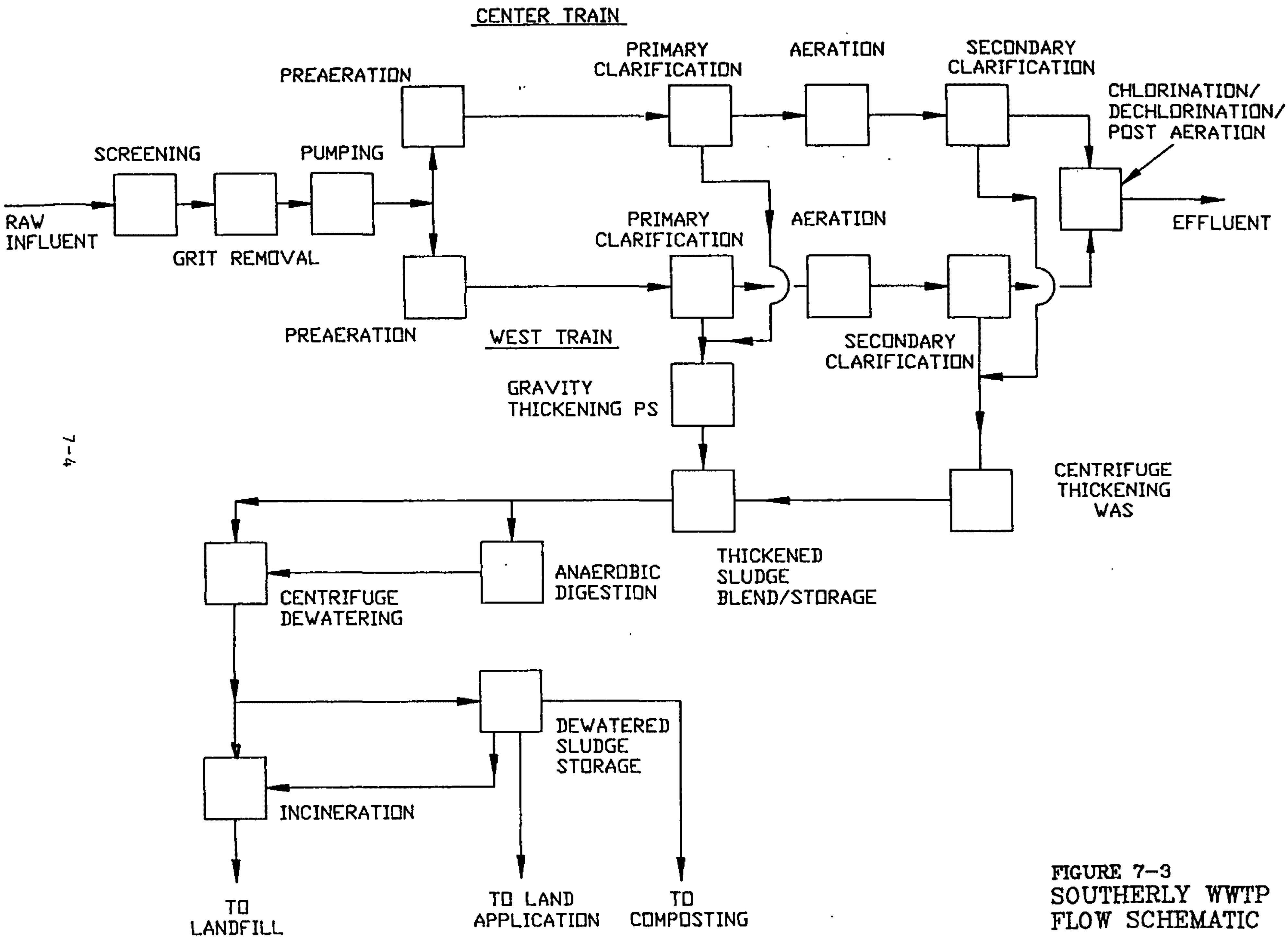


FIGURE 7-3
SOUTHERLY WWTP
FLOW SCHEMATIC

7.1.2 Wet Stream Treatment

The recommended wet stream treatment scheme at both plants would consist of the following processes:

- Preaeration
- Primary Settling
- Aeration
- Final Settling
- Chlorination/Dechlorination
- Post Aeration
- Effluent Pumping.

The existing primary treatment facilities at both plants, which include preaeration and primary settling, have adequate capacity to treat the projected flows. Some rehabilitation of the existing facilities would be required.

The semi-aerobic process is the recommended biological process for both plants. The semi-aerobic process is a modified form of the conventional activated sludge process. It offers more flexibility to achieve nutrient removal and control sludge bulking than the conventional activated sludge or trickling filter/activated sludge processes. It differs from the conventional activated sludge process in that the first 25 percent of the reaction basin is not aerated. Therefore, this section of each basin is in an anaerobic or anoxic state. To eliminate backmixing from the aerated zone to the anaerobic or anoxic zone, two baffles would be installed in the first bay of each aeration basin. An internal mixed liquor recycle loop connecting the effluent end of the aeration basin with the initial bay would be necessary. The recycle loop would be utilized to achieve denitrification in the aeration basin. It is desirable to have denitrification occur in the aeration basin in order to insure that it would not take place in the final clarifiers where it would cause a rising sludge problem.

The semi-aerobic process would be easily incorporated into the existing tankage. Both plants would utilize existing aeration basins. The Southerly WWTP would require two new basins, added to the Center Train, to treat the projected flows and loads.

Post treatment at both plants would include chlorination, dechlorination, and post aeration. Post aeration would take place in the final pass of the chlorine contact tanks.

Existing effluent pumping at the Southerly plant is adequate to handle the projected flows. Jackson Pike does not have an existing effluent pumping facility. However, there are two 3.6 MGD effluent pumps on the A train. In the Revised Facility Plan Update the city indicated that a new 100 MGD effluent pumping facility would be required at Jackson Pike if the two-plant alternative were to be implemented. In subsequent correspondence the city referred to high river levels as the reason a pumping facility would be required. Until further documentation is produced by the city on the frequency and duration of high river elevations, a new effluent pumping facility cannot be recommended. The cost estimates include approximately 4.5 million dollars for the facility. This cost will be subtracted if documentation is not produced.

Tables 7-1 and 7-2 provide details on the recommended wet stream treatment facilities at Jackson Pike and Southerly, respectively.

7.1.3 Sludge Management

The recommended solids handling scheme at both plants includes the following processes:

- Gravity thickening of PS
- Centrifuge thickening of WAS
- Anaerobic digestion
- Centrifuge dewatering.

TABLE 7-1. JACKSON PIKE WET STREAM PROCESS DESIGN CRITERIA

	Plant "A"	Plant "B"
FLOW		
• Average	**42** MGD	**28** MGD
• Peak	60 MGD	40 MGD
PREAERATION		
• Tankage	2 existing @ 180 ft x 26 ft x 15 ft SWD	2 existing @ 113 ft x 26 ft x 15 ft SWD
• Total tank volume	1.05 MG	0.66 MG
• Detention time (avg. flow)	**36** min.	**34** min.
• Detention time (peak flow)	25 min.	24 min.
PRIMARY SETTLING		
• **$CBOD_5$ Removal**	**30%**	**30%**
• **TSS Removal**	**60%**	**60%**
• Tankage	4 existing @ 150 ft x 80 ft x 10 ft SWD	4 existing @ 150 ft x 80 ft x 10 ft SWD
• Total surface area	48,000 sq ft	48,000 sq ft
• Surface loading rate (avg. flow)	**875** gpd/sq ft	**583** gpd/sq ft
• Surface loading rate (peak flow)	1,250 gpd/sq ft	833 gpd/sq ft
AERATION		
• **MLSS**	**2,500 mg/1**	**2,500 mg/1**
• **Solids Retention Time (min.)**	**8.7 days**	**8.7 days**
• Tankage	6 existing @ 900 ft x 26 ft x 15 ft SWD	4 existing @ 900 ft x 26 ft x 15 ft SWD
• Total tank volume	15.75 MG	10.50 MG
• Detention time (avg. flow)	**9.0** hr	**9.0** hr
• Detention time (peak flow)	6.3 hr	6.3 hr

TABLE 7-1. JACKSON PIKE WET STREAM PROCESS DESIGN CRITERIA (CONT.)

	Plant "A"	Plant "B"
FINAL SETTLING		
• Tankage	8 existing @ 153 ft x 60 ft x 12.5 ft SWD	4 existing & 2 new @ 153 ft x 60 ft x 12.5 ft SWD
• Total surface area	73,440 sq ft	55,080 sq ft
• Surface loading rate (avg. flow)	572 gpd/sq ft	508 gpd/sq ft
• Surface loading rate (peak flow	817 gpd/sq ft	726 gpd/sq ft
• Solids loading rate (avg. flow)	20 lb/day/sq ft	18 lb/day/sq ft
• Solids loading rate (peak flow)	29 lb/day/sq ft	26 lb/day/sq ft

	Plants "A" and "B" Combined
CHLORINATION/DECHLORINATION	
• Tankage	2 new @ 100 ft x 75 ft x 10 ft SWD
• Total tank volume	1.12 MG
• Detention time (avg. flow)	23.0 min.
• Detention time (peak flow)	16.1 min.
• Evaporators	4 @ 2,000 lb/day
• Chlorinators	4 @ 2,000 lb/day
• Mixers	4 @ 10 HP
• Sulfinators	4 @ 2,000 lb/day
POST AERATION	
• Location	Final pass of chlorine contact tanks
• Diffuser system	Fine bubble
• Desired DO	7.0 mg/l
EFFLUENT PUMPING	4 new @ 35 MGD, variable speed

TABLE 7-2. SOUTHERLY WET STREAM PROCESS DESIGN CRITERIA

	West Train	Center Train
FLOW		
• Average	42 MGD	42 MGD
• Peak	65.5 MGD	65.5 MGD
PREAERATION		
• Tankage	4 existing @ 112.7 ft x 25.5 ft x 15.5 ft SWD	4 existing @ 112.7 ft x 25.5 ft x 15.5 ft SWD
• Total tank volume	1.33 MG	1.33 MG
• Detention time (avg. flow)	46 min.	46 min.
• Detention time (peak flow)	29 min.	29 min.
PRIMARY SETTLING		
• $CBOD_5$ Removal	30%	30%
• TSS Removal	60%	60%
• Tankage	4 existing @ 170 ft x 100 ft x 10 ft SWD	4 existing @ 165 ft x 80 ft x 10 ft SWD
• Total surface area	68,000 sq ft	52,800 sq ft
• Surface loading rate (avg. flow)	618 gpd/sq ft	795 gpd/sq ft
• Surface loading rate (peak flow)	963 gpd/sq ft	1,241 gpd/sq ft
AERATION		
• MLSS	3,500 mg/l	3,500 mg/l
• Solids Retention Time (min.)	9.9 days	9.9 days
• Tankage	6 existing @ 900 ft x 26 ft x 15 ft SWD	4 existing & 2 new @ 900 ft x 26 ft x 15 ft SWD
• Total tank volume	15.75 MG	15.75 MG
• Detention time (avg. flow)	9.0 hr	9.0 hr
• Detention time (peak flow)	5.8 hr	5.8 hr

TABLE 7-2. SOUTHERLY WET STREAM PROCESS DESIGN CRITERIA (CONT.)

	West and Center Trains Combined
FINAL SETTLING	
• Tankage	6 new @ 190 ft dia x 15 ft SWD
• Total surface area	170,000 sq ft
• Surface loading rate (avg. flow)	494 gpd/sq ft
• Surface loading rate (peak flow)	771 gpd/sq ft
• Solids loading rate (avg. flow)	25 lb/day/sq ft
• Solids loading rate (peak flow)	38 lb/day/sq ft
CHLORINATION/DECHLORINATION	
• Tankage	2 new @ 150 ft x 64 ft x 10 ft SWD
• Total tank volume	1.44 MG
• Detention time (avg. flow)	24.7 min.
• Detention time (peak flow)	15.8 min.
• Evaporators	5 @ 2,000 lb/day
• Chlorinators	5 @ 2,000 lb/day
• Mixers	4 @ 10 HP
• Sulfinators	4 @ 2,000 lb/day
POST AERATION	
• Location	Final pass of chlorine contact tanks
• Diffuser system	Fine bubble
• Desired DO	7.0 mg/1
EFFLUENT PUMPING	6 existing @ 35 MGD, variable speed

Solids disposal of the annual solids production at Jackson Pike would be accomplished by the following processes:

- 50 percent would be incinerated, and the ash product landfilled.
- 50 percent of the dewatered sludge would be land applied.

Disposal of the annual solids production at Southerly would be accomplished by the following processes:

- 50 percent of the sludge would be incinerated, and the ash product landfilled.
- 25 percent of the sludge would be composted and distributed as a soil conditioner.
- 25 percent of the sludge would be land applied.

Redundancy of sludge disposal methods at both plants is provided through the incineration process. At Jackson Pike, the two existing incinerators are capable of incinerating approximately 50 percent more sludge than Jackson Pike will produce. At Southerly, the two new incinerators constructed in 1986 are capable of incinerating aproximately 100 percent more sludge than the Southerly plant is projected to produce under the two-plant alternative. In light of the redundancy exhibited by the new Southerly incinerators, rehabilitation of the older incinerators at Southerly does not appear justified.

Tables 7-3 and 7-4 provide details on the recommended solids handling facilities at Jackson Pike and Southerly, respectively.

7.2 IMPACTS OF THE PREFERRED PLAN

7.2.1 Financial Impacts

User charges are assessed to finance both capital construction costs and O&M costs of operating public facilities. Due to the uncertainty as to the amount and time of current and future grants of Federal funds, it is useful to present estimated user costs in a range from assuming no Federal funds

TABLE 7-3. JACKSON PIKE SOLIDS HANDLING DESIGN CRITERIA

GRAVITY THICKENING PS	
• Number of units	2 modified anaerobic digesters @ 85 ft dia. x 10 ft SWD
• Total surface area	11,350 sq ft
• Solids loading rate	9 lb/day/sq ft
• Hydraulic loading rate	250 gpd/sq ft
CENTRIFUGE THICKENING WAS	
• Number of units	2 existing and 1 new
• Feed rate	500 gpm @ 1% solids
ANAEROBIC DIGESTION	
• Number of units	6 existing @ 85 ft dia. x 23.5 ft SWD
• Total volume	0.8 million cu ft
• VSS loading rate	0.13 lb VSS/day/cu ft
• Solids retention time	20.9 days
CENTRIFUGE DEWATERING	
• Number of units	6 existing
• Feed rate	1,000 lb/hr @ 4% solids
• Polymer dosage	12 lb/dry ton
INCINERATION	
• Number of units	2 existing 7-hearth @ 22.25 ft dia.
• Rated capacity	200 wet ton/day @ 20% solids

TABLE 7-4. SOUTHERLY SOLIDS HANDLING DESIGN CRITERIA

GRAVITY THICKENING PS	
• Number of units	4 existing @ 45 ft dia. x 17 ft SWD
• Total surface area	6,362 sq ft
• Solids loading rate	20 lb/day/sq ft
• Hydraulic loading rate	590 gpd/sq ft
CENTRIFUGE THICKENING WAS	
• Number of units	4 existing and 1 new
• Feed rate	250 gpm @ 1% solids
ANAEROBIC DIGESTION	
• Number of units	6 existing @ 85 ft dia. x 23.5 ft SWD
• Total volume	0.8 million cu ft
• VSS loading rate	0.12 lb VSS/day/cu ft
• Solids retention time	21 days
CENTRIFUGE DEWATERING	
• Number of units	6 existing and 2 new
• Feed rate	1,000 lb/hr @ 4% solids
• Polymer dosage	12 lb/dry ton
INCINERATION	
• Number of units	2 8-hearth @ 25.75 ft dia.
• Rated capacity	260 wet ton/day @ 20% solids

available to assuming a 55 percent grant for all capital construction. This approach shows the full range of possible additional annual user charges. For the recommended alternative, this range is **$40** to **$66.** Added to 1985 annual user fees of $108, this range results in total future annual residential user fee estimates of **$148** to **$174.** These estimated fees only apply to residential users. Commercial and industrial users pay similar fees, and additional charges for extra strength effluent are also levied on some industries.

Median family income often is used to assess the affordability of increases in user charges to average residents. Franklin County, which includes most of the service area, had median family incomes over $17,000 in 1979. Given EPA guidance, an annual user charge of $367 would not be considered excessive for this income category. Based on this guidance, estimated additional user charges for the recommended alternative would not make total user charges excessive.

7.2.2 Environmental Impacts

7.2.2.1 Primary Impacts

Surface Water Quality

The recommended two-plant alternative would protect stream standards for DO and ammonia. However, the treated effluent would contain a minimal residual wasteload, which would be assimilated by the river without violating water quality standards.

The recommended alternative would release the residual effluent DO demand to the Scioto River at two locations (Jackson Pike and Southerly). Two DO sags would therefore result, however, neither sag should result in contravention of water quality standards. Significant improvements to in-stream DO conditions would result from this alternative. Because significant pollutant loads would continue to enter the Scioto River upstream of Jackson Pike (from urban runoff and CSOs from Whittier Street), the degree of water quality improvement below Jackson Pike would be less than below the Southerly WWTP.

Under certain flow conditions, DO levels below the 5.0 mg/l standard may occur below Jackson Pike, related to CSO loadings. However, the presence of Jackson Pike effluent during low flow events may lessen the DO impacts of CSOs and upstream urban runoff.

Air Quality/Odor

The most significant long-term impact to air quality from the recommended alternative would result from the operation of incinerators as a primary method for ultimate solids disposal. However, the recommended alternative should result in a decrease in the total amount of solids incinerated at Southerly due to the fact that anaerobic digestion would be practiced and also because a portion of the solids at Southerly would be land applied. The level of incineration at Jackson Pike would remain approximately the same.

A 25 percent increase in the amount of solids composted would result in increasing odor potential near the composting facility. This increase may or may not be offset by process changes, renovations, and the installation of new units, which are expected to reduce the occurrence of earthy sewage odors characteristic of this facility. Improvements to aeration and dewatering at the Southwesterly Composting Facility could reduce odors through the reduction of moisture and maintenance of optimum temperature, pH, and oxygen content.

Soils/Prime Agricultural Land

The physical and chemical characteristics of local soils govern the extent of impacts from proposed improvements to the Southerly and Jackson Pike WWTPs under the recommended alternative. First, the direct impact of soils disturbance during the construction of new facilities and the removal of existing facilities would result in exposure and accelerated erosion within the limits of the project sites. Second, land application of anaerobically digested waste activated sludge to agricultural lands would modify the composition of the existing soils. The impact of both segments of the project will involve areas that have been designated, based on soils classification, as "prime agricultural" lands.

Under the recommended alternative, there would be no additional land outside the current site required for construction of the proposed upgrading of the Southerly **or Jackson Pike WWTP.**

Land application of anaerobically digested waste activated sludge is a well-known and accepted method of solids management. Under the recommended alternative, approximately 38 dtpd of sludge will be land applied, 12 dtpd from Southerly and 26 dtpd from Jackson Pike. Based on 1985-1986 cadmium concentration figures and a range of soil assimilative capacities typical for this region, an application rate of 3.4 to 5.1 dry tons per acre per year can be estimated. This results in an annual land requirement of 2,755 to 4,133 acres per year. Comments from OEPA and Columbus indicate that a site will be limited to 16 years of active life because of zinc concentrations. Based on the city's estimate of 200,000 acres available for land application within 40 miles, site availability should not be a problem. Current land application operations have proven successful with no reported contamination or adverse health effects; this performance should continue based on current guidelines.

No significant impacts are forecast to area soils or prime agricultural land under the recommended alternative.

Groundwater

The recommended alternative is not expected to cause significant impacts to area groundwater resources through potential interaction with the Scioto River since WWTP discharge levels and any associated impacts will remain similar to current practices. Because the stretch of the Scioto River affected by the Jackson Pike WWTP is small, little, or no impact on the groundwater system by improvements to surface water quality is expected.

A draw-down of groundwater elevations and drinking water wells occurred in 1986 to the town of Shadeville, a suburb of Columbus, due to a dry spell, construction dewatering at the Southerly WWTP, and groundwater pumping for the city's Parsons Avenue Water Treatment Plant. This caused the water table to drop about 8 feet leaving many of Shadeville's wells inoperational. This impact was mitigated through the extension of centralized water service to Shadeville by the city. Any future impacts due to construction dewatering should also be mitigated through provision of city water by extension of the city's centralized water distribution system.

Surface Water Flows

The volume of surface water Columbus currently removes from the Scioto River is about the maximum possible limit, especially during the critical low flow months of summer and fall. Therefore, no future manmade reductions in the volume of flows in the Scioto River area are expected around the Columbus area.

The recommended alternative would discharge flows from the Jackson Pike WWTP at roughly the same levels as currently occur. Average daily discharge will be reduced from 85 to 70 MGD, a decrease of 20 percent. For this reason, impacts from the recommended alternative are not expected to significantly alter the physical parameters of Scioto River surface water between the Jackson Pike and Southerly WWTPs.

Terrestrial and Wetland Biota/Habitat

No impacts to previously undisturbed wetlands or terrestrial habitat are expected under the recommended two-plant alternative.

Aquatic Biota/Habitat

Water quality in the Scioto River, between Columbus and Circleville, is currently degraded by point sources and general non-point runoff for the metropolitan area. The key water quality problem is considered to be low DO. Although the low DO problem is clearly related to discharges from the Jackson Pike and Southerly WWTPs (degraded fish populations have been associated with the DO sags resulting from these two point sources), other sources contributing to the problem included the Whittier Street CSO and general urban runoff.

Upgrading both treatment plants would result in water quality improvements and no water quality violations due to WWTP effluent. Nonpoint and CSO contributions of pollutants will continue to cause problems. These changes should have a favorable impact on aquatic biota and habitat. Sensitive species that currently inhabit the area should persist and increase in abundance. New species may move into the area and increase community diversity.

Decreased turbidity should create a more favorable habitat for turbidity-sensitive species. These species, such as darters, which now inhabit Scioto River tributaries, may begin to move into the Scioto mainstream in greater numbers.

Although the effluent from the WWTPs should not cause violations in DO standards under the recommended alternative, residual wasteloads in the effluents from both WWTPs would continue to exert a DO demand in the receiving water, and a reduced DO sag would persist below both treatment plants. As a result, fish communities would continue to show some degradation as oxygen levels are depressed downstream. These effects would be most noticeable in the sections of the river where the residual DO sags are most critical (i.e., where DO levels approach 5.0 mg/l). Effects of degradation in fish communities include increased numbers of omnivorous fish relative to insectivorous fish, increased hybridization, (lowered biotic index) and decreased diversity. Although the structure of the benthic community would also improve under the recommended alternative, benthic communities would continue to exhibit decreased abundance and diversity in areas experiencing the oxygen sag.

Over the past 6 years, the fish community in the Central Scioto has improved. The recommended alternative would result in a continuation and acceleration of this trend. Although significant improvements should occur, the collective, continuing impacts of WWTP effluents, general urban runoff, and the Whittier Street CSO would prevent free biological recovery in the Central Scioto, when compared with comparatively unimpacted segments upstream of Columbus and downstream of Circleville.

Endangered aquatic species should benefit from implementation of this alternative. Improvements in water quality should allow the fish species that have been captured in the Scioto River (river redhorse, mooneye, gold eye, and Tippecanoe darter) to increase in abundance and allow those species inhabiting tributaries (bluebreast darter, slenderhead darter, spotted darter, and blacknose shiner) to expand their ranges. Specific information on the tolerances of these species to turbidity and lowered DO is not available, preventing a precise assessment of the conditions under which these species would establish permanent breeding populations. Increased habitat for feeding, however, should benefit populations. Improved water quality in the Scioto River may increase potential for the Scioto madtom population to expand its numbers and range.

Mollusk populations should benefit from this alternative because it could offer them an expanded habitat and therefore the opportunity to increase in abundance. Because they are sensitive to WWTP effluent, they would most likely move into areas further downstream from outfalls. As larvae, the unionid mollusks are carried to new environments on gills of fish. Little information is available on suitable fish species, but freshwater drum is believed to be one such species (Stansbury 1987). Freshwater drum is a pollution sensitive species. The potential for increased numbers of freshwater drum in response to improved water quality also may play a role in the migration of mollusks.

Planning and Land Use

No land acquisition or zoning changes should be required under the recommended alternative. Under this alternative, a portion of the current Southerly site would be used for new wastewater facilities. This land has already been purchased and disturbed during construction to meet compliance with water quality standards by 1988. In addition, there would be **no** expansion **outside the current site boundary** of the existing Jackson Pike facility.

Noise

Ambient noise levels near both treatment plants would increase during construction activities; however, construction specifications would minimize these effects. Operational noise is not expected to be a nuisance.

Public Health

Current disinfection practices at both the Southerly and Jackson Pike WWTPs are successfully controlling the release of pathogenic microorganisms to the Scioto River, as evidenced by low effluent fecal coliform counts. Treatment levels would improve slightly with the upgrading of facilities under the recommended alternative. The state of Ohio has issued strict guidelines regulating land application of sludge in order to protect public health interests. Adherence to these regulations under the recommended alternative would protect the public from any adverse health effects.

Energy Use

The energy requirements associated with the upgrading of facilities at Jackson Pike and/or Southerly WWTPs include gasoline and diesel fuel, electric power, and methane gas. The impact of these energy requirements is not projected to deplete local reserves significantly. Current energy requirements would increase slightly under the recommended alternative as flows increase and higher levels of treatment are achieved.

Economics and Employment

Employment levels under the recommended alternative would drop from approximately 212 persons to 191. The economic impact in the Columbus area of combined capital and O&M expenditures would be positive, however, quantification of indirect economic benefits cannot be performed at the current level of project planning and financial analysis.

Historic/Archaeologic Resources

The recommended alternative would have no direct impacts on known historic resources.

Construction at the Southerly WWTP under the recommended alternative is not expected to disturb archaeologic resources identified during surveys in 1985. Phase I and II archaeologic surveys were performed by Dr. John Blank, Professor of Archaeology at Cleveland State University, in order to evaluate impacts from site work planned by Columbus to meet 1988 compliance with water quality criteria. Four sites not eligible for the National Register were identified during Dr. Blank's survey within the boundaries of the Southerly WWTP site. Dr. Blank recommended a further (Phase III) archaeologic survey. However, at a meeting in March of 1986 the Ohio Historic Preservation Officer (OHPO) approved the initiation of site work necessary to build improvements to comply with water quality limits at the Southerly WWTP. This work has since been completed.

During 1985 Dr. Blank also surveyed the Jackson Pike WWTP site. Dr. Blank estimates that Jackson Pike was built on approximately 20 feet of fill material, isolating any archaeologic resources below from disturbance. For this reason, the recommended alternative should have no direct impact on archaeologic resources at Jackson Pike.

Recreation

Direct impacts on recreational use of the Scioto River would be minimal under the recommended alternative.

Transportation

Direct impacts of the proposed project alternatives on vehicular transportation in the Columbus area would involve short-term effects on traffic flow due to construction at both the Southerly and Jackson Pike facilities. These effects would be marginally greater at the Jackson Pike site due to the more congested traffic patterns in the downtown area. In neither case would impacts be significant enough to affect the level of service in the area. No off-site construction is anticipated that would impact vehicular flow.

7.2.2.2 Secondary Impacts

Growth and Development

Sustained growth in the Columbus metropolitan area is projected through 2008. Upgrading existing wastewater facilities under the recommended alternative would accommodate this growth. Secondary impacts projected to occur as part of forecast growth are evaluated below. These include: 1) increased demand for public services, 2) increases in non-point source pollution and erosion and runoff created by disturbances of stable areas, and 3) increased fiscal outlays required to mitigate other secondary impacts, that is, provide additional services.

Although some interceptor sewers in the Columbus area are nearing capacity and future growth could be restricted in some service areas, this EIS cannot assess capacity or potential for growth inducement of these lines, since plans for suburban interceptor expansion are not yet finalized. However, some of the growth projected in the northwest section of Franklin County may not occur if sewer service is not extended.

As long as the Columbus economy is strong and continues to expand, and as long as vacant land is available, the northern suburbs of Columbus should continue to grow (see chapter 4). Developers and local residents find this section of the county to be most attractive because of its recreation resources, existing public services, and close proximity to the Columbus central business district (CBD). Although some infilling has occurred, the city is also expanding its boundaries through annexation in the northwest sector of the county. This is an area where the incorporated areas of Dublin and Hilliard are also expanding their boundaries.

The most obvious impacts of continued forecast growth would be degradation in air and water quality, increased demand for public services, and increased taxes and user fees required to finance these services.

Since portions of Franklin County have been designated as non-attainment for total suspended particulates, the impact of projected growth on future ambient particulate concentrations was assessed.

Growth forecasts (see chapter 4) show a 10 percent growth rate for the period 1988 to 2000, and a 20 percent increase from 1988 to 2015. This population growth will be accompanied by increases in particulate generating activities such as residential and commercial fuel combustion, automotive exhaust, tire and brake wear, and solid waste incineration. An analysis of changes in emissions due to forecast growth conclude that air quality impacts due to project-related growth will not contribute to the exceedance of any air quality standards, add to the local non-attainment areas, or inhibit progress toward achieving ambient air quality standards.

Since the population growth and development are not expected to result in a violation of ambient air quality standards, it is unlikely that growth would contribute to changes in the climate of the area.

Based on the current pattern of population distribution, generalized growth areas within the FPA have been identified in Figure 4-3. These growth areas can be grouped into four general zones, based on watersheds, for the purpose of indirect water quality impacts discussions. Moving clockwise around Columbus, the four general growth impact zones are the Big Walnut Creek basin, including Blacklick Creek and Alum Creek; a small area draining directly to the lower Scioto River, southeast of Grove City, in Jackson Township; the Big Darby Creek basin; and the upper Scioto River including the Olentangy River.

Water quality impacts in these basins would include those typical of urbanization:

- Modified hydrograph (higher peak flows, lower base flows) and bank erosion
- Elevated turbidity, dissolved solids, and sedimentation
- Elevated water temperatures
- Increased organic load (higher BOD, COD, TOC, and nutrients) and decreased DO
- Elevated levels of non-point toxics (pesticides, herbicides, and complex organic compounds)
- Increased coliform bacterial levels.

The extent of these impacts would be dependent on the rate and degree of urbanization actually realized and the extent to which stream management practices are integrated with this growth.

Public Water and Sewer

The city of Columbus provides water and sewer service to most of Franklin County. Parts of this system were installed as early as 1935. The Columbus Infrastructure Report indicates that each of the communities in the Columbus area would have significant funding shortfalls in providing local sewers and water lines and that new revenue sources should be tapped in order to maintain this system. The report urges an increase in user charges and assessment fees to cover operation and maintenance costs.

Aside from maintaining a system of water and sewer lines, Columbus is also responsible for maintaining adequate water supply reserves. A recently completed water supply study (Witlatch & Martin 1985) confirms that the city can meet its water supply needs through the early 1990s and recommends that additional sources be found. In order to meet growth demands, new wells should be located and tested regularly.

Roads and Highways

The level of service provided by the Columbus area highway system appears to be adequately meeting current needs of the system, although some roads in some communities are approaching capacity. While data were not available to precisely quantify the levels of service, experts indicate that the level of service capacity has been reached in some communities and is approaching capacity in others. In many cases highway/road capacity has been reached without regard to additional growth anticipated in the future. It is also clear that growth is anticipated to continue and that the recommended alternative would represent only one factor in determining the magnitude of that growth. It does not appear from the available information that the implementation of the project would increase growth beyond that already projected.

Public Education

Franklin County has 17 independent school districts including Columbus. Each district operates its own schools and raises the funds to finance these schools through local property taxes. Most of the schools in high growth areas such as Dublin, Westerville, Worthington, and Hilliard are at capacity and should require expansion in the near future.

Fire and Police Protection

In 1977, MORPC prepared two reports: one addressing police protection and the other addressing fire protection (Mid-Ohio Regional Planning Commission 1977). Neither of these studies have been updated. Both of these reports indicated that providing adequate police and fire protection for the Columbus area would require increased coordination of services and additional personnel. These reports found that the inconsistent pattern of annexation by Columbus disrupted the delivery of fire and police services. The problems referred to in these reports have not been directly addressed in the intervening 10 years.

Cultural Resources

Secondary impacts on historic resources could occur as a result of changes in land use and zoning patterns as well as changes in the evolution of neighborhoods during the growth process. Historic resources have been inventoried in the study area. The Ohio inventory, in particular, is extensive. Land use changes may affect historic properties adversely in numerous ways without stringent zoning codes, zoning enforcement, containment of strip commercial and zoning map changes.

As described in chapter 2, archaeologic sites have been found to be nearly continuous along the floodplain and on adjacent bluffs along the Scioto River in the area of the Southerly WWTP. Since insufficient data have been collected and inventoried, knowledge of prehistoric culture along the Scioto River and within the study area is incomplete. Increased urban development along the Scioto River in the vicinity of the Southerly plant may increase the disturbance of unknown sites. As part of the recreation plan for the Scioto River, conservation of the southern Scioto riverbanks is recommended as a means of mitigating secondary impacts on these resources.

7.2.2.3 Mitigative Measures

Direct air quality impacts associated with the recommended alternative would include short-term, adverse air quality impacts experienced during the construction phase of the project with the generation of fugitive dust and increased vehicular exhaust. These impacts would be concentrated in the locale of both the Jackson Pike and Southerly facilities. Project specifications should include provisions for mitigating such impacts, through such measures as watering of haul roads and exposed soil.

Noise impacts should be minimized by the following techniques:

- Vehicles and motorized equipment should be properly muffled to state standards.
- Surface construction work should occur only during normal workday hours.

- Any activity potentially causing excessively high noise levels (e.g., blasting) should be carried out in accordance with applicable state and local regulations.

- Noise barriers should be used around sites where required by the local authorities.

Erosion and sedimentation impacts should be minimized by the following techniques:

- Permanent erosion control structures, such as rip-rap or rock fill, should be incorporated into the site design where appropriate.

- The contractor should grade, fertilize, seed, and mulch areas as called for on the plans or as directed by the engineer.

- The contractor should provide for temporary seeding or sodding as called for on the plans or as directed by the engineer.

Well-planned construction phasing takes into consideration the adverse effects on construction sites in which work will be left partially completed while construction continues elsewhere. A preferred phasing policy would call for completion of all necessary construction in a section before proceeding to the next section. This will prove more expensive in short-term costs, but environmentally advantageous in the long-term.

Finally, growth-related impacts (i.e., "secondary growth") will occur in the Columbus area in the future. Although these impacts are not a direct consequence of the proposed project, mitigation should be considered by the city where possible in the interest of sound environmental management to control water quality impacts. Best Management Practices (BMP) should be employed including: construction or farming set-backs from stream corridors as well as other erosion control measures discussed above.

In the area of fiscal and infrastructure planning, greater care should be directed to anticipating and planning for future infrastructure needs and development of longer term financing options. Specific opportunities in this area are included in the Infrastructure Project Final Report, included as Appendix N.

7.3 FUTURE FACILITIES PLANNING

This SEIS has evaluated only a component of a complete waste treatment system; therefore, any grant funds awarded to the city of Columbus would be contingent upon EPA approval of facilities planning for both combined sewer overflow and future interceptors. The last two grant awards to the city have included such grant conditions.

Combined Sewer Overflow (CSO)

The RFPU stated that the environmental impacts of the existing combined sewer overflows were insignificant according to documentation in the draft OEPA Central Scioto River Water Quality Report (CWQR). However, information in the CWQR suggests that the environmental impacts of the existing CSOs are significant. On page 195 the CWQR states that "combined sewer overflow, and as previously discussed, plant bypasses also contribute significant loadings of BOD_5, NH_3-N, TSS, and other substances to the Central Scioto River Mainstream". Further, page 317 states, "Reductions in the magnitude and frequency of combined sewer overflow discharges is needed to improve aquatic community function, alleviate aesthetic problems, and reduce risks to human body contact recreation in the segment between Greenlawn Dam and the Jackson Pike WWTP".

Water quality impacts of CSOs have been identified; however, detailed CSO data is not available to assess the magnitude or determine control methods. Therefore, completion of facility planning to produce a CSO study is required by OEPA to identify the magnitude of CSOs, mitigation measures, and a cost-effective, environmentally sound solution to the CSO problem. The city is also required within the NPDES permit to monitor the combined sewer overflows and report monthly for the permitted discharges.

Future Interceptors

This SEIS addressed only general population growth and secondary impacts associated with growth. Since the city has not completed planning for future interceptors, spacially located growth and impacts could not be identified. The city is also required to complete facilities planning for future interceptors.

CHAPTER 8. RESPONSES TO COMMENTS ON THE DRAFT SEIS

8.1 INTRODUCTION

In December 1987, the U.S. Environmental Protection Agency published the Draft Supplemental Environmental Impact Statement on the Wastewater Treatment Facilities for the Columbus, Ohio Metropolitan Area. Copies of the Columbus Draft SEIS were circulated to a large number of federal, state, and local agencies and organizations as well as private citizens who had expressed interest in the project. On February 16, 1988, a public hearing was held in two sessions, 1:00 p.m. and 7:00 p.m., at the Columbus City Hall to allow the public the opportunity to comment on the Draft SEIS. The period for receipt of comments was 45 days.

The comments received during the public hearing and in writing are included in Section 8.2 in full text. Numbers were placed beside the comments to identify those comments for which responses were prepared.

Comments received from the city of Columbus led to a change in the flow split between the two WWTPs under average flow conditions. Other minor changes have been made to the SEIS as a result of the comments received. The disinfection facilities and final clarifiers at Jackson Pike have been relocated to avoid construction in the lagoon area. Responses were prepared for all numbered comments, and they are included in Section 8.3.

8.2 COMMENT LETTERS

Rity/Columbus

STATE CLEARINGHOUSE

State of Ohio - Office of Budget and Management

30 EAST BROAD STREET • 34TH FLOOR • COLUMBUS, OHIO 43266-0411 • (614) 466-0697 / 0698

U.S. ENVIRONMENTAL PROTECTION AGENCY
230 SOUTH DEARBORN STREET, REGION 5
CHICAGO IL 60604-0000

Attention: HARLAN D. HIRT, CHIEF. PHONE: (000)000-0000

RE: State Clearinghouse Intergovernmental Review-Application Receipt Letter

Project Title: ENVIRONMENTAL IMPACT STATEMENT-DRAFT
Project Description: SUPPLEMENTAL EIS, WASTEWATER TREATMENT FACILITIES FOR COLUMBUS, FRANKLIN COUNTY, OHIO METROPOLITAN AREA.

SAI Number: OH880115-3133-36552
Proposed Federal Funding: $00

Dear Applicant:

The State Clearinghouse has received your notification to apply for federal funds. The review process has begun at the State level and will be completed on 88-03-07.

A State Application Identifier (SAI) number has been assigned to your project. Please refer to this number in all future contacts with the State Clearinghouse and the Area Clearinghouse. This number should also appear on line 3a of the Standard Form 424, as a part of your application.

A copy of your application should have been submitted simultaneously to your Area Clearinghouse, which is:

CLEARINGHOUSE:
MID-OHIO REGIONAL PLANNING COMMISSION (MORPC)

Failure to do so could result in a negative review of your application.

Sincerely,
Linda Weis
Project Coordinator

OHIO AREA CLEARINGHOUSES

Ashland County Regional Planning Commission
110 College Street
Ashland, Ohio 44805

Bel-O-Mar Regional Council
P.O. Box 2086, 2177 National Road
Wheeling, W. Virginia 26003

Brooke-Hancock-Jefferson Metropolitan Planning Commission
814 Adams Street
Steubenville, Ohio 43952

Buckeye Hills-Hocking Valley Regional Development District
216 Putnam Street, Suite 410
Marietta, Ohio 45750

Clark County Planning Commission
A. B. Graham Memorial Building
31 North Limestone Street
Springfield, Ohio 45506

Columbiana County Planning Commission
120 North Market Street
Lisbon, Ohio 44432

Community Improvement Corporation
c/o County Commissioners
46 South South Street
Wilmington, Ohio 45177

Crawford County Board
c/o County Commissioners
112 East Mansfield Street
Bucyrus, Ohio 44820

Eastgate Development and Transportation Agency
47 South Champion Street, Suite 47
Youngstown, Ohio 44503

Erie County Regional Planning Commission
2902 Columbus Avenue
Sandusky, Ohio 44870

Fairfield County Regional Planning Commission
Courthouse
Lancaster, Ohio 43130

Fayette County Planning Commission
c/o County Commissioners
Courthouse, 110 East Court Street
Washington Court House, Ohio 43160

Hancock County Regional Planning Commission
306 Municipal Building
Findlay, Ohio 45840

Hardin County Regional Planning Commission
County Courthouse
Kenton, Ohio 43326

Huron County Commissioners
180 Milan Avenue
Norwalk, Ohio 44857-1195

Knox County Regional Planning Commission
110 East High Street
Mount Vernon, Ohio 43050

KYOVA Interstate Planning Commission
P.O. Box 939, 1221 6th Avenue
Huntington, West Virginia 25712-0939

Licking County Planning Commission
22 North Second Street
Newark, Ohio 43055

Lima-Allen County Regional Planning Commission
212 North Elizabeth, Room 300
Lima, Ohio 45801

Logan-Union-Champaign Regional Planning Commission
East Foundry Street, P.O. Box 141
East Liberty, Ohio 43319

Madison County Regional Planning Commission
County Courthouse, Room 10
London, Ohio 43140

Marion County Regional Planning Commission
120 1/2 South Main Street, 2nd Floor
Marion, Ohio 43302

Maumee Valley Planning Organization
Route 2, P.O. Box 22A
Defiance, Ohio 43512

Mercer County Community Improvement Corporation
Court House, 1st Floor
Celina, Ohio 45822

Miami County Council
201 West Main Street
Troy, Ohio 45373

Miami Valley Regional Planning Commission
117 South Main Street, Suite 200
Dayton, Ohio 45402

Mid-Ohio Regional Planning Commission
285 East Main Street
Columbus, Ohio 43215-5272

Mid-Western Ohio Joint Planning Council
310 North Main Street
Delphos, Ohio 45833

Morrow County Regional Planning Commission
Courthouse
Mount Gilead, Ohio 43338

Northeast Ohio Areawide Coordinating Agency
1501 Euclid Avenue
Cleveland, Ohio 44115

Northeast Ohio Four County Regional Plng & Development Org
969 Copley Road
Akron, Ohio 44320-2992

Ohio-Kentucky-Indiana Regional Council of Governments
801-B West Eighth St, Suite 400
Cincinnati, Ohio 45203

Ohio Mid-Eastern Governments Association
P.O. Box 130
Cambridge, Ohio 43725

Ohio Valley Regional Development Commission
740 Second Street
Portsmouth, Ohio 45662

Pickaway County Regional Planning Commission
Courthouse, Room 5
Circleville, Ohio 43113

Portage County Regional Planning Commission
449 South Meridian Street
Ravenna, Ohio 44266

Richland County Regional Planning Commission
35 North Park Street
Mansfield, Ohio 44902

Seneca County Board of Commissioners
81 Jefferson Street
Tiffin, Ohio 44883

Shelby County Regional Planning Commission
129 East Court Street, Annex
Sidney, Ohio 45365

Stark County Regional Planning Commission
511 County Office Building
Canton, Ohio 44702-2298

Toledo Metropolitan Area Council of Governments
123 Michigan Street
Toledo, Ohio 43624

Wyandot County Board of Commissioners
County Courthouse
Upper Sandusky, Ohio 43351

0271L

Revised 11/30/87

O. WATER
CC: RA/RF

NACD

RECEIVED
JAN 14 1988
U.S. EPA REGION 5
OFFICE OF REGIONAL ADMINISTRATOR

WILLIAM J. HORVATH
North Central Region Representative

January 12, 1988

Valdas V. Adamkus, Administrator
Region 5 EPA
230 South Dearborn
Chicago, IL 60604

Dear Val:

I am in receipt of the *Draft Supplemental Environmental Impact Statement* for the Wastewater Treatment Facilities for the Columbus, OH Metropolitan Area. This is not within my area of expertise and I would appreciate it if you would remove my name from the review list.

Sincerely,

Bill Horvath

William J. Horvath

WJH:bb

National Association of Conservation Districts
1052 Main, Stevens Point, Wisconsin 54481-2895
Phone (715) 341-1022

[redacted]

Glenn King
114 W Dodridge St #B
Columbus, Ohio 43202

Dear Harlan D. Hirt

I have recently seen a copy of the EPA plans for waste water treatment facilities for the Columbus Ohio metropolitan area. I understand that these plans are open to the public. I would like to be sent a copy of the plan. If there is a nominal fee could you send me a copy with the bill attached. Thank you.

Sincerely yours
Glenn G. King

ALBERS AND ALBERS
ATTORNEYS AT LAW
88 NORTH FIFTH STREET
COLUMBUS OHIO 43215
[illegible]

JAMES [illegible] ALBERS
JAMES [illegible] ALBERS
JOHN B. ALBERS [illegible]

[illegible] ALBERS
([illegible])

February 17, 1988

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region Five
230 South Dearborn Street
Chicago, Illinois 60604

Attention: Mrs. Rita Bair

RE: Jefferson Water & Sewer District, SEIS For the Waste Water Treatment Facilities For the Columbus, Ohio Metropolitan Area

Dear Mrs. Bair:

Thank you for the forum to express our concern regarding the above referenced SEIS and the ability of the Jefferson Water & Sewer District to access the Columbus Sewer System. I also appreciate receiving the USEPA material regarding annexation. However, upon review of that material, and a review of the law, I still am somewhat confused regarding the ability of our District to access the Columbus System. Specifically, could you please address the following questions:

1) Is the "Blacklick Interceptor" a Federally funded interceptor?

2) If said interceptor is Federally funded, does the Jefferson Water & Sewer District have the right to access that interceptor?

3) Under what circumstances, if any, would the USEPA compell the City of Columbus to permit us to access their sewer system?

(1)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region Five
Attention: Mrs. Rita Bair
February 17, 1988
Page two.

4) Please provide citations for any law which forms the basis of your opinion in answering any of the above questions. (1)

Thank you for your attention to this matter.

Very truly yours,

JOHN B. ALBERS

JBA/sae

Ohio Historic Preservation Office
1985 Velma Avenue
Columbus Ohio 43211
614/297-2470

OHIO HISTORICAL SOCIETY
SINCE 1885

February 4, 1988

Harlan D. Hirt, Chief
Environmental Planning Section, SWFP
United States Environmental Protection Agency
Region 5
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Hirt:

Re: Draft Supplemental Environmental Impact Statement for the Wastewater Treatment Facilities for the Columbus, Ohio Metropolitan Area

This letter is in response to your correspondence of January 8, 1988 and the report noted above. My staff has reviewed the information provided. We recommend that a correction be made on page 2-78. The third paragraph should be corrected to read as follows:

The Ohio Historical Society (OHS) was established in 1885; its headquarters are in Columbus. The Ohio Historic Preservation Office, a division of the Ohio Historical Society, maintains the Ohio Historic Inventory (OHI) which is a collection of over 60,000 historic properties throughout the state. The OHI contains properties that have been: 1) listed in the National Register of Historic Properties; 2) determined eligible for listing in the National Register; and 3) determined not eligible for listing in the National Register or not evaluated against the National Register criteria. (2)

If you have any questions about this matter, please contact Catherine Stroup at the number noted above.

Sincerely,

W. Ray Luce
W. Ray Luce
State Historic Preservation Officer

WRL/CAS:dh

c.c. Jim Ronk, OEPA

Harlan Hirt

DOCUMENTS DEPARTMENT -BA
THE LIBRARIES
COLORADO STATE UNIVERSITY
FORT COLLINS, CO 80523
(303) 491-1879

February 8, 1988

Environmental Protection Agency
Region V
230 S. Dearborn Street
Chicago, IL 60604

Dear Sir/Madam:

If available, please send us one copy of the following. It is listed in the January 22, 1988 Federal Register.

EIS No. 880009, DSuppl, EPA OH, Columbus Metropolitan Area, Wastewater Treatment Facilities, Modifications and Updated Information, Grant, Franklin, Delaware, Fairfield, Madison and Pickaway Counties, OH

Please inform us, before sending, if there is a charge, or if you cannot supply. Please return a copy of this letter with your reply.

Thank you.

Fred C. Schmidt
Head, Documents Dept.

FCS/br

Mailed 2/26/88

U.S. Department of Transportation
Federal Highway Administration

February 9, 1988

Mr. Harlan D. Hirt
Chief, Environmental Planning Section, 5WFP
U.S. Environmental Protection Agency
Region 5
230 S. Dearborn Street
Chicago, Illinois 60604

Dear Mr. Hirt:

The draft supplemental environmental impact statement for the Wastewater Treatment Facilities, Columbus, Ohio has been reviewed. The proposal does not appear to significantly impact any existing or proposed highway projects. We, therefore, have no comments to offer on the supplemental document.

Sincerely yours,

Ennis V. Heathcock

By: Paul D. Quinn
Regional Environmental Specialist

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta GA 30333

February 10, 1988

Harlan D. Hirt, Chief
Environmental Planning Section, 5WFP
U.S. Environmental Protection Agency
Region 5
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Hirt:

Thank you for sending the Draft Environmental Impact Statement (EIS) for "Wastewater Treatment Facilities for the Columbus, Ohio Metropolitan Area." We are responding on behalf of the U.S. Public Health Service. We have reviewed the document and agree that the recommended two plant alternative appears to be the best solution to the wastewater treatment problem at this location. We particularly appreciate the discussion of public health impacts, including a specific section (6.4.3) entitled Public Health.

We appreciate receiving this document for our review. Please insure that we are included on your mailing list for further documents which are developed under the National Environmental Policy Act (NEPA).

Sincerely yours,

David E. Clapp, Ph.D.
Environmental Health Scientist
Special Programs Group
Center for Environmental Health
and Injury Control

City of Columbus
Mayor Dana G. Rinehart

Public Utilities and Aviation Department

Michael D. Long, Director

March 4, 1988

Mr. Harlin Hirt
Chief, Executive Secretary
USEPA, Region V
230 S. Dearborn
Chicago, Illinois 60604

Re: Columbus SEIS Comments

Dear Mr. Hirt:

Transmitted herewith please find SEIS Comments and the GERBOD Update of October, 1987 as revised for purposes of serving as a Revised Facility Plan.

Please note the following distinctions:

1. GERBOD denotes the General Engineering Report - Basis of Design (dated October, 1985, revised January, 1986).

2. RFPU denotes the Revised Facility Plan Update (dated September 30, 1985).

   In general, the RFPU and GERBOD are similar, although the GERBOD is more extensive and was revised at a later date than the issuance of the RFPU.

3. GDPU denotes GERBOD Update (dated October, 1987, revised February, 1988).

We note that there is new information contained in the GDUP and SEIS Comments that was not previously available to OEPA and USEPA. Considering the near congruence of the SEIS and GDUP, we hope that the explanation offered in our comments will allow some degree of closure between the two recommended plans. It is understood that a significant area of said planning is related to ongoing CSO studies and that certain issues cannot be resolved until completion of that work.

Please write or call if you have any questions.

Very truly yours,

DIVISION OF SEWERAGE AND DRAINAGE

Jerry L. Francis, P.E.
Administrator

JLF:jyl

Enclosure

cc: Sanat Barua, OEPA
File

The City of Columbus is an Equal Opportunity Employer

REVIEW OF THE SEIS

FOR

COLUMBUS, OHIO

PREPARED

FOR

CITY OF COLUMBUS
COLUMBUS, OHIO

BY

URS CONSULTANTS, INC.
33 NORTH HIGH STREET
COLUMBUS, OHIO

FEBRUARY 24, 1988

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SUMMARY OVERVIEWS

INTRODUCTION

Review of the SEIS and the GERBOD Update (GDUP) indicates that there is one key area of difference regarding the treatment process.

Particularly the difference appears to lie in the load allocation to Jackson Pike. Apparently there are factors or pieces of information that the USEPA and their consultants are not fully aware of that result in these differences.

In the following discussion, we will attempt to summarize our design concept and data base and hopefully highlight the apparent basic differences between GOUP and SEIS such that a resolution will be obtained.

FLOWS

The RFPU and GERBOD (1985) compared two plants and one plant on the following basis for year 2015.

	DWF	ADF	WWF
So - 1P	159	176	300
So - 2P	79	96	200
Jp - 2P	80	80	100

The DWF and ADF values were generated based on 80th percentile analysis for low ground water and high ground water conditions respectively. The data was generated from 1984 - 85 plant operating records. The 2008 flows are interpolated from this data as follows:

	DWF	ADF	WWF
So - 1P	153	170	300
So - 2P	73	90	200
Jp - 2P	80	80	100

(3)

It appears that the GDUP and SEIS are in general agreement on the dry weather flow, except for one issue. The SEIS presents the flow as "average" based on the data available. However, considering that the data available may not be based upon the highest ground water conditions, and resultant greater infiltration rates are likely to occur, the GDUP considers higher rates.

Furthermore, there is also concern that unmonitored overflows may have skewed the available data. The SEIS questions basing increased flow rates upon population growth. That comment is well taken.

The Ohio State University has monitored groundwater level since about 1940. The data indicates that high ground water levels have been 8' to 10' higher than levels observed from 1983 to 1987. Therefore, it is likely that infiltration flows will be higher than the data base used for these studies.

In as much as there is reason to expect that existing data does not account for maximum dry weather flows, it is reasonable to make an allowance for this situation, as is reflected in the total 170 MGD ADF. This item becomes of importance in the consideration of flow and load transfer to Southerly, as discussed below. (3)

The sensitivity of the Scioto River to bypasses is well founded and noted in the SEIS. The GERBOD recognizes the need to control bypasses and for this reason has provided a peaking factor more consistent with the criticality of the receiving stream.

It would seem to be inappropriate to design a facility which is incapable of handling Q_{WWF}/Q_{DWF} volume of 2.0 or more for the Scioto River. A few low stream flows, summer storm flow bypasses could negate the benefits of this $200+ million dollar expenditure.

(4)

STANDARDS

Treatment plants which have to meet very strict standards must have higher than normal safety factors than one which must meet a 30/30 effluent criteria. The Columbus plants do not have polishing filters, at a savings of $50,000,000, but this also represents an increase in risk of failing to meet the effluent standard of 8 mg/l $CBOD_5$, 16 mg/l TSS and 1 mg/l NH_4N.

WHITTIER STREET LOAD

Discussion at the meeting of February 17, 1988 indicated that the SEIS was predicated on the assumption that the Whittier Street load is in fact included in the Jackson Pike NORs.

Discussion with City personnel indicates that the normal situation is that wet weather flows usually persist in the system to a such a high degree of quantity and duration of flow that the Whittier Street underflow load overflows at Renick Run most of the time. (5)

This situation has probably not been discussed with the SEIS consultant and it is understandable that SEIS analysis did not include the allowance used in the GERBOD and GDUP. Again, the high effluent quality requirements and the lack of effluent filters are significant considerations.

PROCESS DESIGN

The issues discussed above combined with specific process factors are briefly summarized below. Further detail is provided after the summary.

It can be concluded that the most significant differences in the two design approaches are the determination of the BOD_5 and TKN loadings to aeration and the most suitable peaking factor for the Columbus wastewater treatment plants.

The differences in the design between GERBOD and SEIS at the 80/100 flow condition to Jackson Pike are attributed to four factors. They are:

1. Different peaking factor, hence load shift to Southerly.
2. Inclusion/exclusion of the Whittier Street storm flow tank return.
3. Different primary clarification treatment efficiency.
4. *Different kinetic rates for nitrification.*

At the time of the initial design calculations in September - November, 1985, the design SRT followed the approach promulgated in the EPA Nitrogen Control Manual and projected a design based on 12 days SRT, using the methodology shown in the Appendix A. *In November - December,* 1985, it was estimated that the sludge yield may be as high as 0.75 - 0.9 lb/lb BOD_{SR} and the effect was to reduce the SRT of the selected aeration volume *to 9 - 10 days. By mid 1986,* the SBR work demonstrated that the net sludge yield would be on the order of 0.8 - 0.9 lb/lb at Southerly, which resulted in an SRT of 8 - 9 days in the 16 aeration basins designed for Southerly. Since the lowest SRT occurred in the winter and the SBR tests indicated that 8 - 9 days SRT would be adequate in the absence of inhibitory nitrification components *no changes in the* final design was considered. However, it was recognized that the URS design for Southerly and Jackson Pike used an SRT significantly lower than the EPA *Nitrogen Control FD-4 Manual, or the NPCF Nitrogen Control* Manual design procedure would generate. (6)

DETAIL REVIEW

INTRODUCTION

As discussed in the summarization, the detailed analysis of the two designs is focused on four areas. Further detail is provided as follows.

The SEIS and Appendices were reviewed to define the differences in the conclusions drawn in the SEIS vs those in the GERBOD and GDUP reports. This analysis suffers from a lack of quantification of primary effluent loadings and the design parameters employed in the SEIS to size the biological units.

However, the analysis revealed that there were a number of differences between the SEIS and the GERBOD design which would affect the number and size of biological and clarification units required. The major differences are as follows:

1. The SEIS modified the loadings from Year 2015 in the GERBOD report to Year 2008. However, in this analysis the GERBOD loadings and design will be compared at the Year 2008 conditions.
2. Use of a 1.5 peaking factor (P.F.) rather than the 1.7 factor used by GERBOD resulted in lower loadings at Southerly for the SEIS design.
3. SEIS deleted the storm tanks return loadings from Whittier Street, thus reducing loads @ Jackson Pike.
4. SEIS *used higher primary treatment efficiency* at Jackson Pike and Southerly which thereby reduced the loadings on the biological units at Jackson Pike and Southerly.

Since the SEIS recommended only the 80/100 design, these loading levels and plant design will be reviewed for a comparative analysis.

Year 2008 and Whittier Street Loadings

Table 2-1 in the Appendix to the SEIS provided the 2008 loadings to Jackson Pike and Southerly. The GERBOD loadings corrected to Year 2008 using data from Tables 9-19 and 9-20 of the GDUP are listed and is compiled in Table 1 and explained in Table 1A. As shown, the primary difference in loadings are those attributed to the drainage from the Whittier Street storm tanks following the ending of a high flow period. This is considered to be a realistic estimate of the loading exerted on the facilities since it would only occur when the total is being treated by both facilities. (5)

The differences in BOD_5, TSS, TKN and TP between SEIS and GDUP are insignificant once the Whittier Street loads are removed. That is, the loadings differ by less than 2%. The reason for differences at this level was not investigated.

Peak Flow Treatment

The treatment of peak flows results in a significant load impact on the Southerly facility. The degree of this impact is a function of the peak flow which will be treated as well as the capacity to be processed at Jackson Pike. The design envisioned in the SEIS would process a peak flow of 231 MGD while the GERBOD design was 300 MGD.

In reviewing the comments in the SEIS, it was obvious we erred in presenting the wet weather peak flows. As of 1985-1986, *peak flows* in both the Jackson Pike and Southerly service greatly areas exceed 150 MGD each. This can be readily established from the low levels and quantities of BOD_5 and other contaminants reaching the Jackson Pike and Southerly WWTP during these events. The wet weather flows for Southerly were projected in the GDUP. Furthermore, concern remains that actual maximum dry weather flows (ADF or AAF) maybe higher than recent data shows.

The SEIS and attachments point out the criticality of the sewer discharges from Jackson Pike and Southerly WWTP. The low flows and sensitivity of the Scioto River to oxygen demand of the plant effluents is well *documented. Also, noted by SEIS is the fact that at low water* flows the Jackson Pike flow can constitute 90% of the volume in the stream. (4)

These factors led to OEPA first imposing a 5 mg/l BOD_5, 10 mg/l TSS and a 1.5 mg/l NH_4N limit on the discharges from both plants. Later this was modified to 8 mg/l BOD_5, 16 mg/l TSS and 1.0 mg/l NH_4N. This effluent quality results in a discharge which will contain less than *20 mg/l TOD (2 x BOD + 4.6 NH_4N) or a very high quality effluent.* As a result of this change in effluent quality the decision was made to delete the effluent sand filters.

The SEIS also properly notes that overflows and bypasses contribute major discharge loads to the Scioto River and that these loads need to be controlled. Control of storm flow loadings will be dependent on the peaking factor used for the design. That is, a peaking factor of 1.5 will result in a significantly higher untreated flow discharged into the Scioto River than would a 1.7 or a 2.0 P.F. ratio.

It is equally important that the more stringent the effluent quality, the higher the peaking factor should be. That is, a peaking factor of 1.5 may be appropriate for a 30 mg/l BOD_5/30 mg/l TSS effluent permit, but is not a criteria which should be used for a 8/16/1.0 effluent requirement. The 30/30 effluent has a TOD of 150 mg/l vs 20 mg/l for 8/16/1.0 effluent.

Table 2 shows the quantity of BOD_5 which could be discharged from Jackson Pike and Southerly between a peaking factor of 1.5 and 1.7. The bypassed BOD_5 @ the P.F. of 1.5 would be 129 mg/l at JP and 153 mg/l at Southerly. The TOD of the bypassed wastewater is 335 and 398 mg/l, *respectively.*

The TOD of the wastewater between a P.F. of 1.5 and 1.7 is 85,400 lb/d. *The current permit provides for a total of 30,860 lb/d at* 180 MGD. Thus, the discharge total for this event would be at 123,500 lb/d TOD as shown in Table 3. Since the flow peaks are higher than 1.7 in both the Jackson Pike and Southerly service areas, the discharge often exceeds this loading. If the plant is operating in the range of average *day/month* and maximum week/month criteria, the total discharge could be as much as 470% of the allowable discharge under the permit at 180 MGD.

It is *generally recognized and accepted necessary* to *provide* the higher P.F. for critical effluent waters in order to assure that the damage does not result from a few discharges/year. The Scioto River cannot be upgraded to the extent planned if discharges of +100,000 lb/d TOD periodically occurs. A few periodic D.O. depressions can have a long-term effect. (4)

The effect of SEIS using the lower P.F. is a lower loading at Southerly *since less flow would be treated at Southerly and less flow* would be transferred from Jackson Pike to Southerly in wet weather.

It is presumed that issues regarding the effect of wet weather flows and overflows on the treatment plants and receiving stream can and will be resolved in detail by the completion of the ongoing CSO Study. Nevertheless, we find that some recognition of the existing wet weather situation, however limited the current data, is necessary to ensure the continuing *operability of the facilities under the permits.* The City's current planning has therefore incorporated what are believed to be prudent and reasonable assumptions on these issues, but which may be beyond the scope of the current SEIS.

Unit Process Efficiency - General

It is difficult and in most cases impossible to determine unit process efficiency in the SEIS. The data is not provided. On Page C-28 of the Appendix, the Jackson Pike trickling filters are loaded at 129 lb/1000 $ft^3 \cdot d$ which *produces* a value of 89,900 lb/d BOD_5 in the Jackson Pike primary effluent or 30% BOD_5 removal across the primary. There is no indication of the mass balance for the nitrogen in order to determine rates of nitrification employed. By the same method, the Southerly PE BOD_5 was determined to be 188,200 lb/d using information for the trickling filter loadings provided for the one plant scenario on Page C-31. This is also a 30% removal across the primary clarifiers. (7)

__Process Efficiency__

The design removal of BOD_5 used in GERBOD was 22.7% of the BOD_5 at Jackson Pike at 80/100 MGD flows. This more conservative value was chosen since there is no actual plant data indicating the primary clarifier efficiency. The values of raw wastewater used in the SEIS do not represent the total flow entering the Jackson Pike plant since they are taken at the grit chamber. The SEIS notes that the grit chamber probably contains most of the industrial load. Hence, the removal of the Big Run wastewater to Southerly could result in the PE BOD_5 and TSS concentrations increasing above the values shown is SEIS Table 3-3. In final analysis the use of 22.7% BOD_5 may or may not prove conservative. The effluent quality requirements are too strict to take risks using the higher BOD_5 removals without data and the lack of filters demands caution in data analysis and assumptions. As shown later, the aeration basins are smaller than recommended by the EPA Nitrogen Control Manual.

For Southerly, GERBOD employed a primary clarification efficiency of 24%, whereas the SEIS used 30%. The 24% was based on the knowledge that the monthly percent removal is often less than the annual average as shown in Table 3-7, Page 3-21 of the SEIS, where 5 months of 12 had primary clarification efficiency equal to or less than 25%. It would not be appropriate to use 30% BOD_5 removal in the primary clarification stage in light of existing data and concerns for the level of effluent quality required, as noted above. Anaerobic digestion return can lower removals when it is in place and operating. (7)

In the Southerly two plant scenario, the SEIS used 30% removal at average and peak flows. The GERBOD design used 24% BOD_5 removal for reasons set forth above. It should be noted that moderate to high wet weather flows range from 5 days to over 30 days duration. The design efficiency employed must anticipate and provide for this condition.

In order to compare clarifier and aeration basin needs for Jackson Pike and Southerly at 80/100 and 74/131 (SEIS) and 73/200 MGD, Table 4 was prepared. All data necessary was not available from the SEIS. Specifically, the PE TKN value was needed. Since there will be considerable recycle from the anaerobic digestion, the primary effluent TKN will be higher than the influent TKN.

Using the data of Table 4, the hydraulic loadings and various other parameters were calculated to determine the unit operations' kinetic rates in the Jackson Pike and Southerly designs of the SEIS and GERBOD. As show in Tables 5 and 6, the unit sizing basis are very close when compared on gal/ft²·d, lb/ft²·d, SRT, F/Mv, etc., for the Jackson Pike design. (6)

The difference in requiring 15 aeration basins (GDUP) at Jackson Pike is the GDUP design loading of 109,226 lb/d P.E. BOD_5 vs 89,900 lb/d in the SEIS. The BOD_5 loadings are 7,282 lb/d·basin for GDUP and 7,492 lb/d·basin for SEIS. The revised design plan for Jackson Pike using 10 aeration basins had a loading of 7,299 lb BOD_5/d·basin (3/15/86). This was the loading for the current design for the Jackson Pike aeration basins rated at 60 MGD (AAF). For the reasons provided in the discussion on loadings and primary clarifier efficiency, the use of a BOD_5 loading of 109,226 lb/d is recommended.

Table 6 data shows a substantially lower SRT_{ox} for the SEIS design. The 8.7 day SRT_{ox} is below the EPA recommended SRT of 9.1 days before adding the appropriate design peaking and safety factor. The PE BOD_5 is higher in the GDUP design due to the use of lower primary clarification BOD_5 removal (24% vs 30%) and a larger load shift due to treating a higher total flow. GDUP would not recommend a lower SRT_{ox} than the value noted in Table 6 under GERBOD.

The required average rate of nitrification (Table 6) at Southerly is 0.85 mg TKN_{ox}/gm MLVSS·hr. As shown in Appendix A, the methodology in the EPA Nitrogen Control Manual (NCM) would indicate that Southerly is a very tight design and will not support the design presented by the SEIS. A comparison from this publication is as follows:

	EPA NCM (W/O SF & P.F.)	EPA NCM (1.33 PF + SF)	SEIS Design (Table 5&6)	GDUP Design (Table 5&6)
__Southerly__				
SRT - day	9.1	12.1	6.2	8.7
k_n - mg/gm·hr	0.97	0.73	Unknown (1.13)[1]	0.85
__Jackson Pike__				
SRT - day	9.1	12.1	7.5	7.7
k_n - mg/gm·hr	0.97	0.73	Unknown (1.38)[1]	1.10

[1] Calculated from GDUP TKN_{ox} and SEIS $MLVSS_{ox}$

The data for Jackson Pike was determined in the same manner as Southerly as shown in the calculations presented in Appendix A.

As shown above, the GDUP design does not have a customary level of safety factor and peaking factor, based on the EPA 1975 Nitrogen Control Manual (See Table 4-2, etc.). It was only through the studies conducted by Columbus (SBR and Contract 20) that led to the conclusion that the size of the aeration basins could be held status quo. Since the SEIS did not provide any documentation on the methodology used to develop their design, it is not possible to comment specifically on its adequacy. (6)

It should be noted that an SRT_{ox} of 6.2 days at Southerly as proposed by SEIS is only 68% of the EPA Nitrogen Control Manuals' value of 9.1 days without a peaking factor. The 9.1 SRT days @ 1.33 SF and PF is 12.1 days.

This information indicates that even with lower temperature correction, the SEIS design would not be considered prudent and the GERBOD design marginal, except for having the pilot experiences which were mostly conducted under favorable conditions. It is recognized that to ensure that the design for Southerly is operable, it is necessary for the City to control inhibitory inputs into the sewer.

Laboratory and field tests were conducted on both Jackson Pike and Southerly wastewaters to determine nitrification rates of the MLSS. These tests indicated that the Southerly rates were lower than normally expected and Jackson Pike's were higher than average. However, NH_4N breakthrough occurred at both plants, during Contract 20 and Basins 11 & 12 Jackson Pike tests. Further, it was found in late 1987 that the laboratory nitrification rates were enhanced by conducting them at higher D.O. in the laboratory than in the field. Based on the EPA NCM, the effect of D.O. on nitrification rates is

$$k_{n20} = (\hat{k}_{n20})\,(D.O.)/(k_{O_2} + D.O.)$$

$$= (\hat{k}_{n20})\,(D.O.)/(1.3 + D.O.)$$

(Reference pg. 3-12 to 3-18 NCM)

This would indicate that a test D.O. of 6 mg/l would increase the K_{n20} value to 135% of the 2 mg/l D.O. rate. A D.O. of 2 mg/l is planned for the operation of Jackson Pike and Southerly. However, this writer does not believe the EPA NCM is correct in adding limiting factors such as D.O., pH, temperature and residual NH_4N (see Appendix A). Thus, the higher D.O. may have enhanced the laboratory Jackson Pike nitrification rates to higher than normal levels, but they have had little effect on the already suppressed rates at Southerly; i.e., far lower than zero order. (6)

After adjusting the design for the use of higher kinetic rates in the SEIS design, the design hydraulic peaking factor for Columbus is a major factor which results in differences in the design methodology for Southerly. Review of the design peak/average flow of some of the plants in the EPA Region V may be appropriate. This information is provided in Table 7. (4)

The information shows that the average $Q_P:Q_A$ ratio for these plants were 2.5:1 for the 11 plants in Ohio. The Q_PQ_A ratio was mostly independent of the effluent quality, although plants where the first stage biological effluent was discharged to aeration may also have involved nitrification. Clearly, there is very little support for a treatment plant design peaking factor of 1.5 when discharging to a receiving water which at 7Q10 may be mostly wastewater treatment plant effluent. (4)

__Miscellaneous__

There are a number of questionable concepts in the SEIS document which, in-part appears to be a misunderstanding of the Semi-Aerobic Process. A few key points are as follows:

__Page C-5 & C-18__

While the SEIS properly notes that the MLSS of 3500 mg/l is higher than normally employed, the reason is not the nitrification rates. At a more conventional 2000 mg/l MLSS, the aeration volume would be increased 25% at Jackson Pike and 75% at Southerly, or a total of 15 more aeration basins to maintain the design SRT. This level of MLSS does stress the final clarifiers. Further, higher MLSS can restrict the nitrification rates when the D.O. is suppressed during peak demands. (8)

__Page C-20__

These are severe limitation on clarifier floor loadings as a function of MLSS concentration and SVI which appears to be ignored in the last paragraph of Page C-20. The use of 50 lb/ft²·d floor loading would cause failure of the clarifiers at design conditions. Most designers will not exceed 30 lb/ft²·d loadings for their designs. However, the 1983 Daigger Roper curve was used in the Columbus design and is widely used elsewhere. It is enclosed as Figure 1. It is now in a 1987 EPA publication on bulking sludge control. This curve shows the maximum loading at SVI = 170 mg/l to be about 36 lb/ft²·d.

Therefore, both SEIS and GERBOD design at 38 lb/ft²·d is at the maximum point and the difference in number and size of units is 131 MGD vs 150 MGD peak flow. (9)

__Page C-35__

If the ammonia concentration exceeds 2 mg/l in Bay 6, the aeration in Bay 2 will be activated as well as a general D.O. increase which will enhance nitrification rate. If this is not adequate to reduce NH_4N to 1.0 mg/l, then the internal recycle pump will be shut down to increase real time detention. The internal recycle pump will reduce nitrification capacity due to volume used for denitrification. It must be noted that it may be necessary to run the recycle pumps during normal operations to inhibit denitrification in the finals at Southerly. (10)

Page C-38

There will not be nitrification in Bay 1 or 2, and very little in Bay 3 since the $CBOD_5$ must be processed before nitrification can occur. The OUR/D.O. of at least 250:1 is the objective of the operation to control bulking and is not involved in nitrification or denitrification. This is explained in the April 1983 JWPCF paper provided for the SEIS review. (11)

Page C-40

The biological phosphorus process and nitrification are not interrelated. Bio P removal occurs with and without nitrification. This is well documented in many papers. However, the sludge yield of the Bio P process can decrease nitrification rates (mg/gm VSS·hr) about 15% since the percentage of nitrifiers in the sludge decreased proportionally. (12)

Page 6-30

Aside from the question of peaking and subsequent load shift to Southerly, the primary difference in the recommendations of SEIS and URS relate to Southerly. The specific major differences are in the area employed for gravity thickening and dewatering. (13)

Southerly	SEIS Avg	SEIS Peak	GERBOD Avg	GERBOD Peak
Thickeners				
Number	4		4	+ 1
Dia - ft	45		45	+ 85
Area - ft^2	6,362			12,034
TSS_p - %	55(1)		51.0	50.5
WPS - lb/d	89,100		69,344	99,895
WAS - lb/d(2)	--		12,267	15,510
Total - lb/d	89,000		81,611	115,405
Design Area Required				
WPS - ft^2	4,450		3,467	4,995
WAS - ft^2	--		3,067	3,878
Total - ft^2	4,450		6,534	8,873

(1) Not defined, estimated from thickener loading of 14 $lb/ft^2 \cdot d$

(2) 15% of yield - effluent TSS @ 10 mg/l

The thickener area required to be added to Southerly was equivalent to a 57 ft diameter unit with a 80/100 MGD capacity at Jackson Pike. Based on a design of 60/68/100 MDG (DWF/AAF/MMF) at Jackson Pike and the balance at Southerly, the new 85 ft diameter thickener is the proper size. (13)

The SEIS recommends the addition of 9 new centrifuges @ 1000 lb/hr for Southerly WWTP. Currently, the existing machines which are state-of-the-art Sharples PM75,000 produce a 16 - 20% TS cake. This cake results in very poor feed stock for combustion and composting. Further, it has been known that the EPA is considering a regulation whereby the stack gases must be raised to a minimum deodorizing temperature of 1400 to 1600°F. At a 1987 air quality meeting in Boston, the EPA spokesman stated that the new regulations mandating high temperature deodorization could result in obsolescence of the MHF.

Therefore, it was obligatory on the part of URS to employ dewatering equipment that would minimize the amount of water in the sludge. For this reason, the membrane filter press (MFP) was selected. At Duffin Creek, Ontario, the new belt presses (1980) were abandoned since they produced 19 - 21% TS for combustion. There were replaced by MFP which are producing 34 - 40% TS.

The benefits produced by drier solids are shown in Chapter 17 of the GDUP report. (14)

Page C-41

It should be noted that the reason for the semi-aerobic process is bulking sludge control, not phosphorus removal. The Southerly plant would be in a failure mode at an SVI of 160 - 170 ml/gm, not 200 ml/gm as stated. The basis for the SEIS SVI value of 200 ml/gm was not given. (15)

TABLE 1

Year 2008 Projected Flow and Loads

	SEIS(1)	GERBOD(2)
Tributary to Jackson Pike		
o BOD (lb/day)	141,600	153,666
o TSS (lb/day)	161,600	184,710
o TKN (lb/day)	18,532	20,169
o TP (lb/day)	6,057	6,392
o Average DWF (MGD)	88	87
o Peak Flow (MGD)	132	168
Tributary to Southerly		
o BOD (lb/day)	126,600	126,075
o TSS (lb/day)	121,300	121,108
o TKN (lb/day)	16,570	16,518
o TP (lb/day)	5,248	5,232
o Average DWF (MGD)	66	66
o Peak Flow (MGD)	99	132
Total from Planning Area		
o BOD (lb/day)	268,200	279,741
o TSS (lb/day)	282,900	305,818
o TKN (lb/day)	35,102	36,687
o TP (lb/day)	11,305	11,624
o Average DWF (MGD)	154	153
o Peak Flow (MGD)	231	300

(1) From Table 2-1, Page C-8 of SEIS

(2) Includes Whittier Street storm tank drainage

BOD_5 - 10,000 lb/d
TSS - 20,000 lb/d
TKN - 1,300 lb/d
TP - 225 lb/d

NOTE: The difference in loading between SEIS and GERBOD at Jackson Pike and the total planning area reflects the Whittier Street loading as being a constant load over that period. Data for 2008 was interpolated from the GERBOD. See Table 1A. (5)

TABLE 1-A

Calculation of Table 1 - 2008 Loading to Jackson Pike

DWF	Year 2015	Less Whittier St	Year 2008	Plus Whittier St
Q - MGD	90	90	87	87
BOD_5 - lb/d	158,620	148,620	143,666	153,666
TSS - lb/d	190,390	170,390	174,710	184,710
TKN - lb/d	20,820	19,520	18,869	20,169
TP - lb/d	6,605	6,380	6,162	6,387

Whittier Street Loads

1988 - 2008

BOD_5 - 10,000 lb/d
TSS - 20,000 lb/d
TKN - 1,300 lb/d
TP - 225 lb/d

The Y2008 + Whittier Street Data used in Table 1. (5)

TABLE 2

Loadings Discharged Between 1.5 and 1.7 Peaking Factor

	Jackson Pike	Southerly	Total
SEIS LOADINGS			
Q @ 1.5 PF - MGD	132	99	
BOD_5 - mg/l	129	153	
TSS - mg/l	147	147	
TKN - mg/l	16.8	20.0	
TOD - mg/l(1)	335	398	
GERBOD LOADINGS			
Q @ 1.7 PF - MGD	150	112	
BOD_5 - mg/l	123	135	
TSS - mg/l	148	130	
TKN - mg/l	15.0	17.7	
TOD - mg/l(1)	315	351	
Bypassed Quantities (GERBOD - SEIS)			Total
Q - MGD	18	13	31
BOD_5 - lb/d	18,465	14,637	33,102
TSS - lb/d	22,218	14,095	36,313
TKN - lb/d	2,252	1,919	4,171
TOD - lb/d(1)	47,288	38,101	85,389
Permit Criteria(2) (SEIS Tables 2-3 & 2-4 Appendix C)			
Q - MGD	60	120	180
BOD_5 - lb/d	3,995	7,990	12,010
TSS - lb/d	7,990	15,979	24,019
NH_4N - lb/d	499	999	1,498
TOD - lb/d(1)	10,285	20,575	30,860

(1) TOD = 2 BOD_5 + 4.6 TKN (NH_4N)

(2) Average June - October loadings

④

TABLE 3

Wet Weather Discharge of PF = 1.5 vs PF = 1.7

	Jackson Pike	Southerly	Total
Treated Flow			
Q - MGD	132	99	231
Effl. BOD_5 - lb/d	8,807	6,605	15,412
Effl. NH_4N - lb/d	1,101	826	1,927
TOD - lb/d	22,678	17,010	39,688
Bypass Flow			
Q - MGD	18	13	31
Effl. BOD_5 - lb/d	18,465	14,637	33,102
TKN - lb/d	2,252	1,919	4,171
TOD - lb/d	47,218	38,101	85,389
Total			
Q - MGD	150	112	262
Effl. BOD_5 - lb/d	27,272	21,242	48,514
TOD - lb/d	69,896	55,111	124,007
Effluent Permit @ 180 MGD			
BOD_5 - lb/d	---	---	12,010
NH_4N - lb/d	---	---	1,498
TOD - lb/d	---	---	30,860

Note: For simplicity, the bypassed flows are shown in the service area. In reality, the Jackson Pike flow may sometimes be transported to the Southerly service area and overflowed in that area during high flows in the Southerly service area.

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TABLE 4

Comparison of SEIS and GDUP Design Loadings
For Jackson Pike and Southerly - 2008

	SEIS		GDUP	
	Avg Q	Peak Q	Avg Q	Peak Q
Jackson Pike Influent				
Flow - MGD	80	100	80	100
BOD_5 - lb/d	128,700	107,300	141,302	91,468
TSS - lb/d	146,900	122,400	169,849	109,946
TKN - lb/d	16,850	14,040	18,546	12,005
Jackson Pike Primary Effluent				
BOD_5 - lb/d(1)	89,900	---	109,226	70,705
TSS - lb/d	NS	NS	81,867	52,994
TKN - lb/d	NS	NS	20,957	13,061
Southerly Influent				
Flow - MGD	74	131	73	200
BOD_5 - lb/d	139,500	160,900	138,433	188,273
TSS - lb/d	136,000	160,500	135,969	195,872
TKN - lb/d	18,250	21,060	18,141	24,682
Southerly Primary Effluent				
BOD_5 - lb/d(1)	97,376	112,410	105,209	143,087
TSS - lb/d	NS	NS	66,625	95,977
TKN - lb/d	NS	NS	19,856	26,864

(1)Calculated from T.F. Loadings.

(2)See Table 9-23 GDUP

NS = not specified

⑥

TABLE 5

Comparison of SEIS & GDUP Design for Jackson Pike
@ 80 / 100 MGD

	SEIS	URS
Influent		
Flow - MGD	80/100	80/100
BOD_5 - lb/d	128,700	141,302
TKN - lb/d	16,850	18,546
Primary Clarification		
Number of Units	8	8
Area - ft^2	96,000	96,000
O'Flow Rate - $gal/ft^2 \cdot d$	833/1041	833/1041
BOD_{5R} - %	30	22.7
Activated Sludge		
Number of Units	12	15
Volume - MGD	30.58	38.23
MLSS - mg/l (Max)	2,500	2,500
Mass (VSS) @ 75% - lb	478,100	597,625
$MLVSS_{ox}$ - lb	418,400	523,000
BOD_{5A} - lb/d	89,900	109,226
TKN_A - lb/d	Unknown	20,957
TKN_{ox} - lb/d	Unknown	13,821
F/M_V - lb BOD_5/lb $MLVSS_{ox} \cdot d$	0.21	0.21
Y_N - lb/d (Mack)	74,715	91,142
SRT_{ox} - days (Min)	7.50	7.65
SRT_T - days (Min)	8.57	8.74
k_n - mg TKN_{ox}/gm VSS·hr	Unknown	1.10
Clarification		
Number of Units	14	14
Area - ft^2	128,520	128,520
O'Flow Rate - $gal/ft^2 \cdot d$	622/778	622/778
Solids Loading - $lb/ft^2 d$	22/28	22/28

⑥

TABLE 6

Comparison of SEIS & GERBOD Update for Southerly WWTP

	SEIS	GERBOD
Influent		
Flow - MGD	74/131	73/200
BOD_5 - lb/d	160,900	188,272
TKN - lb/d	21,600	24,682
Primary Clarification		
Number of Units	8	10
Area - ft^2	120,800	171,670
O'Flow Rate - gal/ft^2·d	613/1084	425/1165
BOD_{5R} - %	30	24
Activated Sludge		
Number of Units	12	16
Volume - MG	30.58	40.77
MLSS - mg/l (Max)	3,500	3,500
Mass (VSS) @ 75% - lb	669,340	892,550
$MLVSS_{ox}$ - lb	585,670	780,900
BOD_{5A} - lb/d	112,410	143,100
TKN_A - lb/d	Unknown	26,864
TKN_{ox} - lb/d	Unknown	18,141
F/M_V - lb BOD_5/lb $MLVSS_{ox}$·d	0.192	0.183
Y_N - lb/d (Max)	93,970	120,080
SRT_{ox} - days (Min)	6.23	8.7
SRT_T - days (Min)	7.12	9.91
k_n - mg TKN_{ox}/gm VSS-hr	Unknown	0.85
Clarification		
Number of Units	6	6
Area - ft^2	170,030	188,400
O'Flow Rate - gal/ft^2·d	435/770	387/1062
Solids Loading - lb/ft^2d	22/38	19/38

⑥

TABLE 7

Peaking Factors Used In Region V WWTP Designs

Name of Plant City	Flow - MGD Q_A	Q_P	Q_P/Q_A	Effluent Permit-mg/l BOD_5 S/W	TSS S/W	NH_4N S/W
Buckeye Lake, OH	1.1	2.6	2.4	10	12	3.0/-
Centerville, OH	0.2	0.4	2.0	10	10	2.0
Belleville, OH	0.33	0.825	2.5	15	20	---
Des Moines, WI	6.25	12.5	2.0	30	30	---
Elyria, OH	13.0	30.0	2.3	20	30	---
Geneva, OH	1.0	2.5	2.5	20	--	6/2
Gallipolis, OH	1.3	5.7	4.4	30	30	---
Genesco, IL	1.5	4.0	2.7	--Roughing Tower---		
Huxley, IA	0.345	0.634	1.8	30	30	10/15
Iowa City, IA	5.0	12.0	2.4	25	30	---
Lorain, OH	6.5	13.0	2.0	20	20	---
Leipsig, OH	0.62	1.25	2.0	30	30	---
Mechanicsville, IA	0.21	0.84	4.0	30	45	---
Milford, OH	0.6	1.20	2.0	10	10	2.0/1.5
Nelsonville, OH	0.55	1.8	3.3	--To Aeration---		
Oberlin, OH	1.5	4.5	3.0	10	12	1.5/3.5
Washington, IL	2.7	7.65	2.8	--To Aeration---		
Wauconda, IL	1.4	4.70	2.9	10/15	12/20	1.5/4.0

Averages:

All:	2.5
NH_4N_{ox}:	2.4
$CBOD_5$:	2.6
Ohio Only:	2.6

④

⑨

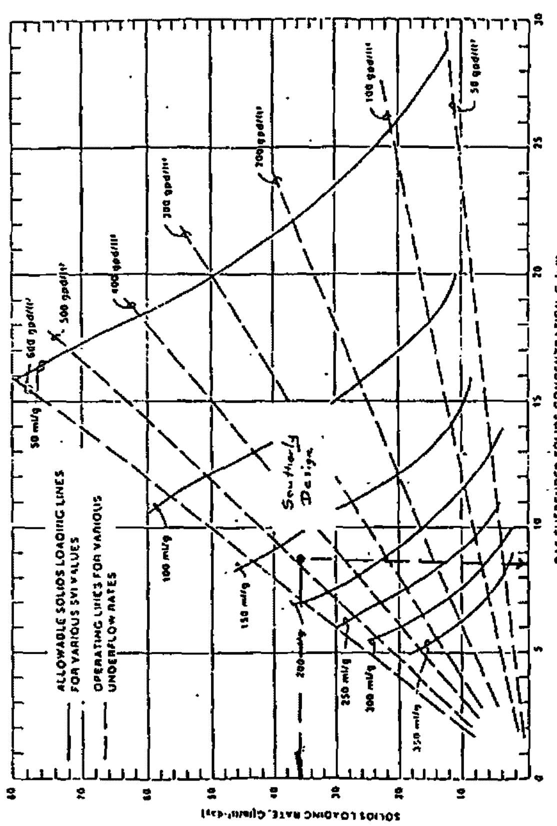

FIGURE 1

FIGURE 38 CLARIFIER DESIGN AND OPERATION DIAGRAM (AFTER DAIGGER AND ROPER (1985))

- 18 -

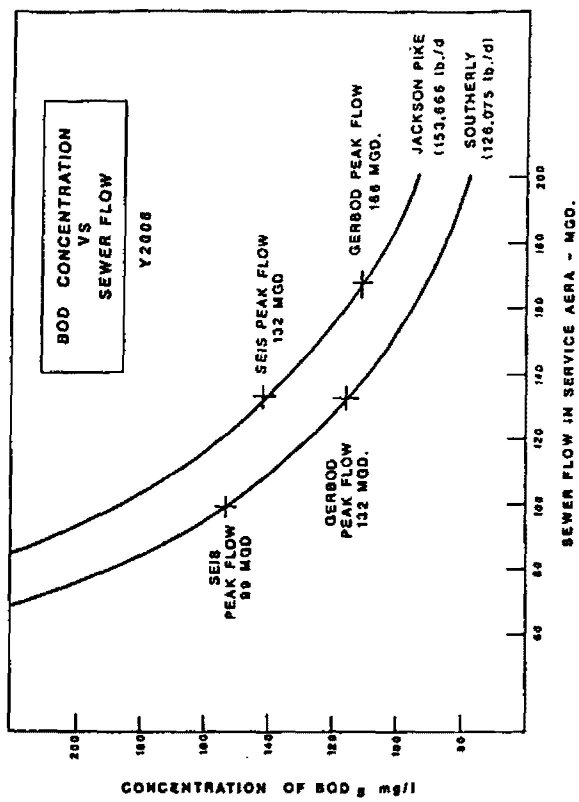

FIG. 2

- 19 -

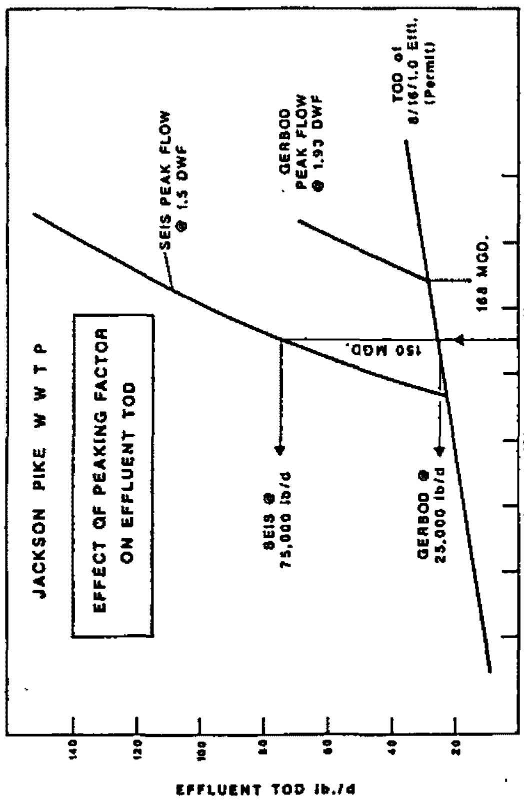

FIG. 3
- 20 -

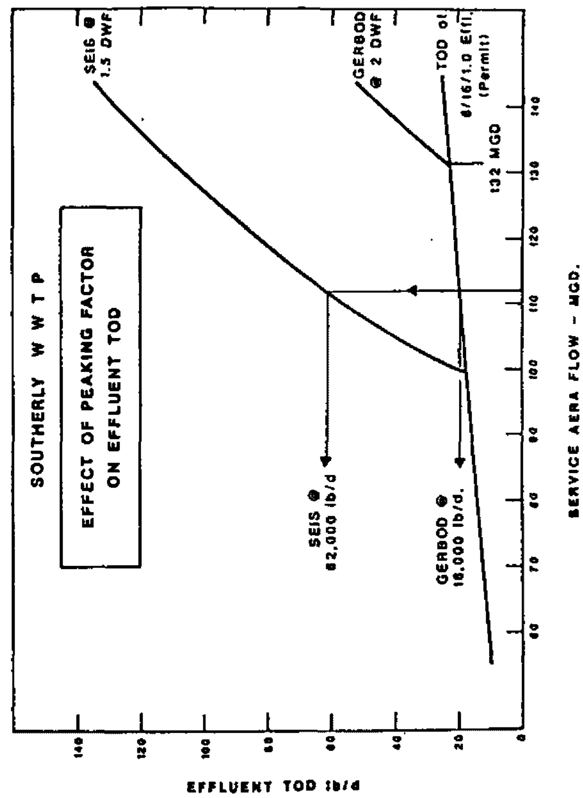

FIG. 4
- 21 -

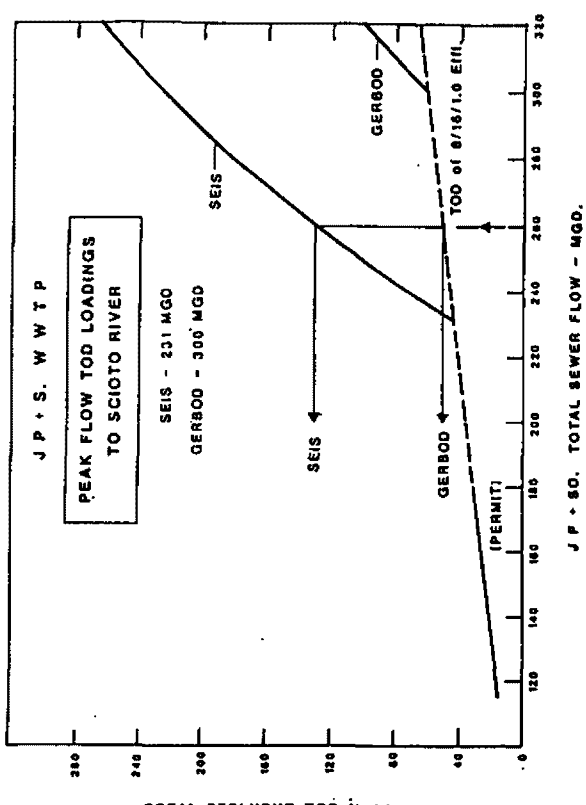

FIG. 5
- 22 -

APPENDIX A

EPA NITROGEN CONTROL MANUAL (NCM)

A. Nitrifier Fraction Approach, Pg 3-21 thru 3-26

Southerly

TKN_{ox} - 18,141 lb/d [Table 6]

Y_{N_N} = 2721 lb/d @ 0.15 lb Y_{N_N} /lb TKN_{ox}

BOD_5 Y_N = 120,020 lb/d (Table 6)

% Nitrifiers = $\frac{2721}{120,020}$ (100)

= 2.27%

10% Nitrifiers $\hat{k}_n$ = 0.3 lb/lb MLVSS-d [Figure 3-7]

$k_{n_{20}}$ = 0.0227 (0.3) (10)

= 0.0681 lb TKN_{ox}/lb MLVSS-d (2.38 mg TKN_{ox}/gm-hr)

TKN_{ox} = 0.0681 (780,900 lb VSS) [Table 6]

= 53,178 lb/d

Correct for 12°C and effluent NH_4N equal to 0.5 mg/l. To meet 1.0 mg/l effluent NH_4N, the design is based on 0.5 mg/l.

⑥

0220e

Temperature Correction:

$$\Theta = 1.123^{t-20}$$

or — These yield same results

$$\hat{\mu} = 0.18e^{0.116(t-15)}$$

(Figure 3-1)

$$\hat{k}_{n_{20}} = 2.83 \text{ mg } TKN_{ox} / \text{gm MLVSS-hr}$$

$$\hat{k}_{n_{12}} = 2.83\,(1.123^{12-20})$$

$$= 1.12 \text{ mg } TKN_{ox}/\text{gm MLVSS}\cdot\text{hr}$$

Effluent NH_4N Correction:

Use plug flow modifier as shown on Pg. 4-20 of NCM.

$$k_{n_{12}} = \frac{(\hat{k}_{n_{12}})\,(N_o) - (N_1)}{N_o - N_1 + K_N \ln\,(N_o/N_1)} \qquad (1)$$

$$k_n = \frac{1.12\,(10 - 0.5)}{(10 - 0.5) + 0.5 \ln\,(\underline{10})/0.5}$$

$$= 0.967 \text{ mg } TKN_{ox}\text{-d}$$

$$SF = \frac{0.967}{0.85}$$

$$= 1.14 \qquad \text{low!!}$$

(1) $k_{n_{12}}$ is the same as μ_{n12} and can be substituted into the equation.

(2) K_N was less than or equal to 0.5 mg/l NH_4N in SBR tests although a more conservative value of K_N of 1.0 mg/l is commonly employed.

(6)

2.0 SRT and Growth Approach

NCM: Figure 3-1 for activated sludge

$$\hat{\mu} = 0.18e^{0.116\,(t-15)}$$

$$= 0.18e^{0.116\,(12-15)}$$

$$\hat{\mu}_{12} = 0.127 \text{ day}^{-1}$$

Correct for effluent ammonia of 0.5 mg/l in a plug flow reactor.

$$\mu_{12} = \frac{\hat{\mu}_{12}\,(N_o - N_1)}{(N_o - N_1) + K_N \ln\,(N_o/N_1)}$$

$$= \frac{(0.127)\,(10 - 0.5)}{(10 - 0.5) + 0.5 \ln\,(10/0.5)}$$

$$= 0.1097 \text{ days}^{-1}$$

$$\mu_{12} = 1/\Theta_c$$

$$\text{Calc } \Theta_c = 9.1 \text{ days}$$

$$S.F. = \frac{8.7}{9.1}$$

$$= 0.96 \qquad \text{(less than 1.0!)}$$

It may be noted that no correction is made of pH or D.O. as proposed in the EPA Nutrient Control Manual. It is the opionion of this author that the effects of all parameters are not additive as indicated in the Manual. Thus, no correction for pH or D.O. if D.O. is greater than 2 mg/l.

Orris E. Albertson, P.E.
Process Consultant

(6)

APPENDIX B

HISTORICAL REVIEW

The order and basis for significant decisions are outlined below:

1. GERBOD and RFPU: dated September - October 1985, latest GERBOD Revision: January 1986.
2. Design starts December 1986:
   - Reports compared 1 plant versus 2 plants and recommended 1 plant
   - One plant recommendation was not ratified
   - Project 88 proceeded on basis that as much as possible facilities constructed would be useful for either alternative: 1 plant or 2 plants
3. Review of plant MOR's indicates possible ammonia toxicity: January and February 1986.
4. *New NPDES permit in preparation and filters deleted from design:* Summer 1986.
5. Excess yield and toxicity noted in SBR studies. Conclusion is that reliability of the process is reduced, but the design process is still feasible if the toxicity is removed. Southerly is re-rated at 90 MGD from 114 MGD due to yield and toxicity. However, Jackson Pike is re-rated at 60 MGD ADF & PDF based upon new NPDES permit and full scale testing: Fall 1986.
6. Project 88 Bidding and Construction Starts: Summer 1986.
7. Preliminary Design Evaluation of Sludge Dewatering Issued, *recommending membrane filter presses: December 12, 1986.*
8. GERBOD Update, review of situation focused especially on new NPDES permit and pilot data. Cost effectiveness of 2 plants without filters now indicates a 2 plant recommended plan. *Furthermore, due* to better information available regarding Jackson Pike treatment capacity a series of 2 plant alternatives are evaluated and Alternate 3 is chosen where Jackson Pike will operate at 60/68/102 MGD - DWF/ADF/PDF respectively: Issued October 1987, Revised: February 1988.
9. SEIS Issued: December 1987. Received by Columbus: January 1988.
10. *FY88 Design Grant Application submitted to OEPA by City of Columbus* - most of the package relates to upgrade of Jackson Pike: February 1988.

United States Department of the Interior

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
~~230 S. DEARBORN, SUITE [illegible]~~
CHICAGO, ILLINOIS 60604

ER 88/24 March 4, 1988

Mr. Valdas V. Adamkus
Administrator
Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Adamkus:

This letter responds to your request of the Department of the Interior to review the supplemental draft environmental impact statement (Statement) for the wastewater treatment facilities for the Columbus, Ohio, Metropolitan Area. Overall, we support the preferred two-plant alternative. Implementation of that alternative will result in minimal impacts to aquatic and terrestrial wildlife habitats. We also have the following specific comments.

Page 2-25 states that piping plovers use the Jackson Pike Waste Water Treatment Plant. Please be aware that the piping plover was added to the Federal endangered species list on December 11, 1985. Discussions of endangered species in the Statement should include the piping plover. (16)

The Statement does not include a discussion of the mixing zone, discharge plume characteristics, or zone of passage. Such a discussion in the Statement would permit a better understanding of the impacts of the proposed wastewater treatment plant to aquatic life. (17)

Section 5.4.2.8, page 5-38 discusses the land application of sewage sludge. More attention should be paid in this section to the problem of metal accumulation in top soils from land application of sewage sludge. The Statement should indicate if the wastewater treatment plant management keeps records of the lands to which the sludge is applied or makes an effort to inform the farmer or other user of the restrictions to its use. In addition, the Statement should also indicate if subsequent owners of a parcel of land are made aware of the land applications and who is responsible for monitoring crop and soil metal residues. (18)

Mr. Valdas V. Adamkus 2

Section 6.4.3, page 6-87 states that "Adequate disinfection of the effluent from sewage treatment facilities is critical for protection of public health." A 1977 report to the Congress by the General Accounting Office titled "Unnecessary and Harmful Levels of Domestic Sewage Chlorination Should be Stopped" concluded that, except in areas of shellfish-harvesting or unrestricted irrigation, disinfection of treated wastes is not needed to protect:

- swimmable waters in cold weather months,
- waters rarely used for swimming, or
- drinking water.

The Centers for Disease Control, in this same document, have taken the official position that disinfection of sewage provides little public health benefit. Widespread sewage disinfection is a relatively recent phenomenon in the United States with little accompanying improvement in public health. In fact, the disinfection of sewage is not practiced extensively in other industrialized countries with public health experience similar to that of the United States. If there is a factual basis for wastewater chlorination that strongly argues against the position of the Centers for Disease Control and the General Accounting Office, we would appreciate being made aware of the literature. (19)

Further, it is our understanding that the effectiveness of sewage chlorination varies depending on the specific waterborne disease agent involved. Fecal coliform are not pathogenic and although they are used as an indicator, they do not establish the presence or absence of pathogens. (20)

Because disinfection standards for waste waters are established, we would like to suggest that alternatives to chlorine, such as ultraviolet light, be addressed in the Statement. However, we are pleased that the addition of dechlorination to the disinfection system is proposed in the Statement.

The opportunity to comment on this Statement is appreciated.

Sincerely,

Sheila Minor Huff
Regional Environmental Officer

cc: Ohio Division of Wildlife, Fountain Square, Columbus, OH 43225
Ohio Environmental Protection Agency, Water Pollution Control, Columbus, OH 432
Harlan D. Hirt, Chief, Environmental Planning Section (SWFP), U.S. EPA V
Chicago, IL 60604

VILLAGE OF NEW ALBANY

P.O. BOX 188 21 EAST MAIN
NEW ALBANY, OHIO 43054

Harlan D. Hirt, Chief
Environmental Planning Section,
5WFP-TUB-08
U.S. Environmental Protection Agency
Region 5
230 S. Dearborn Street
Chicago, Illinois 60604

Re: Draft Supplemental Environmental Impact Statement for the Wastewater Treatment Facilities for the Columbus, Ohio Metropolitan Area

Dear Mr. Hirt:

The Village of New Albany, Ohio, submits the following comments and questions on the "Draft Supplemental Environmental Impact Statement for the Wastewater Treatment Facilities for the Columbus, Ohio Metropolitan Area" ("SEIS").

The Village of New Albany is a small community, located in Franklin County northeast of the City of Columbus' municipal boundaries. The City of Columbus has included New Albany in its facilities planning area in connection with obtaining federal construction grant money. Although included in Columbus' planning area, residents of New Albany are not presently served by the Columbus sewer system. Instead, residents of the Village rely on well water and septic tanks for sewage treatment.

The 1979 Environmental Impact Statement prepared by this Agency discusses a heavy impact on surface water pollution from the individual septic tanks and leachfields in and around the Village of New Albany. Recent correspondence to the Village of New Albany from Ohio EPA identifies this as a continuing problem, in violation of Ohio Water Pollution Control Laws, and requests that the Village develop a proposal and schedule for correcting violations identified by Ohio EPA.

Harlan D. Hirt, Chief
March 1, 1988
Page 2

U.S. EPA's 1979 Environmental Impact Statement concludes that the extension of Columbus' sewer system in and around New Albany is the most cost-effective way to address an identified pollution problem. The SEIS appears to ignore the pollution problem in New Albany area, identified by both the state and federal EPAs; suggesting only that the Village of New Albany, but not adjacent rural areas, will at some unspecified future time be within the Columbus service area. (SEIS, p. 6-96). New Albany perceives that the policy of the City of Columbus of not providing sewer service to unincorporated areas will prevent the most cost-effective solution to sewage treatment in the New Albany area.

Columbus has performed facilities planning for a region extending beyond the Columbus corporate boundaries pursuant to federal construction grants. Improvements to Columbus' wastewater treatment facilities, and construction of interceptor sewers to implement parts of the facilities plan, have been funded with federal money under the construction grant program.

Given the benefits Columbus has received from the grant program, U.S. EPA should not permit Columbus to apply a "no-annexation, no-service" policy when this Agency has determined that the extension of service to an area is the most cost-effective and environmentally beneficial. A community such as Columbus that has benefitted from federal moneys to construct sewer improvements with capacity for future expansion should not be permitted to deny service to unincorporated areas that were included in the regional planning solely because of an annexation policy. Where federal grant money has been provided to a community for regional planning and improvements, that community should not be permitted to thwart or ignore the goals of regional planning by insisting on annexation or other unreasonable terms as a prerequisite to service. (1)

The Village of New Albany would like to know whether there are circumstances under which U.S. EPA could require a construction grant recipient (like Columbus) to provide service to an area included in the regional facilities plan (like New Albany and the surrounding territory). Will U.S. EPA allow a grant recipient to benefit from construction grant funds and then refuse to extend service to an unincorporated area identified in the facilities plan solely because that area is not part of a municipality? Will U.S. EPA impose conditions on a grant recipient to insure that the grantee does not refuse to serve

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part of its planning area if that area is prepared to pay reasonable costs for the service?

The Village of New Albany would appreciate your response to these comments and questions.

Very truly yours,

Carl Musgrave
Mayor, Village of New Albany

Ohio EPA

State of Ohio Environmental Protection Agency

P.O. Box 1049, 1800 WaterMark Dr.
Columbus, Ohio 43266-0149

Richard F. Celeste
Governor

March 10, 1988

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MAR 17 1988
ENVIRONMENTAL IMPACT UNIT
USEPA

Mr. Harlan D. Hirt, Chief (5WF1)
Environmental Impact Section
U.S. EPA, Region V
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Hirt:

This letter transmits the Ohio EPA's comments on the Draft SEIS for the City of Columbus Wastewater Treatment Facilities. First, we would like to acknowledge the enormous technical effort put forth by the U.S. EPA and their contractors in compiling the SEIS. The document is well prepared, technically sound, implementable and is a major step toward water quality improvements in the Scioto River.

The following review comments are provided for your consideration:

1. The potential primary impacts from constructing four seventy-eight inch sewers at the proposed location (approximately RM 118) are significant. Among these impacts are the following: (21)

   - West bank construction would destroy trees of substantial age and size, while disrupting a mature forest habitat (page 6-71, SEIS).
   - Extensive construction and deep excavations would be necessary in the Scioto River floodplain.
   - Trees along the Scioto River may provide habitat for the federally endangered Indiana Bat, sighted recently in Pickaway County (page 6-82, SEIS). Removal of such trees could have a significant adverse impact on the species by further reducing suitable habitat.
   - Several state endangered species of fish have been collected in the Scioto River between Columbus Southerly and Circleville between 1979 and 1986. Existence of the river redhorse has been documented from RM 130.6 to RM 70.7. The SEIS states that fish mortalities should be expected.

   The mitigation outlined in table 6-13 represents only generalized mitigation which was obtained from the city prior to initiation of the SEIS. Additional specific mitigation and a clear mandate requiring implementation of appropriate mitigative measures is necessary to support the impact conclusions concerning any expansion of the interconnector crossing (i.e., the one plant alternative or any flow diversion from Jackson Pike which would require an additional interconnector crossing). (22)

A. If an additional interconnector crossing would become necessary, the mitigation listed in table 6-13 of the SEIS and the additional mitigation outlined in this comment should be required both in the project specifications and as a general notes page in the actual detailed plans and insure implementation by the contractor. These detailed plans would require approval by the Ohio EPA prior to construction.

B. The SEIS should prescribe construction easement limits. A construction easement width of 150 feet was previously proposed (URS-July, 1986). Please address the appropriateness of this easement given the nature of the necessary construction and associated environmental concerns. The general notes page should clearly state that work easements are not to be exceeded.

C. The detailed plan sheets should clearly delineate trees to be saved, work easements, stockpile areas, locations of hay bales, jute mesh, silt barriers, rip rap, and other erosion control measures. Detailed inserts showing proper construction techniques for these various erosion controls should also be included (please see enclosed sample for hay bale checks).

D. Clearing and grading shall not begin prior to July.

E. Clearing shall be done in stages near the river to avoid vast exposure of bare soils.

F. Tree removal shall be minimized along the river banks. (22)

G. No construction in or near the Scioto River shall be permitted during the spring spawning months.

H. The contractor shall backfill and rough grade all trenches at the end of each workday. The disturbed area over the trenches shall be graded, seeded, and mulched within 72 hours after backfilling. The contractor shall maintain all seeded and mulched areas in accordance with the specifications until final acceptance of the work.

I. The clean-up and disposal of cleared materials shall be done as soon as practical after laying of the pipe and as the resident project engineer may direct. However, clean-up work shall not fall behind the pipe laying more than 600 feet. Should the contractor not keep his clean-up work within the aforementioned distance, the contractor shall be required to cease further pipe laying until such clean-up work is accomplished.

J. If work on this project is suspended for any reason, the contractor shall maintain the soil erosion and sedimentation control facilities in good condition during the suspension of work. Also, when seasonal conditions permit and the suspension of work is expected to exceed a period of one month, the contractor shall place topsoil, fine grade, seed, fertilize, and mulch all disturbed areas left exposed when work is stopped.

K. All dewatering flows are to be kept free of silt, sedimentation, debris, and other pollutants through appropriate means (settling basins, filters, etc.) and following this, the flows shall only be released directly into storm drains, stream channels, or other stabilized drainage courses and not onto exposed soils or steep slopes. (22)

L. If at any time before the expiration of the Contract Bond (usually one year after final payment is made) any part of the seeded area is not in good condition, the contractor shall re-seed as often as necessary to get a good stand of grass.

2. Page 6-83 states that downstream estimates of sediment transport are not available. However, previous facilities planning comment responses indicated that based on a hydrograph with a 90 MGD discharge from Jackson Pike, river velocity at RM 118 would be .421 feet per second with a water depth of three feet during low flow periods (URS-July, 1986). Please address the accuracy of this velocity figure and define the anticipated downstream distance of construction related sedimentation impacts associated with any expansion of the interconnector crossing. The data should then be related to the endangered species identified in the SEIS before the significance of impacts are determined. (23)

3. The SEIS identifies the south end interconnector pump station as having a pumping capacity of 70 MGD on pages 5-10 and 60 MGD throughout the rest of the document. Please clarify and identify the maximum diversion capability of the existing pump station forcemains. (24)

4. Please clarify if the SEIS hearings fulfill the public participation requirements necessary for approval of the facilities plan. (25)

5. Page 7-16 of the SEIS indicates that the recommended Jackson Pike Upgrade would require expansion in an existing isle lagoon area. The SEIS should further address potential impact concerns with construction in this area and the disposal of excavated materials.

   - Will special construction techniques be necessary in this unstable area?
   - What is the volume and moisture content of the material which will require disposal? (26)
   - What is the composition of the lagoon?

   It appears that total metals analyses and e.p. toxicity/extraction testing may be necessary to determine if the materials should be classified as hazardous wastes. The levels of PCBs, heavy metals, dichlorobenzenes or other toxic materials should be defined to allow for environmentally sound excavation and disposal methods.

6. The list of existing sewer contracts on page 4-11 of the SEIS includes New Albany. It appears that the previous contract that included New Albany was cancelled by the Columbus City Council in July of 1987 (Columbus Dispatch article 2/18/88). Unless a new service contract is currently being negotiated, New Albany should be deleted from page 4-11, Table 4-5 of the SEIS. (27)

   Additional clarification is needed to define the existing treatment needs and twenty-year service area for the city of Columbus.

7. Please include a map of the existing Columbus service area in the SEIS.

8. Construction grants regulations appear to require implementation statements from all entities included in the city's existing service area. These statements would provide each entity's agreement to accept service via the twenty-year capacity being provided for them at the Columbus WWTPs.

9. It also appears that at a minimum each entity included in the ultimate twenty-year service area for Columbus should be directly notified of the city's intent to provide service. This notification may prompt the necessary negotiations and the city in completing the remaining facilities planning for interceptors. (27)

10. Is the city required to provide service to the entities shown in the ultimate service area (Figure 4-1, draft SEIS) if a grant is provided to implement the SEIS alternative?

    Also, please discuss annexation as it relates to this issue. (1)

11. The archaeological report prepared by Dr. John Blank stated that if future construction is planned at the Columbus Southerly Wastewater Treatment Plant or in the vicinity of Columbus Facility Sites # 1 through # 4, a Phase III Archaeological Survey will be required to more precisely define the horizontal boundaries of the sites and determine if the sites are eligible for inclusion on the National Register of Historic Places.

    Based on Dr. Blank's recommendations and our recent discussions with the OHPO, two revisions should be made to the SEIS. First, the SEIS states that the four Southerly archaeological sites are not eligible for the National Register of Historic Places. This determination appears to require completion of the Phase III survey work. (28)

    Secondly, the SEIS should clearly state that the Phase III survey must be undertaken prior to any construction near the identified archaeological sites at Southerly.

Re: Process Peaking Factor (PPF)

12. We agree that based on the lack of flow information, one is forced to rely on empirical means to derive peak flow data. Our question relates to the application of the formula:

PPF = 1.95 (Qp) 0.95

It appears that if the design flow values for Jackson Pike and Southerly are seperately put into the equation, one would compute a PPF closer to 1.6. Since we do not know how this equation was derived, we acknowledge that this may be a misapplication of the formula. *Please comment.* (29)

13. Does the PPF have significance to a real world, hydrologic condition such as *post-storm rain-derived* infiltration, or is the PPF related to the determination of process capacity apart from hydrologic concerns. Please discuss. (30)

Re: Biological phosphorous removal

14. Based on what we understand about the semi-aerobic process, it appears that with the strategic placement of anoxic, anaerobic, and oxic zones, biological phosphorous removal will, most likely occur. Literature states that, at least theoretically, an activated sludge (AS) process which achieves biological *phosphorous removal produces more* waste sludge than an AS process without biological phosphorous removal. We are interested in the effect that the extra sludge may have in the sizing of solids train facilities especially the thickening of waste activated sludge. (31)

15. This is related to the above comment. It is our understanding that the waste sludge will release phosphorous once it enters an anaerobic condition, such as the anaerobic digesters. What would be the subsequent impact of the phosphorous rich recycle on the semi-aerobic process, if any? (32)

Re: Dechlorination/post aeration

16. Our review did not locate a discussion of this subject. (33)

Re: Toxicity in the Southerly service area

17. The bench studies *performed by the city's* consultant reveal that the ammonia removal rates at the Southerly plant are hindered by the presence of one or more toxicants. To date, the city appears to have not located the source or sources. The end result is that to compensate for the slow substrate conversion rates, the activated sludge system has been designed to operate at 3500 mg/l as *opposed to* 2500 mg/l at Jackson Pike. The city's consultant stated that new circular clarifiers must be constructed with hydraulic sludge removal devices to accomodate the higher floor loading. The existing rectangular clarifiers were determined to be (34)

poorly suited. Our question is that if the source or sources of these toxicants were eliminated, would the new circular clarifiers still be required or would the existing rectangular limits be satisfactory? (34)

18. The Ohio EPA, *Division of Water Quality Monitoring and Assessment*, supports the recommended SEIS two-plant alternative. This alternative will meet the warm water habitat use requirements of the water quality standards. However, the following critique of the one plant/two plant environmental impact analysis is presented for your consideration:

Our concerns basically focus on the reasoning used in the SEIS to conclude that a two-plant scenario is more environmentally acceptable than the one-plant proposal. In our view, some of the predictions of environmental harm are erroneous, lack sufficient documentation, and do not consider future remedial actions to control CSO and stormwater discharges.

The SEIS concludes that it is essential that the Jackson Pike discharge be maintained to:

A) provide low-flow augmentation for 8.8 miles of the Scioto River during dry weather periods;

B) provide dilution for loads discharged upstream from the Whittier Street CSO;

C) provide a "buffer" for any shock loadings that might upset WWTP *performance and cause subsequent instream impacts;* and, (35)

D) prevent an increased impact on the Scioto River downstream from Southerly caused by discharging the whole load at one point instead of two.

On the surface it may seem prudent to be concerned about "losing" 120 cfs of sustained dry weather flow from any river. This has certainly been an issue in the western U.S. where water projects and diversions can result in stream drying and subsequent severe impacts on aquatic resources. The *situation downstream from Jackson Pike is not really analogous to the* western U.S., however. First, it should be recognized that complete removal of a WWTP discharge from a river regardless of its real or potential effluent quality should be taken advantage of unless there are overriding factors involved. Only in the lowest flow situations (usually 0 to 0.1 cfs) do we view the augmentation benefits of a continuous WWTP discharge to be more beneficial than its removal. The SEIS estimates that 20 cfs will remain in the Scioto River at low flow. The $Q_{7,10}$ flow (May - November) for the Olentangy River at Worthington is 11 cfs and the 90% flow is 22 cfs, thus the SEIS estimate seems reasonable. This is a far different situation than 0 or 0.1 cfs, however. In addition, supplemental flow augmentation provided by the American Aggregates discharges of quarry water was not considered.

Predicting biological impacts from a current situation to a future situation is a difficult task. Using analogous situations to help in predicting future impacts is the most commonly used approach. Its validity is supported by *the ability to establish patterns of response* in situations that have similar characteristics. Therefore we are considering 1) the beneficial influence of complete wasteload removal for 8.8 miles of river, and 2) the biological character of other rivers in close proximity to the Scioto that have low-flow characteristics similar to the situation without Jackson Pike.

The beneficial impact of complete wasteload removal was underestimated in the SEIS probably because it was overshadowed by other concerns (loss of CSO dilution, loss of low-flow augmentation, etc.). If these other *concerns can be eliminated or reduced then the benefits of WWTP removal* are magnified. There is no question that biological communities perform better in streams and rivers where such large WWTP discharges are absent. This is not to say that the Scioto River is not capable of meeting the warmwater habitat (WWH) use with an improved Jackson Pike effluent - it is. The point is that *the biological performance could be* even better without the presence of such a flow dominating effluent. Even minor WWTP upsets, etc. can marginally depress biological performance, particularly with communities that approach and even attain exceptional levels like the Scioto River and its tributaries. For instance we might expect the IBI (or ICI and Iwb) to attain the WWH criterion (42) with the WWTP meeting its final limits. However, it may attain closer to 50 without the discharge. Thus better biological *performance could be expected with complete* WWTP removal. (36)

The above assertion is valid only if the other concerns about extended CSO impacts and low-flows can be reduced or dismissed. With regard to low-flows there are other streams in the basin that support high quality WWH *and even EWH* biological *performance even though their critical* low-flows are less than that projected for the Scioto River without Jackson Pike. Big Darby Creek at Darbyville (approximately 10 miles from the mouth) has a $Q_{7,10}$ (May - November) flow of 5.3 cfs and a 90% flow of 17 cfs. The exceptional status of the fish and naiad mollusk fauna for this segment of Big Darby Creek are well known - the SEIS acknowledges this fact. Most if not all of the endangered fish species identified by the SEIS as being threatened by WWTP flow removal have abundant and widely distributed populations in lower Big Darby Creek. All of this occurs despite a flow regime <u>lower</u> than that projected for the Scioto River. The habitat and stream channel of the Scioto River downstream from Jackson Pike is not markedly dissimilar to that provided by Big Darby. Thus we could expect the Scioto River to take on a physical appearance similar to that of its major tributaries like Big Darby Creek and Big Walnut Creek. The biological performance of the Scioto River may not exactly match that of Big Darby Creek because of some inherent habitat differences (especially substrate diversity), but its biological performance would be better without a 120 cfs WWTP *effluent.*

The concern about the loss of dilution for the Whittier Street CSO seems to be based on an assertion that this discharge has a load equal to *Jackson Pike and would, therefore, overwhelm the assimilative capacity of* a much reduced flow regime. If this were the case and the CSO had similar spatial and temporal characteristics as the Jackson Pike discharge then we would likewise be concerned. However, neither assumption is really correct. The Central Scioto River CWQR attempted to compare loadings between the CSO and the two WWTPs. Table 3-16 shows the comparison for the years 1978 - 1982. CSO data was available for 1978 and 1982 only.

On an annual basis the CSO discharged 55% and 84% of the Jackson Pike BOD load in 1978 and 1982, respectively. On a third quarter (July 1 - September 30) basis the fraction decreased to 22% and 17%, respectively. The more severe impacts would be expected in the third quarter because of reduced flows, higher temperatures, and lower ambient D.O. This is not consistent with the EIS claim that the CSO load is equal to the WWTP load. It is in fact much less and much more variable. The CSO loadings are highest when river flows are higher and thus more dilution is available to assimilate the impact.

The SEIS implicitly evaluates the CSO as a low-flow, dry weather impact which is actually when the CSO loadings are lowest, much lower than the sustained low-flow, dry weather load produced by the WWTP. No one will contest that the CSO is not having an adverse impact on the Scioto River between the Greenlawn Dam and Frank Rd. The discharge of sewage solids and their settling on the bottom is of particular concern. However, this is the most serious in closer proximity to the CSO outfall and its effect diminishes with increased distance downstream. Additionally, *we should* operate under the expectation that loadings from this and other CSOs will be reduced in the near future. (37)

With regard to the two-plant scenario providing a better "buffer" against *possible shock loadings there is little ecological benefit.* A shock loading at a WWTP whether it is a 80 MGD or 150 MGD facility can have serious consequences in the receiving stream. Under a two-plant scenario, this risk is extended to two river segments instead of one. Under a one-plant scenario, the unimpacted segment upstream from *Southerly would serve as a refuge and repopulation epicenter* for any short-term impacts downstream. The segment downstream from Southerly is clearly better suited to respond to a short-term incident due primarily to the closer proximity of larger tributaries (Big Walnut, Walnut Creek, Big Darby Creek) which are totally absent between Southerly and Jackson Pike. These tributaries serve as refuges and repopulation epicenters as well. During the 1987 fish sampling, we experienced this ability first-hand when Southerly had a serious incident which resulted in a small fish kill. This was detected by our second sampling pass (one week after the incident). On the third pass one month later the community had returned to its pre-incident condition.

Harlan D. Hirt
March 10, 1988
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The issue of discharging all of the load at Columbus Southerly is partly a modeling question. However, along with increased load comes increased flow which should be of considerable importance in an effluent dominated situation. Does it really matter from an effluent/stream flow perspective if 10 MGD of upstream flow dilutes 80 or 150 MGD of effluent? Ecologically we doubt if it is really significant.

19. The Ohio EPA comments concerning the water quality modeling review in the SEIS are the same as those submitted in the March 23, 1987 letter from Mr. Turner to Mr. Sutfin.

20. The SEIS two-plant option was environmentally justified by citing benefits of dilution provided by the Jackson Pike effluent which would mitigate impacts of urban runoff and CSO's. This approach does not address the real issue which is the correction of overflows. Improvements to treatment facilities, in the absence of concomitant corrections of overflows, may not provide for the attainment of Water Quality Standards.

21. The SEIS cites the negative effects of algae on the D.O. regime and contends that there is an increased nutrient release with the one-plant option which may negatively affect D.O. levels below Southerly. The SEIS also projects increased nitrogen compounds from urban runoff may impact the Scioto River downstream of Columbus. It is not clear how these conclusions are derived. Algae generally results in a net increase in D.O. after respiration and decay (except where predominated by blue-green colonies or in nuisance proportions). Also the design of the WWTP specifically reduces nutrients. The SEIS assumes that increases in nitrogen compounds will enhance algae growth. This assumption does not consider that algae is most likely phosphorous limited in the Scioto River, and under either option, the loading of nutrients to the Scioto River is greatly reduced from existing conditions.

22. Modeling to date has generally concluded the one-plant or two-plant alternative effect on D.O. is comparable. The D.O. sag consistently occurs at RM 106 under all options. What is the basis for concluding the one-plant alternative may impact the Circleville area affecting other point source discharges (page 6-46, 6-85)? The increased severity of the D.O. sag below Southerly is substantiated in modeling, but the length of the sag is not known to be increased. (pp 6-40). The increase in algae metabolism and interference with downstream discharges is conjecture. The statements regarding modeling on page 6-4 are out of content and not well informed. The basis for not modeling the Circleville area is based solely on a lack of physical data collection and is not related to discharger interaction. It seems to be inconsistent to rely upon the modeling for major decisions (such as permit limitations and projections of standards attainment) and acknowledge its adequacy for these purpose, while pointing to deficiencies in the model as a means of justifying one alternative over another. Based upon model results, either alternative will provide for protection of standards and recovery of uses, when implemented in concert with elimination of bypasses and reduction of CSO at Whittier Street.

Harlan D. Hirt
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23. Ohio EPA experience in peak hydropower operations suggests hydropower operations at O'Shaughenessy Reservoir would have not have significant impact on in-stream flows. Damping of flow variations will occur at Griggs Reservoir and the low head dams upstream of the segments receiving discharges from the WWTPs. Until firm proposals are available for operational parameters of hydropower peaking operations, no conclusions can be made. The discussion regarding hydropower on page 6-47 is confusing with regard to the current operational status of hydropower.

24. An extensive discussion on potential groundwater impacts (pp6-50-54) suggests the selection of alternatives may affect the quantity and quality of groundwater in the buried valley aquifer under development as a water supply. Aquifers, like reservoirs, dampen short term water quantity conditions. Even if stream recharge is a significant factor, the short term nature of low flows and the abundance of surface water in lakes and quarries adjacent to the river should effectively mitigate this short term impact. Ohio EPA surveys of physical conditions do not substantiate the assertion the river substate is sealed by industrial and municipal sludges (Central Scioto River CWQR, 1986, PP 357-360).

25. The discussion of groundwater draw-down in Shadesville residential wells is unrelated to the objective of the discussion in this section (page 6-52).

Thank you for addressing our concerns. If you have any questions regarding these comments, please contact Jim Bonk at (614) 481-7065.

Sincerely,

M. B. Tin, P.E., Chief
Division of Water Pollution Control

MBT/GHS/djb
0776D

U. S. Environmental Protection Ag.
Region 5
230 South Dearborn Street
Chicago, IL 60604

Attn: Mr. Harlan D. Hirt, Chief
Environmental Planning
Section, 5WFP

OFFICE OF THE COMMISSIONERS
Court House
Lancaster, Ohio 43130
[illegible]

January 19, 1988

Re: Draft Supplemental Environmental Impact Statement
Wastewater Treatment Facilities For the Columbus, Ohio
Metropolitan Area (Dated December, 1987)

Gentlemen:

Historically, USEPA has supported policies to minimize the proliferation of small satellite plants by regionalization, to include high growth areas in planning considerations, and, when federal funds are utilized for the construction of treatment facilities, trunks and interceptors, everyone within the service area has an obligation to connect to the resulting system. The planning area for Columbus includes portions of Delaware, Pickaway, Licking and Fairfield Counties. Fairfield County is identified as having very rapid growth within the planning period. This fact is depicted on figure 4-3 (page 4-10) of the referenced document. Other appropriate supporting figures and their page numbers are 1-1, 1-7; 3-1; 3-2; 4-1; 4-3, 4-9, 4-12.

Currently, in Fairfield County, there are six (6) small plants totaling 1.33 MGD capacity, projected to increase to 8 MGD capacity within the planning period. They are all located in Violet Township, where the service area has been substantially reduced from the original envisioned area. Currently none of these six plants is identified as connecting to the completed system. This appears to be a deviation from the regionalization, planning and service policies of U.S.E.P.A., especially since a sewer known as the "Blacklick Trunk" passes through Fairfield County and can readily intercept these six plants.

Donna L. [illegible] Lori M. [illegible] Commissioner Steven L. Goodyear Commissioner Ron [illegible] Commissioner

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USEPA

It is respectfully requested this situation be reviewed and that the Violet Township area be included in the area served by the Columbus collection facilities.

Should you have any questions concerning this communication, please do not hesitate to call.

Very truly yours,

William Verocchi
Fairfield Sanitary Engineer

WV/be

cc: Board of Commissioners

Village of Pickerington

500 HEREFORD DRIVE PICKERINGTON, OHIO 43147-1399
TELEPHONE 837-3974

January 18, 1988

United States Environmental Protection Agency
Region 5
230 South Dearborn Street
Chicago, Illinois 60604

Attn: Mr. Harlan D. Hirt, Chief
Environmental Planning Section, 5WFP

Dear Mr. Hirt:

The EPA has wisely supported certain policies regarding proliferation of small satellite wastewater plants, consideration of high growth areas in planning for federally funded plants, and connection guarantees within the planned service area. The planning area for the Columbus Wastewater Treatment Facility once included much of Violet Township, Fairfield County, Ohio. The final area includes a very much smaller portion of Violet Township.

This area is experiencing very rapid growth. Within the planning period described by the Draft Statement, we will produce more than the 6 MGD projected. With on-line or projected capacity of existing plants all considered, processing capacity will be between 3MGD and 4MGD during the planning period. There are EPA and local concerns regarding the watershed's capacity to handle more effluent than 4 MGD.

It would seem appropriate, under EPA's regionalization criteria to reevaluate the project area in order to mitigate probable effluent problems after 1993. The presence of the "Blacklick Trunk" and its potential as an interceptor of all existing Violet Township plants presents a cost-effective opportunity which we respectfully request the EPA to consider. (27)

Thank you for the opportunity to comment.

Sincerely,

Cornell Hopkins
Village Manager

cc: Council/Mayor
CH/es

process that we are undergoing, that is, the EIS process, I and my staff will deal with them. The technical questions we will refer them to the technical staff. We don't guarantee we can answer the questions today because some of them can be very technical and require some additional thinking. However, cross-examination of the speakers will not be permitted, and if you do wish to make comments then, please state your name and affiliation. And if you wish, certainly you are invited to come up and ask the questions from the front, so we can all hear you better. With that then, John Albers from the Jefferson Sewer and Water District.

MR. ALBERS: Right. Thank you. My name is John Albers. I am an attorney. I am here representing the Jefferson Water and Sewer District which has recently been informed the Jefferson and Water District encompasses the entire unincorporated portion of Jefferson Township. We are in the process of preparing and looking at the feasibility of providing water and sewer services to the residents of our district. We have, therefore, become aware of the SEIS, and we have become aware of the fact that the Jefferson Water and Sewer District is included within the planning district as set forth in the SEIS. (1)

As such, it would appear that our district is included with respect to the projections for expansion and improvement of the facilities under either plan within the

SEIS. As such, when federal funds are used for the planning improvement and expansion of the Columbus system and service to our area is provided for in the city's facilities planning, can access to the unincorporated area such as our district be denied?

We would ask the federal EPA to come to a determination to formulate a policy and express to us that policy. It would seem to us if federal funds are being so used such as for interceptors that are located within close proximity to us, we wonder about the ability of those facilities to be denied to areas which are unincorporated that are not included within the area of the City of Columbus. We, of course, design to coexist peacefully with the City of Columbus and all other municipalities. We would, however, like access to any system for which we would -- which we might be entitled where federal funds are utilized for construction or plan those systems. Thank you. (1)

HEARING OFFICER HIRT: Okay. I believe your question is one that EPA has spent considerable time dealing with in other places, other communities, and we do have a stated policy which can be made available, will be referenced I expect in answering your question. Basically we do -- the policy basically states we work within the existing state and local laws regarding annexation. We do not have a policy that says you must annex to get service. We don't say the

MR. MAXWELL: My name is Ed Maxwell. I am representing a neighborhood which is just downwind from Southerly and Southwesterly compost facility. Before I begin I would really like to commend those who prepared this document. It is truly amazing that a document of this size produced by the Federal Government could be this interesting and this informative. I really enjoyed reading it. And gentlemen, I have got to say after reading that too I have to comment on the magnitude of your responsibility too. It is truthly impressive.

I want to talk a minute about odor. It is a small part of the report, but it is of critical importance to we who live in southwest Franklin County. Our population growth doesn't reflect on your density graphs, but we have people there who live a sort of different lifestyle. Typically they will have from two to five acres, and for example, we have right now on my street four houses under construction and a number of those houses are in the $150,000 to $200,000 price range. We can't be ignored.

After doing some homework and discussing these various problems with some of your experts, I find that the name of the game in odor control is containment. This means that whatever stinks has to be enclosed. These are your tanks, your digestors, and whatnot. The gases of these sources need to be scrubbed and this includes the effluent (45) from incineration or stacks. There are known current odor problems both at Jackson Pike and at Southerly. Jackson Pike is one of the big three of the odor producers that one detects as you drive down Interstate 71. Jackson Pike has a strong sludge like odor, and Southerly has a powerful burned odor from the incinerator.

I would like to know as my first question with these known problems and a budget in excess of $140 million whether or not state of the art odor containment has been incorporated into Project 88?

My second comment relates to a paragraph in chapter 6, page 63 of this revised impact statement. It reads as follows, if I may. "Recently the city has designated an odor control committee comprised of city employees, chemists, and local residents. The committee has designed an odor control action plan which involves an employment of an independent consultant to conduct a qualitative study of program with specific efforts aimed at correlating odor complaints with the plant operations and meet logical conditions. It is expected that with results of these and other proposed studies the odor sources including individual processes in the facility will be identified." (45)

Now, the last two sentences are critical. "This knowledge can then be used to establish control measures designed to alleviate or substantially reduce the odor

levels. This may be accomplished through decreasing the emission of odor and/or enhancing the dispersion potential of the source."

My question is are these last two sentences a contract? Do they constitute a commitment by the city of Columbus and the United States Environmental Protection Agency with the residents of southwest Franklin County? If they don't, they should. If they do, can be and may be should be changed to will be. And a time frame should be specified. If completion of the current work in Project 88 can be required by 1 July, 1988, let's get specific about a reasonable but mandated completion date for odor control. (45)

So I would like to have responses to my first question to what extent are they incorporating into Project 88 state of the art odor controls containment, and secondly, to what extent can we conclude that these comments that I have just read to you are a commitment that we will get this odor problem under control? Thank you.

MR. HIRT: Okay. This being at this point the only statement I think I will ask the technical staff if they can address any of the -- those two specific questions in terms of their understanding of what's in the EIS. The first one being -- I had these down here, state of the art in Project 88.

MR. HEINBOLZ: I would have to say that's the city's

8.3 COMMENT RESPONSES

Comment 1

Comment: Several commentors questioned whether USEPA has the ability to require the city of Columbus to allow service to unannexed areas in light of the 1979 EIS and the federally funded Blacklick Interceptor which passes near these entities.

Commentor/s: Jefferson Water & Sewer District, Village of New Albany, and Ohio EPA

Response:

The questions, which specifically address both the Blacklick Interceptor, constructed with a previously awarded grant, and interceptors in general, are not within the scope of this SEIS.

This SEIS was based on the treatment facilities required for a 20-year solution of wastewater treatment needs. Since the city has not completed facilities planning for CSO or future interceptors, the SEIS was limited to an analysis that determined the cost-effective alternative for treating dry weather flows. For a discussion of future service areas, see comment 27.

The federal policy which applies to this annexation issue includes the following main elements:

"1. Cost-effective solutions to water pollution problems cannot be discarded because of local annexation disputes. One cost-effective project may not be split up into less cost-effective segments because parties cannot resolve an annexation problem.

"2. Federal grant assistance intended for pollution abatement cannot be used to cause annexation. Annexation is a local and state question involving both legal and political considerations that should not be resolved solely by the Construction Grants Program."

A copy of this national policy is attached for reference. In view of this policy, USEPA has concluded that annexation is a local issue to be decided in accordance with state and local laws. The issue will continue to be reviewed as it relates to conditions of service under previous and/or future grants.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Region V

DATE: July 28, 1980

SUBJECT: Annexation as a Prerequisite for
Wastewater Treatment Services

FROM: Todd A. Cayer, Assistant Division Director
for Construction Grants

TO: Construction Grant Program Branch Chiefs
and Region V State Agencies

Enclosed is a copy of a June 19, 1980 memorandum from Mr. Longest subject as above. The memorandum restates the Agency's construction grant program policy on the matter through elaboration on the policy principles set forth in the September 29, 1978 memorandum, a copy of which is attached. A copy of the City of Columbia, South Carolina, grant appeal decision, referenced on page one of the June 19 memorandum, was provided to you on August 27, 1979.

Simply stated, the policy is to keep the construction grant program from being used to force or preclude annexation contrary to local and State laws and objectives. It should be noted that the policy in conjunction with the cost-effective analysis guidelines affirmatively support the President's urban policy.

Those guidelines are intended to minimize urban sprawl induced by unplanned or unnecessary sewerage infrastructures. They do so by allowing only justifiable reserve capacity for treatment works and by careful sizing, staging and location of interceptor lines. Through the guidelines EPA discourages placement of facilities in environmentally sensitive areas such as floodplains, wetlands and prime agricultural lands. These policies reflect not only the Agency's desire to fund only cost-effective projects but also an awareness that provision of sewage treatment and collection services represent serious inducements to development that could override local planning efforts.

In terms of implementation it is essential that the section of the facilities plan concerning implementability--40 CFR 35.917-6—thoroughly address annexation in context of the policy. Along these lines the Facilities Planning Branch is responsible for modifying its facilities plan review documents to ensure that annexation issues are adequately addressed in facilities plans for Indiana and Ohio municipalities. The modified review documents should explicitly provide for identification that appropriate agreements, pursuant to State and local law, have been or will be provided where a facilities plan alternative is proposed to serve a constituency of more than one political entity or that an existing established policy requiring areas contiguous or adjacent to the municipality to submit to annexation in order to receive utility services preclude such agreements.

Effective immediately any municipality whose facilities plan proposed annexation as a means of implementation must document that it has an established annexation policy in accordance with the June 19, 1980 policy before the facilities plan is approved. If there are questions concerning the subject matter of this memorandum please discuss them with the Facilities Planning Branch Chief or me, preferably in that order.

Cy to: Division Director
Construction Grant Program
Section Chiefs

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUN 1[illegible] 1980

OFFICE OF WATER
AND WASTE MANAGEMENT

MEMORANDUM

SUBJECT: Annexation as a Prerequisite for Wastewater Treatment Services

FROM: Henry L. Longest II, Deputy Assistant Administrator for Water Program Operations (WH 546)

TO: Water Division Directors, Regions I-X

In a September 29, 1978, memorandum from John Rhett to Charles Sutfin, Environmental Protection Agency's (EPA) Construction Grants Program policy on annexation was set forth (copy attached).

This policy has had essentially two main elements:

1. Cost-effective solutions to water pollution problems cannot be discarded because of local annexation disputes. One cost-effective project may not be split up into less cost-effective segments because parties cannot resolve an annexation problem.

2. Federal grant assistance intended for pollution abatement cannot be used to cause annexation. Annexation is a local and State question involving both legal and political considerations that should not be resolved solely by the Construction Grants Program.

"Annexation" in the context of EPA policy means the complete absorption of an area by a municipality and involves all municipal services (fire, police, schools, etc.)

A few controversies have arisen which seem to indicate that our attempt to completely disassociate our Federal actions from a clearly non-Federal issue may have had the opposite effect, unintentionally injecting the Construction Grants Program into State and local decision-making, and inhibiting or preventing what would have otherwise occurred. This situation is discussed further in the grant appeal of the City of Columbia, South Carolina (Docket No. 77-20). I have, therefore, decided to restate our policy and address the grant appeal decision.

As the September 29, 1978, memorandum states, "annexation may be acceptable where all parties agree that annexation is in their joint interest and such action is voluntary, or where there is a valid basis under State law to assume that a proposed annexation will occur." That is, if a State has a statute dealing with annexation and provision of municipal services our policy is not meant to preclude its normal functioning. Similarly, where a municipality by ordinance, resolution or other means consistent with State law has an established policy requiring areas contiguous or adjacent to the city to submit to annexation in order to receive utility services, EPA policy is not meant to preclude these local processes from taking place.

Where voluntary annexation is the issue, regardless of whether or not the municipality is able to obtain voluntary annexation, acceptance of a grant is a commitment to completion of the treatment works in accordance with the facilities plan.

I want to reiterate here the role intermunicipal agreements can play in meeting the same concerns that annexation addresses. Intermunicipal agreements need not be executed by two incorporated municipalities. The definition of "municipality" in 40 CFR 35.905 is very broad and includes nearly every public body having a principal responsibility for the disposal of sewage. An agreement between a county, on behalf of a portion of unincorporated territory, and an incorporated city would be an "intermunicipal agreement" for the purpose of the regulation. Further, such agreements can be structured to minimize the potential for urban sprawl; annexation is not the only means of controlling it.

EPA Regions must use the basic EPA policy on annexation issues: Annexation is a local issue to be decided in accordance with State and local laws. The Regions must be sure the Construction Grants Program - as an outside element - is not being used to force or preclude annexation contrary to local and State objectives.

If you have further questions about our policy please contact Roger Rihm, Facility Requirements Division (FTS) 755-8056.

Attachment

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF WATER AND HAZARDOUS MATERIALS

SEP 29 1978

MEMORANDUM

Subject: Annexation as a Prerequisite for Wastewater Treatment Services

From: John T. Rhett, Deputy Assistant Administrator for Water Program Operations (WH 546)

To: Charles H. Sutfin
Water Division Director
Region V

We have reviewed your memorandum of June 2_ concerning the issue of annexation as a prerequisite for the provision of municipal wastewater treatment services.

"Annexation" in the context of this memorandum means the complete absorption of an area by a municipality and involves all municipal services (fire, police, schools, etc.). This memorandum is not meant to deal with "annexation" in the limited sense where an area joins a sanitary district solely for the purposes of wastewater treatment.

The Agency's policy on annexation is based upon two considerations:

1. Cost-effective solutions to water pollution problems cannot be discarded because of local annexation disputes. One cost-effective project may not be split-up into less cost-effective segments because parties cannot resolve an annexation problem.

2. Federal grant assistance destined for pollution abatement cannot be used to cause annexation. Annexation is a local and State question that involves both legal and political considerations that should not be resolved solely by the Construction Grants Program.

There are four basic sources for annexation arguments. One involves the Clean Water Act (section 204) while the other three are based upon regulations and procedures on service agreements, sewer use ordinances and user charges.

Section 204(b)(1)(c) of the Clean Water Act requires a grantee to have adequate "legal, institutional, managerial and financial" capabilities. These requirements, however, do not require annexation where a municipal grantee is acting on behalf of areas outside the grantee's municipal boundary. Intermunicipal service agreements make it possible for a municipal grantee to serve a region that includes unannexed territory.

Such service agreements should be voluntary and should not be used to apply pressure in a local dispute over annexation. Service agreements are dealt with in the revision to the construction grants regulations in 40 CFR Part 35, which are effective on October 1, 1978. A Step 2 application must include "proposed or executed (as determined appropriate by the Regional Administrator) intermunicipal agreements necessary for the construction and operation of the proposed treatment works." (40 CFR 35.920-3(b)(6)). The grant applicant must furnish the final intermunicipal agreements before a Step 3 grant can be made (40 CFR 35.920-3(c)(1)).

Experience has shown that there are inordinate program delays unless intermunicipal agreements are obtained prior to the award of grant assistance. It should be noted that intermunicipal agreements need not be executed by two incorporated municipalities. The definition of "municipality" in 40 CFR 35.905 is very broad and includes nearly every public body having a principal responsibility for the disposal of sewage. An agreement between a county, on behalf of a portion of unincorporated territory, and an incorporated city would be an "intermunicipal agreement" for the purpose of these regulations. A grantee cannot simply dispense with intermunicipal agreements without risking the denial of grant assistance or an action to enforce or terminate an existing grant agreement.

A letter addressed to the Ohio EPA from your office dated September 23, 1977, and attached to your June 23 memorandum, mentioned that a sewer use ordinance "which contains a policy requiring annexation prior to conclusion of the treatment works would not be approved." Regulations and procedures relating to sewer use ordinances mandate technical requirements for new connections and prohibit new sources of inflow. EPA Region V should allow itself some discretion when evaluating each individual sewer ordinance. Annexation may be acceptable where all parties agree that annexation is in their joint interest and such action is voluntary, or where there is a valid basis under State law to assume that a proposed annexation will occur.

Finally, section 204(b)(1)(A) requires development of a user charge system to cover the costs of operation and maintenance of wastewater treatment services. The provision does not address the recovery of capital costs. A city could thus complete service agreements to cover operation and maintenance (O&M), and later attempt to levy an additional capital cost charge to force a given area to comply with the grantee's annexation plans. Such a dispute over capital costs and annexation should be resolved under State laws because EPA's regulations do not apply to the problem. It is a local concern that should be resolved through local negotiations. We urge that you encourage communities to include recovery of capital costs in their initial service agreements to avoid disruptive local controversy during construction or after municipal treatment works are completed. Planning entities should also address the question of local capital cost recovery.

A few closing comments are appropriate. First, annexation battles should be anticipated if possible. This could be done by State agencies responsible for drawing 201 area boundaries. EPA regions must ensure that such disputes do not suddenly arise during construction or at the end of Step 3. Parties must see that appropriate arrangements (which may or may not include annexation) can be agreed upon prior to the end of the planning process.

EPA regions must be flexible when faced with annexation. The regional approach should be based upon the premise that an annexation dispute should not be decided solely because a 201 facility happens to be built in the area. As you aptly point out in your September 1977 letter, the Construction Grants Program is supported by American taxpayers as a whole and the benefit derived from a 201 facility should not depend simply upon the location of a municipal boundary. Annexation decisions should neither be dictated by the 201 program nor mandated by one party against the will of another to further the water pollution abatement goals of both.

We hope this discussion has helped to resolve the issue you raised. If we can be of any further help, please let us know.

Also it is noted that in 1980 a Negotiated Investment Strategy (NIS) was entered into by the federal, state, and city representatives. One of the NIS sections specifically deals with annexation and control of urban sprawl, which relates to questions of the commentors and is included for information. It should be noted that the state was not a party to the agreement on items a-g.

"The Federal and Local (City) Teams agree that the Local Team will provide services to outlying areas with water quality or sewage disposal problems under several types of situations:

"(a) The City will accept into its sewer system, publicly owned and operated package wastewater treatment plants existing April 30, 1980, where such a plant is accessible to an existing City line.

"(b) In the case of on-lot treatment systems, the City will permit hook-up of a subdivision that is developed prior to April 30, 1980, if a City line goes by the overall subdivision and if a collection system is constructed within the subdivision by another public entity.

"(c) Neither of the above collection systems would be permitted to expand in keeping with the City's non-sprawl policy.

"(d) If a subdivision is proposed outside the existing City sewer system and annexation to the City is not desired; the City will not accept Federal grant dollars to serve this area and will not serve this area because this would promote sprawl. The Federal team will not become involved in the annexation decision between the City and the outlying area.

"(e) In general, the City will not annex an area unless other basic municipal services such as police, fire, and sanitation can be feasibly provided in addition to water and sewer services.

"(f) The City now encourages suburban municipalities to develop in a non-sprawl fashion by executing contracts for a growth area within which such suburban municipality can provide Columbus sewer and water services upon annexation of same growth area to the suburban municipality rather than to Columbus. The growth area of the suburban municipality provides for the reasonable growth of the suburban municipality over the life of the contract. In most cases this is twenty years. The suburban municipality must also provide basic municipal services such as fire, police, and sanitation.

"(g) The City has refused to accept private sewer systems into its utility systems because the City then becomes a party to the rate-making process under the Public Utilities Commission of Ohio. If the private system agrees to transfer ownership to a public entity, the City will permit hook-up of such a system provided it is accessible to an existing line.

"(h) The Federal, State, and Local teams agree that additional areas of water pollution problems need to be studied and included in the area-wide plan."

The facilities planning prepared by the city has not confirmed how the city is implementing this policy. As part of the ongoing planning in the Columbus area, the appropriate regulatory agency will continue to address the commentors concerns to seek satisfactory resolutions.

Comment 2

Comment: The third paragraph on page 2-78 of the Draft SEIS should be changed to more accurately describe the organizational structure and responsiblities of the Ohio Historical Society (suggested text given).

Commentor/s: Ohio Historical Society

Response:

Comment noted; suggested text was placed on page 2-78.

Comment 3

Comment: Average Flow

The SEIS average flow was based on data which may not represent the highest groundwater conditions and resultant greater infiltration rates are likely to occur. The Ohio State University has monitored groundwater levels since 1940. The data indicates that high groundwater levels have been eight to ten feet higher than levels observed from 1983 to 1987. There is also concern that unmonitored overflows may have skewed the analysis.

Commentor/s: City of Columbus

Response:

The average flow was established by evaluating dry weather flow data from 1985 and 1986 and selecting the maximum monthly average flow. The maximum monthly flow occurred in May of 1985, with a combined Jackson Pike and Southerly flow of 145 MGD. Table 8-1 shows the monthly precipitation data and corresponding dry weather flow data for 1985 and 1986. The 1979 EIS states that the long term annual mean precipitation is 37 inches. As shown in the table, 1985 had 38.5 inches which is higher than the long term mean. In addition the month of November was extremely wet, with 10.67 inches of rain and no dry weather days. One would expect high groundwater levels during December and resultant higher flow rates due to increased infiltration. December had an average flow of 143 MGD.

The city did not present any data to support this decrease in the groundwater level. It is possible that the decrease in high groundwater levels in recent years may be a result of increased groundwater pumping and it may be an indication of a further decrease in the future. In light of the precipitation data discussed above and the possibility that the groundwater decrease may be caused by increased pumping, the SEIS projected 2008 average flow will remain at 154 MGD.

<u>Comment 4</u>

Comment: Peak Flow

The city is recommending a peak flow of 300 MGD which corresponds to a peaking factor (i.e., ratio of peak to average flow) of approximately 1.7. The draft SEIS recommended a peak flow of 231 MGD which corresponds to a peaking factor of 1.5. The city maintains that a peaking factor of 1.5 will result in a significantly higher untreated flow discharged into the Scioto River than would a 1.7 or 2.0 peaking factor ratio. They also state that the more stringent the effluent limits, the higher the peaking factor should be. A table of peaking factors for some of the WWTPs in EPA Region V is presented in Table 7 of the city's comments on the SEIS.

Commentor/s: City of Columbus

TABLE 8-1

TOTAL PRECIPITATION AND
COMBINED MONTHLY AVERAGE DRY WEATHER FLOWS
FOR JACKSON PIKE AND SOUTHERLY

1985	Precipitation (inches)	Average Flows (MGD)
January	1.26	132.30
February	1.67	139.94
March	3.78	142.55
April	0.56	140.22
May	4.96	144.76
June	1.41	134.03
July	6.88	138.87
August	2.34	127.03
September	1.18	124.02
October	1.98	124.88
November	10.67	ND
December	1.81	143.16
Total	38.50	---
Average	---	132.67
1986		
January	1.54	134.76
February	2.96	ND
March	2.61	143.23
April	1.31	140.21
May	2.47	124.87
June	5.53	138.67
July	3.60	137.12
August	1.61	132.87
September	3.44	131.05
October	4.16	131.33
November	3.00	124.60
December	2.81	140.04
Total	35.04	---
Average	---	133.85

ND - No dry weather/no bypass days

Response:

The SEIS peaking factor was determined based on the data which was available. The SEIS acknowledges that the peak to average flow ratio may exceed 1.5. However, due to a lack of comprehensive flow monitoring at bypasses and overflow locations a higher peaking factor could not be supported. Furthermore, it may be cost effective to remove some of the infiltration/inflow from the collection system or provide temporary storage rather than provide additional capacity for advanced wastewater treatment. Therefore, until the combined sewer overflow study is complete, the SEIS recommends providing capacity for a peak to average flow of 1.5.

It should also be noted that untreated flow would only be discharged to the Scioto River if, in fact, the peak to average flow does exceed 1.5.

More stringent effluent limits do not require higher peaking factors. The peaking factor is based on the ratio of peak to average flow which must be treated at the treatment plant, independent of the effluent limits.

The treatment plants listed in Table 7 are all significantly smaller (majority under 3 MGD) than the Jackson Pike and Southerly plants. Peak to average flow is usually a function of the type of collection system (i.e., separate or combined) and the size of the service area. The larger the service area, the lower the peaking factor tends to be. The Chicago Northside WWTP, with an average flow of 333 MGD, has a peaking factor of 1.35.

In light of the fact that the SEIS analysis does not account for CSOs, there is no basis to increase the peak design flow.

<u>Comment 5</u>

Comment: Whittier Street Loads

Discussion at the meeting of February 17, 1988 indicated that the SEIS was predicated on the assumption that the Whittier Street load is in fact included in the Jackson Pike Monthly Operating Reports.

Discussion with city personnel indicates that the normal situation is that wet weather flows usually persist in the system to such a high degree of quantity and duration of flow that the Whittier Street underflow load overflows at Renick Run.

Commentor/s: City of Columbus

Response:

The SEIS design flows and loads were based on the actual flows and loads that currently arrive at the WWTPs adjusted for growth. Since the SEIS design does not take into account the capture of combined sewer overflows which are not currently conveyed to the plant, it does not seem reasonable to adjust the loadings to reflect their treatment.

Comment 6

Comment: Nitrification

The city's design parameters for the biological process (i.e. aeration basins and final clarifiers) were compared to the design parameters assumed to be used in the SEIS. They are shown in Tables 5 and 6 of the city's comments. The design parameters for the SEIS Jackson Pike design are very close to the city's design parameters. The difference in the basin requirements at Jackson Pike is primarily a result of a difference in pollutant loadings. The Southerly calculations show a significantly lower design solids retention time (SRT) for the SEIS design. The information indicates that Southerly would have a solids retention time (SRT) of 7.1 days. The city recommends a minimum SRT of 9.9 days.

Commentor/s: City of Columbus

Response:

The SEIS recommendations for the aeration basins were based on an evaluation of information provided by the city of Columbus during the preparation of the draft SEIS. This information included requirements for mixed liquor suspended solids (MLSS) concentrations, hydraulic retention times, and pilot data on nitrification rates.

The SEIS recommendations have undergone extensive review by the EIS consultant, USEPA - Region V; USEPA - Water Engineering Research Laboratory (WERL); and Ohio EPA based on the design information provided in the city's comments. The city's recommended MLSS concentrations and design SRTs were used along with the SEIS recommended wastewater flows and loads to check the adequacy of the SEIS recommendation. The SEIS flows and loads are presented in Table 8-2. As shown in the table, the flow split between the Jackson Pike and Southerly WWTPs has been changed from the recommendation in the draft SEIS. Based on the city's recommended design parameters, it would be more efficient to treat an additional 10 MGD of Jackson Pike's average flow at Southerly. This would result in a total of 18 MGD being transferred from Jackson Pike to Southerly under average conditions. This would also provide Southerly with a more constant pollutant loading under average and peak flow conditions.

Table 8-3 provides the actual design data for the new flow split. The draft SEIS recommendation of two additional aeration basins at Southerly and use of existing aeration basins at Jackson Pike is adequate for this flow split. In fact, each plant has the added reliability of operating under the design conditions specified in Table 8-3 with one aeration basin out of service in each train.

The solids handling recommendations in the SEIS for Jackson Pike have also been reevaluated based on the decreased loadings which result from the additional flow transfer. The SEIS will adopt the city's recommendation of modifying two existing digesters to operate as gravity thickeners rather than constructing three new gravity thickeners. The SEIS also recommends that only six digesters be renovated for anaerobic digestion rather than ten as previously recommended. The remaining digesters could be used for sludge holding tanks. The costs in the SEIS (Appendix Page D-5) have been revised to reflect this recommendation.

Comment 7

Comment: Unit Process Efficiency

Data on unit process efficiency was not provided in the SEIS. Based on loading information, a $CBOD_5$ removal of 30 percent was calculated for the primary clarifiers. The design removal of BOD_5 in the primary clarifiers used in the GERBOD was 22.7 percent for Jackson Pike and 24 percent for Southerly.

TABLE 8-2
DESIGN SEIS FLOWS AND LOADS

	JACKSON PIKE		SOUTHERLY	
	Average	Peak	Average	Peak
Tributary Area				
• Flow (MGD)	88	132	66	99
• $CBOD_5$ (lb/day)	141,600	141,600	126,600	126,600
• TSS (lb/day)	161,600	161,600	121,300	121,300
• TKN (lb/day)	18,532	18,532	16,570	16,570
Influent to Plant				
• Flow (MGD)	70	100	84	131
• $CBOD_5$ (lb/day)	112,600	107,300	155,600	160,900
• TSS (lb/day)	128,500	122,400	154,400	160,500
• TKN (lb/day)	14,740	14,040	20,360	21,060
Primary Effluent				
• $CBOD_5$ (lb/day)	86,700	83,000	120,180	123,900
• TSS (lb/day)	64,400	61,760	80,360	82,800
• TKN (lb/day)	15,920	15,290	22,110	22,740

TABLE 8-3
DESIGN DATA

	Jackson Pike	Southerly
Influent		
Flow - MGD	70/100	84/131
BOD_5 - lb/d	112,600	160,900
TKN - lb/d	14,740	21,060
Primary Clarification		
Number of Units	8	8
Surface Area - ft^2	96,000	120,800
O'Flow Rate - $gal/ft^2 \cdot d$	730/1040	700/1080
BOD_{5R} - %	30	30
Activated Sludge		
Number of Units	10	12
Volume - MG	26.25	31.50
MLSS - mg/l (Max)	2,500	3,500
Mass (VSS) @ 75% - lb	410,480	689,610
$MLVSS_{ox}$ - lb	359,170	603,410
BOD_{5A} - lb/d	86,700	123,900
TKN_A - lb/d	15,920	22,740
TKN_{ox} - lb/d	11,060	15,250
F/M_V - lb/d BOD_5/lb $MLVSS_{ox} \cdot d$	0.24	0.21
SRT_{ox} - days (Min)	7.6	8.7
SRT_T - days (Min)	8.7	9.9
Clarification		
Number of Units	14	6
Area - ft^2	125,660	170,030
O'Flow Rate - $gal/ft^2 \cdot d$	560/800	490/770
Solids Loading - $lb/ft^2 d$	20/28	25/38

Commentor/s: City of Columbus

Response:

The SEIS used the following removal rates for the primary clarifiers:

- TSS - 60%
- $CBOD_5$ - 30%
- TKN - 10%

These removals apply to total flow (i.e. influent plus recycle flows). The TSS and $CBOD_5$ removals appear reasonable when compared to published information. The book entitled Wastewater Engineering: Treatment, Disposal, Reuse by Metcalf and Eddy, Inc., states that "Efficiently designed and operated primary sedimentation tanks should remove 50 to 70 percent of the suspended solids and from 25 to 40 percent of the BOD_5". Furthermore, preaeration which is also employed at the Columbus WWTPs, increases BOD removal in the primary clarifiers.

The TKN removal of 10 percent is consistent with what is used in the solids balance presented in the GERBOD.

No change will be made to the SEIS.

Comment 8

Comment: Pages C-5 and C-18

While the SEIS properly notes that the MLSS of 3500 mg/l is higher than normally employed, the reason is not the nitrification rates. At a more conventional 2000 mg/l MLSS, the aeration volume would be increased 25 percent at Jackson Pike and 75 percent at Southerly, or a total of 15 more aeration basins to maintain the design SRT. This level of MLSS does stress the final clarifiers. Further, higher MLSS can restrict the nitrification rates when the D.O. is suppressed during peak demands.

Commentor/s: City of Columbus

Response:

Comment noted. We agree that more aeration capacity would be required at a lower MLSS.

Comment 9

Comment: Page C-20

There are severe limitations on clarifier floor loadings as a function of MLSS concentration and SVI which appear to be ignored in the last paragraph of Page C-20. The use of 50 $lb/ft^2 \cdot d$ floor loading would cause failure of the clarifiers at design conditions. Most designers will not exceed 30 $lb/ft^2 \cdot d$ loadings for their designs. However, the 1983 Daigger Roper curve was used in the Columbus design and is widely used elsewhere. It is now in a 1987 EPA publication on bulking sludge control. This curve shows the maximum loading at SVI=170 mg/l to be about 36 $lb/ft^2 \cdot d$. Therefore, both SEIS and GERBOD design at 38 $lb/ft^2 \cdot d$ is at the maximum point and the difference in number and size of units is 131 MGD vs 150 MGD peak flow.

Commentor/s: City of Columbus

Response:

Comment noted. The SEIS evaluation was checked against the Daigger Roper curve and we agree that 38 lb/ft^2d is the maximum allowable solids loading rate for this particular design.

Comment 10

Comment: Page C-35

If the ammonia concentration exceeds 2 mg/l in Bay 6, the aeration in Bay 2 will be activated as well as a general D.O. increase which will enhance nitrification rates. If this is not adequate to reduce NH_4N to 1.0 mg/l, then the internal recycle pump will be shut down to increase real detention time. The internal recycle pump will reduce nitrification capacity due to the volume used for denitrification. It must be noted that it may be necessary to run the recycle pumps during normal operations to inhibit denitrification in the finals at Southerly.

Commentor/s: City of Columbus

Response:

Comment noted. We concur.

Comment 11

Comment: Page C-38

There will not be nitrification in Bay 1 or 2, and very little in Bay 3 since $CBOD_5$ must be processed before nitrification can occur. The OUR/DO of at least 250:1 is the objective of the operation to control bulking and is not involved in nitrification or denitrification. This is explained in the April 1983 JWPCF paper provided for the SEIS review.

Commentor/s: City of Columbus

Response:

It is agreed that nitrification will not occur in Bays 1 and 2 if no air is supplied and very little will occur in Bay 3. However, if adequate air is supplied, nitrification can proceed prior to complete conversion of the $CBOD_5$.

Comment 12

Comment: Page C-40

The biological phosphorus process and nitrification are not interrelated. Bio P removal occurs with and without nitrification. This is well documented in many papers. However, the sludge yield of the Bio P process can decrease nitrification rates (mg gm VSS·hr) about 15 percent since the percentage of nitrifiers in the sludge decreases proportionately.

Commentor/s: City of Columbus

Response:

Comment noted. We concur.

Comment 13

Comment: Page 6 - 10

The SEIS and GERBOD differ in their recommendations for gravity thickening at Southerly. The GERBOD recommended four thickeners at a diameter of 45 feet plus one thickener at a diameter of 85 feet. The SEIS recommended four thickeners at a diameter of 45 feet.

Commentor/s: City of Columbus

Response:

The sizing of the Southerly gravity thickeners for the SEIS was based on the following design criteria:

Solids Loading Rate: 20 - 30 lbs/day/sf

Hydraulic Loading Rate: 400 - 900 gpd/sf

The design loadings to the gravity thickeners utilizing the new flow split are as follows:

Solids Loading at Average Flow: 120,500 lbs/day

Solids Loading at Peak Flow: 124,500 lbs/day

The gravity thickeners were sized to settle primary sludge (PS). Waste activiated sludge (WAS) loading rates were not used in sizing since the amount of the WAS recycle flow that would settle out in the primary clarifiers would be small compared to the total amount of solids settling out. Therefore, the SEIS recommendation of four gravity thickeners provides adequate thickening capacity.

Comment 14

Comment: Dewatering

The SEIS recommends the addition of 9 new centrifuges @ 1000 lb/hr for the Southerly WWTP. The city is installing membrane filter presses because they believe these units will produce a drier sludge cake than centrifuges.

Commentor/s: City of Columbus

Response:

Comment noted.

Comment 15

Comment: Page C-41

It should be noted that the reason for the semi-aerobic process is bulking sludge control, not phosphorus removal. The Southerly plant would be in a failure mode at an SVI of 160-170 ml/gm, not 200 ml/gm as stated.

Commentor/s: City of Columbus

Response:

Comment noted. Based on a review of the Daigger Roper curve we concur.

Comment 16

Comment: The piping plover has been sighted at the Jackson Pike WWTP and was added to the Federal Endangered Species List on December 11, 1985. This species should be included in the SEIS discussion of endangered species.

Commentor/s: U.S. Department of Interior

Response:

This sighting was confirmed by the local Audubon Society and Tom Thompson, author of Birding In Ohio. Mr. Thompson, indicated that the piping plover (charadrus melodus) was last sited in the area in the 1940's. Comment noted; corrections placed on pages 2-25, 2-52 and Appendix H, Table H-1.

Comment 17

Comment: In characterizing treatment plant effluent discharges, the SEIS should discuss the mixing zone, discharge plume characteristics, or zone of passage to provide a better understanding of the impacts to aquatic life.

Commentor/s: U.S. Department of Interior

Response:

Available modeling data are not sufficiently detailed to support a discussion of the characteristics of mixing zone, effluent plume and "zone of passage".

Comment 18

Comment: Section 5.4.2.8, page 5-38 of the SEIS discusses the land application of sewage sludge. More attention should be paid in this section to the problem of metal accumulation in top soils from land application of sewage sludge. The statement should indicate if the wastewater treatment plant management keeps records of the lands to which the sludge is applied or makes an effort to inform the farmer or other user of the restrictions associated with its use. In addition, the statement should also indicate if subsequent owners of a parcel of land are made aware of the land applications and who is responsible for monitoring crop and soil metal residues.

Commentor/s: U.S. Department of Interior

Response:

The city of Columbus program for land application of Bio-Rich (sludge) is implemented by a private contractor. The selection of the land application sites is done by the contractor. The Ohio EPA Land Application of Sludge Design Manual is used as a guide for site selection. All the sites selected are subject to inspection and approval by the city of Columbus and Ohio EPA. Prior to approving a site, the city and the contractor will make an informational visit to residents within close proximity of the site to provide them with educational material about land application. Following site approval, the contractor completes a contract and provides it to the city. The intent of the contract is to define the specific responsibilities and agreements made between the landowner and the contractor.

All soil, water, and sludge sampling, analysis, and reporting is conducted by the city. The city generates and maintains the following records and reports:

- Bio-Rich Fertilizer Summary
- Metal Accumulation Summary
- Site Status Report
- Bio-Rich Application Report
- Land Application of Sewage Sludge Report

These reports are briefly described in the following paragraphs.

The Bio-Rich Fertilizer Summary is completed following the sludge spreading on a site. It documents the quality of primary nutrients and heavy metals applied in pounds per acre so the farmer can determine if additional fertilizer is necessary.

The Metal Accumulation Summary is a record filed on the computer by farm number. Each application of sludge on a farm is listed chronologically by date of completion. In addition nutrients, heavy metals, and dry tons applied are reported.

A Site Status Report is generated from the Metal Accumulation Summary. The Site Status Report is sent to Ohio EPA within 90 days after sludge application is completed. It documents chronologically all sludge applications at a specific site and total dry tons and heavy metals applied.

The Bio-Rich Application Request which documents the agreement between the city and the farmer accomplishes several other objectives. It is used to communicate information from the city to the farmer on the value of sludge as a fertilizer. The farmer uses it to communicate to the city the location of the field and the dates it is available. The city also uses it to instruct the contractor regarding application rates and site locations. A field map of the site is printed on the back side of the form. Finally the form is also used as an invoice record.

The Land Application of Sewage Sludge Report is a monthly report which documents the quantity and acreage applied as each site is completed. This report is sent to Ohio EPA.

The city does not have a policy for notifying subsequent owners of the sites regarding the Bio-Rich application. However, the sludge is applied at agronomic rates and the soil is monitored to determine cumulative metal concentrations so that maximum allowable levels are never exceeded. This results in no future land use restrictions with regard to crops.

Section 6.2.5, page 6-69 provides a summary of this information.

Comment 19

Comment: Section 6.4.3, page 6-87 states that "Adequate disinfection of the effluent from sewage treatment facilities is critical for protection of public health." A report to Congress was cited which concluded that disinfection of treated wastes is not needed under every situation. Also, the Centers for Disease Control, in the same report, have taken the official position that disinfection of sewage provides little public health benefit.

Commentor/s: U.S. Department of Interior

Repsonse:

USEPA agrees that disinfection is not needed in all cases. For the Columbus Ohio WWTPs, disinfection is required on a seasonal basis. Chlorination is the chosen method of disinfection for the facilities with dechlorination required so that the residual chlorine level meets the NPDES permit limit of less than 0.019 mg/l for Jackson Pike and 0.026 mg/l for Southerly. The Ohio Disinfection Policy correlates directly with your comment and requires limited use of chlorination for disinfection. The text has been revised accordingly on page 6-89.

Comment 20

Comment: Disinfection

Because disinfection standards for wastewater are established, we would like to suggest that alternatives to chlorination, such as ultraviolet light, be addressed in the SEIS.

Commentor/s: U.S. Department of Interior

Response:

The NPDES permits for the Columbus WWTPs include an effluent fecal coliform limit of 1000 counts/ml during the summer months. Therefore, they will only be performing disinfection during the summer months.

The Columbus WWTPs have been disinfecting since the late 1970's with chlorine. Some of the existing equipment will be utilized in the new chlorination/dechlorination facilities.

Ultraviolet (UV) disinfection requires an effluent quality of less than 20 mg/l TSS for consistent, reliable disinfection. At the time the Facility Plan was being prepared (1985), as well as during preparation of the SEIS (1987), UV disinfection had not been proven cost effective on facilities the size of the Columbus WWTPs.

Ozonation, another method of disinfection, is quite expensive and relatively complex to operate and maintain compared to chlorination. Contact basins must be covered to control off-gas discharges and ozone generation equipment is very expensive.

Comment 21

Comment: The potential primary impacts from constructing four seventy-eight inch pipes at the proposed loction are significant. The impacts would include destruction of mature forest along the west bank of the Scioto, extensive construction within the floodplain, potential habitat reduction for an endangered species of bat, and potential adverse impacts on endangered species of fish at this site.

Commentor/s: Ohio EPA

Response:

This comment lists a number of impacts that should be included in Table 6-13. This table was originally written to reflect mitigative measures proposed by the City of Columbus. This table has been reformatted to include mitigative measures recommended by Ohio EPA, USEPA and the consultants. In addition, the text on page 6-41 was strengthened to stress the significant impacts that could occur as a result of placing four 78-inch pipes across the Scioto River.

Comment 22

Comment: Table 6-13 of the SEIS contains only generalized mitigative measures. Additional specific mitigative measures and a mandate requiring these measures are necessary to support the impact conclusions concerning any expansion of the interconnector crossing.

Commentor/s: Ohio EPA

Response:

These comments include specific recommendations for the containment of site runoff and erosion during and after construction. These recommendations would minimize construction related impacts and are incorporated by reference as mitigating measures in USEPA's recommended alternative. Table 6-13 has been adjusted to incorporate these comments.

Comment 23

Comment: The downstream impacts from construction related sedimentation should be developed, from available hydraulic data and used to assess potential impacts on endangered species.

Commentor/s: Ohio EPA

Response:

The hydraulic component of the model is not considered reliable at low flow and the possible error margin in any quantitative projections of downstream sedimentation impacts would be too great to be of use in endangered species impacts discussions related to interceptor construction. However, experience with similar construction projects clearly demonstrates that some level of sedimentation would inevitably occur under virtually any mitigation approach. For this reason, avoidance of a river-crossing through implementation of the two-plant alternative is preferred.

Comment 24

Comment: The SEIS identifies the South End Interconnector Pump Station as having a pumping capacity of 70 MGD on pages 5-10 and 60 MGD throughout the rest of the document. Please clarify and identify the maximum diversion capability of the existing pump station force mains.

Commentor/s: Ohio EPA

Response:

The pumping capacity is 70 MGD. Pages 6-4 and 6-6 of the SEIS have been corrected.

Comment 25

Comment: Please clarify if the SEIS hearings fulfill the public participation requirements necessary for approval of the facilities plan.

Commentor/s: Ohio EPA

Response:

As part of the NEPA process a 45-day public comment period and a public hearing were held on the draft SEIS. This NEPA public participation requirement is similar to facilities planning (FP) requirements. Since FP approval has been delegated, we believe it is OEPA's responsibility to determine if the SEIS public hearing meets FP requirements.

Comment 26

Comment: Address the potential impacts of filling the lagoons at the Jackson Pike plant.

Commentor/s: Ohio EPA

Response:

The city's consultant has proposed relocating the new clarifiers to another section of the plant site. USEPA agrees that it is possible to relocate the clarifiers. Page 7-16 has been changed to reflect this new proposal. Sitework costs have also been revised on page D-5 of the SEIS appendix. Malcolm Pirnie has been retained to monitor the groundwater in the area where this lagoon and an abandoned landfill are located. The city has no plans to build on or disturb these areas.

Comment 27

Comment: Ohio EPA stated that the New Albany contract has been cancelled and should be deleted from Table 4-5, page 4-11 of the SEIS. They also requested, along with two other commentors, additional clarification on the service area for the recommended treatment facilities. The two local governments that commented further mentioned that the Blacklick Interceptor passes near and presents a cost-effective opportunity for them and requested USEPA review of the situation.

Commentor/s: Ohio EPA, Fairfield County, and Village of Pickerington

Response:

The first part of OEPA's comment addressed the sewer contract between the city of Columbus and Franklin County for the Village of New Albany. This contract was cancelled last summer during an administrative review of all County contracts. The Village of New Albany was not a signatory to this contract and was not consulted prior to its cancellation. Page 4-11 and Table 4-5 on pages 4-12 and 4-13 have been revised to reflect these changes.

Comments by OEPA and two local governments seek clarification on the service area for the recommended treatment facilities. It should be noted that a detailed determination on the service area was not in the scope of the SEIS and that the city of Columbus is continuing planning for regional interceptors. The Draft SEIS presented available information regarding a projected 20-year service area so that: (1) the size of the treatment facilities could be determined for cost-effective analysis; (2) general environmental impacts of sewers could be assessed; and more specifically, (3) whether those impacts would be different for the alternatives being considered. The Draft SEIS did not present projected 20-year sewer service area boundaries and forecast growth for the purpose of determining which communities will or will not eventually be included within the sewer service area.

As of October 1984, as required by the Clean Water Act, the USEPA regulations were revised to specify that reserve capacity is no longer an allowable cost for grant funding. While cost-effectiveness continues to be based on a 20-year projection and the applicant must provide a plan to meet treatment requirements for a 20-year period, unless there is a physical connection at the time of project completion, the designated capacity for the potential service area is reserve capacity, even if the needs currently exist. This is why OEPA is requiring agreements to implement the facilities plan, so that this determination can be made.

The general service area, shown in Figure 4-1, identifies the areas for which studies have concluded that service by the city of Columbus is cost-effective. As additional studies are completed for non-contractual areas, the boundaries may be modified. Table 4-5 on page 4-12 has been updated to include the current sewer service contracts. Table 4-5 includes footnotes which outline constraints to sewer expansion decribed in the city's sewer service contracts with each jurisdiction. Most sewer service expansion is expected to be linked to cities or villages annexing new development into their corporate limits. Figure 4-2 of the draft SEIS has also been replaced with a more current service area map showing existing sewer service areas.

As noted in comment 1, USEPA requires that these decisions regarding sewer extension be based on cost-effectiveness, if federal funding is utilized, and promotes the same concept in other cases.

It is further noted that USEPA's analysis of the treatment facilitites is based on flows from the entire area, and the projections for the metropolitan area provide the necessary base. An exact distribution of population and definition of the service area were not essential to determining the cost-effective alternative for treatment.

Please refer to Comment 1 on questions specifically relating to the Blacklick Interceptor.

Comment 28

Comment: Due to the proximity of archaeologic sites to the Southerly WWTP, the Final SEIS should state that Phase III Archaeological Survey work must be performed to determine the boundaries of these sites prior to any future construction near these areas, and to determine their status for inclusion on the National Register of Historic Places.

Commentor/s: Ohio EPA

Response:

This was noted; adjustments to page 6-91 were made.

Comment 29

Comment: Our question relates to the application of the formula:

$$PPF=1.95(Q_A)^{0.95}$$

It appears that if design flow values for Jackson Pike and Southerly are separately put into the equation, one would compute a PPF closer to 1.6. Please comment.

Commentor/s: Ohio EPA

Response:

The Columbus WWTPs serve the same metropolitan area and are connected by a major interceptor which allows diversion of flows from one plant to another. Therefore, it seems reasonable that the peaking factor would be determined in this equation utilizing the combined average flow.

In addition to utilizing this formula from the 1979 EIS, the following approaches were evaluated to determine an appropriate peaking factor.

- Value engineering
- Peaking factor of existing facilities
- Peaking factor vs. number of exceedances

The value engineering approach showed that above a peaking factor of 1.6 less benefit was provided for each dollar invested.

The peaking factor of existing facilities based on current effluent limits (30/30) is approximately 1.4.

The final method utilized 1986 available flow data. Peak flows were developed for peaking factors ranging from 1.0 to 2.0 based on an average flow of 145 MGD. These peak flows were then compared to the 1986 flow data to determine the number of days each peak flow was exceeded. This analysis showed that on only 9 days of the year the flow exceeded a peaking factor of 1.5. In light of these few exceedences, the 1.5 process peaking factor established using the formula from the 1979 EIS seems reasonable.

Comment 30

Comment: Does the PPF have significance to a real world, hydrologic condition such as past-storm rain-derived infiltration, or is the PPF related to the determination of process capacity apart from hydrologic concerns.

Commentor/s: Ohio EPA

Response:

The PPF is developed based on actual flow data, which includes past-storm rain-derived infiltration, and it is utilized to determine required process capacity.

Comment 31

Comment: We are interested in the effect that the extra sludge produced by the semi-aerobic process may have in the sizing of solids train facilities especially the thickening of waste activated sludge.

Commentor/s: Ohio EPA

Response:

Review of Southerly and Jackson Pike WWTP operating data for 1984 and 1985 show that phosphorus removal was occurring while operating as a conventional activated sludge process. Southerly was achieving approximately 80 percent removal while Jackson Pike was achieving approximately 40 percent removal.

Biological phosphorus removal will also occur when operating in the semi-aerobic mode. Biological phosphorus removal produces approximately 10 percent more waste activated sludge (WAS). Sludge production rates which were used to determine sizings for solids handling processes were taken from the semi-aerobic process pilot data. Therefore, these rates sould reflect increased WAS production due to phosphorus removal.

Comment 32

Comment: It is our understanding that the waste sludge will release phosphorus once it enters an anaerobic condition, such as the anaerobic digesters. What would be the subsequent impact of the phosphorus rich recycle on the semi-aerobic process, if any?

Commentor/s: Ohio EPA

Response:

A phosphorus rich recycle would not cause any operational problems for the semi-aerobic process.

Comment 33

Comment: Our review did not locate a discussion of dechlorination/post-aeration.

Commentor/s: Ohio EPA

Response:

The SEIS agreed with the recommendations in the facility plan to add post aeration and dechlorination facilities. The NPDES permits for the Jackson Pike and Southerly WWTPs require that dissolved oxygen in the final effluent be maintained at a level of not less than 7.0 mg/l. The permits also require that the chlorine residual in the final effluent not exceed 19 ug/l at Jackson Pike and 26 ug/l at Southerly.

Table 7-1 and 7-2 in the SEIS provide design criteria for the post aeration and dechlorination processes.

Comment 34

Comment: If the source or sources of toxicants were eliminated from the Southerly service area, would new circular clarifiers still be required or would the existing rectangular clarifiers be satisfactory?

Commentor/s: Ohio EPA

Response:

New circular clarifiers would still be recommended for the Southerly WWTP even if the source or sources of toxicants were eliminated. Historically, Southerly has had problems with rising sludge in the final clarifiers. Rising sludges are frequently caused by biological activity in the clarifier resulting in the release of micro gas bubbles which attach to the sludge particles. Over-pumping of the sludge from the final clarifiers is required to prevent the sludge from rising. Circular clarifiers are more efficient for over-pumping because they are equipped with hydraulic sludge removal devices. Furthermore, operating at a mixed liquor of 3500 mg/l rather than 2500 mg/l would still be recommended since it decreases the required number of aeration basins by approximately 25 percent.

Comment 35

Comment: The water quality benefits from removal of the Jackson Pike effluent discharge would outweigh any aquatic habitat impacts resulting from the loss of the current low flow augmentation provided by this discharge. Also, the supplemental flow augmentation provided by discharges from American Aggregates was not considered.

Commentor/s: Ohio EPA

Response:

The SEIS conclusion that removal of Jackson Pike flows would exert a negative impact on the Scioto River at low flow was based on two observations:

(1) The biological community and morphology of the channel are acclimated to a current minimum low flow of approximately 140 cfs or more, and

(2) Effluent quality at Jackson Pike will protect water quality standards at the minimum low flow.

If water quality is not seriously impaired (ie: standards are met) under conditions in which a continuous WWTP effluent constitutes more than 85% of the total flow, the water quality arguments for removing that flow are unclear. Secondly, the 86% reduction in the current, minimum low flow, which would result from removal of Jackson Pike, would result in a significant reduction in habitat area with little if any apparent compensation from improvements in water quality, due to the continued CSO and nonpoint loadings from the Columbus area.

No mention of the supplemental flow augmentation resulting from discharges of quarry water from American Aggregates is made either in the draft CWQR (1985) or the recent modeling analysis described in the July 16, 1987 memo from S. K. Goranson to Dale Luecht. Apparently, this supplemental flow was not accounted for in the QUAL2E model and was not, therefore, considered in the SEIS.

Comment 36

Comment: The SEIS underestimates the beneficial effects which would result from complete removal of the Jackson Pike effluent because these benefits are overshadowed by the negative effects from other factors which could be reduced or eliminated.

Commentor/s: Ohio EPA

Response:

This comment contains a continuation of the philosophical discussion initiated in the previous comment, and introduces several conditions which would favor removal of Jackson Pike effluent. These conditions are summarized as follows:

- "If these other concerns ['loss of CSO dilution, loss of low-flow augmentation, etc.'] can be eliminated or reduced then the benefits of WWTP removal are magnified", and
- "The above assertion ['...better biological performance could be expected with complete WWTP removal'] is valid only if the other concerns about extended CSO impacts and low-flows can be reduced or dismissed."

While there is some agreement with these statements, no CSO removal projections were available for use in the SEIS. Consequently, the worst case projections in the SEIS were based on present, worst case information, which does not include the conditions cited by the commentor which might favor removal of the Jackson Pike effluent.

An additional part of this comment suggests that the low flow impacts of complete removal of Jackson Pike effluent on stream biota would not be as significant as suggested in the SEIS, citing the presence of a balanced fauna in Big Darby Creek, which exhibits a critical low flow less than the calculated Scioto River low flow, minus Jackson Pike. The biota indigenous to any stream acclimate to a range of flow conditions typical to that stream. In the Scioto River below Jackson Pike, channel morphometry and stream biota are currently acclimated to a critical low flow of equal to or greater than 140 cfs (the Big Darby Creek channel morphometry and biota are acclimated to a critical low flow of approximately 5 cfs). By reducing the Scioto River critical low flow to 20 cfs (through removal of Jackson Pike), the available habitat area and physical characteristics of the channel at low flow will be critically reduced from the conditions to which the stream biota in this stretch of the river have acclimated (this would be comparable to the impacts of suddenly reducing Big Darby Creek from 5.3 cfs to 0.7 cfs at critical low flow). Additionally, the continuing presence of upstream pollutants may result in water quality deterioration and additional biological stress at low flow.

While the commentor is correct in arguing that CSO removal would ameliorate this impact, no CSO correction projections were available for use in the SEIS. Even with the correction of CSO, the upper Scioto River would continue to be subject to periodic stress from non-point runoff during storm events, from proximity to the urban area. Consequently, use of a present-conditions, worst-case scenario was necessary. Under this worst-case scenario, the Jackson Pike effluent (which contributes an estimated 86% of the critical low flow) will protect water quality in the Scioto River, based on modeling results. However, given the pollutants present in flows upstream from Jackson Pike (which constitute the remaining 14% of the critical low flow), it is not certain that water quality standards would be maintained at all flow conditions with removal of Jackson Pike. Over time, however, the indigenous biota would acclimate to the different low flow, water quality, and channel morphometry conditions which would result from removal of Jackson Pike.

<u>Comment 37</u>

Comment: The SEIS overestimates the water quality impacts of CSO discharges, in comparison to the Jackson Pike effluent, through failure to adequately consider a variety of factors.

Commentor/s: Ohio EPA

Response:

The commentor has interpreted the SEIS as stating that "...the CSO load is equal to the WWTP load", arguing that "It is in fact much less". However, on page 6-36 of the SEIS, the CWQR (OEPA 1986a) was quoted as indicating that, "...on an annual basis, the Whittier Street CSO contributed nearly as much BOD_5 loading (32.7% percent) in 1982 as did the Jackson Pike WWTP (38.8 percent)" [underlining added]. Further, the SEIS concluded, on page 6-39, that "...the calculated BOD_5 loading from the Whittier Street CSO approximates the current loading from Jackson Pike..." [underlining added]. The commentor actually supports this conclusion, by correctly citing the CWQR as indicating that the BOD_5 load from the Whittier Street CSO was 84% of the Jackson Pike load in 1982, the most recent year from which comparative data are available. However, the commentor may have been confused by a second statement on page 6-39 (last paragraph) of the SEIS which stated that "...the other wasteload sources entering the Scioto River near Jackson Pike (CSO and urban runoff) contribute pollutant loads equal to or greater than Jackson Pike" [underlining added]. This statement was comparing the annual, combined loadings from the CSO and other urban pollutant sources to the loadings from Jackson Pike.

The commentor also argues that "The more severe [CSO] impacts would be expected in the third quarter [of the year] because of reduced flows, higher temperatures, and lower ambient D.O." This observation is correct, however it is also consistent with the SEIS statement that "Although the [CSO] loadings are highest during the spring and winter, some discharge does occur during periods of low flow and high temperature when the river is most sensitive to depressed DO." In any event, it is important to realize that the pollutants loading from the Whittier Street CSO "...has been shown to result in violations of in-stream DO standards..." (page 6-36) under current conditions. Because no predictions of future CSO corrections were available for use in the SEIS, it was necessary to assume a worst-case scenario (which includes a continuation of these negative CSO-related impacts).

The commentor also contends that "The SEIS implicitly evaluates the CSO as a low-flow, dry weather impact which is actually when CSO loadings are lowest, much lower than the sustained low-flow, dry weather load produced by the WWTP." As in the previous paragraph, the seasonal variability of CSO loadings was recognized in the SEIS. However, data are not available to characterize the actual CSO loads during low flow conditions; therefore, and as stated in several locations, the SEIS assumed a worst-case scenario. Sensitivity analyses would be especially helpful in determining the relative significance of CSO on the DO profile.

Another comment is that the impact of the Whittier Street CSO "...is the most serious in closer proximity to the CSO outfall and its effect diminishes with increased distance downstream." The SEIS also recognized this effect, as reflected in the conclusions on page 6-36 that "...the section of the Scioto River exhibiting continued depressed DO levels ... will be essentially constricted to an area below Whittier Street", and that "...downstream areas...will exhibit the greatest overall improvement in DO conditions...while improvements in upstream areas, closer to Whittier Street...will be reduced."

Additionally, the commentor argues that "We should operate under the expectation that loadings from [the Whittier Street] and other CSOs will be reduced in the near future." As stated above, no projections of the amount or timing of CSO corrections were available for use in the SEIS, necessitating the use of worst-case scenarios.

Finally, the commentor disagrees with the SEIS conclusion that the two-plant alternative provides "... a better 'buffer' against possible shock loadings...", arguing that "...there is little ecological benefit." In support of this counterargument, the commentor incorrectly assumes that, under a two-plant scenario, both plants would be impacted by a shock loading problem and that two river reaches would therefore be impacted. Although flows from Jackson Pike may be routed to Southerly, each treatment plant receives flows from separate interceptors and collection systems; therefore, a shock load in one collection system would have no bearing on the other.

Comment 38

Comment: There is little ecological significance whether the effluent is discharged at a single location (Southerly) or at two locations (Jackson Pike and Southerly).

Commentor/s: Ohio EPA

Response:

The commentor has invoked an erroneous modeling assumption that "...along with increased load [ie; the loads currently being treated at Jackson Pike] comes increased flow which should be of considerable importance...", questioning whether "...it really matters from an effluent/stream flow perspective if 10 MGD of upstream flow dilutes 80 or 150 MGD of effluent".

First, the Scioto River flows, and the flow-dominated component of the river's assimilative capacity, will be the same under either the one-plant or two-plant alternatives immediately below Southerly, as all upstream river and effluent flows become additive at this point. Therefore, although the one-plant alternative will result in increased effluent loads being discharged at Southerly, no increase in flows (or assimilative capacity) will be present below Southerly to compensate for this increase.

Second, under the two-plant alternative, the residual wasteload demand from the upstream discharge at Jackson Pike will have been at least partially assimilated by the river before the flow volume reaches Southerly, and the river's capacity to accept another effluent demand (ie; the Southerly discharge) will be at least partially regenerated, even though the flow volume below Southerly is not changed in comparison with the one-plant scenario. While it is recognized that these differences are not extreme (existing modeling indicates that the DO sag from Jackson Pike will have only just begun to recover before reaching Southerly), it is nevertheless apparent that the river would be somewhat more capable of assimilating the residual wasteload demand when the effluent is discharged at two locations. As evident in Attachment D to the 7/16/87 memo from Goranson to Luecht, the model reflects a slightly more severe DO sag under the one-plant alternative, affecting a slightly longer stretch of the river below Southerly, in comparison with the two-plant alternative. Finally, critical low flow at Southerly, under the one-plant alternative, will be approximately 13.5 mgd (the 20 cfs critical low flow calculated for Jackson Pike, plus a 1 cfs allowance for base flow addition between Jackson Pike and Southerly), not 10 mgd, as stated by the commentor.

Comment 39

Comment: The Ohio EPA comments concerning the water quality modeling review in the SEIS are the same as those submitted in the March 23, 1987 letter from Mr. Turner to Mr. Sutfin.

Commentor/s: Ohio EPA

Response:

The March 23, 1987 letter was prepared by the Ohio EPA and the City of Columbus' modeling consultant as a reaction to a technical critique of the model prepared by the USEPA's SEIS contractor. Because of the non-specific nature of this comment, it was noted but no response was prepared.

Comment 40

Comment: The SEIS cites beneficial effects of Jackson Pike effluent in dilution of CSO loads, however the real issue is the correction of overflows.

Commentor/s: Ohio EPA

Response:

Although arguing at length, in previous comment number 18, against the SEIS conclusion that the Jackson Pike flow is important for its value in diluting upstream CSO loads at low flow, the commentor concludes this comment by stating that "Improvements to treatment facilities, in the absence of concomitant corrections of [combined sewer] overflows, may not provide for the attainment of Water Quality Standards". Clearly, the SEIS also recognized the impact of CSO and urban nonpoint pollutant loads on the upper Scioto River. While it is agreed that the CSO loads should be removed, no projections of timing or degree of removal were available for use in the SEIS, necessitating the adoption of a worst-case scenario.

Comment 41

Comment: Impacts projections in the SEIS regarding effluent-derived nitrogen loading, algal stimulation and downstream DO impacts, under the one-plant alternative, are erroneous.

Commentor/s: Ohio EPA

Response:

Overall, this comment focuses on the issue of effluent-derived nutrient enrichment and the related problems of algal stimulation and effects on the DO regime downstream of Southerly. The SEIS concluded that, under the one-plant alternative, the increase in nutrients released at Southerly "... will further stimulate algal biomass below Southerly which may depress low flow DO below in-stream standards due to algal metabolism." The commentor argues that "Algae generally results [sic] in a net increase in D.O. after respiration and decay (except where predominated by blue-green colonies or in nuisance proportions)." It should be noted that algal growth is not usually considered to be a beneficial condition, and is not usually considered to be part of a stream's assimilative capacity when determining a wasteload allocation. Under optimum growing conditions, it is true that algae may generally produce more oxygen than is consumed by respiration, on a net, 24-hour basis. However, this net balance results from averaging the oxygen surplus which results from daylight photosynthesis with the oxygen deficit which results from nighttime respiration.

If DO is depressed to levels approaching the minimum in-stream standard from other influences (eg; decay of residual effluent demand), the additional DO demand resulting from algal respiration in non-daylight hours can result in ambient DO levels below the standard (existing algal populations have been shown to have a significant impact on in-stream DO levels below Southerly at low flow). This potential is increased by increased algal biomass, which may result from increased nutrients released at Southerly under the one-plant alternative. Also, at the conclusion of the annual growing season, decay of an enhanced algal community can result in a significant additional DO demand.

Further, the commentor states that "...the design of the WWTP specifically reduces nutrients." The basis for this comment is unclear. Although Southerly is operated for ammonia removal, the ammonia is simply converted to nitrates and released to the river in the effluent. In the river, the nitrates are bioavailable as plant nutrients (ie; the mass of nitrogen is conserved). Although some denitrification will occur at Southerly (which would actually result in nutrient removal, through release of gaseous nitrogen), the plant will not be operated in a denitrification mode continuously.

In addition, the commentor states that "... algae is [sic] most likely phosphorus limited in the Scioto River, and under either option, the loading of nutrients to the Scioto River is greatly reduced from existing conditions." Information available in preparing the SEIS did not provide a basis to determine if algal communities below Southerly are nitrogen or phosphorus limited. Further, because the existing and proposed permit limits for Southerly do not include nutrients, it is not apparent how this conclusion was reached (complete nitrogen removal will not occur continuously at Southerly under the proposed one-plant alternative [see above]). The degree of phosphorus removal which currently takes place at Southerly is expected to continue. It is possible that the commentor confused $CBOD_5$ and NH_3 removal with nutrient removal (the permit for Southerly includes TSS, $CBOD_5$ and NH_3). Based on the design conditions evaluated in the SEIS and the current/future permit limits for Southerly under the one-plant alternative, $CBOD_5$ loading from Southerly will be increased by over 100% during winter, increased by less than 10% during May (the winter/summer "transition" limits), and reduced by approximately one-third during summer. The corresponding values for NH_3 are over 100% increase in winter, less than 20% decrease in May, and over 50% decrease in summer. The net annual loadings were not calculated. As indicated previously, ammonia removal cannot be equated with nutrient removal. While ammonia can be reduced through conversion to nitrate, this form of nitrogen is a plant nutrient.

Comment 42

Comment: The SEIS conclusions regarding increased DO impacts below Southerly, under the one-plant alternative, are inconsistent with the water quality modeling results and do not consider the beneficial effects which will occur with the elimination of CSO and effluent bypasses.

Commentor/s: Ohio EPA

Response:

This comment generally addresses issues related to water quality modeling. The commentor notes that the DO sag resulting from the Southerly effluent discharge occurs at river mile 106 under either the one-plant or two-plant alternative, and questions the SEIS conclusion that the one-plant alternative may impact Circleville, specifically citing pages 6-46 and 6-85 of the SEIS.

The SEIS conclusions were based on several factors, including (1) "Under current conditions ... water quality at Circleville reflects residual BOD_5 from the Southerly effluent discharge" (page 6-41); (2) comparing future residual BOD_5 loading from Southerly, under the one-plant alternative, with current loadings under the present two-plant arrangement, the future BOD_5 loadings will be twice the present level in winter, essentially the same in the winter/summer transition period, and one-third less in summer; (3) nitrogen compounds in the effluent consume far more oxygen, pound-for-pound, than BOD, yet "The existing modeling does not provide a reliable basis for evaluating the DO impact of ammonia, nitrite/nitrate, organic nitrogen, and TKN" (page 6-36); (4) ammonia reduction at Southerly will only convert the ammonia to another form of nitrogen (nitrate-N), which will be bioavailable (to algae) and may exert an additional oxygen demand; (5) the increased effluent discharge at Southerly under the one-plant alternative will include a proportionate increase in the release of nitrogen compounds; (6) nitrogen is a plant nutrient which may further stimulate algal growth below Southerly (under current conditions, algal metabolism has been shown to have a significant impact on in-stream DO levels at low flow); and (7) the QUAL2E model predicts that the Southerly DO sag may be longer and may more closely approach Circleville under the one-plant alternative, but this model does not adequately represent the nitrogen series compounds and does not extend far enough downstream to adequately assess potential impacts at Circleville.

Collectively, these factors are interpreted as introducing the potential that an increased DO sag may occur under certain circumstances, and that "Any increase in the length of the river affected by the expanded DO sag will be in a downstream direction" (page 6-40). Because the existing modeling and other environmental data were not sufficient to clarify the potential for this impact to occur, the SEIS expressed the issue in tentative terms. For example, on the specific pages cited by the commentor (6-46 and 6-85), the SEIS stated that "The combination of these factors results in a possibility that the one-plant alternative may impact the Circleville area ...", and that "It is possible that this enlarged sag may extend to Circleville..." [underlining added].

The commentor further states that "The increased severity of the D.O. sag below Southerly is substantiated in modeling, but the length of the sag is not known to be increased." In fact, the model reflects both a longer and more severe sag below Southerly under the one-plant alternative. Specifically, while the minimum DO under the one-plant alternative appears to occur at essentially the same river mile as under the two-plant alternative (approximately 12 miles below Southerly), the minimum DO is approximately 0.5 mg/l lower under the one-plant alternative. In addition, the DO sag appears to be translated approximately one to two miles further downstream under the one-plant alternative; DO recovery therefore occurs further downstream under the one-plant alternative.

The commentor also challenges the SEIS statements of increased algal metabolism and interferences with downstream dischargers as conjecture. The basis for the SEIS statements is reviewed above. The number of technical factors suggesting that the argued impact could develop were judged to be sufficient to introduce the possibility of the impact; however, because existing information was not sufficient to clarify the potential for this impact to occur, the SEIS expressed the issue in tentative terms only, and made no attempt to disguise the speculative nature of the issue.

In addition, the commentor argues that "The statements regarding modeling on page 6-4 are out of context and not well informed". In fact, there are no comments regarding modeling on page 6-4. Assuming the commentor is referring to page 6-40, three modeling-related statements were made, as discussed in the following. The first statement indicated that "Water quality modeling has determined that final effluent limits for the Southerly WWTP will protect instream DO standards below Southerly, under the one-plant alternative". As this statement has not been contested elsewhere, it is assumed that the commentor does not believe this statement to be "not well informed". The second statement indicated that "...the severity of the sag is greater under the one-plant alternative ... based on the QUAL2E model results". The veracity of this statement has already been established (see above).

The third statement indicated that, with regard to the potential for downstream impacts from decay of residual wasteload DO demand and increased algal metabolism, "The QUAL2E model does not extend far enough downstream to assess this potential impact". In fact, the QUAL2E model (as developed by Ohio EPA and URS-Dalton) only extends to approximately river mile 103 (15 miles below Southerly). At this location, the DO sag has only just begun to recover, under either scenario, and the characteristics of the DO profile below this point cannot be ascertained with the existing modeling.

In the remainder of this comment, the commentor argues that it is inconsistent to accept the model as reliable for certain purposes (ie; evaluating the adequacy of proposed permit limits to attain standards), while identifying deficiencies in the same model in support of other purposes (ie; selection of a preferred alternative). During preparation of the SEIS, the reliability of the model was questioned, on several grounds. These technical issues were summarized in a draft critique, which was included in Appendix L to the SEIS. The critique of the model was reviewed by the staff who developed the model, who determined that the model was accurate and that no changes were warranted on the basis of the critique. On this basis, "...the USEPA has concluded that the error margin in the existing QUAL2E model is acceptable and that the permit limits based on this model are reliable and would achieve DO and NH_3

water quality standards" (page 6-32). The SEIS accepted the accuracy of the model for those elements which it considered; however the selection of the preferred alternative was based more on factors not fully considered in the model.

This comment concludes with the observation that "Based upon model results, either alternative will provide for protection of standards and recovery of uses, when implemented in concert with the elimination of bypasses and reduction of CSO at Whittier Street". The SEIS repeatedly called attention to the CSO problem and the potential effects of this pollutant source on water quality conditions in the Scioto River, particularly in regards to the two-plant alternative. In that the OEPA has repeatedly taken strong exception to the SEIS statements on this issue (see previous comments), this comment, which appears to condition the success of the proposed project on the removal of CSOs, is puzzling. However, this caution is also apparent at the conclusion of Comment No. 40 ("Improvements to treatment facilities, in the absence of concomitant corrections of [combined sewer] overflows, may not provide for the attainment of Water Quality Standards"). Although these comments seem to be inconsistent with the other comments challenging the SEIS's statements on the importance of CSOs and nonpoint runoff on water quality, they appear to support the SEIS's position and no additional response is warranted.

Comment 43

Comment: The discussion regarding the hydropower plant at the O'Shaughnessey Reservoir is confusing.

Commentor/s: Ohio EPA

Response:

Adjustments to the bullet items on page 2-9 and the first paragraph of page 2-67 and page 6-50 were made. These adjustments stressed that the hydropower plant is an auxiliary facility, can be shut down during low flow periods and will not adversely impact the water quality of the Scioto when properly operated even under low flow conditions.

Comment 44

Comment: The assertion that groundwater quantity and quality may be affected by the selection of alternatives, on pages 6-50 through 6-54 of the SEIS, is not warranted. In addition, the assertion that the river bottom is sealed by industrial and municipal sludges is not substantiated by Ohio EPA survey data.

Commentor/s: Ohio EPA

Response:

This was noted; the discussion on page 6-50 through 6-54 is misleading. Page 6-53 was revised to reflect the speculative nature of these reports. In addition, the reference to municipal and industrial sludges sealing the river bed was deleted on pages 6-47 and 7-17.

Comment 45

Comment: To what extent can we conclude that the city of Columbus has committed to controlling odors?

Commentor/s: Dr. Maxwell

Response:

The commitment of Columbus to containing odors in southern Franklin County can best be described by (1) the formation and continued efforts of the Odor Control Committee; (2) recently or nearly completed capital projects such as Project 88 which have been designed to effect process and operations improvements, thereby lessening the potential for the formation of odorous compounds; and similarly, (3) future capital projects for which a contract to proceed has been issued or for which funding has been identified; and (4) current programs in the areas of odor identification and evaluation, in particular, the Odor Emissions Evaluation Study. A brief discussion on the city's progress in each of these areas is described below.

The Odor Control Committee has been operating since 1986. Its membership is open to interested citizens, local industry, and local and state regulatory officials. The Committee has recently identified the various potential odor sources in the affected region, put into place an odor complaint response procedure and acquired meteorological data to be used in conjunction with the Odor Emissions Evaluation Study.

Project 88, managed by the Columbus Division of Sewerage and Drainage, includes more than 130 million dollars worth of renovations and process improvements at the WWTPs and the Southwesterly Composting Facility. Several of the improvements are directly related to odor control. In fact, the city has concentrated its efforts on improving processes and operations with the goal of decreasing the potential for the formation of odorous compounds, rather than implementing pollution control strategies to contain odors. A discussion regarding current construction projects which are expected to have a positive impact on reducing the levels of odors produced at the Southwesterly Composting and the Southerly Wastewater Treatment Plant follows:

> "Now under construction at Composting is a mechanized mixing facility (contract C-7) scheduled for completion in June, 1988. This facility will provide for complete mixing of the raw sludge and building agent, permitting a more efficient, effective, and thorough air flow through compost piles, maintaining a complete aerobic condition. Current mixing practices by front-end loaders, provide an incomplete mix, resulting in pockets of anaerobic material that emits obnoxious odors when the piles are torn down.
>
> As part of Project 88, gravity thickeners are being constructed to enhance the concentration of raw primary sludge for further processing. Previously, primary sludge was thickened in the primary clarifiers which was relatively ineffective for this purpose. The method required solids to be held in the clarifiers and, particularly during warm months, decomposition occurred, generating hydrogen sulfide gas that emitted to the atmosphere. With the gravity thickener operation, raw solids will be removed continuously at a rapid rate from the clarifiers before decomposition has started. The solids will then be pumped to the thickeners where effluent water containing dissolved oxygen will be combined with the primary sludge flow, maintaining an aerobic environment thus preventing the formation of hydrogen sulfide gas. Construction of the gravity thickeners is substantially complete at Southerly and four of the units have been placed in operation.
>
> With the success of the gravity thickeners at Southerly, plans are being developed for construction of gravity thickeners at the Jackson Pike plant. In addition, a major digester rehabilitation is planned that will improve the solids stabilization process. Presently the digesters have inadequate mixing and poor heat transfer that contribute to incomplete digestion of solids. This condition will produce odors, particularly in the winter months when the optimum digestion temperatures are not

obtained. Start of construction for the gravity thickeners and the digester rehabilitation is scheduled for the spring of 1989 (Scott 1987)."

Additionally, Columbus is considering the use of liquid, rather than cake-applied sludge to control odors during land application. Liquid application offers the advantage that the sludge is stored in the plant rather than stockpiled. The city would use tank trucks for delivery and then inject the liquid sludge into the soil. Injection controls odor and is less visible (Hoff 1988).

The Odor Emissions Evaluation Study is in the data collection phases, during which a panel of selected and trained residents are evaluating and reporting the intensity of objectionable odors. "Sixteen residents representing the south side of the greater Columbus area were selected and underwent sensory profile analysis by the consultant that includes odor detection sensitivity and differentiation ability. The study objective is to identify the source of odors and to determine the degree of control needed at various locations to reduce air emission concentrations to nonobjectionable odor levels. The majority of work is scheduled for completion by August, 1988". (Scott 1987).

Dispersion modeling calculations will be performed to confirm the source and movement of identified odors, and chromatographic or mass spectrometric analyses will be conducted to chemically characterize odorous constituents. Assessment of possible control measures will be tackled during subsequent phases of the study.

Beyond the evaluations and capital projects described above, the city has expressed its intent to utilize the information gleamed in the Odor Emissions Evaluation Study to implement effective odor control measures (Scott, 1988; Francis 1986; Burgess & Niple, Ltd. 1987). "Directly addressing the issue by construction of phyical facilities will not be forthcoming until the odor study has been completed. Realistically, odor will not be eliminated, only reduced to some level that is below the threshold of the average citizen's sensitivities. Determination of that level is part of the current study under way. Also to be considered is the cost of odor control, not only by the public sector, but also the identified private industries. These are political questions that will have to be answered". (Scott 1987).

This intent must be regarded at this time as a planning reference, as the particular odor control mechanism has not been identified, and therefore, cannot be expressed as a contractual commitment nor have funds been applied to such programs.

Comment 46

Comment: To what extent is the city of Columbus incorporating into Project 88 state-of-the-art controls and containment?

Commentor/s: Dr. Maxwell

Response:

Project 88 is related to improving processes and operations which contribute to the development of odorous compounds rather than on scrubbing or containment of emissions from the various processes. Particular process and operations improvements are described in the discussion related to Comment 46.

CHAPTER 9. REVISED APPENDIX PAGES

During the preparation of the response to comments on the draft SEIS, it became necessary to make some modifications to the appendix. Since these changes were minimal, USEPA decided to print only those pages of the Draft SEIS that were changed resulting from response to comments. These changed appendix pages make up Chapter 9. The entire appendix was not reprinted as part of the Final SEIS. The original mailing included the Draft SEIS and the Appendix. Those who did not receive an Appendix may receive one by making a request to this agency.

of its poor settling characteristics a bulking sludge will cause BOD and total suspended solids violations due to the loss of particulates over the weirs of the secondary clarifier. High SVI numbers are indicative of a bulking sludge.

A rising sludge is one in which the sludge blanket of the secondary clarifiers floats to the surface, once again causing TSS and BOD violations. Rising sludges are frequently caused by biological activity in the clarifier resulting in the release of micro gas bubbles which attach to the sludge particles. One of the most frequent causes of a rising sludge is denitrification in the secondary clarifiers. The denitrification process releases nitrogen gas and carbon dioxide which causes the sludge to float. No degree of increased clarifier sizing or decreasing the clarifier surface overflow rate will compensate for a rising sludge. The cause of the denitrification in the secondary clarifiers must be eliminated for the wastewater treatment plant to meet standards.

Carbonaceous BOD Removal - This is the biological conversion of carbonaceous organic matter in wastewater to cell tissue and various gases and by-products. In the conversion it is assumed that nitrogen present in the various compounds is converted to ammonia. High carbonaceous BOD values will result in effluent violations.

Denitrification - The biological process by which nitrate is converted into nitrogen and other gaseous end products. When denitrification occurs in the secondary clarifiers the result is a rising sludge and effluent violations.

F/M Ratio - The food to mass ratio. This is a ratio of food substrate (BOD) to biological mass (MLSS) which is used as a control parameter for determining the organic loading rate to a biological treatment system. A high F/M ratio means that oxygen uptake rates will be high, biological metabolic rates will be high, and in the absence of excess oxygen, obligate aerobic bacteria will be removed. A low F/M ratio generally results in high dissolved oxygen concentrations and may result in the selection of bulking bacteria in a municipal wastewater treatment system. In the semi-aerobic process high F/M ratios are intentionally maintained in the first bay of the aeration tank in order to **maintain anaerobic or anoxic conditions necessary to select against bulking bacteria.**

Mixed Liquor Suspended Solids - (MLSS) The mixed liquor suspended solids or mixed liquor volatile suspended solids are a measure of the amount of biomass present in the aeration system. For most conventional activated sludge systems, this concentration is approximately 1,200 to 3,000 milligrams per liter (mg/l).

Nitrification - The two-stage biological process by which ammonia or total kjeldahl (TKN) nitrogen is first converted to nitrite then to nitrate. Nitrification is the necessary first step in the nitrification/denitrification cycle. The goal is to convert ammonia into nitrates and ultimately into gaseous end products.

The selection of an F/M ratio of 5 in the first bay of the semi-aerobic system is based on correspondence with Mr. Orris E. Albertson, Process Consultant to the city's consultant. Mr. Albertson also stated in an article published in the April 1987 Journal of the Water Pollution Control Federation that the maintenance of a high F/M ratio in the initial contact basin of a semi-aerobic system was required to maintain the anaerobic and anoxic conditions necessary to select against bulking bacteria. This high F/M ratio would be realized in both the semi-aerobic and activated sludge options. It is assumed that the trickling filter option would greatly reduce this F/M ratio due to the attenuating effect the upstream roughing filter would have on carbonaceous BOD loadings. An overall aeration basin F/M value of 0.13 to 0.17 would be consistent for a well operated nitrifying activated sludge system.

The mixed liquor suspended solids concentrations of 3,500 mg/l for the Southerly plant and 2,500 mg/l for the Jackson Pike plant were derived from SBR studies conducted by the city's consultant. It is assumed that mixed liquor concentrations of the same magnitude would be required for a conventional activated sludge system. The primary reason for the higher mixed liquor suspended solids in the Southerly aeration basin is the low nitrification rates observed at that plant. **Increasing the MLSS to 3,500 mg/l allows nitrification to proceed with fewer aeration basins than would be required at 2,500 mg/l.** The Jackson Pike WWTP experiences nitrification rates well within the range of most sewage treatment facilities.

The cause of lower nitrification rates at the Southerly plant is most likely due to toxicity of some non-conventional pollutants present in the Southerly raw wastewater. Nitrification rates for the Jackson Pike wastewater treatment system are well within the range of nitrification rates realized in North American municipal treatment facilities.

condition, act as the initial zone or anaerobic/anoxic zone of the aeration basin under the semi-aerobic or activated sludge options. The roughing trickling filters would reduce the volume of aeration basin required and effectively assist in control of sludge bulking.

3.1.1.3 Clarifiers

Given the fact that the three previously selected biological treatment processes (semi-aerobic, conventional activated sludge, and trickling filter followed by activated sludge) all can act as effective selectors against bulking organisms, it was assumed that SVIs would generally be in the range of 70 to 150. Given this SVI range, there are two critical design factors which must be considered when selecting and sizing final clarifiers. These are surface overflow rates (gallons per day per square foot surface area) and solids or floor loading rates (pounds of suspended solids per day per square foot). The city's consultant has selected conservative surface overflow rates for their final clarifiers. These are generally in the range of 470 for average flows and 800 for sustained peak flows. Mr. Richard Brenner, USEPA Cincinnati, indicated that conservative design criteria for average flow rates would be in the range of 500 to 550 with peak sustained surface overflow loading rates set at 900 to 950. For the purposes of this evaluation, a range of 400 for average flow and 1,000 for sustained peak flow will be used.

The city's consultant selected solids or floor loading rates for their clarifiers in the range of 18 to 23 pounds per day per square foot for average flows and 29 to 36 pounds per day per square foot for peak flows. A solids loading criteria of 20 to 50 pounds per day per square foot is cited in the USEPA Innovative and Alternative Technology Manual. Rectangular clarifiers should generally be sized on the lower end of this solids loading rate. Circular clarifiers with hydraulically assisted sludge removal devices can easily accommodate the higher solids loading rates without causing sludge channeling or solids entrainment. **However, as pointed out by the city's consultant, SVIs are also a limiting factor in determining an acceptable solids loading rate. Therefore, the Daigger and Roper Clarification Tank Design and Operation Diagrams will also be used in this evaluation.**

criteria. Removal of one of the six trickling filters would not result in violations of the established maximum hydraulic or organic loading rates.

In terms of clarifier capacity it was assumed that one of the circular clarifiers would be removed from the west and center section and one from the east section. Under these conditions, the surface overflow rate as well as the solids loading rate under peak hydraulic loadings would approach the critical limits of the design criteria; however, they would not violate them. Once again, this should not be a problem for circular clarifiers.

In summary, all of the components under each alternative would be capable of operating within the specified design criteria in the event that a unit was removed from operation.

The second measure of system reliability is its ability to respond to system upsets or toxicity problems. The semi-aerobic process provides excellent capabilities to adjust to high ammonia loadings. Ammonia concentrations will be monitored in the number 6 bay in each of the aeration basins. Once ammonia concentrations above 2 mg/l are found, **the aeration in Bay 2 will be activated as well as a general D.O. increase which will enhance the nitrification rate. If this is not adequate to reduce NH_4N to 1.0 mg/l, then the internal recycle pump will be shut down to increase the real detention time. The internal recycle pump reduces nitrification capacity due to the volume used for denitrification.**

The roughing trickling filter acts as an anaerobic/anoxic aeration bay in the semi-aerobic process. The filter reduces BOD loadings to the aeration basins and effectively aids in the control of sludge bulking. Effluent recycling from the aeration basins back to the trickling filters acts in much the same way as the internal recycle of the semi-aerobic process. Aeration basin effluent recycling would also cause denitrification to occur within the trickling filters. Denitrification is vital during the summer months to prevent a rising sludge in the final clarifiers. One significant limitation of the trickling filter in cold climates is the tendency to ice. Under these

The data in Table 3-10 summarizes reported pollutant concentrations in the Jackson Pike and Southerly influent and presents inhibition levels of these pollutants for various biological processes. Influent concentrations of copper and zinc at the Columbus plants may be found at levels which can inhibit the nitrification process. Copper and zinc could act as inhibitory pollutants if the influent concentrations shown in Table 3-10 are carried through the primary effluent and enter the biological treatment process. The city of Columbus must consider controlling the level of inhibitory industrial pollutants to prevent system upsets. An aggresive and well-monitored industrial pretreatment program would be necessary to ensure the nitrification process is protected from inhibitory and/or toxic effects of industrial discharges.

3.2.2 Flexibility

System flexibility is defined as the ability of the system to expand or to turn-down (respond to reduced flows or loads) its biological processes. It will be necessary for the city of Columbus to control slug loads of ammonia and TKN no matter which biological option or treatment plant option is selected. Impacts can also be manifested in terms of loss of load. At the present time, it is estimated that 35 to 45 percent of the BOD loading to the Southerly plant originates with the Anheuser-Busch Brewery. The impacts of losing this BOD loading are most directly felt in the first bay of the semi-aerobic system. Mr. Albertson has indicated that in order **to control bulking,** an OUR/DO ratio of at least 250-1 must be maintained. Under current design conditions, the OUR/DO ratio is approximately 500-1. Given the loss of all brewery waste for a sustained period, it can be assumed that a critical OUR/DO ratio can be maintained. If the brewery wastes are the primary source of the historical bulking problems at Southerly, the plant could operate in a semi-aerobic or conventional activated sludge mode with little or no problems.

The second advantage of the semi-aerobic process in terms of responding to periodic upsets is what Mr. Albertson has described as sludge memory. Most activated sludge systems which have biological phosphorus removal capabilities are able to respond in a linear fashion to organic loading upsets based on sludge age. Assume the sludge age is maintained at 9 days for a 2-day period and the primary source of organic loading is removed from the system. The impact on the effluent would be comparable to the ratio of 2-9 or approximately 22 percent loss of system efficiency. Under these conditions, the system would recover rapidly once the source of organic loading is placed back into the system. The disadvantage of this type of activated sludge (i.e., one which demonstrates biological phosphorus removal), is that the sludge yield in terms of pounds of sludge produced per pound of BOD destroyed is quite high. This is due to the fact that the elemental phosphorus percipitated from the system contributes to the total sludge volume. **(Sentence deleted)**

3.3 ENVIRONMENTAL CRITERIA

One purpose for evaluating treatment alternatives and options is ultimately to ensure that the treatment plants meet their environmental limits. Meeting these limits is predicated on a combination of conservative design criteria, projection of hydraulic and pollutant loading rates, and pilot testing to demonstrate system strengths and weaknesses under real-world conditions. To date, pilot testing in Columbus has utilized a sequencing batch reactor (SBR), and most testing has been at the Southerly plant. In reviewing the work done to date, additional information needs to be gathered on the impacts of blending Jackson Pike and Southerly primary effluent to determine if nitrification rates can be sustained.

It will also be necessary to limit the mass loading of TKN to the Southerly waste treatment plant in order for the nitrification process to be effective. Periodic high loadings of TKN have resulted in the bleedthrough of ammonia from the primary effluent during the Project 20 pilot demonstration. Unless these loads of TKN are controlled, all three biological processes would be subject to ammonia bleedthrough resulting in violation of the permit ammonia concentration and mass-loading limits.

Meeting total suspended solids and BOD limits is primarily a function of clarifier efficiency. Soluble BOD is rapidly removed in the aeration basin. That portion of the BOD associated with the particulates in the wastewater as well as the suspended solids which escape from the clarifier, would cause BOD or suspended solids violations. Controlling suspended solids violations is based on controlling the SVI of both Jackson Pike and Southerly biological treatment systems.

All three processes have the ability to select against filamentous organisms which cause bulking. The semi-aerobic and activated sludge systems, as demonstrated by Project 20 data, could reduce SVIs and keep ammonia concentrations well within permit limits given the absence of slug primary effluent ammonia loadings. Operating data for the Southerly waste treatment plant from 1983 through 1986, indicate SVIs in the range of 75 to 181 are possible. **(Sentence deleted)**

Denitrification is equally important during the summer months. Denitrification will prevent the formation of a rising sludge in the final clarifiers. No amount of clarifier upsizing or clarifier configuration modification can prevent a violation during episodes of rising sludges. It is, therefore, necessary that the denitrifiers complete the chemical reaction, converting the nitrates into nitrogen and carbon dioxide, in the aeration basin. This is accomplished by overpumping the secondary clarifiers, maintaining a minimum sludge blanket in those clarifiers, and holding the mixed liquor suspended solids in the aeration basin to 3500 mg/l (Southerly plant). Denitrification also has the side benefit of eliminating nitrites and nitrates from the plant effluent.

At the present time there is no nitrate or nitrite standard in the Ohio EPA permit limitations written for the Jackson Pike and Southerly plants. However, removing these pollutants from the effluent wastewater would result in the removal of pollutants from the receiving waters and subsequently any groundwaters which are recharged from the surface waters. Denitrification is considered a benefit, not only in terms of removing unwanted pollutants from the surface waters and the groundwaters of the state, but also in terms of limiting the occurrence of rising sludges in the secondary clarifiers.

TABLE 1-2. BRIEFING PAPER CAPITAL COSTS

Cost Component	Southerly (One-Plant)	Southerly (Two-Plant)	Jackson Pike (Two-Plant)
Site Work	$ 22,932,000	$ 11,448,000	$ 1,550,000
Miscellaneous Buildings	5,232,000	4,857,000	1,857,000
Plumbing/HVAC	5,875,000	5,875,000	4,337,000
Headworks	14,300,000	--	8,271,000
Preaeration	5,905,000	1,533,000	3,750,000
Primary Settling	13,590,000	4,717,000	7,372,000
Aeration	46,533,000	12,284,000	22,502,000
Final Settling	35,462,000	20,521,000	8,691,000
Chlorination	4,000,000	2,500,000	2,000,000
Effluent Pumping	6,270,000	--	4,340,000
Outfall Line	3,000,000	--	700,000
Gravity Thickening	5,070,000	2,520,000	1,967,000
Digestion	11,460,000	4,280,000	9,170,000
Centrifuge Thickening	5,600,000	2,000,000	4,500,000
Centrifuge Dewatering	21,040,000	5,120,000	490,000
Dewatered Sludge Storage	1,300,000	1,300,000	--
Incineration	1,300,000	--	3,600,000
Sludge Conveyor System	--	--	5,000,000
Instrumentation & Control	10,070,000	4,799,000	6,995,000
Electrical Distribution	1,896,000	1,896,000	607,000
Jackson Pike Rehabilitation	13,564,000	--	--
Interconnector South	4,982,000	--	--
Interconnector North	5,048,000	--	5,048,000
TOTAL CONSTRUCTION COSTS	$244,429,000	$ 85,650,000	$102,747,000
Contingency (15%)	36,664,000	12,848,000	15,412,000
Land	200,000	200,000	--
Salvage Value (PW)	- 12,582,000	- 4,644,000	- 5,137,000
CAPITAL PRESENT WORTH	$268,711,000	$ 94,054,000	$113,022,000

APPENDIX H

TABLES OF ENDANGERED SPECIES

TABLE H-1. ENDANGERED FAUNA SPECIES KNOWN TO OCCUR IN THE COLUMBUS FACILITIES PLANNING AREA, OHIO[a]

Species	State Endangered	Federally Endangered	Remarks
Indiana bat (Myotis sodalis)	x	x	Habitat requirements are not fully known.
Peregrin falcon (Falco peregrinus)	x	x	Occurs as an uncommon migrant.
Bald eagle (Haliaeetus leucocephalus)	x	x	Occurs as an uncommon migrant.
Kirtland's warbler (Dendroica kirtlandii)	x	x	Occurs as an uncommon migrant.
Upland sandpiper (Bartramia longicauda)	x		May occur in suitable, grassy habitat anywhere in the country. Recent records exist for Bolton Field and Rickenbacker Air Base.
Common tern (Sterna Hirundo)	x		Occurs as an uncommon migrant.
Four-toed salamander (Hemidactyliumd scutatum)	x		Requires a bog-like habitat. A recent record exists for the northeastern corner of the country.
Northern brook lamprey (Icthyomyzon fossor)	x		Rare occurrence in Big Walnut Creek and Big Run (tributary of Olentangy River).
Paddlefish (Polyodon spathula)	x		One specimen observed in Scioto River below Greenlawn Dam in 1976.
Blacknose shiner (Notropis heterolepis)	x		Population in Rocky Fork Creek (tributary of Big Walnut Creek, northeast Franklin County).
River redhorse (Moxostoma carinatum)	x		Known population in Scioto River and tributaries.

TABLE H-1. ENDANGERED FAUNA SPECIES KNOWN TO OCCUR IN THE COLUMBUS FACILITIES PLANNING AREA, OHIO[a] (Continued)

Species	State Endangered	Federally Endangered	Remarks
Slenderhead darter (Percina phoxocephala)	x		Known population in Big Walnut and Big Darby Creeks.
Spotted darter (Etheostoma Maculatum)	x		Small population in Olentangy River and Big Walnut Creeks.
Lake Chubsucker (Erimyzon succtta)[b]			
Shortnose gar (Lepisosteus platostomius)[b]			
Mooneye (Hiodon tergisus)[c]			
Tippecanoe darter (Ethestoma tippecanoe)[d]	x		Collected just downstream of FPA at Circleville.
Scioto madtom (Noturus trautmani)[d,e]	x	x	Found only in Big Darby
Piping Plover (charadrius melodus)[f]		x	Last seen at the Jackson Pike Wastewater Treatment plant in the 1940's.

[a]Source: Ohio Department of Natural Resources 1986, unless otherwise noted.

[b]Source: OEPA 1986a.

[c]Source: Yoder 1987; Ohio Department of Natural Resources 1986.

[d]Source: Cavender 1986.

[e]Source: Multerer 1986.

[f]Source: Huff 1988

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