PERMITS, STUDIES, AND WASTEWATER TREATMENT PROJECT INFORMATION

A. NPDES PERMITS

B. ONSLOW BEACH OUTFALL STUDY

C. CAMP JOHNSON TREATMENT PLANT STUDY

D. EFFLUENT TOXICITY STUDY

E. SURFACE WATERS RECLASSIFICATION INFORMATION

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G. MASTER PLAN SCOPE OF WORK

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WASTEWATER TREATMENT AT CAMP LEJEUNE

Surface water quality of North Carolina's rivers and streams is a paramount issue with the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR). Regional water quality issues and regulations are being administered by the Division of Environmental Management (DEM) in the Wilmington Regional Office to ensure compliance with State administrative codes and policies. Population growth and development of Onslow County have resulted in an increasing demand on the New River for wastewater discharge locations and capacities. The result has been degradation of New River water quality which has prompted the State to implement more stringent wastewater treatment requirements for dischargers.

Seven wastewater treatment plants within the Camp Lejeune complex handle all sewage flows generated on Base except for minor quantities disposed of through septic tanks in outlying areas. All plants are permitted for surface water discharge totaling 13.17 million gallons per day. Six of the seven plants discharge into the New River or its tributaries and the remaining plant discharges into the Atlantic Intracoastal Waterway (AIWW). Sewage discharge lines can only be located in surface waters classified as "SC". Class SC is saltwater suitable for secondary recreation, fishing and aquatic life propagation. Class SA is saltwater suitable for commercial shellfishing and all Class SC uses. The AIWW is Class SA and sewage discharge is prohibited regardless of treatment. Recent reclassication of New River Class SC waters to High Quality Waters (HQW) prohibits increases in discharge volumes unless stricter effluent limits are implemented. A map indicating treatment plant locations and surface water classifications is included in the appendix.

Discharges are regulated by National Pollution Discharge Elimination System (NPDES) permits issued by NCDEHNR under authority granted by the US Environmental Protection Agency. The NPDES permits contain effluent limitations that are required to be met to protect water quality in the receiving stream under existing conditions. The effluent limitations contained in the permits are usually effective throughout the term of the permit. However, these limits may be changed during the five year term of the permits if: (1) a water quality concern is documented in the receiving stream or, (2) the federal guidelines change for facilities with limits based on effluent guidelines. Effluent limits are also subject to change at the time of reissuance of NPDES permits. These changes may result from several factors such as: (1) more discharges in the immediate area, (2) an increase in total permitted flow in the receiving stream, (3) a change in the condition of the receiving stream, and (4) an increase in the understanding of the receiving stream. North Carolina Administrative Code (NCAC), Title 15: 2H.0404(c) states: "The Director may prohibit or limit any discharge of wastes into surface waters if, in the opinion of the Director,

the surface waters experience or the discharge would result in:

(1) growths of microscopic vegetation such that chlorophyll-a values are greater that 40 ug/l; or

(2) growths of microscopic or macroscopic vegetation which substantially impair the intended best usage of the waters."

Changes in the current NPDES permits have been implemented by the State for toxicity under a reopener clause, and changes will be made in future permits for phosphorus limitation based on current conditions of the New River. A phosphorus limit of 2 mg/l is being implemented in the 1992 permits for Hadnot Point, Tarawa Terrace, Camp Johnson, Rifle Range, Onslow Beach, and Courthouse Bay treatment plants. The permit for Camp Geiger is scheduled for renewal in 1993 and will include the phosphorus limit. The decision by the State to incorporate phosphorus limits is based on a study conducted in 1986 by the DEM Water Quality Section that concluded that there is strong evidence of severe enrichment problems in the New River and its tributaries near Jacksonville. The State continued to collect extensive water quality data as a follow-up to the 1986 study. Camp Lejeune participated in data collection by providing water samples and analysis for the New River. The collective data indicate numerous violations of the North Carolina water quality standards for pH, dissolved oxygen, dissolved gases, and chlorophyll-a in the upper portion of the basin. The study has recently been completed and supports the State's position that surface waters in the upper New River subbasin have reached their assimilative capacity.

The wastewater treatment plants at Hadnot Point, Tarawa Terrace, and Camp Johnson are currently exceeding the 2 mg/l phosphorus limit and probably will continue to do so until the plants are upgraded to advance treatment capability or an alternate treatment system such as land application is used. All seven plants are routinely failing to reduce toxicity levels in the effluent. Projects for installation of dechlorination equipment at each plant is under design and is scheduled for contract award in early FY 91. Estimated compliance date with toxicity standards is July 1991 after the dechlorination equipment is put into operation. The State is also mandating removal of the Onslow Beach outfall line since it discharges into the AIWW which is classified as SA. The outfall line for the Camp Geiger plant may have to be removed as well because of its location in Wilson Bay where the water quality is extremely poor due to discharges located upstream. At a meeting with the State held in April 1990, the Regional Supervisor stated that the Camp Geiger joint venture with the City of Jacksonville are not feasible. An acceptable alternative may be to pump the Camp Geiger effluent to a discharge point in the lower New River. The State has also stated that the discharge capacity at the Courthouse Bay plant will not be increased beyond the current 600,000 gallon per day limit due to surrounding waters being classified as SA. This

limitation may have a significant impact on development of the Courthouse Bay area. A wastewater master plan study is being pursued to determine the best alternatives for wastewater treatment basewide. The plan will include recommendations for treatment, cost estimates for alternatives, possible environmental impacts, and estimates of acceptability to the State. The study scope includes current and future treatment requirements with a detailed plan for the next ten years and a general plan for the following ten years. The master plan will be a multi-phase study, and the first phase is being negotiated for evaluation of current wastewater treatment plants and identification of the best three alternatives for facility improvements and environmental compliance. An initial report is anticipated in February 1991, and a final report is anticipated in August 1991. The first phase of the study will cost approximately $100,000. The entire master plan may cost up to $250,000 dependent upon the selected treatment alternative(s). The master plan will provide requirements for a FY 94 MCON project for wasterwater treatment plant improvements that may cost up to $25,000,000. The State has requested a compliance schedule for meeting new discharge limits, but a firm schedule cannot be provided until completion of the master plan study. The Base will be in violation of water quality standards for phosphorus limits in 1992 and currently is in violation of toxicity standards. These violations will continue until compliance is obtained by plant improvements or a Special Order by Consent (SOC) is negotiated. Since plant improvements will not be completed until 1996 or beyond, a SOC is beyond, a SOC is being discussed by FAC, EMD, and SJA. The State has recommended a SOC and is ready to begin negotiations. Negotiations may be difficult because the Base does not have a defined plan of action to meet all discharge requirements. Following is a list of significant actions that have influenced the current status of wastewater treatment and environmental compliance:

8 AUG 86 - DEM issues directive to remove Onslow Beach outfall from the AIWW because of classification of "SA" waters.

1 JAN 87 - DEM implements policy to reduce nutrient inputs to the New River based on results of additional sampling in 1986.

22 DEC 87 - DEM Compliance Inspection Report identifies toxicity of effluent due to high chlorine residuals.

3 FEB 88 - Base letter to NCDEHNR requesting moratorium on Notices of Violation for toxicity until corrective action can be determined and implemented. (No response)

13 APR 88 - Receipt of New River water quality guidance from City of Jacksonville.

14 APR 88 - Meeting between DEM, City of Jacksonville, Onslow County, and Base on New River water quality. DEM indicated stricter effluent limits will be incorporated in new permits and recommends regional concept for wastewater treatment.

AUG 88 - Engineering study completed for elimination of Onslow Beach outfall recommending pumping of sewage from Onslow Beach and Courthouse Bay to Hadnot Point plant for treatment. MCON project submitted in accordance with recommendations.

AUG 88 - Engineering study completed on upgrading Camp Johnson plant recommending pumping of sewage to Hadnot Point plant for treatment. MCON project submitted in accordance with recommendations.

JAN 89 - Engineering study completed for identification of toxicity reductions alternative at treatment plants. R-2 projects developed for construction of dechlorination chambers at treatment plants.

31 OCT 89 - Meeting between DEM and Base to discuss new effluent limitations for discharge into the New River.

7 DEC 89 - DEM provides notification of effluent toxicity self-monitoring requirements.

29 DEC 89 - Letter from DEM stating results of ongoing New River water quality study and anticipate effluent limits.

26 MAR 90 - Notification from DEM on 2 mg/l phosphorus limit.

24 APR 90 - Meeting between DEM and Base to discuss permitting requirements for renewal of NPDES permits, toxicity monitoring and Notices of Violation.

18 MAY 90 - Letter to DEM from Base stating compliance schedule for phosphorus limit is unavailable and is dependent upon wasterwater master plan study.

29 MAY 90 - Letter from DEM stating enforcement action will be taken if Base does not comply with phosphorus limit when permits are renewed in 1992 and recommended a SOC.

21 JUN 90 - DEM recommends the upper New River receive supplemental classification of Nutrient

Sensitive Waters (NSW) and quality standards for NSW be met based on Report No. 90-04, "New River, Onslow County: Nutrient Control Measures & Water Quality Characteristics for 1986 - 1989" dated June 1990.

31 JUL 90 - Meeting between A/E and Base to discuss scope of wastewater master plan. Fee negotiation is expected to be completed in August, 1990.

1 AUG 90 - Environmental Management Commission designates New River SC waters as HQW.

Table 1 in the appendix lists current effluent limitations for wastewater treatment plant NPDES permits. The phosphorus limit is the only new effluent characteristic parameter that the State has notified the Base about regarding permit renewals. This does not mean that the remaining limits will not change if an increase in discharge volume is requested. For planning and compliance purposes, the sooner the actual permit renewal is requested, the sooner the Base will know all effluent limitations.

Table 2 in the appendix lists wastewater treatment plant status. The plants are in good condition except for the Camp Geiger facility, which is under repair. The major problems foreseen with the plants are inability to meet the phosphorus limit at Hadnot Point, Tarawa Terrace and Camp Johnson, and increasing discharge volumes at Courthouse Bay, Tarawa Terrace, Camp Johnson and Camp Geiger due to development and modernization of facilities in the areas.

Failure to comply with NPDES permit limits may result in enforcement action by the State or the Environmental Protection Agency (EPA). Also, non-compliance status may result in civil actions by private citizens and public groups. The Staff Judge Advocate has investigated the civil and criminal consequences for non-compliance with NPDES permits, and the results are provided in the appendix. Some type of agreement with the State is anticipated to prevent violation of permits.

For long range compliance with wastewater treatment requirements, the following actions must occur: (1) the Base must enter into a negotiated agreement with the State or EPA or both, (2) a wastewater master plan must be completed, (3) a MCON project for upgrading or replacing existing treatments plants must be programmed and funded, and (4) a continuous dialogue with the State must be maintained. Execution of these actions will be very time consuming as well as expensive and will require commitment from all parties involved. Meeting the demands for surface water quality improvements, environmental protection, and providing adequate sewage collection and disposals systems will be one of the Base's major challenges in this decade.

APPENDIX

SEWAGE TREATMENT

TABLE 1

EFFLUENT LIMITATIONS OF CURRENT NPDES PERMITS

PLANT	FLOW (MGD)	BOD (MG/L)		TOTAL SUSP. RESIDUE (MG/L)		DISSOLVED OXYGEN (MG/L)		FECAL COLIFORM		OIL AND GREASE (MG/L)	
		MONTHLY AVG.	WEEKLY AVG.	MONTHLY AVG.	WEEKLY AVG.	MONTHLY AVG.	WEEKLY AVG.	MONTHLY AVG.	WEEKLY AVG.	MONTHLY AVG.	WEEKLY AVG.
HADNOT POINT	8.0	30.0	45.0	30.0	45.0	5.0	5.0	14.0/100ML	28.0/100ML	30.0	60.0
TARAWA TERRACE	1.25	30.0	45.0	30.0	45.0	5.0	5.0	1000/100ML	2000/100ML	30.0	60.0
CAMP JOHNSON	1.0	30.0	45.0	30.0	45.0	5.0	5.0	1000/100ML	2000/100ML	30.0	60.0
CAMP GEIGER	1.6	30.0	45.0	30.0	45.0	5.0	5.0	200/100ML	400/100ML	30.0	60.0
RIFLE RANGE	0.525	30.0	45.0	30.0	45.0	5.0	5.0	14.0/100ML	28.0/100ML	30.0	60.0
ONSLOW BEACH	0.195	30.0	45.0	30.0	45.0	5.0	5.0	14.0/100ML	28.0/100ML	30.0	60.0
COURTHOUSE BAY	0.600	30.0	45.0	30.0	45.0	5.0	5.0	14.0/100ML	28.0/100ML	30.0	60.0

SEWAGE TREATMENT

TABLE 2

SEWAGE TREATMENT PLANT STATUS

PLANT	CAPACITY (MGD)	MAX. LOAD (MG)	PERCENT CAPACITY	PLANT CONDITION	PERMIT RENEWAL	TOXICITY* COMPLIANCE	PHOSPHORUS COMPLIANCE	REMARKS
HADNOT POINT	8.0	7.4	93	GOOD	1992	NO	NO	EXPAND PLANT TO HANDLE 15 MGD INCLUDING TT, CJ, CHB & OB.
TARAWA TERRACE	1.3	1.3	101	GOOD	1992	NO	NO	
CAMP GIEGER	1.6	1.5	93	POOR	1993	NO	YES	REMOVE OUTFALL. PLANT UNDER REPAIR.
CAMP JOHNSON	1.0	0.7	74	GOOD	1992	NO	NO	COMPLIANCE PROBLEMS DUE TO HIGH BOD LEVELS IN INFLUENT.
COURTHOUSE BAY	0.6	0.8	139	GOOD	1992	NO	YES	MORATORIUM ON INCREASED DISCHARGES.
RIFLE RANGE	0.6	0.3	43	GOOD	1992	NO	YES	
ONSLOW BEACH	0.2	0.2	94	GOOD	1992	NO	YES	REMOVE OUTFALL.

* TOXICITY CONTROL EQUIPMENT TO BE INSTALLED IN FY 91.

- WASTEWATER MASTERPLAN BEING PURSUED TO DETERMINE THE BEST ALTERNATIVES FOR TREATMENT ($200,000).
- SPECIAL ORDER BY CONSENT RECEIVING INITIAL CONSIDERATION.
- CONSEQUENCES OF NOT INVESTING: NON-COMPLIANCE, NOTICES OF VIOLATION, ENFORCEMENT ACTION, DETRIMENTAL ENVIRONMENTAL IMPACT, CITIZEN SUITS.

APPENDIX TO WASTEWATER TREATMENT AT CAMP LEJEUNE

Subj: CIVIL AND CRIMINAL CONSEQUENCES FOR VIOLATION OF DISCHARGE PERMIT

1. The Clean Water Act provides various enforcement tools for the U.S. Environmental Protection Agency (EPA), the states, and citizens.

2. The EPA or state may institute criminal proceedings against any person who violates any permit condition or limitation. Under the federal Clean Water Act a negligent violation may be punished by a fine of not less than \$2500 or more than \$25,000 per day of violation and by imprisonment for up to 1 year. A person who knowingly violates a permit condition or limitation may be punished by a fine of not less than \$5000 or more than \$50,000 per day of violation and by imprisonment for up to 3 years.

3. Although these criminal penalties are available, it is more likely that civil enforcement would be used. The civil enforcement process usually starts with a notice of violation (NOV). The NOV places the federal facility on notice that a violation has occurred. An NOV is designed to lead to either a consent order or a consent agreement.

4. An order, as the term implies, is a unilateral directive issued to a violator. The EPA will negotiate with violators before issuing an order but give and take is extremely limited. EPA has authority to issue compliance orders under the Clean Water Act. However, as a matter of executive branch policy, the EPA will not issue orders to federal facilities under the Clean Water Act. Instead, the EPA will enter into a compliance agreement. Theoretically, the EPA and the federal facility are coequal parties. As a practical matter, however, the EPA is very inflexible and usually insists on essentially the same terms as appear in their consent orders with two major exceptions. These exceptions are that (1) the EPA will not seek civil monetary penalties against a federal facility under the Clean Water Act, and (2) the EPA will not judicially enforce a violation of the agreement. (Criminal enforcement against individuals, including federal employees remains available to the EPA.)

5. The State of North Carolina also has enforcement authority under provisions of the North Carolina General Statutes. The enforcement scheme is very similar to the federal scheme except for the use of different terms. The North Carolina Environmental Management Commission is empowered to issue unilateral orders to persons who cause or contribute to water pollution within the State. North Carolina calls these unilateral orders "special orders." The Commission may also enter into bilateral orders.

ENCLOSURE (1)

These are called "consent special orders" and allow more negotiation between the parties. The Commission may also accept voluntary assurances of compliance, an even lesser form of enforcement. Special orders and consent special orders are subject to public comment. This provision of North Carolina law is found at North Carolina General Statutes (NCGS) § 143-215.2.

6. Under North Carolina law, the effect of entering into a consent special order is that any person who later installs a treatment works in order to comply with the order is not required to take or refrain from any further action nor is required to achieve any further water pollution control results under the terms of State law for the period of the order. If a person does not comply with any term or conditions in the order then this protection is no longer available. In other words, a violation of the consent special order will take the polluter back to square one and subject them to normal civil sanctions.

7. I have examined a standard North Carolina consent special order and note that it contains a section stipulating deadlines and penalties for failing to comply with the deadlines. Thus, a violation of the consent special order will automatically lead to stipulated penalties without requiring the State to seek judicial enforcement. This is the advantage the State achieves in entering into such orders. I believe this will be a major sticking point in any negotiations with the State for a consent special order. In my opinion, a federal facility may not agree to penalties under the federal Clean Water Act. I interpret the waiver of federal facility immunity from state enforcement under the Clean Water Act as not authorizing penalties. Clean Water Act § 313. Section 313 specifically states that federal facilities are subject only to civil penalties arising under Federal law or imposed by a State or local court to enforce an order or the process of such a court. Penalties under a consent special order are not the processes of a court.

8. If the State is unwilling to enter into a consent special order absent penalties, they could initiate civil judicial enforcement under State law in North Carolina courts. Although North Carolina law provides for civil enforcement in state court, as a practical matter enforcement will be at the federal level since the Base would exercise its right to remove any enforcement action to federal court. Thus a state court should never be in the position of assessing penalties against Marine Corps Base.

9. Federal judicial enforcement under the Clean Water Act is quite broad and involves what is known as equitable enforcement. What this essentially means is that a federal court may enjoin Marine Corps Base from violating the terms of any permit. The court could also force a compliance order on the Base. In this case, any order would become a judicial order and would be

judicially enforced. A violation of the order or an injunction could result in contempt proceedings. Contempt can be punished by jail and fines.

10. The Clean Water Act also provides for citizen suits. Ordinarily citizens are not able to sue federal agencies absent a particular and personal injury to a person. However, the Clean Water Act specifically overcomes this general rule by allowing citizens to sue federal facilities. A citizen may sue for any violation of an effluent standard or limitation. In other words, any violation of a permit gives rise to a potential citizen suit. A citizen may not sue if the state or federal government is diligently prosecuting a civil or criminal action in a court to require compliance with a standard, limitation, or order. In a citizen suit, a court may exercise its equitable enforcement discussed in paragraph 9 and it may impose civil penalties.

11. In my opinion, the consent special order proposed by the State would not be a judicial enforcement. However, there is a strong argument that under North Carolina law the special order sets new effluent standards or limitations. Thus, compliance with the special order means compliance with effluent standards and limits, thus, preventing a citizen suit even if the original permit or state standard had been or would be violated. Conversely, however, violating the terms of the special order would immediately give rise to grounds for a citizen suit. This issue is unsettled. I am aware that an environmental group is in the process of preparing to sue MCCDC for Clean Water Act violations.

12. One other matter should be noted. The State consent special order would protect the Base from any other State water pollution control requirements during the term of the order. I note that the language used in the State law specifically refers to State imposed requirements. In my opinion this still would leave the Base subject to additional Federal requirements. In other words, the EPA or Congress could impose more stringent water pollution control standards during the period of the order and the Base would be subject to these standards notwithstanding the State consent special order.

C. H. Beale

C. H. BEALE
Staff Judge Advocate
Marine Corps Base
Camp Lejeune, NC

State of North Carolina
Department of Natural Resources and Community Development
Division of Environmental Management
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
S. Thomas Rhodes, Secretary

February 19, 1988

R. Paul Wilms
Director

Commanding General
U.S. Marine Corps Base
Camp Geiger Sewage Treatment Plant
Camp LeJeune, N.C. 28542

Subject: Modification to NPDES
Permit No. NC0062995
USMC - Camp Geiger STP
Onslow County

Dear Sir:

On February 18, 1988, the Division of Environmental Management issued NPDES Permit No. NC0062995 to US Marine Corps. A review of the Permit file has indicated that an error was inadvertently made in the Permit. Accordingly, we are forwarding herewith this modification to correct the Permit Number on the cover page of the Permit.

Please find enclosed an amended cover page which should be inserted into your Permit. The old cover page should be discarded. All other terms and conditions contained in the original Permit remain unchanged and in full effect. This Permit modification is issued pursuant to the requirements of North Carolina General Statutes 143-215.1 and the Memorandum of Agreement between North Carolina and the U.S. Environmental Protection Agency.

If any parts, measurements frequencies or sampling requirements contained in this permit are unacceptable to you, you may request a waiver or modification pursuant to Regulation 15 NCAC 2B .0508 (b) by written request to the Director identifying the specific issues to be contended. Unless such request is made within 30 days following receipt of this permit, this permit shall be final and binding. Should your request be denied, you will have the right to request an adjudicatory hearing.

Please take notice that this permit is not transferable. Part II, B.2 addresses the requirements to be followed in case of change in ownership or control of this discharge.

This permit does not affect the legal requirement to obtain other permits which may be required by the Division of Environmental Management or permits required by the Division of Land Resources, Coastal Area Management Act or any other Federal or Local governmental permit that may be required.

If you have any questions concerning this Permit modification, please contact . Dale Overcash (919) 733-5083.

Sincerely,

R. Paul Wilms
Director

cc: Mr. Jim Patrick, EPA
Wilmington Regional Office
Permit File

Permit No. NC0062995

STATE OF NORTH CAROLINA

DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT

DIVISION OF ENVIRONMENTAL MANAGEMENT

PERMIT

To Discharge Wastewater Under the

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

US Marine Corps

is hereby authorized to discharge wastewater from a facility located at

Camp LeJeune
Camp Geiger Sewage Treatment Plant
Onslow County

to receiving waters designated as the New River in the White Oak River Basin

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective March 1, 1988

This permit and the authorization to discharge shall expire at midnight on February 28, 1993

Signed this day February 18, 1988

for R. Paul Wilms, Director
Division of Environmental Management
By Authority of the Environmental Management Commission

A. (1). **EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS** Final (with diffuser)

During the period beginning after construction of a diffuser **and lasting until** expiration, **the permittee is authorized to discharge from outfall(s) serial number(s)** 001. **Such discharges shall be limited and monitored by the permittee as specified below:**

Effluent Characteristics	Discharge Limitations (1)				Monitoring Requirements		
	Kg/day (lbs/day)		Other Units (Specify)				
	Monthly Avg.	Weekly Avg.	Monthly Avg.	Weekly Avg.	Measurement Frequency	Sample Type	* Sample Location
Flow			1.6 MGD		Continuous	Recording	I or E
BOD, 5Day, 20°C			30.0 mg/l	45.0 mg/l	Daily	Composite	E
Total Suspended Residue			30.0 mg/l	45.0 mg/l	Daily	Composite	E
NH_3 as N					Daily	Composite	E
Dissolved Oxygen (minimum)			5.0 mg/l	5.0 mg/l	Daily	Grab	E,U,D
Fecal Coliform (geometric mean)			200.0/100 ml	400.0/100 ml	Daily	Grab	E,U,D
Residual Chlorine					Daily	Grab	E
Temperature					Daily	Grab	E,U,D
Total Nitrogen (NO_2 + NO_3 + TKN)					Monthly	Composite	E
Total Phosphorus					Monthly	Composite	E
Oil and Grease			30.0 mg/l	60.0 mg/l**	2/Month	Grab	E

*Sample locations: E - Effluent, I - Influent, U - Upstream, D - Downstream
**Daily Maximum Limitation
Upstream and downstream samples shall be grab samples.

Stream samples shall be collected three times per week during June, July, August and September and once per week during the remaining months of the year.

(1) These effluent limitations apply only to a discharge from a 50-foot diffuser pipe.

The pH shall not be less than 6.0 **standard units nor greater than** 8.5 **standard units and shall be monitored** daily at the effluent by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

F. Toxicity Repener

This permit shall be modified, or revoked and reissued to incorporate toxicity limitations and monitoring requirements in the event toxicity testing or other studies conducted on the effluent or receiving stream indicate that detrimental effects may be expected in the receiving stream as a result of this discharge.

State of North Carolina
Department of Natural Resources and Community Development
Division of Environmental Management
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
S. Thomas Rhodes, Secretary

R. Paul Wilms
Director

January 30, 1987
CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commanding General
Marine Corps Base
Office of AC/S Facilities
Camp Lejeune, NC 28542

Subject: Permit No. NC0063011
Camp Johnson STP
Onslow County

Dear Sir:

In accordance with your application for discharge permit received on November 9, 1984, we are forwarding herewith the subject State - NPDES permit. This permit is issued pursuant to the requirements of North Carolina General Statute 143-215.1 and the Memorandum of Agreement between North Carolina and the US Environmental Protection Agency dated December 6, 1983.

If any parts, measurement frequencies or sampling requirements contained in this permit are unacceptable to you, you may request a waiver or modification pursuant to Regulation 15 NCAC 2B .0508(b) by written request to the Director identifying the specific issues to be contended. Unless such request is made within 30 days following receipt of this permit, this permit shall be final and binding. Should your request be denied, you will have the right to request an adjudicatory hearing.

Please take notice that this permit is not transferable. Part II, B.2. addresses the requirements to be followed in case of change in ownership or control of this discharge.

This permit does not affect the legal requirement to obtain other permits which may be required by the Division of Environmental Management or permits required by the Division of Land Resources, Coastal Area Management Act or any other Federal or Local governmental permit that may be required.

If you have any questions concerning this permit, please contact Mr. Dale Overcash, at telephone number 919/733-5083.

Sincerely,

for Dennis R. Ramsey
R. Paul Wilms

: Mr. Jim Patrick, EPA
Wilmington Regional Supervisor

Permit No. NC0063011

STATE OF NORTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES & COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT

PERMIT

To Discharge Wastewater Under The

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

US Marine Corps Base

is hereby authorized to discharge wastewater from a facility located at

Camp LeJeune
Camp Johnson Sewage Treatment Plant
Onslow County

to receiving waters designated as the Northeast Creek in the White Oak River Basin

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III hereof.

This permit shall be effective February 1, 1987

This permit and the authorization to discharge shall expire at midnight on January 31, 1992

Signed this day of January 30, 1987

for Dennis R. Ramsey

R. Paul Wilms, Director
Division of Environmental Management
By Authority of the Environmental
Management Commission

SUPPLEMENT TO PERMIT COVER SHEET

US Marine Corps Base
Camp LeJeune

is hereby authorized to:

1. Continue to operate a 1.0 MGD trickling filter type wastewater treatment plant located at Camp Johnson Sewage Treatment Plant in Onslow County (See Part III, condition No. B. of this permit), and

2. Discharge from said treatment works into Northeast Creek which is classified Class "SC" waters in the White Oak River Basin.

A. (1). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS Final (with diffuser)

During the period beginning on the effective date of the Permit and lasting until expiration, the permittee is authorized to discharge from outfall(s) serial number(s) 001. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations				Monitoring Requirements		
	Kg/day (lbs/day)		Other Units (Specify)				
	Monthly Avg.	Weekly Avg.	Monthly Avg.	Weekly Avg.	Measurement Frequency	Sample Type	* Sample Locati
Flow			1.0 MGD		Continuous	Recording	I or E
BOD, 5Day, 20°C			30.0 mg/1	45.0 mg/1	2/Month	Composite	E
Total Suspended Residue			30.0 mg/1	45.0 mg/1	2/Month	Composite	E
NH_3 as N					2/Month	Composite	E
Dissolved Oxygen (minimum)			5.0 mg/1	5.0 mg/1	Weekly	Grab	E
Fecal Coliform (geometric mean)			1000.0/100 ml	2000.0/100 ml	2/Month	Grab	E
Residual Chlorine					Daily	Grab	E
Temperature					Weekly	Grab	E
Total Nitrogen (NO_2 + NO_3 + TKN)					Quarterly	Composite	E
Total Phosphorus					Quarterly	Composite	E
Oil and Grease			30.0 mg/1	60.0 mg/1 **	2/Month	Grab	E

*Sample locations: E - Effluent, I - Influent

**Daily Maximum Limit

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored 2/Month at the effluent by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

State of North Carolina
Department of Natural Resources and Community Development
Division of Environmental Management
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
S. Thomas Rhodes, Secretary

R. Paul Wilms
Director

January 30, 1987
CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commanding General
Marine Corps Base
Office of AC/S Facilities
Camp Lejeune, NC 28542

Subject: Permit No. NC0063002
Tarawa Terrace STP
Onslow County

Dear Sir:

In accordance with your application for discharge permit received on November 9, 1984, we are forwarding herewith the subject State - NPDES permit. This permit is issued pursuant to the requirements of North Carolina General Statute 143-215.1 and the Memorandum of Agreement between North Carolina and the US Environmental Protection Agency dated December 6, 1983.

If any parts, measurement frequencies or sampling requirements contained in this permit are unacceptable to you, you may request a waiver or modification pursuant to Regulation 15 NCAC 2B .0508(b) by written request to the Director identifying the specific issues to be contended. Unless such request is made within 30 days following receipt of this permit, this permit shall be final and binding. Should your request be denied, you will have the right to request an adjudicatory hearing.

Please take notice that this permit is not transferable. Part II, B.2. addresses the requirements to be followed in case of change in ownership or control of this discharge.

This permit does not affect the legal requirement to obtain other permits which may be required by the Division of Environmental Management or permits required by the Division of Land Resources, Coastal Area Management Act or any other Federal or Local governmental permit that may be required.

If you have any questions concerning this permit, please contact Mr. Dale Overcash, at telephone number 919/733-5083.

Sincerely,

for R. Paul Wilms

: Mr. Jim Patrick, EPA
Wilmington Regional Supervisor

Permit No. NC0063002

STATE OF NORTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES & COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT

P E R M I T

To Discharge Wastewater Under The

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

US Marine Corps Base

is hereby authorized to discharge wastewater from a facility located at

Camp LeJeune
Tarawa Terrace Sewage Treatment Plant
Onslow County

to receiving waters designated as Northeast Creek in the White Oak River Basin

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III hereof.

This permit shall be effective February 1, 1987

This permit and the authorization to discharge shall expire at midnight on January 31, 1992

Signed this day of January 30, 1987

for R. Paul Wilms, Director
Division of Environmental Management
By Authority of the Environmental
Management Commission

SUPPLEMENT TO PERMIT COVER SHEET

US Marine Corps Base
Camp LeJeune

is hereby authorized to:

1. Continue to operate a 1.25 MGD trickling filter type wastewater treatment plant located at Tarawa Terrace Sewage Treatment Plant in Onslow County (See Part III, condition No. B. of this permit), and

2. Discharge from said treatment works into Northeast Creek which is classified Class "SC" waters in the White Oak River Basin.

A. (1). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS Final

During the period beginning on the effective date of the Permit and lasting until expiration, the permittee is authorized to discharge from outfall(s) serial number(s) 001. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations				Monitoring Requirements		
	Kg/day (lbs/day)		Other Units (Specify)				
	Monthly Avg.	Weekly Avg.	Monthly Avg.	Weekly Avg.	Measurement Frequency	Sample Type	* Sample Locat
Flow			1.25 MGD		Continuous	Recording	I or E
BOD, 5Day, 20^oC			30.0 mg/l	45.0 mg/l	Daily	Composite	E
Total Suspended Residue			30.0 mg/l	45.0 mg/l	Daily	Composite	E
NH_3 as N					2/Month	Composite	E
Dissolved Oxygen (minimum)			5.0 mg/l	5.0 mg/l	Daily	Grab	E
Fecal Coliform (geometric mean)			1000.0/100 ml	2000.0/100 ml	Daily	Grab	E
Residual Chlorine					Daily	Grab	E
Temperature					Daily	Grab	E
Total Nitrogen (NO_2 + NO_3 + TKN)					Monthly	Composite	E
Total Phosphorus					Monthly	Composite	E
Oil and Grease			30.0 mg/l	60.0 mg/l **	2/Month	Grab	E

*Sample locations: E - Effluent, I - Influent

**Daily Maximum Limit

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored daily at the effluent by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

State of North Carolina
Department of Natural Resources and Community Development
Division of Environmental Management
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
S. Thomas Rhodes, Secretary

R. Paul Wilms
Director

January 30, 1987
CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commanding General
Marine Corps Base
Office of AC/S Facilities
Camp Lejeune, NC 28542

Subject: Permit No. NC0063029
Hadnot Point STP
Onslow County

Dear Sir:

In accordance with your application for discharge permit received on November 9, 1984, we are forwarding herewith the subject State - NPDES permit. This permit is issued pursuant to the requirements of North Carolina General Statute 143-215.1 and the Memorandum of Agreement between North Carolina and the US Environmental Protection Agency dated December 6, 1983.

If any parts, measurement frequencies or sampling requirements contained in this permit are unacceptable to you, you may request a waiver or modification pursuant to Regulation 15 NCAC 2B .0508(b) by written request to the Director identifying the specific issues to be contended. Unless such request is made within 30 days following receipt of this permit, this permit shall be final and binding. Should your request be denied, you will have the right to request an adjudicatory hearing.

Please take notice that this permit is not transferable. Part II, B.2. addresses the requirements to be followed in case of change in ownership or control of this discharge.

This permit does not affect the legal requirement to obtain other permits which may be required by the Division of Environmental Management or permits required by the Division of Land Resources, Coastal Area Management Act or any other Federal or Local governmental permit that may be required.

If you have any questions concerning this permit, please contact Mr. Dale Overcash, at telephone number 919/733-5083.

Sincerely,

R. Paul Wilms

cc: Mr. Jim Patrick, EPA
Wilmington Regional Supervisor

Permit No. NC0063029

STATE OF NORTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES & COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT

PERMIT

To Discharge Wastewater Under The

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

US Marine Corps

is hereby authorized to discharge wastewater from a facility located at

Camp LeJeune
Hadnot Point Sewage Treatment Plant
Onslow County

to receiving waters designated as the New River in the White Oak River Basin

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III hereof.

This permit shall be effective February 1, 1987

This permit and the authorization to discharge shall expire at midnight on January 31, 1992

Signed this day of January 30, 1987

R. Paul Wilms, Director
Division of Environmental Management
By Authority of the Environmental Management Commission

SUPPLEMENT TO PERMIT COVER SHEET

US Marine Corps Base
Camp LeJeune

is hereby authorized to:

1. Enter into a contract for construction of a wastewater treatment facility, and

2. Make an outlet into the New River, and

3. Continue to operate a 8.0 MGD trickling filter type wastewater treatment plant consisting of an influent grit channel and comminutors, primary clarifiers, dual trickling filters, anaerobic sludge digestors, dual secondary clarifiers, a chlorine contact chamber, sludge drying beds, and a flow measuring device located at Hadnot Point Sewage Treatment Plant in Onslow County (See Part III, Condition No. B. of this permit), and

4. Discharge from said treatment works into the New River which is classified Class "SC" waters in the White Oak River Basin.

H 3

A. (1). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS Final

During the period beginning on the effective date of the Permit and lasting until expiration, the permittee is authorized to discharge from outfall(s) serial number(s) 001. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations (1) Kg/day (lbs/day) Monthly Avg.	Weekly Avg.	Other Units (Specify) Monthly Avg.	Weekly Avg.	Monitoring Requirements Measurement Frequency	Sample Type	* Sample Location
Flow (1)			5.87 MGD		Continuous	Recording	I or E
BOD, 5Day, 20°C			30.0 mg/1	45.0 mg/1	Daily	Composite	E
Total Suspended Residue			30.0 mg/1	45.0 mg/1	Daily	Composite	E
NH_3 as N					Daily	Composite	E
Dissolved Oxygen (minimum)			5.0 mg/1	5.0 mg/1	Daily	Grab	E
Fecal Coliform (geometric mean)			14.0/100 ml	28.0/100 ml	Daily	Grab	E
Residual Chlorine					Daily	Grab	E
Temperature					Daily	Grab	E
Total Nitrogen (NO_2 + NO_3 + TKN)					Monthly	Composite	E
Total Phosphorus					Monthly	Composite	E
Oil and Grease			30.0 mg/1	60.0 mg/1 **	2/Month	Grab	E

*Sample locations: E - Effluent, I - Influent
**Daily Maximum Limitation

(1) These discharge effluent limitations apply only to flows of 5.87 MGD of less. For flows greater than 5.87 MGD, See Part I, A. (2) of this permit.

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored daily at the effluent by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

H 3

A. (2). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS Final (with diffuser) Winter: November 1 - March 31

During the period beginning on the effective date of the Permit **and lasting until** expiration, **the permittee is authorized to discharge from outfall(s) serial number(s)** 001. **Such discharges shall be limited and monitored by the permittee as specified below:**

Effluent Characteristics	Discharge Limitations[1]: Kg/day (lbs/day) Monthly Avg.	Kg/day (lbs/day) Weekly Avg.	Other Units (Specify) Monthly Avg.	Other Units (Specify) Weekly Avg.	Monitoring Requirements: Measurement Frequency	Sample Type	* Sample Locati
Flow [1]			8.0 MGD		Continuous	Recording	I or E
BOD, 5Day, 20°C			22.0 mg/l	33.0 mg/l	Daily	Composite	E
Total Suspended Residue			30.0 mg/l	45.0 mg/l	Daily	Composite	E
NH_3 as N			19.0 mg/l	28.5 mg/l	Daily	Composite	E
Dissolved Oxygen (minimum)			5.0 mg/l	5.0 mg/l	Daily	Grab	E
Fecal Coliform (geometric mean)			14.0/100 ml	28.0/100 ml	Daily	Grab	E
Residual Chlorine					Daily	Grab	E
Temperature					Daily	Grab	E
Total Nitrogen (NO_2 + NO_3 + TKN)					Monthly	Composite	E
Total Phosphorus					Monthly	Composite	E
Oil and Grease			30.0 mg/l	60.0 mg/l **	2/Month	Grab	E

*Sample locations: E - Effluent, I - Influent

**Daily Maximum Limit

1 These discharge limitations apply to flow rates greater than 5.87 MGD up to 8.0 MGD.

The pH shall not be less than 6.0 **standard units nor greater than** 8.5 **standard units and shall be monitored** daily at the effluent by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

A. (2). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS Final (with diffuser) Summer: April 1 - October 31

During the period beginning on the effective date of the Permit **and lasting until** expiration, **the permittee is authorized to discharge from outfall(s) serial number(s)** 001. **Such discharges shall be limited and monitored by the permittee as specified below:**

Effluent Characteristics	Discharge Limitations [1] Kg/day (lbs/day) Monthly Avg.	Kg/day (lbs/day) Weekly Avg.	Other Units (Specify) Monthly Avg.	Other Units (Specify) Weekly Avg.	Monitoring Requirements Measurement Frequency	Sample Type	* Sample Location
Flow [1]			8.0 MGD		Continuous	Recording	I or E
BOD, 5Day, $20^{o}C$			22.0 mg/l	33,0 mg/l	Daily	Composite	E
Total Suspended Residue			30.0 mg/l	45.0 mg/l	Daily	Composite	E
NH_3 as N			13.0 mg/l	19.5 mg/l	Daily	Composite	E
Dissolved Oxygen (minimum)			5.0 mg/l	5.0 mg/l	Daily	Grab	E
Fecal Coliform (geometric mean)			14.0/100 ml	28.0/100 ml	Daily	Grab	E
Residual Chlorine					Daily	Grab	E
Temperature					Daily	Grab	E
Total Nitrogen (NO_2 + NO_3 + TKN)					Monthly	Composite	E
Total Phosphorus					Monthly	Composite	E
Oil and Grease			30.0 mg/l	60.0 mg/l **	2/Month	Grab	E

*Sample locations: E - Effluent, I - Influent

**Daily Maximum Limit

1 These discharge limitations apply to flow rates greater than 5.87 MGD up to 8.0 MGD.

The pH shall not be less than 6.0 **standard units nor greater than** 8.5 **standard units and shall be monitored** daily at the effluent by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

State of North Carolina
Department of Natural Resources and Community Development
Division of Environmental Management
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
S. Thomas Rhodes, Secretary

January 30, 1987
CERTIFIED MAIL
RETURN RECEIPT REQUESTED

R. Paul Wilms
Director

Commanding General
Marine Corps Base
Office of AC/S Facilities
Camp Lejeune, NC 28542

Subject: Permit No. NC0063037
Rifle Range STP
Onslow County

Dear Sir:

In accordance with your application for discharge permit received on November 9, 1984, we are forwarding herewith the subject State - NPDES permit. This permit is issued pursuant to the requirements of North Carolina General Statute 143-215.1 and the Memorandum of Agreement between North Carolina and the US Environmental Protection Agency dated December 6, 1983.

If any parts, measurement frequencies or sampling requirements contained in this permit are unacceptable to you, you may request a waiver or modification pursuant to Regulation 15 NCAC 2B .0508(b) by written request to the Director identifying the specific issues to be contended. Unless such request is made within 30 days following receipt of this permit, this permit shall be final and binding. Should your request be denied, you will have the right to request an adjudicatory hearing.

Please take notice that this permit is not transferable. Part II, B.2. addresses the requirements to be followed in case of change in ownership or control of this discharge.

This permit does not affect the legal requirement to obtain other permits which may be required by the Division of Environmental Management or permits required by the Division of Land Resources, Coastal Area Management Act or any other Federal or Local governmental permit that may be required.

If you have any questions concerning this permit, please contact Mr. Dale Overcash, at telephone number 919/733-5083.

Sincerely,

Arthur Mouberry
R. Paul Wilms
for

cc: Mr. Jim Patrick, EPA
Wilmington Regional Supervisor

Permit No. NC0063037

STATE OF NORTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES & COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT

P E R M I T

To Discharge Wastewater Under The

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

US Marine Corps Base

is hereby authorized to discharge wastewater from a facility located at

Camp LeJeune
Rifle Range Sewage Treatment Plant
Onslow County

to receiving waters designated as the New River in the White Oak River Basin

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III hereof.

This permit shall be effective February 1, 1987

This permit and the authorization to discharge shall expire at midnight on January 31, 1992

Signed this day of January 30, 1987

for R. Paul Wilms, Director
Division of Environmental Management
By Authority of the Environmental
Management Commission

SUPPLEMENT TO PERMIT COVER SHEET

US Marine Corps Base
Camp LeJeune

is hereby authorized to:

1. Continue to operate a 0.525 MGD trickling filter type wastewater treatment plant located at Rifle Range Sewage Treatment Plant in Onslow County (See Part III, condition No. B. of this permit), and

2. Discharge from said treatment works into the New River which is classified Class "SC" waters in the White Oak River Basin.

A. (1). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS Final

During the period beginning on the effective date of the Permit and lasting until expiration, the permittee is authorized to discharge from outfall(s) serial number(s) 001. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations: Kg/day (lbs/day) Monthly Avg.	Kg/day (lbs/day) Weekly Avg.	Other Units (Specify) Monthly Avg.	Other Units (Specify) Weekly Avg.	Monitoring Requirements: Measurement Frequency	Sample Type	* Sample Location
Flow			0.525 MGD		Continuous	Recording	I or E
BOD, 5Day, 20^{o}C			30.0 mg/1	45.0 mg/1	2/Month	Composite	E
Total Suspended Residue			30.0 mg/1	45.0 mg/1	2/Month	Composite	E
NH_3 as N					2/Month	Composite	E
Dissolved Oxygen (minimum)			5.0 mg/1	5.0 mg/1	Weekly	Grab	E
Fecal Coliform (geometric mean)			14.0/100 ml	28.0/100 ml	2/Month	Grab	E
Residual Chlorine					Daily	Grab	E
Temperature					Weekly	Grab	E
Total Nitrogen (NO_2 + NO_3 + TKN)					Quarterly	Composite	E
Total Phosphorus					Quarterly	Composite	E
Oil and Grease			30.0 mg/1	60.0 mg/1**	2/Month	Grab	E

*Sample locations: E - Effluent, I - Influent

**Daily Maximum Limit

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored 2/Month at the effluent by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

State of North Carolina
Department of Natural Resources and Community Development
Division of Environmental Management
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
S. Thomas Rhodes, Secretary

R. Paul Wilms
Director

January 30, 1987
CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commanding General
Marine Corps Base
Office of AC/S Facilities
Camp Lejeune, NC 28542

Subject: Permit No. NC0063045
Courthouse Bay STP
Onslow County

Dear Sir:

In accordance with your application for discharge permit received on November 9, 1984, we are forwarding herewith the subject State - NPDES permit. This permit is issued pursuant to the requirements of North Carolina General Statute 143-215.1 and the Memorandum of Agreement between North Carolina and the US Environmental Protection Agency dated December 6, 1983.

If any parts, measurement frequencies or sampling requirements contained in this permit are unacceptable to you, you may request a waiver or modification pursuant to Regulation 15 NCAC 2B .0508(b) by written request to the Director identifying the specific issues to be contended. Unless such request is made within 30 days following receipt of this permit, this permit shall be final and binding. Should your request be denied, you will have the right to request an adjudicatory hearing.

Please take notice that this permit is not transferable. Part II, B.2. addresses the requirements to be followed in case of change in ownership or control of this discharge.

This permit does not affect the legal requirement to obtain other permits which may be required by the Division of Environmental Management or permits required by the Division of Land Resources, Coastal Area Management Act or any other Federal or Local governmental permit that may be required.

If you have any questions concerning this permit, please contact Mr. Dale Overcash, at telephone number 919/733-5083.

Sincerely,

R. Paul Wilms

cc: Mr. Jim Patrick, EPA
Wilmington Regional Supervisor

Permit No. NC0063045

STATE OF NORTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES & COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT

PERMIT

To Discharge Wastewater Under The

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

US Marine Corps Base

is hereby authorized to discharge wastewater from a facility located at

Camp LeJeune
Courthouse Bay Sewage Treatment Plant
Onslow County

to receiving waters designated as the New River in the White Oak River Basin

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III hereof.

This permit shall be effective February 1, 1987

This permit and the authorization to discharge shall expire at midnight on January 31, 1992

Signed this day of January 30, 1987

for R. Paul Wilms, Director
Division of Environmental Management
By Authority of the Environmental Management Commission

SUPPLEMENT TO PERMIT COVER SHEET

US Marine Corps Base
Camp LeJeune

is hereby authorized to:

1. Continue to operate a 0.6 MGD trickling filter type wastewater treatment plant located at Courthouse Sewage Treatment Plant in Onslow County (See Part III, condition No. B. of this permit), and

2. Discharge from said treatment works into the New River which is classified Class "SC" waters in the White Oak River Basin.

M 3

A. (1). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS Final

During the period beginning on the effective date of the Permit and lasting until expiration, the permittee is authorized to discharge from outfall(s) serial number(s) 001. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations				Monitoring Requirements		
	Kg/day (lbs/day)		Other Units (Specify)		Measurement Frequency	Sample Type	* Sample Location
	Monthly Avg.	Weekly Avg.	Monthly Avg.	Weekly Avg.			
Flow			0.600 MGD		Continuous	Recording	I or E
BOD, 5Day, 20°C			30.0 mg/l	45.0 mg/l	2/Month	Composite	E
Total Suspended Residue			30.0 mg/l	45.0 mg/l	2/Month	Composite	E
NH_3 as N					2/Month	Composite	E
Dissolved Oxygen (minimum)			5.0 mg/l	5.0 mg/l	Weekly	Grab	E
Fecal Coliform (geometric mean)			14.0/100 ml	28.0/100 ml	2/Month	Grab	E
Residual Chlorine					Daily	Grab	E
Temperature					Weekly	Grab	E
Total Nitrogen (NO_2 + NO_3 + TKN)					Quarterly	Composite	E
Total Phosphorus					Quarterly	Composite	E
Oil and Grease			30.0 mg/l	60.0 mg/l**	2/Month	Grab	E

*Sample locations: E - Effluent, I - Influent

**Daily Maximum Limits

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored 2/Month at the effluent by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

A 2/9/87

(1)

State of North Carolina
Department of Natural Resources and Community Development
Division of Environmental Management
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
S. Thomas Rhodes, Secretary

R. Paul Wilms
Director

January 30, 1987
CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commanding General
Marine Corps Base
Office of AC/S Facilities
Camp Lejeune, NC 28542

Subject: Permit No. NC0063053
Onslow Beach STP
Onslow County

Dear Sir:

In accordance with your application for discharge permit received on November 9, 1984, we are forwarding herewith the subject State - NPDES permit. This permit is issued pursuant to the requirements of North Carolina General Statute 143-215.1 and the Memorandum of Agreement between North Carolina and the US Environmental Protection Agency dated December 6, 1983.

If any parts, measurement frequencies or sampling requirements contained in this permit are unacceptable to you, you may request a waiver or modification pursuant to Regulation 15 NCAC 2B .0508(b) by written request to the Director identifying the specific issues to be contended. Unless such request is made within 30 days following receipt of this permit, this permit shall be final and binding. Should your request be denied, you will have the right to request an adjudicatory hearing.

Please take notice that this permit is not transferable. Part II, B.2. addresses the requirements to be followed in case of change in ownership or control of this discharge.

This permit does not affect the legal requirement to obtain other permits which may be required by the Division of Environmental Management or permits required by the Division of Land Resources, Coastal Area Management Act or any other Federal or Local governmental permit that may be required.

If you have any questions concerning this permit, please contact Mr. Dale Overcash, at telephone number 919/733-5083.

Sincerely,

Dennis R Ramsey
for R. Paul Wilms

cc: Mr. Jim Patrick, EPA
Wilmington Regional Supervisor

Pollution Prevention Pays

P.O. Box 27687, Raleigh, North Carolina 27611-7687 Telephone 919-733-7015

An Equal Opportunity Affirmative Action Employer

Permit No. NC0063053

(2)

STATE OF NORTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES & COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT

PERMIT

To Discharge Wastewater Under The

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

US Marine Corps Base

is hereby authorized to discharge wastewater from a facility located at

Camp Lejeune
Onslow Beach Sewage Treatment Plant
Onslow County

to receiving waters designated as the Intracoastal Waterway in the White Oak River Basin

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III hereof.

This permit shall be effective February 1, 1987

This permit and the authorization to discharge shall expire at midnight on January 31, 1992

Signed this day of January 30, 1987

for Dennis R. Ramsey
R. Paul Wilms, Director
Division of Environmental Management
By Authority of the Environmental
Management Commission

(7)

SUPPLEMENT TO PERMIT COVER SHEET

US Marine Corps Base
Camp LeJeune

is hereby authorized to:

1. Continue to operate a 0.195 MGD trickling filter type wastewater treatment plant located at Onslow Beach Sewage Treatment Plant in Onslow County (See Part III, condition No. B. of this permit), and

2. Discharge from said treatment works into Intracoastal Waterway which is classified Class "SA" waters in the White Oak River Basin.

A. (1). EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS Final

During the period beginning on the effective date of the Permit and lasting until expiration, the permittee is authorized to discharge from outfall(s) serial number(s) 001. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations				Monitoring Requirements		
	Kg/day (lbs/day)		Other Units (Specify)				
	Monthly Avg.	Weekly Avg.	Monthly Avg.	Weekly Avg.	Measurement Frequency	Sample Type	* Sample Location
Flow			0.195 MGD		Continuous	Recording	I or E
BOD, 5Day, $20^{o}C$			30.0 mg/l	45.0 mg/l	2/Month	Composite	E
Total Suspended Residue			30.0 mg/l	45.0 mg/l	2/Month	Composite	E
NH_3 as N					2/Month	Composite	E
Dissolved Oxygen (minimum)			5.0 mg/l	5.0 mg/l	Weekly	Grab	E
Fecal Coliform (geometric mean)			14.0/100 ml	28.0/100 ml	2/Month	Grab	E
Residual Chlorine					Daily	Grab	E
Temperature					Weekly	Grab	E
Total Nitrogen (NO_2 + NO_3 + TKN)					Quarterly	Composite	E
Total Phosphorus					Quarterly	Composite	E
Oil and Grease			30.0 mg/l	60.0 mg/l **	2/Month	Grab	E

*Sample locations: E - Effluent, I - Influent

**Daily Maximum Limit

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored 2/Month at the effluent by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

(4)

F. Toxicity Reopener

This permit shall be modified, or revoked and reissued to incorporate toxicity limitations and monitoring requirements in the event toxicity testing or other studies conducted on the effluent or receiving stream indicate that detrimental effects may be expected in the receiving stream as a result of this discharge.

G. The issuance of the permit does not relieve the US Marine Corps Base from complying with the requirements of Title 15, North Carolina Adminstrative Code, Subchapter 2H .0400. The US Marine Corps Base shall continue to evaluate alternatives to discharging to Class "SA" waters and shall submit an acceptable plan that complies with the subject regulations by July 31, 1987.

OPTIONS FOR THE ELIMINATION
OF THE ONSLOW BEACH
SEWAGE TREATMENT PLANT OUTFALL

MARINE CORPS BASE

CAMP LEJEUNE, NORTH CAROLINA

PREPARED BY
HOBBS, UPCHURCH & ASSOCIATES, P.A.
290 S. W. BROAD STREET
SOUTHERN PINES, NORTH CAROLINA
AUGUST 1988

INTRODUCTION

This study will analyze various options that have been proposed by the Government to eliminate the application of effluent from the Onslow Beach Sewage Treatment Plan to the Intracoastal Waterway by direct outfall. The various options will be discussed, each option will be analyzed to ascertain its present worth and a recommendation will be made.

OPTION DISCUSSIONS

Option #1 - Pump Treated Sewage to Courthouse Bay Outfall

This option would continue to utilize the Onslow Beach STP and pump the treated effluent to Courthouse Bay where it would be added to the Courthouse Bay STP effluent and would outfall into the New River.

A 350 GPM duplex pump station would be installed at the beach. The effluent would be pumped under the Intracoastal Waterway into an eight inch PVC force main along existing road right-of-ways to Courthouse Bay. The force main would be approximately seven miles long.

This conveyance system would easily handle the maximum design output of the Onslow STP. The projected maximum population of Onslow Beach matches this plant design size.

It is foreseeable that the trend in regulations could possibly create a problem at Courthouse Bay over discharging into the river at this point. If such a condition did develop, the Onslow Beach effluent would require conveyance to another site (probably Hadnot Point STP) for disposal. This effluent could be handled with the Courthouse Bay effluent although it would require unnecessary double pumping.

From an operational standpoint, this option would require only the additional maintenance of a pump station. No additional procedures, testing or record keeping would be necessary. This small added maintenance burden could probably be absorbed by existing personnel without too much upheaval.

The discharge permit for Courthouse Bay might require modification

for the additional effluent. This should pose no problem and should be allowable.

The proposed route of the sewer main follows existing highway right-of-ways. This should minimize any line construction problems.

Option #2 - Pump Treated Sewage to Hadnot Point

As in Option #1, this plan would continue to utilize the present Onslow Beach STP to treat present and future projected flows. A 350 GPM duplex pump station would be installed at Onslow Beach to convey effluent via an eight inch PVC force main under the Intracoastal Waterway and along major road right-of-ways to the Hadnot Point STP. This flow would be consolidated with the Hadnot Point treated effluent and discharged into the present river outfall.

The location of the Hadnot Point outfall, being much further inland than the Courthouse Bay outfall, would cause less environmental impact on the shellfish waters nearer the river inlet. This would appear to be a better long term solution than Option #1. In the event that all base sewage treatment was consolidated at a point further inland at a future date, the Onslow Beach untreated effluent could be pumped in the same conveyance system and rerouted into the head of the Hadnot Point STP for treatment.

It is foreseeable that tertiary treatment might become a requirement for river discharge at a future date. Should this requirement be implemented, the tertiary treatment of the consolidated Hadnot Point and Onslow Beach flows could be handled at the same location.

The maintenance and operational considerations would be the same as for Option #1.

Also, as in Option #1, the Hadnot Point discharge permit might require modification for the quantity allowed. The proposed route of the sewer main is along existing highways and should minimize any problems associated with line construction.

Option #3 - Pump Untreated Sewage to the Hadnot Point STP

It is desirable to consolidate untreated effluents into large scale treatment facilities to reduce the manpower required to operate and maintain separate smaller facilities.

The Hadnot Point STP has a design capacity of 8,000,000 GPD and is presently treating between five and six million GPD. The projected maximum flow from Onslow Beach which is presently limited by the size of the Onslow Beach STP is 192,000 GPD. This flow could be easily absorbed by the Hadnot Point STP.

In the event that development of Onslow Beach would require larger sewage treatment facilities, the Hadnot Point STP could handle any foreseeable flow. The more likely scenario is a short term reduction of the Onslow Beach effluent flow due to relocation of the reconnaissance personnel to Courthouse Bay. The continued operation of the Onslow Beach STP will require similar manpower expenditure even if flows fall to a fraction of the present flow.

This option solves the problems created by uncertainty in projected flows. The pump station installed would handle any foreseeable

flows. The force main could handle even greater flows by installing larger pumps. The station and force main would be identical to that needed in Option #2.

Manpower requirements would be reduced by the elimination of the Onslow Beach STP but would be somewhat offset by pump station maintenance. No additional manpower problems should result at Hadnot Point from this increased effluent.

The proposed route of the force main is the same as for Option #2.

Option #4 - Land Application of Effluent by Irrigation

Land application of the effluent from the Onslow Beach STP by means of irrigation is a problematic though viable alternative. This would be accomplished by building a pump station at the Onslow Beach STP to pump the effluent via a force main to the irrigation site.

At the site the effluent would be stored in a lagoon sized to hold a thirty day output of the STP. Another pump station would be installed to supply the stored wastewater to the irrigation system. Wastewater would be applied through a system of valves to one of several application areas using permanently installed PVC piping and rotary head sprinklers. Flowmeters would be needed to monitor amounts of wastewater applied. Records substantiating application rates, times and areas of application would be maintained.

To avoid build-up of constituents filtered by the soil, a crop management program would be necessary A regular program of harvesting the crop would extract the applied substances from the soil. Biannual testing

of the soil would monitor the levels of critical constituents and the effectiveness of the crop program. It would be necessary to apply other nutrients to promote growth of the crops and take up of undesirable soil constituents.

Based on the application rate of one inch of effluent per unit area per week, a buffer zone of 200 feet around the perimeter of the spray area and a holding lagoon site it would require an estimated seventy acres of dedicated land. Factors which must be taken into account in chosing suitable land include permeability factors, type of soil and depth to water table, the ability of the soil to trap contaminants and the ability of the soil to support a crop capable of removing the contaminants from the soil. Those requirements severely limit the choice of a suitable site. Appendix A shows several possible sites.

Any site would require testing to confirm the suitability for this use, however, these preliminary choices have been screened to increase their probability of acceptance. Any site chosen would be hereafter precluded from military use.

Even if seventy acres of suitable land could be found on the island with the STP, it would likely be an undesirable location. The necessary lagoon and spray areas would create a barrier that military personnel or equipment could not cross. It would not be practical to spray this effluent adjacent to a recreational area. The most desirable soils on the island are deposited dredge spills. Irrigation fields might interfere with future dredging operations and could

present problems with the Corps of Engineers.

For these reasons, our proposed irrigation sites are on the mainland. Either choice would necessitate the crossing of the Intracoastal Waterway by the force main from the new STP pump station with its added cost.

Maintenance and management of the irrigation system, pump stations and application program would require additional labor although it should not require a full time operator. The load application program would require a licensed operator to oversee the application and maintain records. Further coordination of harvesting contractors and environmental testing would be needed.

Environmental concerns for such a system are varied and include soil contamination, groundwater contamination and surface run-off to surface water systems. As mentioned previously, a biannual soil testing program would be required to monitor the levels of applied wastewater constituents in the soil. This list of constituents is fairly lengthy and analytical costs should be considered as operating expense. Similarly, groundwater testing should be considered. Monitoring wells would be necessary to guard against lagoon leakage as well as infiltration of groundwater by undesirable irrigation water constituents. An estimated three monitoring wells would be needed for groundwater flow determination and for periodic sampling. Biannual sampling with necessary analytical work should be sufficient unless problems would arise.

The possibility of surface runoff into surface water systems must be addressed in site selection and system design. Ditches or berms might be necessary to prevent runoff if required by the chosen site.

Accessibility to the chosen application site should be of some concern. This factor has been taken into account in proposed site selection, however, the situation is less than ideal. It would likely be necessary to run the force main along some unpaved roads or trails to reach the application site.

In the event that this option should be chosen, it would be necessary to obtain a land application permit from the State and maintain it.

Option 5 - Subsurface Injection of Effluent

Subsurface injection is a land application alternative that would require much less dedicated land than needed for spray irrigation. In such a system the treated wastewater is pumped into absorption fields similar to septic system nitrification fields under low pressure. Perforated pipe evenly distributes the water into gravel troughs where it is percolated into the surrounding soil. A typical loading rate is one gallon of wastewater/sq. ft./day. In this case with buffer zones, approximately eight acres would be required. No vehicular traffic would be allowed on the site and human traffic would be discouraged. It would be advisable to dedicate such a site to this purpose.

One drawback of this system is the necessity of additional treatment of the wastewater prior to application. The addition of tertiary

treatment facilities at the Onslow Beach STP would be necessary. This would be a cost factor as well as an additional maintenance burden.

After treatment, the effluent would be collected at a pump station and pumped via a force main to a holding lagoon at the application site. The lagoon would be sized for a two to four week effluent supply. Application would be accomplished using a low pressure, high flow pump. The flow would likely be pumped to one of two or more equally sized distribution networks. Pumping to each network would be regulated to achieve the proper hydraulic loading rate. Records would be kept to substantiate application rates.

As with spray irrigation, several factors must be considered in selecting a site. The primary concerns are permeability, type of soil and depth to the water table. The requirement for depth to the water table makes any site on the island marginal if not impossible. The alternative is to cross the Intracoastal Waterway with a force main to the mainland.

Possible sites for the location of the application area are shown in Appendix B. These areas have been prescreened for soil type and water table depth although soil testing would be required to verify a site for this use. Obviously, it would be desirable to locate the site as near the present STP as possible.

Should this option be chosen, maintenance requirements would increase due to added treatment at the Onslow Beach STP, the addition of a lagoon and two pump stations and the management of the distribution system. Tertiary treatment at Onslow Beach would require a full time, one

shift operator to be stationed at the plant. This solution would, however, handle projected population growth for a few years if not indefinitely. Before upgrading the Onslow STP, thought should be given to the condition and life expectancy of the plant and equipment.

The chosen site might present some problems of access for the force main. These should be considered in light of special knowledge of the areas in question.

The land application of the effluent would require a permit by the State. The conditions of the permit would be continually in force throughout the project life.

Option #6 - Ocean Outfall

There is presently no ocean outfall in North Carolina. The N.C. Department of Environmental Management warns that the first such outfall permit application will undergo abnormally intense scrutiny. It is our feeling that it would also be subject to monitoring by the State that might be burdensome. One criteria for such an outfall would be that effluent would not be allowed to be carried to the shore by waves or currents. Ocean currents are not presently quantifed. We feel that ocean current data would be necessary in order to be granted a permit. Estimated cost of a study to gather the needed information would run in excess of $100,000.00. Studies that have been made on sediment migration indicate that material on the ocean floor moves inland from far out into the ocean. The assumption is that water-borne or settled matter from an outfall would also migrate shoreward. This phenomenon occurs outward from

Onslow Beach for many miles indicating that an outfall line would need to be many miles long making it economically unfeasible. In addition to these concerns, we must consider potential negative impact on marine life. New studies are being conducted to determine the effects of certain previously ignored constituents of treated sewage on marine life. Even if a permit could be obtained using the present criteria, the trend of ever tightening effluent requirements might result in future prohibition of ocean discharge.

Finally, the outfall would require that the present treatment plant remain in operation. In light of possible reduced flows, it might be wiser to phase out the plant for maintenance and operating cost reasons.

CROSSING OF THE INTRACOASTAL WATERWAY

Authority for the approval of the construction of utility lines under the Intracoastal Waterway is vested in the Corps of Engineers.

It is possible to approve construction under a general permit by following the guidelines set forth in the permit. These guidelines cover such aspects of construction as depth of burial and the handling of spoil material created by dredging. Also addressed is the environmental impact of the construction on marine life as well as public water supplies.

Should conflict arise between desired methods of construction and the permit conditions, a special permit would be required from the Corps of Engineers.

In any event, design should take into account the ramifications of obtaining a permit from the Corps.

In order to reduce the vulnerability to pipe failure of any treatment scheme utilizing a waterway crossing, it would be desireable to install two parallel lines with isolation valves. In the event of failure of one line, the other could be utilized.

The actual pipe installed would likely be ductile iron river crossing pipe or plastic pipe. The estimated cost of installing these pipelines is $150,000.00,

CONSTRUCTION, OPERATION AND MAINTENANCE COSTS

Option #1 - Pump Treated Sewage to Courthouse Bay Outfall

A. Construction

1.	Duplex Pump Station	$ 40,000
2.	Intracoastal Waterway Crossing	150,000
3.	Force Main - Class 160 8" PVC 36,960 LF @ $7.50/LF	277,200
4.	Tie in at Courthouse Bay	5,000
5.	Creek Crossing 2 EA @ $5,000.00/EA	10,000
6.	Asphalt Replacement 150 SY @ $15.00/SY	2,250
7.	Steel Casing by Boring 120 LF @ $55.00/LF	6,600
8.	Reseeding (Included in Pipe Price)	______
	Sub-Total	$491,050
	Adjustment for payroll taxes, insurance, bond, sales tax, overhead and profit @ 50%	245,525
	Sub-Total	$736,575
	Minus 7% location factor	-51,560
	TOTAL EST. CONSTRUCTION COST	$685,015

B. Operation

Assume 85% motor efficiency

$$\frac{19.87 \text{ pump HP}}{.85} \times 9.6 \text{ Hr./Day} \times 365 \text{ Day/Yr}$$

$\times$ 20 Years $\times$ 1.34 Kw/HP $\times$ \$.047/KwHR = \$103,424

C. Maintenance

2 Manhours/Week x $15.50/Manhour x 52 Week/Year x

20 Years =	$ 32,240
Repaint lift station equipment every 5 years @	
40 manhours x 4 occurrences x $15.50/Manhour =	$ 2,320

<u>Option #2 - Pump Treated Sewage to Hadnot Point</u>

A. Construction

1. Duplex Pump Station	$ 40,000
2. Intracoastal Waterway Crossing	150,000
3. Force Main - Class 160 8" PVC 48,048 LF @ $7.50/LF	360,360
4. Tie in at Courthouse Bay	5,000
5. Creek Crossing 4 EA @ $5,000.00/EA	20,000
6. Asphalt Replacement 56 SY @ $15.00/SY	840
7. Steel Casing by Boring 120 LF @ $55.00/LF	6,600
8. Reseeding (Included in Pipe Price)	
Sub-Total	$582,800
Adjustment for payroll taxes, insurance, bond, sales tax, overhead and profit @ 50%	291,400
Sub-Total	$874,200
Minus 7% location factor	-61,194
TOTAL EST. CONSTRUCTION COST	$813,006

B. Operation

Assume 85% motor efficiency

$\frac{23.7 \text{ pump HP}}{.85}$ x 9.6 Hr./Day x 365 Day/Yr

x 20 Years x 1.34 Kw/HP x $.047/KwHR = $123,187

C. Maintenance

2 Manhours/Week x $15.50/Manhour x 52 Week/Year x

20 Years = $ 32,240

Repaint lift station equipment every 5 years @

40 manhours x 4 occurrences x $15.50/Manhour = $ 2,320

Option #3

A. Construction Costs Same as Option #2 - $813,006

B. Operation Costs - Same as Option #2 - 123,187

Reduced Manpower caused by Plant Shutdown

2 Manhours/Day x 365 Day/Year x 20 Years x

$15.50/Manhour = -226,300

C. Maintenance Cost - Same as Option #2 - 34,560

Option #4 - Land Application of Effluent by Irrigation

A. Construction Costs

1. Sprinklers
   120 EA @ $30.00/EA $ 3,600

2. Set Sprinklers and Post (Post Included)
   120 EA @ $35.00/EA 4,200

3. Piping

   12" PVC Force Main
   4200 LF @ $13.50/LF 56,700

	5" PVC Force Main 12000 LF @ $4.00/LF	48,000
4.	Fittings	
	12x5 Cross - 20 EA @ 475 Lb. 12x12 Cross - 1 EA @ 615 Lb. 12x12 Tee - 1 EA @ 450 Lb.	
	10,565 Lbs. @ $1.50/LB	15,858
5.	12" Gate Valve w/Extensions	
	4 EA @ $900.00/EA	3,600
6.	Duplex Pump Station at Onslow Beach	40,000
7.	Duplex Pump Station at Spray Site	45,000
8.	Lagoon	97,000
9.	PVC Force Main to Spray Site	
	6" PVC Class 160 - 8000 Ft. @ $4.60/FT	36,800
10.	Strainers or Filters	2,000
11.	Intracoastal Waterway Crossing	150,000
12.	Seeding or Planting	
	67 AC x $500.00/AC	33,500
13.	Flow Measurement Recorder	7,000
14.	Monitor Wells	10,000
15.	Site Testing	1,000
16.	Clearing (Depending on site choice)	70,000
	Sub-Total	$624,248
	Adjustment for payroll tax, insurance, bond, sales tax, overhead and profit @ 50%	312,124
	Sub-Total	936,372

Minus 7% Location Factor - 65,546

TOTAL EST. CONSTRUCTION COST $870,826

B. Operation

Pump Station at Onslow Beach

Assume 80% motor efficiency

$\frac{11.8 \text{ pump HP}}{.80}$ = 14.75 HP x 9.6 Hr./Day x

365 Day/Yr x 20 Years x 1.34 Kw/HP x $.047/KwHR = $ 65,101

Pump Station at Spray Area

Assume 85% motor efficiency

$\frac{33.25 \text{ pump HP}}{.85}$ = 39.1 HP x 19 Hr./Week x

52 Week/Yr x 20 Years x 1.34 Kw/HP x $.047/KwHR = 48,659

Personnel to Operate

Additional 20 Manhours/Week x 52 Week/Hear x 20 Years

x $15.50/Manhour = 322,400

Annual Groundwater and Soil Testing
$3000 x 20 Years 60,000

C. Maintenance

Two Pump Stations @

4 Manhours/Week x $15.50/Manhour x 52 Week/Year x

20 Years = $ 64,480

Repaint lift station equipment every 5 years @

80 manhours x 4 occurrences x $15.50/Manhour = $ 4,960

Additional Cost Considerations:

1. It might be necessary to build a structure for an operator or expand the pump station for this purpose.

2. Power must be run to the site.

3. The land value must be taken into account.

4. The land must be fertilized depending on crop required.

5. The harvesting of the cover crop must be managed.

6. Uncertainty of suitability of desired site for irrigation and cost of conveyance to site will affect overall cost.

Option #5 - Subsurface Injection of Effluent

A. Construction Costs

1.	Tertiary Treatment Plant Expansion	$200,000
2.	Duplex Pump Station at Onslow Beach	40,000
3.	6" Force Main to Lagoon (Worst Case) 3900 LF @ $4.60/LF	17,940
4.	Duplex Station at Injection Site	40,000
5.	Injection Piping - 12" PVC 1918 LF @ $12.90/LF	24,742
6.	1-1/2" PVC Perforated Pipe for Laterals 40,000 LF @ $1.50/LF	60,000
7.	Lateral Fittings 360 EA @ $15.00/EA	5,400
8.	Trench Excavation 40,000 LF @ $1.00/LF	40,000
9.	Strainers	2,000
10.	Backfill with Gravel 3120 TN @ $15.00/TN	46,800
11.	Fittings - 12" Ells 4 EA @ 295 Lb.	

1180 Lb. x $1.50/LB	1,770
12. Valves - 12" 4 EA @ $900.00/EA	3,600
13. Lagoon	75,000
14. Soil Sampling for Site Determination	2,000
15. Clearing & Grubbing (if necessary)	8,000
Sub-Total	647,652
Adjustment for payroll taxes, insurance, bond, sales tax, overhead and profit @ 50%	323,826
Sub-Total	971,478
Minus 7% Location Factor	-68,003
Total Estimated Construction Costs	903,475
With Adjusted Cost of Waterway Crossing	209,250
New Total Estimated Const. Cost	$1,112,725

B. Operation

1. Cost of Tertiary Treatment

Additional 20 Manhours/Week x 52 Week/Year x	
20 Years x $15.50 =	$322,400
Estimated Power Cost - $500.00/HR x 20 YRS =	10,000

2. Pumping Costs

a. Onslow Beach Pump Station Assume 80% Motor Efficiency

$\frac{7.1 \text{ pump HP}}{.80}$ x 9.6 Hr./Day x 365 Day/Yr

x 20 Years x 1.34 Kw/HP x $.047/KwHR = 39,171

b. Injection Pump Station - Assume 80% Motor Efficiency

$\frac{4 \text{ Pump HP}}{.80}$ x .33 HR/DAY x 365 DAY/YR

x 20 YRS x 1.34 KW/HP x $.047 = 765

3. Operation of Injection System

1 Manhour/Day x 365 Day/Year x 20 Years x

$15.50/Manhour = 113,150

C. Maintenance

Two Pump Stations @

4 Manhours/Week x $15.50/Manhour x 52 Week/Year x

20 Years = $ 64,480

Repaint lift station equipment every 5 years @

80 manhours x 4 occurrences x $15.50/Manhour = $ 4,960

Additional Cost Considerations:

1. Loss of use of 8 acres of land.
2. Uncertainty of suitability of desired sites for injection and cost of conveyance to site.
3. Power must be run to injection site.

<u>Option #6 - Ocean Outfall</u>

This option has previously been determined to be undesirable based on a preliminary study supplied by this office.

PRESENT WORTH OF EACH OPTION

Assume an interest rate of 9%, a 20 year life span of all equipment and a salvage value of $0 at the end of 20 years. Operation and Maintenance costs shown are annual costs.

<u>Option #1 - Pump treated Effluent to Courthouse Bay</u>

A.	Capital Outlay	$615,265
B.	Annual Operation Cost	5,171
C.	Annual Maintenance Cost	1,728

Uniform series present worth multiplier (P/A) = 9.2

Present Worth = $685,015 + 6,899 (9.2) = $748,486

<u>Option #2 - Pump Treated Effluent to Hadnot Point</u>

A.	Capital Outlay	$813,006
B.	Annual Operation Cost	6,159
C.	Annual Maintenance Cost	1,728

P/A = 9.2

Present Worth = $813,006 + 7,887 (9.2) = $885,566

<u>Option #3 - Pump Untreated Effluent to Hadnot Point</u>

A. Capital Outlay $813,006

B. Operation Cost

Utility Cost - Manpower Saved (per year)

6,159 - 11,315 = - 5,156

C. Maintenance Cost 1,728

Present Worth = $813,006 + [-3,428 (9.2)] = $781,468

Option #4 - Land Application of Effluent by Irrigation

A. Capital Outlay $870,826

B. Operation Cost 24,808

C. Maintenance Cost 3,472

Present Worth = $870,826 + 28,280 (9.2) = $1,131,002

Option #5 - Subsurface Injection of Effluent

A. Capital Outlay $903,475

B. Operation Cost 24,274

C. Maintenance Cost 3,472

Present Worth = $903,475 + 27,746 (9.2) = $1,158,738

If crossing Intracoastal Waterway is necessary:

Add $209,250

Present Worth = $1,367,988

CONCLUSION AND RECOMMENDATIONS

Although cost estimates are difficult in cases such as Options #4 and #5 due to uncertainty of design, it seems quite clear that these options not only pose problems of land use and operation but are very expensive as well. Such options can not be recommended. Our initial inclination was to avoid these land application options as overly burdensome and counterproductive to the best use of military training lands even before financial analysis was done. Either option would create unusual operational and maintenance problems, possibly requiring additional personnel. In the case of subsurface application, the upgrading of the present Onslow Beach STP would require similar adjustments. The uncertainty of future effluent flows from Onslow Beach makes any expansion sized to a particular flow economically risky.

Option #1 is the least expensive of the options. One potential problem lies in the expected growth of the population of Courthouse Bay. The projected figures indicate that by 1991, the effluent into the Courthouse Bay STP from that area alone may exceed the plant capacity. The addition of treated effluent from Onslow Beach to the Courthouse Bay Outfall may not compound the problem, but the trend of protecting inlet waters may tighten restrictions on such outfalls. If the State refused to grant an increased outfall flow, this Onslow Beach flow could cause problems. When, as projected, Courthouse Bay outgrows its treatment plant, the logical solution would be to transfer the untreated effluent to the

large Hadnot Point STP. At this time, it would be necessary to maintain the Courthouse Bay outfall just for the flow from Onslow Bay. If it became impossible due to tightening restrictions to use the Courthouse Bay outfall, the Government would be required to pump the Onslow Beach flow to Hadnot Point also. At such time it would be logical to abandon the Onslow Beach STP and pump the effluent untreated to Courthouse Bay. Here it would be consolidated with the Courthouse Bay inflow and pumped to Hadnot Point for treatment.

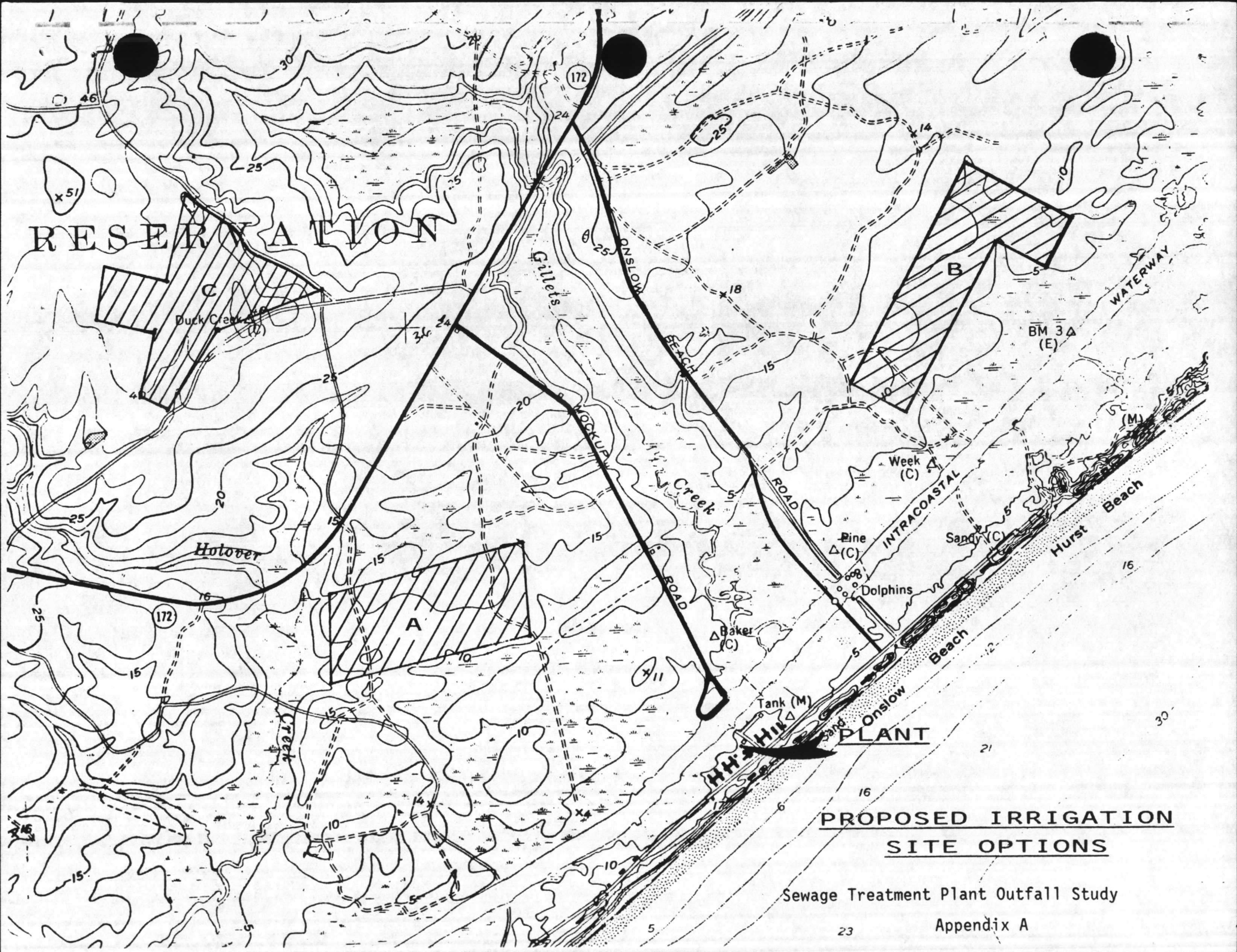
Another undesirable aspect of this option is the continued operation of the small, inefficient, Onslow Beach STP to service the uncertain quantity of Onslow Beach effluent.

As the size of the Onslow Beach flow would be easily handled by the Hadnot Point STP, it seems unwise to choose Option #2 which costs more than Option #1 or #3 and requires the continued operation of the Onslow Beach STP. We do not recommend this option.

While costing more, our recommendation is Option #3, the pumping of untreated effluent from Onslow Beach to be treated at the Hadnot point STP. This plan eliminates the small Onslow Beach STP and helps consolidate the base flow. We feel that consolidation into large plants is more efficient from an operational and a maintenance standpoint. As mentioned earlier, Hadnot Point can easily handle this flow. In fact, this plant could handle the projected flows from Onslow Beach and Courthouse Bay. When and if an expansion becomes needed, this one large plant could be more cost effectively expanded.

Although not included in the economic analysis, additional savings would be realized by the more efficient treating of the effluent at the larger Hadnot Point STP.

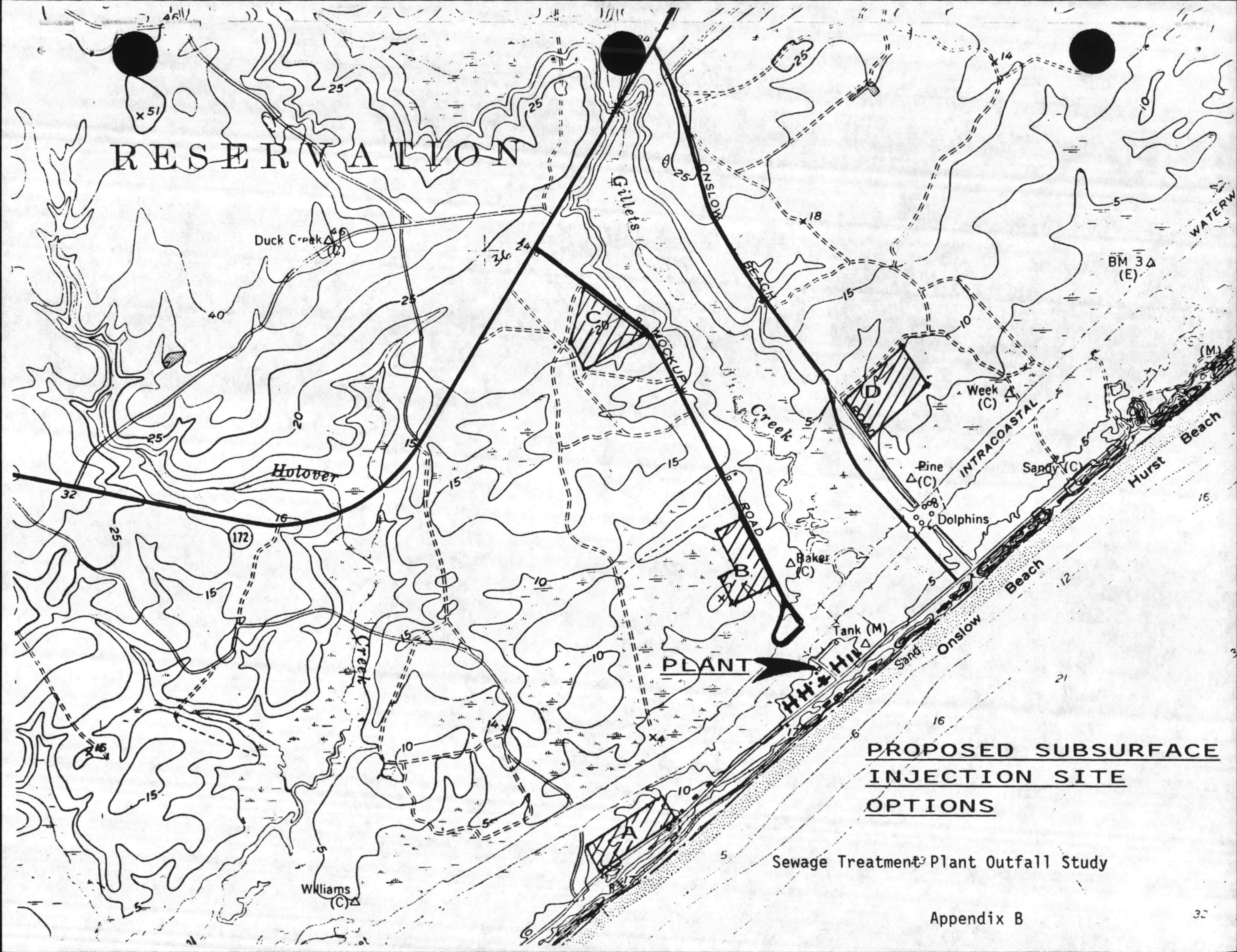
APPENDIX



PROPOSED IRRIGATION SITE OPTIONS

Sewage Treatment Plant Outfall Study

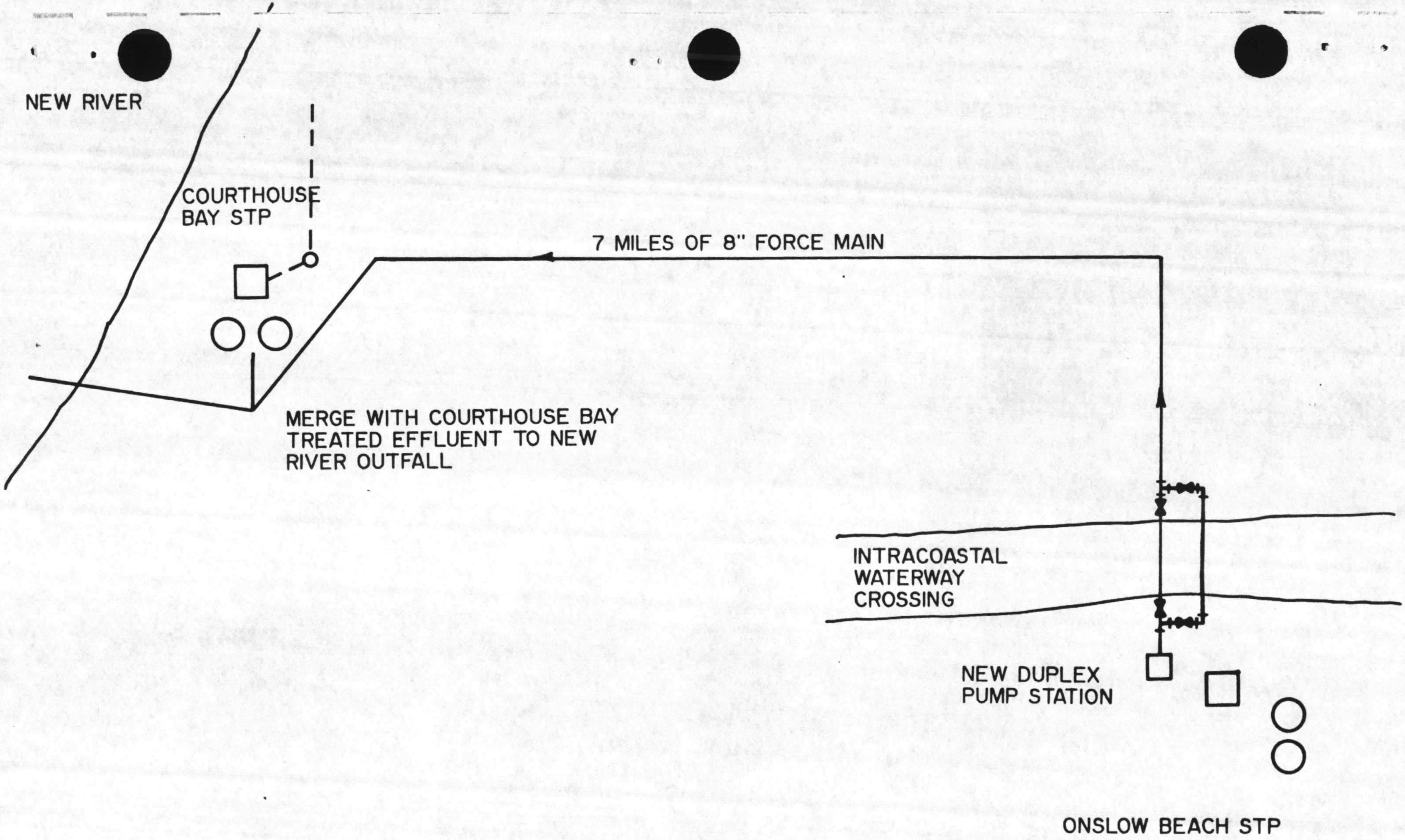
Appendix A



PROPOSED SUBSURFACE INJECTION SITE OPTIONS

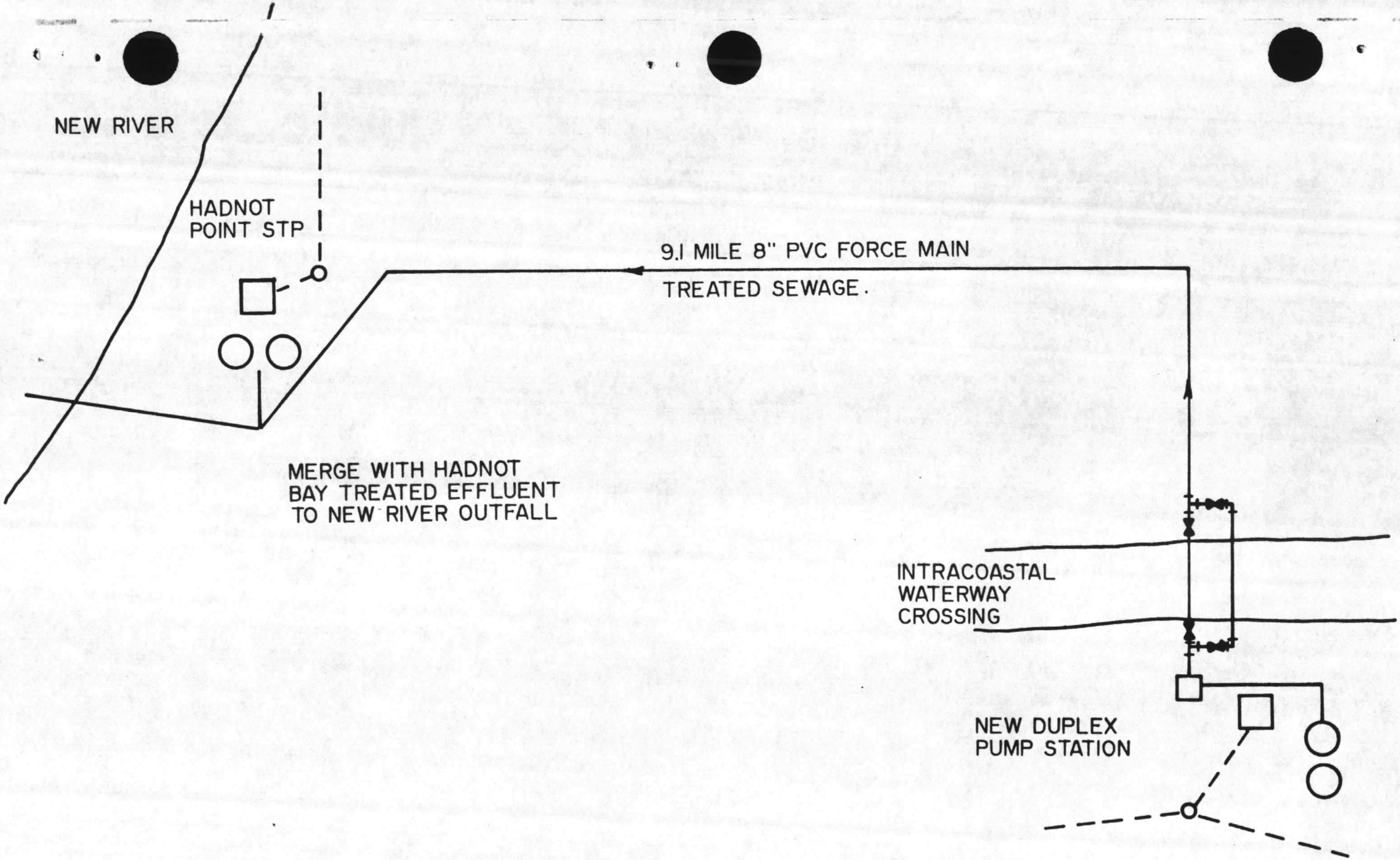
Sewage Treatment Plant Outfall Study

Appendix B



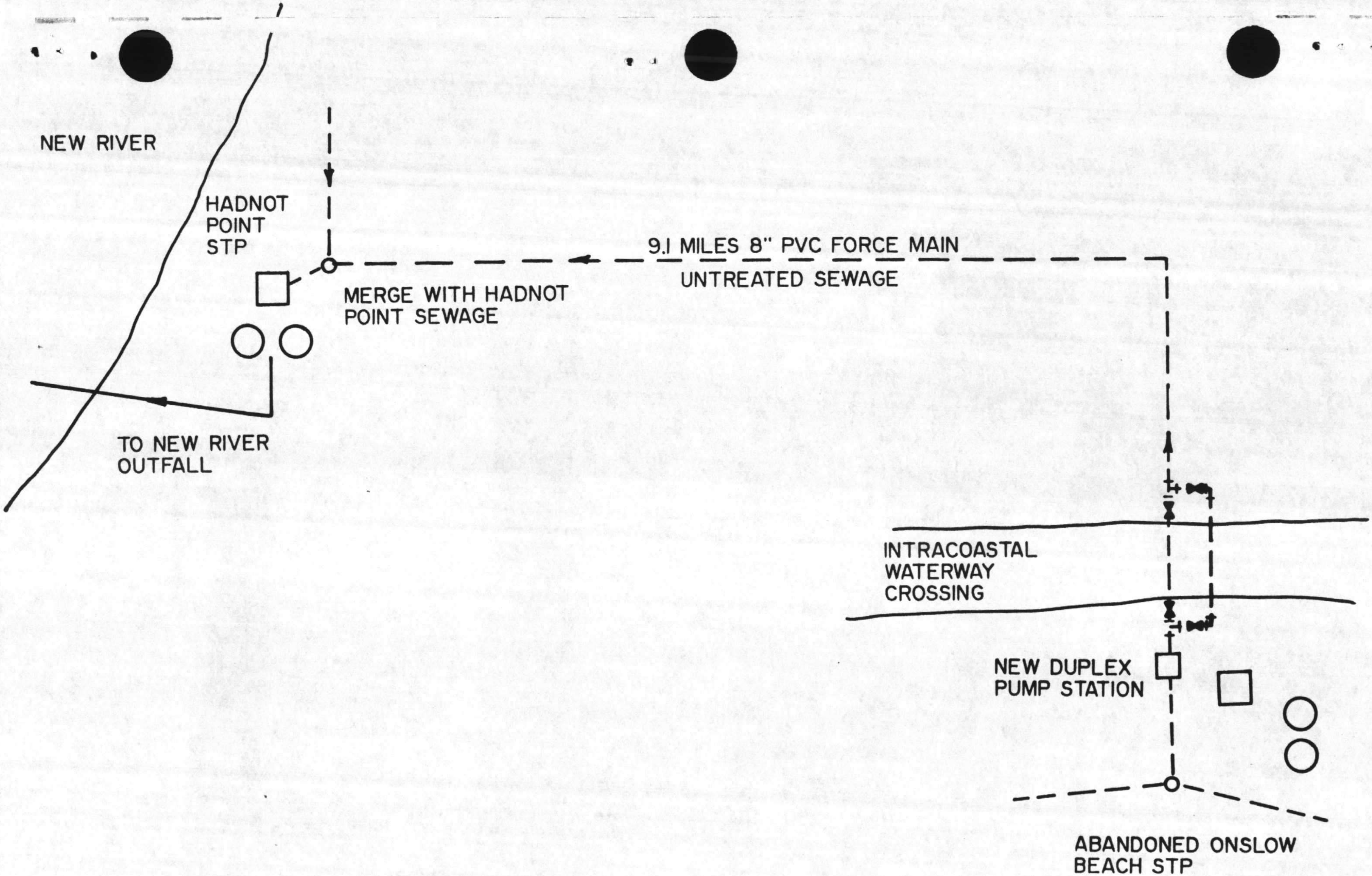
OPTION # I SCHEMATIC

APPENDIX C



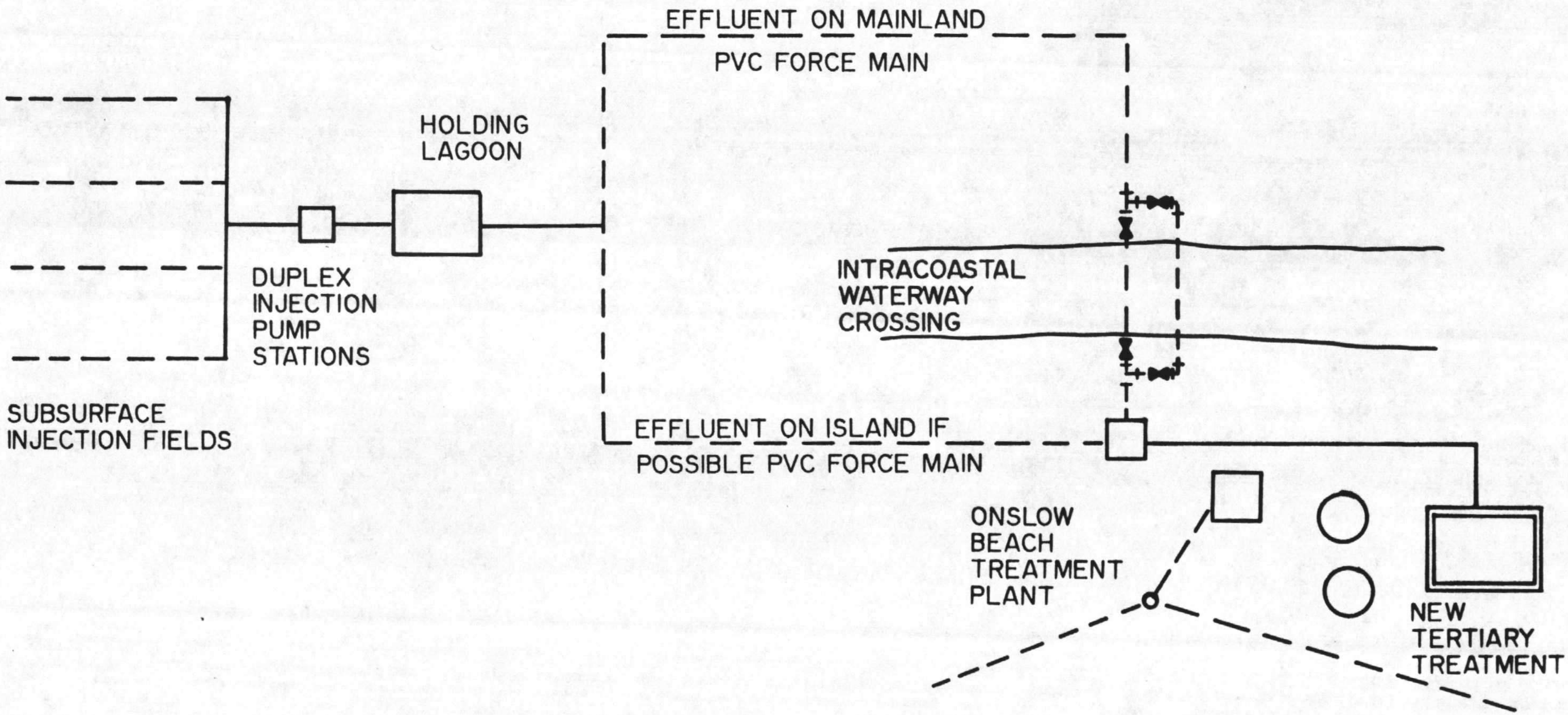
OPTION # 2 SCHEMATIC

APPENDIX D

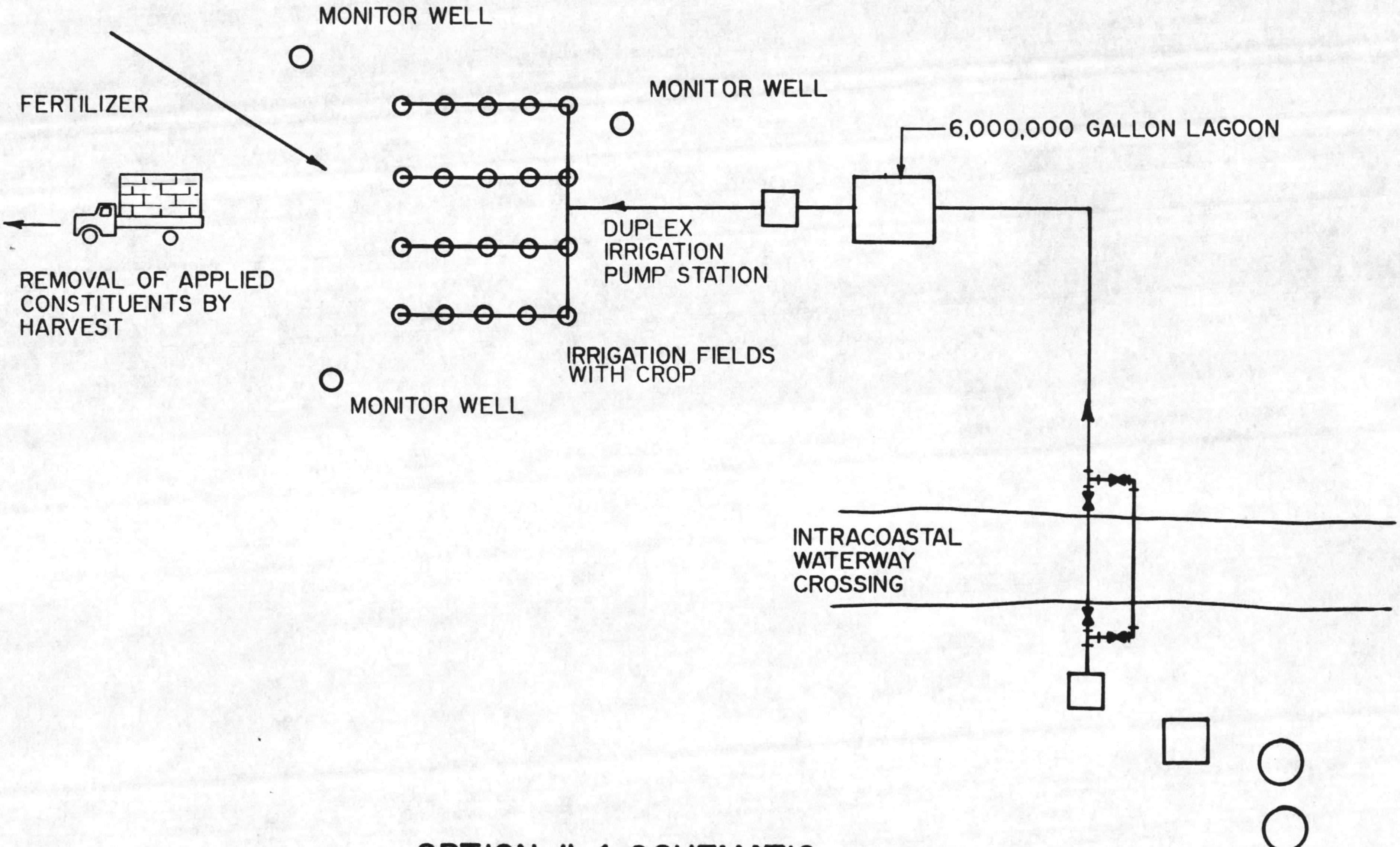


OPTION # 3 SCHEMATIC

APPENDIX E



OPTION # 5 SCHEMATIC



OPTION # 4 SCHEMATIC

APPENDIX G

STUDY TO UPGRADE WASTEWATER

TREATMENT PLANT M-136

PREPARED BY

HOBBS, UPCHURCH & ASSOCIATES, P.A.

290 S. W. BROAD STREET

SOUTHERN PINES, NORTH CAROLINA

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APPENDICES

I. INTRODUCTION

The purpose of this study is to analyze the sewage treatment situation at Camp Johnson with respect to capacity, adequacy of treatment, treatment problems and future treatment requirements.

The present plant is around fifty years old. At the head of the plant is an influent flow measurement unit with grit chamber. The primary treatment utilizes Imhoff tanks followed by a trickling filter and secondary clarifier before being chlorinated by a manual system and discharged into Northeast Creek near the confluence of Northeast Creek and the New River.

The Imhoff tank serves as both a primary clarifier and a digestor. It was the first technology developed after the septic tank and does an inefficient job of digestion. The plant presently has no other means of sludge digestion.

Secondary treatment is accomplished by a trickling filter and secondary clarifier. A trickling filter is not actually a filter but a means of bringing the wastewater into contact with organisms which grow on the surfaces of the filter rocks. The treatment is provided by this contact. Excess grease which is being experienced in the wastewater tends to coat this biological growth and inhibits oxidation of the wastewater. The wastewater passes from the trickling filter to the secondary clarifier and decanted water from the clarifier goes into the effluent flow measurement chamber and into the chlorine contact chamber for disinfection. The settled matter from the clarifier is recycled to the Imhoff tanks where inefficient digestion takes place. Normal plant operation includes recirculation of some wastewater from the secondary clarifier to the head of the plant to optimize treatment.

In spite of the age of the plant and a large variance of the BOD and grease content of the raw sewage, the plant performs within the specified effluent limits of 30 mg/l of BOD and suspended solids. The plant is currently permitted for one million gallons per day. A limitation has been placed on oil and grease of 60 mg/liter per day with a monthly average of 30 mg/liter.

The plant has been physically well maintained and is presently undergoing installation of new sand sludge drying beds.

II. TREATMENT PROBLEMS

A. Infiltration

Many gravity sewers comprising the collection system for the plant are old and allow substantial infiltration from rainfall. One operator indicated that an increase of influent flow of 50% was not uncommon following rain. This problem is being addressed where particularly bad lines can be identified. The collection line from Knox Trailer Park is being replaced for this reason. There are, however, no plans to replace other lines at present.

B. Grease and BOD

Another serious problem is an unusually large amount of grease in the wastewater. This grease is fouling equipment and causing high BOD levels in the wastewater. It is attributed to the cooking facilities at Camp Johnson. The mess hall currently feeds approximately 1,200 people per meal. Food waste is processed through two shredders. One handles scrapings from trays while the other handles the consolidated wastes from the kitchen. Both machines pulverize the scraps separating the solids from the liquid portions. Naturally, the liquid contains oil and grease. Both machines discharge into the sewer system.

A grease trap is employed to remove the grease. The configuration of sewer lines is not known, therefore we cannot be certain what portion of kitchen waste passes through the trap. Even if both machines empty into the trap, sinks and floor drains may not. In addition to regular mess hall waste, waste generated at the nearby cooking school is also processed through the larger machine.

It has been theorized that the high BOD levels are caused by the large amounts of grease in the wastewater. Historical data seems to indicate that the increased BOD levels coincide roughly with the installation of the garbage grinders at the mess hall and have increased since then. All garbage was previously removed from the Base. Other BOD peaks coincide with the start of the fiscal year when new menu plans are implemented and richer foods are often served (see Graph Appendix No. 1). No other theories as to the source of the higher BOD presently exist. It is our understanding that a similar trend

to higher BOD levels has been noted all over the Base. Garbage grinders were simultaneously installed in many, if not all, mess halls.

While better attention to plant functions such as recirculation rate by operators might somewhat improve the treatment capabilities of the plant, a better course of action would be to eliminate the BOD at the source if feasible. Perhaps even a return to the old policy of garbage removal should be considered if other methods fail.

The relationship of influent and effluent BOD of the plant seems quite erratic. Effluent BOD remains relatively steady even though large swings in the influent BOD are occurring. Effluent BOD levels increase in the colder months. Records do not show influent and effluent BOD on a daily basis and therefore do not provide enough information to evaluate the relationship between the two. Chlorine, in addition to disinfection, is being used to reduce BOD. This fact was reinforced recently when experiments were conducted to reduce residual chlorine. The effluent BOD increased greatly prompting a return to the policy of overchlorination.

In a plant such as Camp Johnson, the trickling filter is sized to accommodate a certain amount of BOD and hydraulic loading. Typically a high rate trickling filter can accommodate a BOD loading of 25-45 lbs. per 1,000 cubic feet of filter media per day and a hydraulic loading rate of .16 to .48 gallons per square foot of surface area per minute. Plants are designed based on design flows and some estimation of influent BOD. (Normal domestic wastewater might be expected to have an influent BOD of 200 mg/l.) The influent BOD at this plant has averaged as high as 650 mg/l for a month (April 1988) with the previous month average being approximately 275 mg/l. With such variance, it is easy to understand the difficulty of trying to optimize performance of the plant.

While there is presently no method of controlling the influent BOD, there is a manual means of exercising some control over the hydraulic loading of the trickling filter. This is supposedly controlled by optimizing the number of pumps used to feed the trickling filter. According to Base Maintenance personnel, this would avoid overloading the filters. Even this rough control is not being maintained due to the unfamiliarity of some operators with the idiosyncrasies of the plant.

C. Toxicity

The problem of toxicity of Camp Johnson's treated effluent to marine life has recently come to the attention of State regulatory agencies and the base has been required to submit remediation plans. This problem is common to all base treatment plant effluents.

Toxicity is defined by actual tests of the effects of the effluent on marine life. If non-toxic, a solution of 90% effluent and 10% water would cause no acute mortality of fathead minnows or other specified life forms. Tests run on effluent from Hadnot Point have shown the effluent to be toxic. Chlorine residual from disinfection is known to be causing this toxicity. A random sampling showed the chlorine residual at Camp Johnson to be much higher than that of Hadnot Point inferring even higher toxicity at this location. The effluent currently contains as much as 5.0 mg/liter of chlorine. This is an obviously toxic amount. Modifications must be made to reduce this number to approximately .2 mg/liter. The broader question is whether or not this will reduce the toxicity to acceptable levels. It is prudent to test the unchlorinated effluent to determine whether or not any other harmful constituent is present. This was done and the results indicate that the pre-chlorinated effluent is non-toxic.

As chlorine is causing the toxic effect, treatment will require automatic control of chlorine addition, possible dechlorination and continuous measurement of chlorine residual, or the implementation of a different disinfection scheme.

At the time of this writing, a timetable for detoxifying the effluent had not been set, but it seems likely that the State will attempt to require progress to be made before the current discharge permits come up for renewal in 1992.

D. Hydraulic Capacity

The primary factor in planning for the future of Camp Johnson's wastewater needs is the projected population and the resulting change in flows. Present flows are quite erratic due to fluctuations in school populations and infiltration from rains. Since August of 1986 the average monthly flows hava varied from .335 to .710 MGD. The average daily flow has been .519 MGD with daily flows ranging from a low flow of .252 MGD to a high

of 1.207 MGD. This high flow was noted as being caused by "excessive" rain.

The design flow of the plant is 1 MGD. Infrequent flows above this amount do not constitute serious violations of discharge permits, but frequent infractions would cause concern. The infractions certainly encourage more scrutiny by regulatory agencies.

We have attempted to make flow projections based on discussions with Base personnel. The various schools at Camp Johnson have a present population of approximately 3,000 with no projected growth in the next five years. For long term planning we feel that a population of 3,500 should be used.

Traditionally, modernization of school facilities has brought increased water usage even without population increase. Housing facilities are being upgraded and will result in some increase. The present mess hall will be replaced in 1992 by a new facility which will serve 1,600 people instead of the present 1,200. The Knox Trailer Park area is to be expanded to accommodate seventy-five more trailers. The estimated impact of these factors on wastewater flow rates is as follows:

Pre-1992

1. Modernization of Facilities

10% of Present Average Flow	51,900 GPD

2. Seventy-Five Additional House Trailers

75 Units x 3 Occupants x 100 GPD =	22,600 GPD
Total Increase in Flow	74,500 GPD
Present Average Flow	519,000 GPD
Projected Average Flow	593,500 GPD

Post-1992

1. 500 New Students

   1992 Projected Average Flow x 17% = 100,895

2. Mess Hall Expansion

400 Seats x 40 GPD =	16,000 GPD
Total Increase in Flow	116,895 GPD
Average 1992 Flows	593,500 GPD
Future Projected Flows	710,395 GPD

These projections do not include any added infiltration that might result from sewer deterioration or any reduced infiltration resulting from line replacement.

In view of the fact that the Camp Johnson plant has exceeded its permittable flow in the past, it is certain that it will happen again. As normal influent flows increase, infractions will become more likely. The post 1992 average projected flow for the plant is 710,395 GPD up from a present average of 519,000 GPD taken from the last two years. Several factors will determine the frequency of design flow infractions such as rainfall, normal peak flows and school enrollment. The coincidence of rain and high effluent flows will cause infractions. As an indicator, we have examined the daily flows since August of 1986 and added 191,395 gallons/day (the difference in present and future projected averages) to see how many days would have produced excessive flows and possible corresponding warning letters from the State. This number was found to be twenty-one. Twenty-one infractions in twenty-four months, while not a scientific estimate indicates that infractions could be expected to increase dramatically. On a monthly basis, the addition of 191,395 gallons/day to all monthly averages would in no month have exceeded 1 MGD of average flow. While the State is somewhat tolerant of infrequent infractions that don't

cause effluent limit violations, the effluent limits will become increasingly harder to meet unless the excessive BOD can be controlled at its source. It may be that the Base administrators have little or no tolerance for periodic infractions in which case expansion of treatment capabilities is inevitable.

E. Phosphorous

We have been informed that concern over the excess nutrification of the waters of the New River and the bodies of water emptying into it in the Camp Lejeune area will result in new limits being placed on the phosphorous content of treated effluents. Harmful nutrification is the addition to receiving waters of amounts of phosphorous and/or nitrogen or other substances causing excessive growth of macroscopic or microscopic vegetation per Section .0214 of North Carolina Administrative Code 2B. Upon issuance of permits in 1992, Camp Lejeune will be required to begin a program or schedule which will reduce effluent phosphorous levels to 2 mg/liter over a three to five year period.

While nutrification is a major concern in the entire area, it is particularly severe in Northeast Creek and other areas of low flow where sufficient mixing and dilution of effluents does not occur. This low mixing causes similar problems with all effluent constituents and is a limiting factor on quality and quantity of effluent that can be received safely by a body of water.

The majority of phosphorous (approximately 60%) found in domestic wastewater is due to detergent use. It is not practical to substantially reduce the amount of detergents used. Detergents without phosphates exist but some substitutes have been found to be harmful to humans. Without a large Base controlled laundry, it would be impractical to attempt any type of restriction of phosphorous input from such sources. Consequently, removal of phosphorous by treatment will be required to reach the new limits when applied.

Although there are several variations, phosphorous is normally removed with one of three methods. The first is by flocculation and settling of the phosphorous. This can be accomplished by lime, alum or iron addition to the raw wastewater, introduction of flocculation agents with proper floc time prior to secondary clarification or by tertiary treatment with flocculation, mixing, clarification and then filtration. Different approaches have advantages but one common disadvantage is increased sludge formation and

subsequent disposal problems.

The second method of phosphorous removal is accomplished by Sequential Batch Reaction in which organisms are starved until they release phosphorous and are then fed while being exposed to the phosphorous rich wastewater at which time they eat up available phosphorous removing it from the waste. This approach would not generate appreciable new sludge but cannot be adapted to existing conventional treatment schemes as it also serves as secondary treatment and is an activated sludge process. The batch nature of the system also would tend to overload the chlorine contact chamber requiring possible enlargement of the chamber to ensure adequate chlorine contact time.

The third method is actually composed of several proprietary treatment schemes collectively known as biological phosphorous removal. Each is a modification of the activated sludge process and while some existing activated sludge plants can be modified to incorporate these treatments, they are generally used with new construction. When built new it is reported that these plants are not a great deal more expensive than conventional plants without phosphorous remove. They do, however, require a one time proprietary fee at present.

The mechanism for phosphorous removal in these proprietary processes is the uptake of the phosphorous by certain "bug" constituents of the activated sludge. The phosphorous is removed from the system with the normal sludge or decanted from the sludge in a side stream process which causes the phosphorous to be released by the "bugs".

The advantages of these processes are the lack of chemicals and additional equipment needed to settle out the phosphorous and the avoidance of additional sludge production. An increase in sludge production of approximately 50 percent could be expected after implementation of a chemical phosphorous removal system.

During research on the phosphorous removal question we have learned that a new plant or addition can be constructed that will remove phosphorous during the course of treatment without an increase in treatment costs by means of a proprietary process. Money spent for phosphorous remediation at an existing plant could be applied directly to a central plant expansion without much additional cost for phosphorous removal. The combination of low phosphorous effluents from the expanded portion of an existing plant

might be mixed with effluent from the conventional side of the plant to achieve an acceptable average. This could be more accurately determined by study of existing and past phosphorous content of the effluent and projections of effluent quality of a new plant addition. Proprietary removal processes can presently reduce phosphorous to 1 mg/l.

F. FUTURE PERMITS

The quantification of the dilution and mixing properties of the waters of the area has not be accomplished. For this reason, the State cannot properly evaluate the dilution capabilities of the waters at particular points where discharges are being or might be made. As studies to ascertain the necessary information are very expensive and time consuming, there are as yet no conclusive results. The Base has been cooperating with the State to obtain the needed information. Dye testing is presently scheduled for this fall. The results should be out next spring at which time more will be known about the dilution and mixing capacities of the subject waste courses.

The effects of this lack of information is a moratorium on increased effluent quantities and a conservative approach to effluent quality. We have been informed that any request to increase flows at Camp Johnson would initiate study of the waters. The approval of such a request, if given at all, might very well require the extension of the outfall farther out into the creek where superior mixing and dilution can be achieved as was necessary at Camp Geiger. Such uncertainties make planning difficult; however, regardless of these studies or the lack of them, phosphorous removal will be required by the mid-1990's.

The State is presently seeking to foster cooperation between Camp Lejeune and other area municipalities to reduce or eliminate the discharge of treated effluent anywhere that results in inadequate dispersal of the effluent. A successful solution would be a regional outfall at the point designated by the State as safe. It is anticipated that this point might be upstream of the present Hadnot Point Treatment Plant near the area of the hospital.

III. UPGRADE OF CAMP JOHNSON PLANT

In order to continue to utilize the existing Camp Johnson plant, the aforementioned problems must be addressed. Grease should be removed in an effort to control influent BOD, toxicity must be reduced, phosphorous must be removed to specified limits and the

hydraulic capacity of the plant must be considered. We will look at solutions to each problem separately. Capital costs of implementing each option will be presented and projected operation and maintenance costs for a twenty-year period will be given a present value.

For present value calculations, we will use an interest rate of 8%, a life span of twenty years for equipment assuming no salvage value at that time.

The uniform series present worth multiplier (P/A) equals 9.82. This figure will be mulitplied by annual O&M costs to yield a present worth of the O&M. This will be added to the construction cost to give a total present worth.

A. Grease

The grease situation at Camp Johnson can be handled in three ways. If, however, it is desired to reduce the actual grease input to the plant, this can only be effectively handled at the source. We recommend that this be done.

To accomplish this, a careful look should be taken at the kitchen wastewater collection system at the mess hall. The interception of all kitchen waste lines by the existing grease trap should be verified. Special emphasis must be placed on lines from the two garbage grinders. A new grease separator system consisting of one or more separators should be properly sized and installed to remove more of the grease before it enters the sewer lines. These separators will require routine maintenance to remove trapped grease. We would suggest inspection of the sewer lines leading from the mess hall to see if any greasy residual remains in the lines. Based on the build up of BOD levels of the plant influent over the period of time since the installation of the garbage grinders, it seems quite probable that a grease residual does exist (See Graph in Appendix No. 1. Such a residual could continue to cause a problem even after the source was corrected. It would be wise to clean the affected gravity sewer to remove this residue. This could best be accomplished by pressure washing the lines. Such an operation could be done in two weeks for approximately $14,000.00. This would, however, cause temporary problems by flooding the treatment plant with the stripped off grease.

Although we feel that a well designed and maintained grease removal system should reduce the grease content of the wastewater and will hopefully render the problem manageable, we suggest that more drastic measures such as a modification of mess hall waste disposal practices be sought if necessary to solve this problem.

1. Cost of Implementation

A. Separator - 1-100 gpm	$ 5,000.00
B. Installation and Drain Work	<u>5,000.00</u>
TOTAL	$ 10,000.00

Another alternative is to do nothing with the present situation and see that proper grease separation is incorporated into plans for the new mess hall to be constructed by 1992. We suggest that the new plans be reviewed in any case, but it might be decided that modification of the existing system would not be desirable since the facility is to be abandoned.

We feel that the grease should be removed at the source no matter what other future plans are implemented. This should improve the conditions at the treatment plant and these improvements are needed now.

B. <u>Toxicity</u>

As discussed earlier, chlorine is the source of toxicity of the wastewater. The present chlorination system is manually controlled by the adjustment of a feeder valve which allows a certain amount of chlorine per unit time to enter the wastewater to disinfect it. One problem with this system is the varying flow at the plant. Operators are instructed to check the chlorine residual of the wastewater every hour. According to one operator, they are instructed to maintain a residual of 4.0 mg/l. This particular operator increases the chlorine flow whenever the residual gets below 2.0 mg/l. This is very loose control of chlorine addition. Ideally only enough chlorine is added to reduce bacteria counts to acceptable levels. Any chlorine used beyond this amount is wasted and contributes to the high chlorine residual and toxicity. Unfortunately, in this case additional chlorine is

also needed to further reduce BOD making normal doses impractical.

We have been informed by the State that a chlorine residual of no more than .2 mg/l will be allowed under the new guidelines. Control of this would begin by determining as accurately as possible the amount of chlorine necessary to kill unwanted organisms and supply the necessary BOD reduction. This dosage would be applied at a rate proportional to the actual flow being treated at the time. A flow measurement device would be employed to control the rate of chlorine addition. A well designed chlorine addition system should achieve adequate disinfection with the addition of 8-15 mg/l of chlorine. The key phrase here is "well designed". A well designed system provides excellent initial mixing either by introduction of the chlorine under pressure which creates mixing by turbulence or by means of a mechanical mixer. It also requires adequate contact time with the wastewater to achieve maximum benefit. A contact time of thirty minutes is desireable although chlorine contact chambers are often designed for less contact time at peak flows.

The existing contact chamber at Camp Johnson contains approximately 2,000 cubic feet of volume. This volume is adequate to provide a thirty minute contact time at a flow of 749,000 GPD. A one million GPD plant such as Camp Johnson's could experience peak flows in excess of three times this amount reducing contact time to around ten minutes. This is not adequate to achieve maximum performance from the chlorine even under ideal mixing conditions.

A review of flow charts at the plant revealed peak flows of approximately 1,400,000 GPD. At this rate the existing contact chamber would allow a contact time of approximately fifteen minutes. This is not adequate contact time. As flows increase to the plant, this time will decrease under present conditions.

Under these less than ideal conditions more chlorine than necessary will be required to achieve adequate disinfection, and reduced BOD, resulting in higher residual chlorine and toxicity. Under these circumstances, dechlorination will be required. This is generally accomplished by addition of sulfur dioxide, sodium metabisulfite or other chemicals. To control the residual and the rate of addition of the dechlorinator, a residual analyzer would be needed. This device would sample the chlorinated effluent and determine the chlorine residual. This information would be fed to a microprocessor that would trim

rates of addition of the dechlorinator and the chlorinator to maintain a preset residual.

Chlorine is not the only means of disinfecting effluent. A non-chemical alternative that would impart no toxicity to the wastewater is disinfection by exposure to ultraviolet light. Such a system would be composed of banks of ultraviolet light tubes arranged in flow channels that would assure the necessary proximity of the wastewater to the tubes. Typically, several banks of tubes are used, some of which would be automatically turned on and off in accordance to the flow rate being experienced.

The effectiveness of this system and its proper design depend on the ability of the wastewater to transmit light at a wavelength of 25+ nanometers. A transmittance of 65 - 70% is needed to achieve good results. The wastewater must be tested to determine this quality as it is not readily assumed or apparent.

Assuming that the wastewater is acceptable for this type of treatment, other considerations should be made. The life of the light tubes is variable but should be considered to be approximately one year. Some tubes will be used intermittently while some will be used constantly. For this reason it is desireable to have totalizing run meters on each bank of tubes. Build up on the tubes reduces their effectiveness and tube banks must be pulled out and cleaned with a degree of frequency that depends on the wastewater but would likely be once a month.

A system designed for 1 MGD with a peak flow rate of 2.5 MGD would utilize approximately 170 tubes. At 1 MGD an average of seventy bulbs would be burning and burning out. At a life span of one year this would require seventy new bulbs per year at a cost of roughly $100.00 apiece.

There would be no mechanical equipment to maintain or chemical costs associated with this type of treatment.

Without more detailed study into flow rates and characteristics of the existing wastewater it is difficult to estimate costs of implementing such a system but it would be much more expensive than a chlorination and dechlorination controller.

Of concern regarding the addition of chlorine at the plant is another problem.

Experiments have been undertaken to reduce the amounts of chlorine added to the wastewater to see how the chlorine residual would be affected. While these experiments indicated that the residual could be lowered somewhat while still controlling fecal coliform to the required 1,000/100 ml, the effluent BOD increased. The experiments were run in the winter when effluent BOD runs higher, but this condition is normal and should be evaluated as a worse case. During the experimentation, the monthly average effluent BOD of 30 mg/l was exceeded.

While it is normal for chlorination to reduce BOD, chlorine should not be required to reach acceptable BOD levels. In the case of this plant, however, it is obvious that this is the case. The requirement of chlorine for BOD removal precludes the implementation of ultraviolet disinfection.

The above mentioned two options address retrofitting the existing plant to meet the coming toxicity requirements. The third option is to make plans to pump the untreated wastewater to a centralized treatment point and seek a Special Order of Consent or moratorium on the toxicity question at Camp Johnson while the necessary planning and construction is taking place. Of course, in any event, the toxicity limits must be met, but it would be wasteful to retrofit and subsequently abandon the Camp Johnson plant.

PRESENT WORTH OF OPTIONS

1. Chlorination and Dechlorination

A. Equipment

1. Expansion of contact chamber	$ 20,000.00
2. Flowmeter - May be able to adapt present unit to control scheme	3,000.00
3. Automatic chlorine feed system, residual analyzer, microprocessor, automatic sulphur dioxide feed system, injectors, and diffusers, piping, agitating mixer	20,000.00

4. Installation and Wiring — 5,000.00

Total Construction — $ 48,000.00

B. Chemicals

Assume chlorine saved offset by sulphur dioxide used. (This will not be true if excess chlorine is still needed to reduce BOD) — 0

C. Operation and Maintenance (Annual)

1. Maintenance time will be reduced some by alleviating need to sample residual every hour but operator will still be needed.

2. Technician to maintain electronics

$\frac{24 \text{ Hrs.}}{\text{Year}}$ @ $\frac{\$18.00}{\text{Hour}}$ — $ 432.00

3. Electricity

2 HP x 8,760 Hr/Yr x $\frac{.746 \text{ KwHr}}{}$ x $.05/KwHr — 654.00

Total Annual O&M — $ 1,086.00

Present Worth

48,000.00 + 9.82 (1,086.00) = — $ 58,665.00

2. Ultraviolet System

A. Equipment

1. Tube racks, intensity meter, flow meter and auto light switching controls and totalizing counters sized for 1MGD flow — 125,000.00

B. Operation and Maintenance (Annual)

1. Bulb Replacement

70 Tubes/year @ $100.00/Tube x — 7,000.00

2. Operator Cost

8 Hrs./Month x 14.00/Hr. x 12 Mo./Yr x — 1,344.00

(This might be absorbed into duties of regular operator)

3. Electricity

1 MGD Average Flow

100 KwHr/Day x 365 x $.05/KwHr — 1,825.00

Total O&M — $ 10,169.00

Present Worth

125,000.00 + 9.82 (10,169.00) = — $224,860.00

C. Phosphorous Removal

To remove phosphorous at a plant like that of Camp Johnson would require chemical addition and subsequent settling out of the precipitate and handling it as sludge from the secondary clarifier. Such a system would consist of a liquid alum tank and feeder pumps, possible polymer tank with feeder pumps, a 30 minute detention tank with mixers and controls to regulate the addition of alum and polymer.

The detention tank would empty into the secondary clarifier where the phosphorous would settle out. The particulars of chemical addition and percentage of phosphorous removal are dependent on the wastewater characteristics. Generally, a lab test is performed to determine these values. The necessary hardware would remain the same unless it was determined that no polymer addition was needed. The degree of treatment necessary would determine the amount of additional sludge produced.

Assuming an 80% removal of phosphorous from 10.0 mg/l (normal range for domestic waste) to 2.0 mg/l it would require a weight ratio of approximately 1.1 pounds of aluminum to 1.0 pound of phosphorous removed. Theoretically, 9.7 pounds of alum is required on a one to one weight ratio. Multiplying 9.7 x 1.1 gives an adjusted weight of 10.67 pounds alum per pound of phosphorous removed. This equates to the following:

Pounds of Phosphorous Removed Per Day

$$1{,}000{,}000 \text{ Gal/Day} \times 8.34 \text{ \#/Gal} \times \frac{8\text{\# Phosphorous Removed}}{1{,}000{,}000 \text{ \# Water}} = 66.7\text{\# Phos/Day}$$

Pounds Alum Needed

$$66.7 \text{ \# Phosphorous/Day} \times \frac{10.67 \text{ \# Alum}}{\text{\# Phosphorous}} = 712 \text{ \# Alum/Day}$$

Pounds Sludge Generated Per Day to Remove Phosphorous

66.7# Phosphorous/Day + 712# Alum/Day = 778.7#/Day

As mentioned earlier, lab tests must be run to determine actual amounts of alum needed as well as optimum points to add the alum. It seems reasonable to assume that less than this amount will be needed.

We suggest that consideration must be given to this additional sludge. The capacity of the new drying beds under construction should be reviewed and a determination made as to their ability to handle additional sludge. Any new construction required could be costed accurately by comparing with the project being constructed.

As mentioned before, the removal of phosphorous at Camp Johnsc ... uld likely be avoided by submitting plans to the State to consolidate flows at a more desireable point in the future and remove phosphorous at that time.

1. Present Worth of Phosphorous Removal Implementation

A. Equipment

1. Chemical Mixers 2 EA @ $9,000.00/EA	$ 18,000.00
2. Detention Tank	20,000.00
3. Bulk Tank for Alum	12,000.00
4. Dual Metering Pumps for Alum with Variable Speed (Controlled from Effluent Flow Meter)	10,000.00
5. Polymer Batch Tank with Mixer	1,600.00
6. Dual Metering Pumps with Variable Speed	10,000.00

7. Installation 10,000.00

Total Construction $ 81,600.00

Note: An alternate method eliminating the detention tank and mixing in the clarifier could possibly be installed for $60,000.00.

B. Operation and Maintenance (Annual)

1. Operator Cost
   4 Hrs./Day x 365 Day/Yr. x $14.00/Hr. $ 20,440.00

2. Maintenance Technician
   52 Hrs./Yr. x $18.00/Hr. 936.00

3. Electricity

   $2 \text{ HP} \times 88{,}760 \text{ Hrs./Hr.} \times \frac{.746 \text{ KwHr}}{\text{HP Hr.}}$

   x $.05/KwHr = 654.00

C. Sludge Costs

1. Assume that sludge handling and drying beds will be expanded by 50%

   Total Annual O&M $22,030.00

   Present Worth

   81,600.00 + 9.82 (22,030.00) = $297,935.00

Note: These costs do not include construction and handling necessary for extra sludge.

D. Hydraulic Loading Considerations

While we do not feel that a large investment in the antiquated Camp Johnson plant to increase its capacity would be desireable from an ideal standpoint, it may represent the cheapest alternative if increased capacity is deemed necessary. To accomplish this in effect an entire new plant would be built beside the present one. For the sake of uniformity it would likely be a trickling filter plant with primary settling basins and clarification to replace the Imhoff tanks. It might be desireable to install digestors for the entire plant. A problem that must be considered is the space problem. Not only would a parallel plant be needed, but room would also be needed for the phosphorous removal equipment and a new or enlarged chlorine contact chamber. Assuming phosphorous removal and a .5 MGD expansion, drying beds would require addition of approximately 125% of their present area. Hydraulic complications might be encountered. Space might require two separate phosphorous removal systems. If the plant is to be expanded, all upgrades of the present plant should be done simultaneously if possible to better utilize space.

For comparison purposes, we will formulate an approximate present worth of a plant expansion of .5 MGD.

1. Cost of .5 MG Plant Expansion (Without Digestors)

   A. Equipment

1. Primary Clarification	$110,000.00
2. Hi Rate Trickling Filter	125,000.00
3. Secondary Clarifier	110,000.00
4. Recycle Pump Station	35,000.00
5. Sludge Pumps (Clarifier Drain)	50,000.00
6. Phosphorous Removal	55,000.00

7. Drying Beds - 75% of present bed area. Refer to recent construction costs.

8. Chlorination - Dechlorination including contact chamber and assuming use of equipment needed anyway for main plant — 30,000.00

9. Installation - Wiring — 100,000.00

Total Construction Cost Excluding Drying Beds — $615,000.00

B. Operation and Maintenance (Annual)

1. Composite Cost Based on 50% of Present O&M Cost — $ 49,438.00

2. Phosphrous Removal and Chlorination/Dechlorination Based on 50% of Previous Estimates in Report

   a. Operator Cost — $ 10,220.00

   b. Maintenance Technician — $ 684.00

   c. Electricity — $ 654.00

   Total Annual O&M — $ 60,996.00

   Present Worth

   615,000.00 + 9.82 (60,996.00) = — $1,213,981.00

Note: These costs do not include construction or O&M costs for increased sludge handling or for other requirements that might be enforced such as an extended outfall line.

IV. OTHER CONSIDERATIONS

During the course of our research we have identified several situations that might come into play in making a decision on a course of action in this matter. Although we could not fully evaluate some of these factors, we will mention them.

In discussing possible expansions of either the Camp Johnson or Tarawa Terrace treatment plants, we discovered the moratorium on any increases in effluents into Northeast Creek. Tarawa Terrace, being further upstream than Camp Johnson, presently has no chance of receiving a permit to discharge more effluent. Any money spent at either plant would be lost if in the near future, the plant became overloaded requiring the conveyance of the untreated effluent to another point for treatment and closing of the plant. If the Base decides to keep the smaller plants open indefinitely, these factors should be considered in planning for changes in Base operations which will effect wastewater flows.

It appears that the enlargement of the Tarawa Terrace plant to accommodate the Camp Johnson flow, as stated as an alternative, is not presently permittable by the State. We feel that it is highly unlikely that it ever would be permittable since it would entail outfalling more treated effluent further upstream than is now being allowed. While it is likely that a larger flow at Camp Johnson would be permittable if necessary, (this might require a lengthening of the present outfall) a small plant addition offers no economy of scale and would become part of a plant that is already fifty years old. Also, additions to the plant to meet new phosphorous and toxicity requirements also offer no economy of scale and require similar control equipment that would suffice for a much larger plant.

We feel that before additional monies are spent at these smaller treatment facilities, consolidation of all base wastewater at Hadnot Point should be considered.

For comparative purposes we will present rough estimates of costs incurred to pump untreated effluent to the Hadnot Point Treatment Plant and to the area of lift stations S-47 and S-47A, an area that we feel is a logical area to locate a regional treatment plant.

Any lines constructed to convey untreated effluent should consider future consolidation and size lines accordingly to handle anticipated flow from all sources. These estimates

will be for lines large enough to convey the effluent from Camp Johnson to the treatment point. Values will be given in present worth as was done previously.

Force Main to Hadnot Point Plant

A. Construction Cost

1.	12" PVC Force Main - Camp Johnson to Hadnot Point 60,000 LF @ $13.00/LF	$780,000.00
2.	12" DI Pipe for River Crossing 1,000 LF @ $24.00/LF	24,000.00
3.	Air Release Valves 5 EA @ $500.00/EA	2,500.00
4.	Ductile Iron Fittings 4,000 LB @ $1.50/LB	6,000.00
5.	24" Steel Casing by Boring 550 LF @ $60.00/LF	33,000.00
6.	River and Creek Crossing - Bridge Pipe Installation Lump Sum	50,000.00
7.	Pump Stations 2 EA @ $60,000.00	120,000.00
	Total Construction Cost	$1,015,500.00

B. Annual Operation @ 700,000 GPD

2 Stations @ 6.72 Hr./Day @ 1,736 Gal/Min @
135 HP @ $.05/KwHr

Annual Electrical Cost	$ 24,528.00

C. Maintenance (Two Stations)

4 Manhours/Wk x 15.50/Manhour x 52 Wks.	3,224.00
Repaint both stations equipment every 5 years @ 80 Manhours x 2 Occurrences x $15.50/Manhour	248.00
Total Annual O&M	$ 28,000.00

Present Worth

1,015,500.00 + 9.82 (24,076) =	$1,251,926.00

Force Main to Present Station S-47 Area

A. Construction Costs

1. 12" PVC Force Main 49,800 LF @ $13.00/LF	$647,400.00
2. 12" DI Force Main for River Crossing 800 LF @ $24.00/LF	19,200.00
3. Air Release Valves 4 EA @ $500.00/EA	2,000.00
4. Ductile Iron Fittings 4,000 LB @ $1.50/LB	6,000.00
5. 24" Steel Casing by Boring 450 LF @ $60.00/LF	27,000.00

6. River Crossing - Bridge Pipe Installation
   Lump Sum — 40,000.00

7. Pump Stations
   2 EA @ $60,000.00/EA — 120,000.00

   Total Construction Cost — $861,600.00

B. Annual Operation @ 700,000 GPD

   2 Stations @ 6.72 Hrs./Day @ 1,736 Gal/Min
   @ 115 HP @ $.05/KwHr

   Annual Electric Cost — 20,604.00

C. Maintenance

   Same as Other Option (Annual) — $ 3,472.00

   Total Annual O&M — $ 24,076.00

   Present Worth

   861,600.00 + 9.82 (24,076) = — $1,098,026.00

Any plans to abandon the present treatment plant should result in substantial labor savings that should be accounted for.

V. CONCLUSIONS AND RECOMMENDATIONS

We feel that unless steps can be taken to limit increases in Camp Johnson's wastewater volume, steps should be taken to accommodate larger flows by expansion of the present plant, if allowable by the State, or conveyance of the untreated wastewater to a central treatment location. As stated earlier, this might not be necessary if frequent flow violations can be tolerated; however, we feel that the Base will not tolerate these infractions.

Unfortunately, the State cannot offer guidance on the feasibility of expanding the present Hadnot Point Treatment Plant until dilution capabilities of the New River are better quantified. This guidance will hopefully be available in the spring of 1989. Until this information is available we do not feel that evaluation of alternatives will be meaningful on any other than a preliminary basis. We suggest that the following preparations be made in the interim period so that intelligent choices may be made when guidance is received by the State.

1. Petition the State for tentative permission to expand the Camp Johnson Plant and ascertain what such permission would require (i.e. extension of the present outfall).

2. Research upcoming capital costs that will be necessary to keep all present plants in compliance, including costs to maintain or improve other facilities that might become obsolete if a consolidation of Base flows is implemented.

3. Formulate estimates of construction and Operation and Maintenance costs for a centralized treatment facility.

4. Determine the impact on present operator costs and Operation and Maintenance costs of implementing such a plan.

5. Begin negotiations in earnest with Jacksonville and other area New River dischargers to attempt to formulate a plan to centralize area wastewater treatment or at least to allow access to the Base lands so that discharges may reach optimum outfall locations.

6. Make necessary long term budget requests to pave the way for anticipated funding.

7. Investigate any availability of State or Federal Funds for implementation of any desireable plan.

8. Request State verification that present facilities would be allowed to operate out of compliance if a master plan to centralize treatment facilities were being formulated.

In view of the uncertainty of the situation concerning the New River we recommend that nothing be done about upgrading of treatment capabilities until the needed dilution

information is available. This includes implementation of toxicity and phosphorous treatments. If, however, based on our projected flow rates, it is decided that the present plant can handle future flows with the expected flow infractions, we recommend immediate implementation of the toxicity control using chlorination and dechlorination by the addition of sulfur dioxide. As phosphorous controls are mandated, we recommend implementation of chemical settling as outlined previously in this report with its corresponding sludge handling increase.

In any event we recommend immediate implementation of source grease removal as outlined in the previous section. After installation of the equipment, we recommend that the affected sewer lines be inspected closely and pressure cleaned if needed.

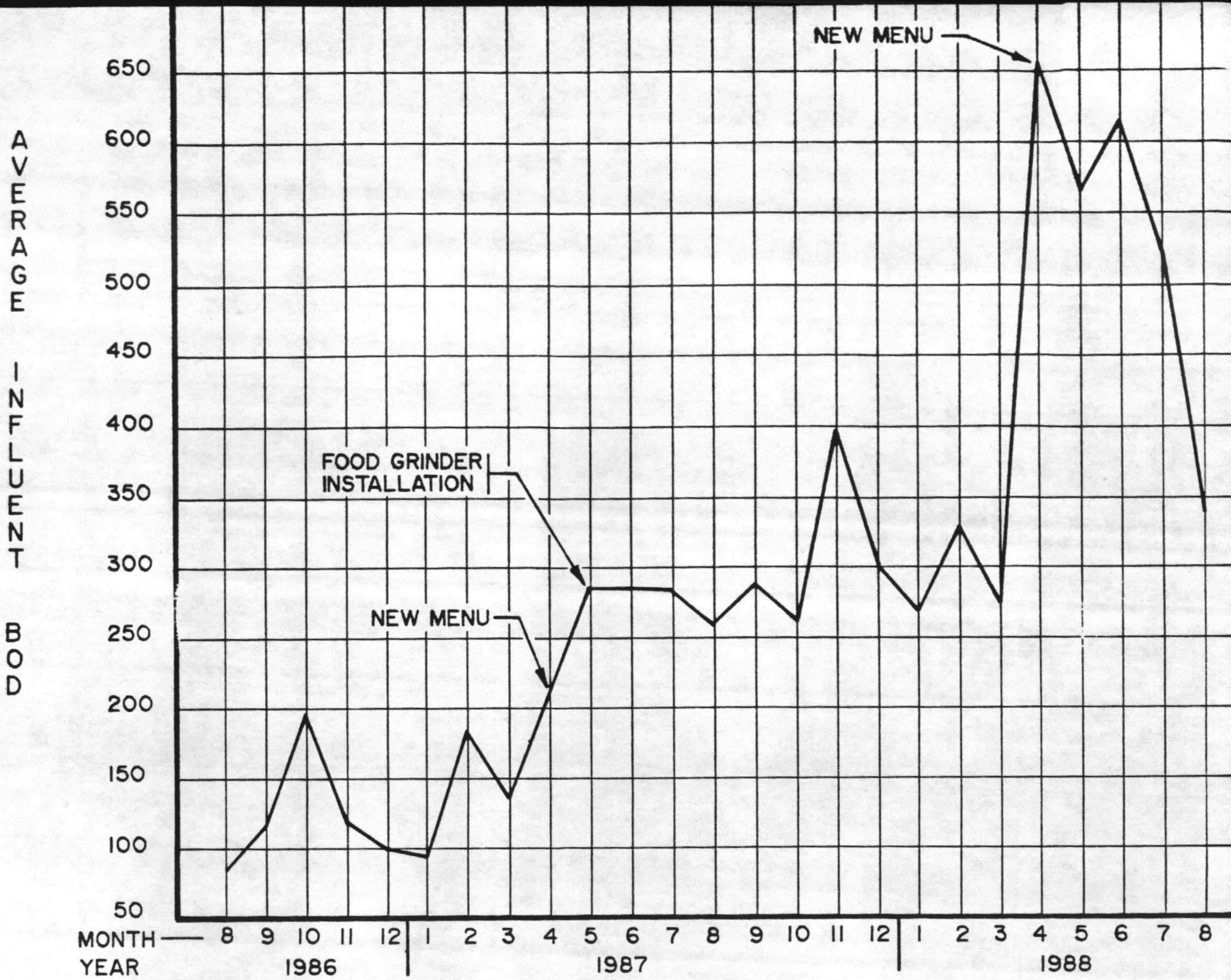
These grease recommendations are based on our conclusion that grease is causing the BOD problem. By way of verification, we feel that it might be enlightening to sample wastewater from the mess hall at strategic times to verify that the high BOD is in fact being caused by the mess hall wastewater. We further recommend that plans for the new mess hall be reviewed to insure that effective grease removal is being addressed.

In closing, it has been our observation that consolidation of wastewater flows to a central treatment location is viewed by everyone as the most desireable long term solution to the wastewater treatment problem of the Base. The State also holds this view and feels that a regional treatment system is extremely desireable. We believe that movement in this direction will be strongly encouraged by the State.

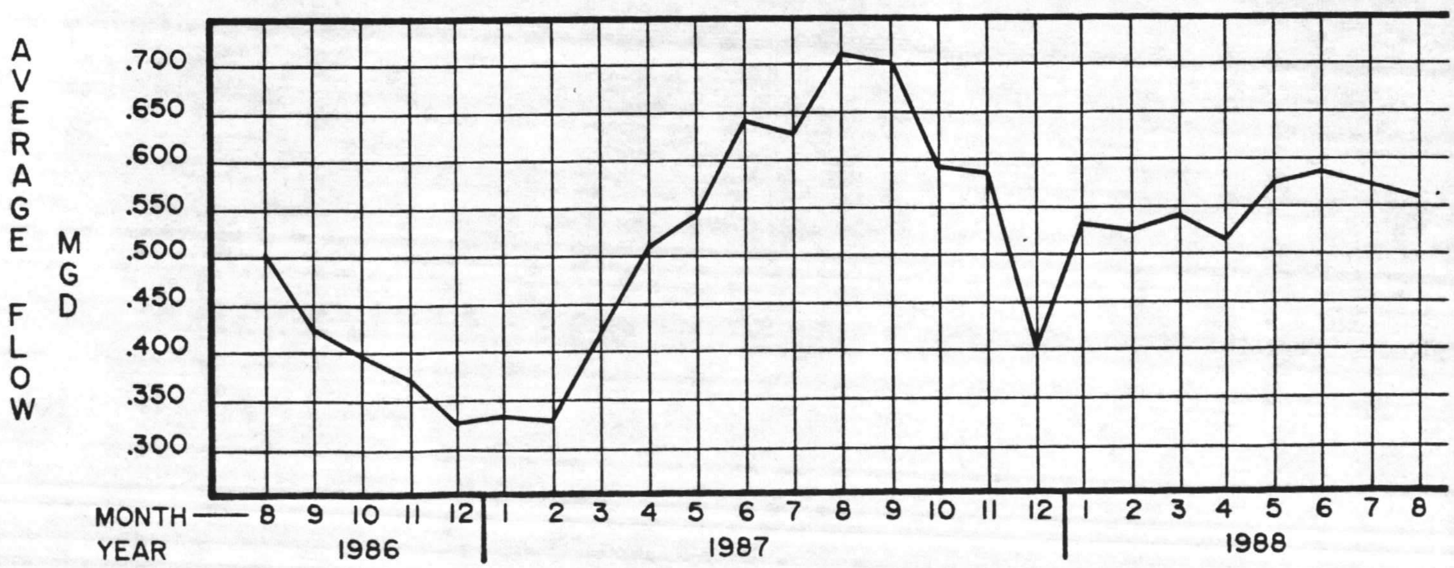
A modern large facility would offer long term savings in treatment costs as well as O&M costs and would offer large benefits to the environment, notably the health of the New River and its tributaries.

We recommend that the Base take a comprehensive look at the advantages and disadvantages of such an approach before spending money on temporary solutions to wastewater problems.

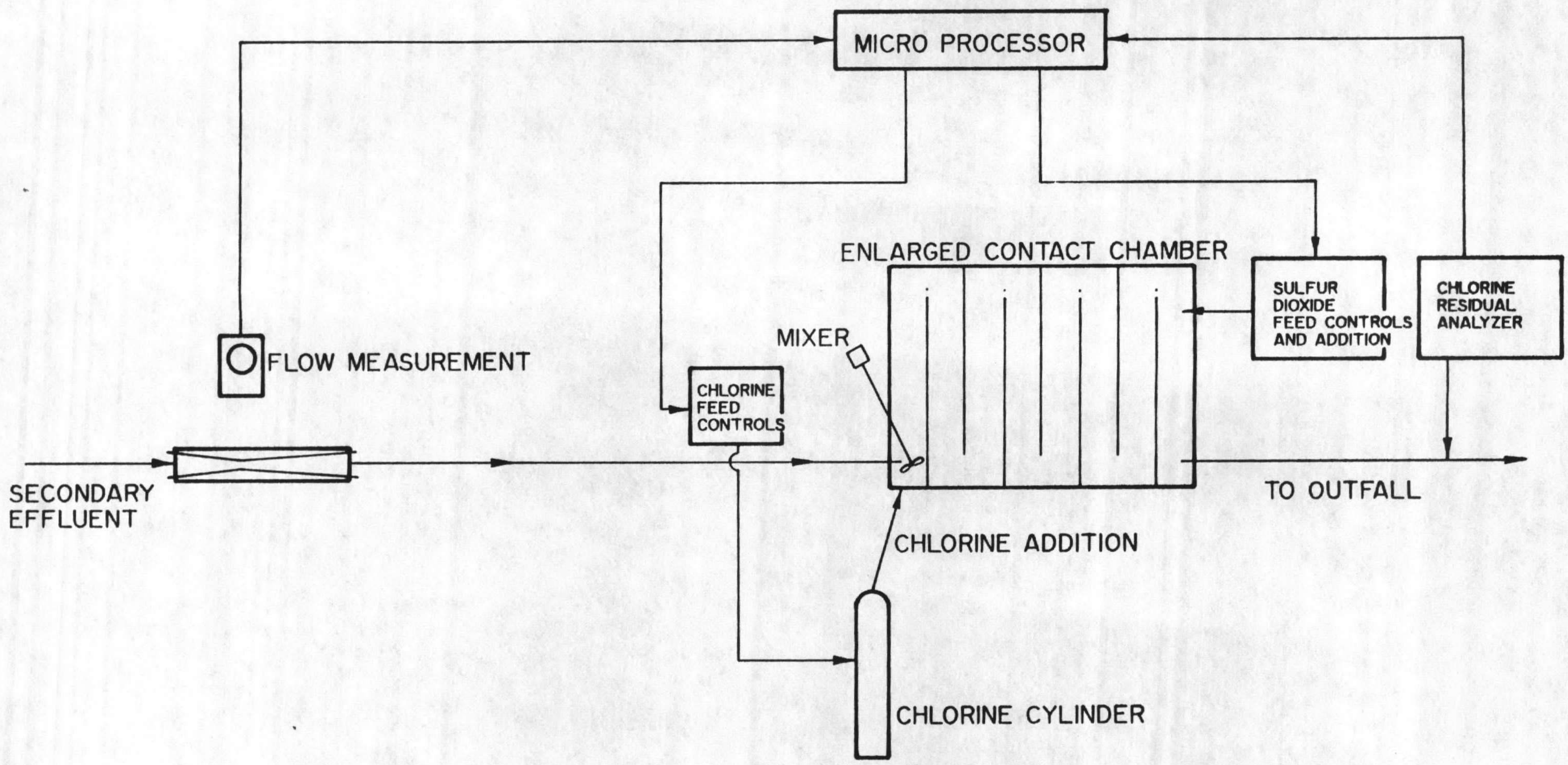
APPENDIX 1



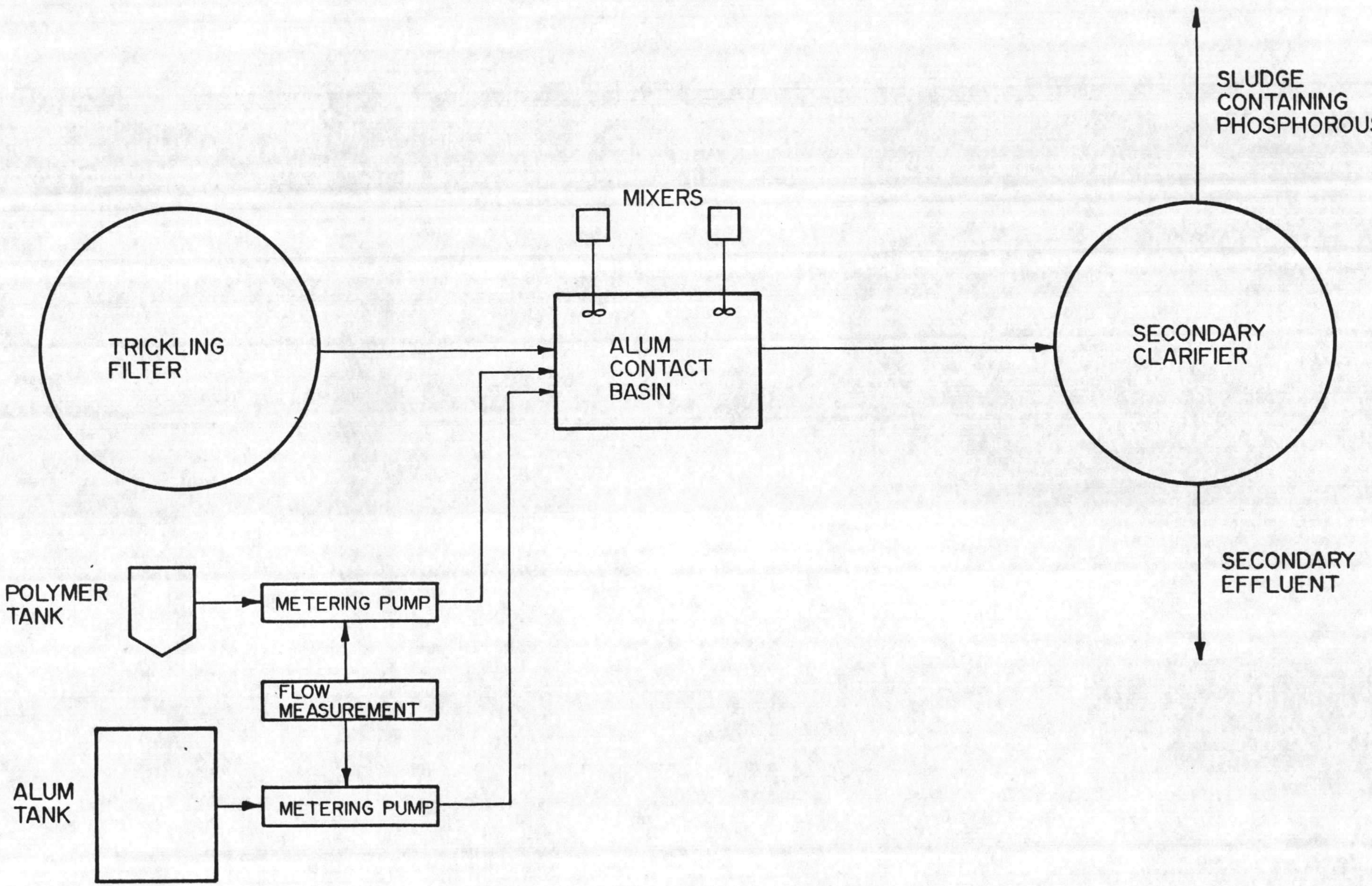
AVERAGE FLOW AND INFLUENT BOD
AT CAMP JOHNSON SEWAGE TREATMENT PLANT



APPENDIX 2



CHLORINATION - DECHLORINATION SCHEMATIC



PHOSPHOROUS REMOVAL SCHEMATIC

APPENDIX 3

PLANT CAMP JOHNSON

MONTH AUGUST 1986

DATE	PLANT EFFLUENT DATA: FLOW TOTAL DAILY MGPD	PH	CHLORINE RESIDUAL: PLANT mg/1	CHLORINE RESIDUAL: LAB mg/1	5 DAY 20° C. BOD: RAW mg/1	5 DAY 20° C. BOD: EFFLUENT mg/1	5 DAY 20° C. BOD: PERCENT REMOVAL	SUSPENDED SOLIDS: RAW mg/1	SUSPENDED SOLIDS: EFFLUENT mg/1	SUSPENDED SOLIDS: PERCENT REMOVAL	COLIFORM: NUMBER PER 100 ml	COLIFORM: GEOMETRIC MEAN
1	.433	6.8	5.0									
2	.444	7.0	4.0									
3	.951	6.7	4.0									
4	.486	6.6	1.0									
5	.700	6.4	4.0	2.3	68	6	91	22	4	82	0	
6	.555	6.6	4.0									
7	.507	6.6	4.0	1.5	64	8	88	34	3	91	0	
8	.478	6.6	4.0									
9	.390	6.8	6.0									
10	.483	6.8	8.0									
11	.550	6.8	2.0									
12	.580	6.8	4.0	3.3	112	8	93	210	4	98	0	
13	.555	6.6	1.5									
14	.528	6.8	1.5	1.6	156	7	96	70	3	96	0	
15	.390	6.8	5.0									
16	.377	6.7	5.0									
17	.444	6.7	6.0									
18	.569	6.4	3.0									
19	.843	6.4	1.5	1.2	64	12	81	196	39	80	82	
20	.713	6.6	5.0									
21	.524	6.8	1.0	0.7	96	13	86	25	4	84	0	
22	.422	6.6	4.0									
23	.446	6.8	4.0									
24	.473	7.0	5.0									
25	.438	6.8	4.0									
26	.590	6.6	5.0	3.1	44	16	64	8	2	75	0	
27	.518	6.6	4.0									
28	.379	6.8	4.0	2.3	96	6	94	130	1	99	0	
29	.311	7.0	5.0									
30	.267	6.8	8.0									
31	.317	6.6	8.0									
Tot.	15.661		130.5		700	76	697	695	60	705		
Ave.	.505		4.2		88	10	87	87	8	88		1.73

Correct
8/13

RESULTS OF COMPLIANCE MONITORING

Plant: Caswell Johnson Month: August Year: 86

INSTRUCTIONS:

1. Each day at approximately ____, collect samples of plant effluent and run each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed ~~And~~ signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	433,000	0930	21°	6.8	5.0	7.1	S.E. Hill
2	[illegible],000	0830	21°	7.0	4.0	6.8	S.E. Hill
3	951,000	0830	21°	[illegible]	4.0	8.[illegible]	S.E. Hill
4	486,000	0830	21°	6.6	1.0	7.[illegible]	S.E. Hill
5	700,000	0830	22°	6.4	4.0	7.7	S.E. Hill
6	555,000	0830	21°	6.6	4.0	7.9	K.C. Norris
7	507,000	0830	21°	6.6	4.0	7.5	K.C. Norris
8	478,000	0830	21°	6.6	4.0	7.2	S.E. Hill
9	390,000	0830	22°	6.8	6.0	8.1	S.E. Hill
10	483,000	0830	23°	6.8	8.0	8.7	S.E. Hill
11	550,000	0930	22°	6.5	2.0	7.0	S.E. Hill
12	580,000	0830	23°	6.8	4.0	7.3	S.E. Hill
13	555,000	0830	23°	6.6	1.5	7.8	S.E. Hill
14	528,000	0830	21°	6.8	1.5	7.6	S.E. Hill
15	390,000	0830	22°	6.8	5.0	7.4	K.C. Norris
16	372,000	0830	22°	6.7	5.0	7.8	K.C. Norris
17	444,000	0830	24°	6.7	6.0	8.1	K.C. Norris
18	569,000	0830	24°	6.4	3.0	7.1	K.C. Norris
19	843,000	0900	23°	6.4	1.5	6.5	S.E. Hill
20	715,000	0830	23°	6.6	5.0	7.4	S.E. Hill
21	524,000	0850	23°	6.8	1.0	7.0	S.E. Hill
22	412,000	0830	24°	6.6	4.0	7.6	S.E. Hill
23	446,000	0830	22°	6.8	4.0	7.8	S.E. Hill
24	473,000	0830	23°	7.0	5.0	8.4	S.E. Hill
25	438,000	0830	22°	6.8	4.0	7.5	S.E. Hill
26	590,000	0830	23°	6.6	5.0	7.5	S.E. Hill
27	518,000	0830	23°	6.6	4.0	8.4	K.C. Norris
28	379,000	0830	23°	6.8	4.0	7.6	K.C. Norris
29	311,000	0830	21°	7.0	5.0	8.2	S.E. Hill
30	267,000	0830	21°	6.8	8.0	9.8	S.E. Hill
31	317,000	0830	21°	6.6	8.0	10.0	S.E. Hill
Total	15,661,000		686	[illegible]	1305	2402	
Ave.	505,193		22°	[illegible]	4.2	7.7	
Max.	951,000		24°	7.0	8.0	10.0	
Min.	267,000		21°	6.4	1.0	6.5	

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/8 (REV. 9-86)

PLANT	NPDES PERMIT NO.	MONTH	YEAR
CAMP JOHNSON		SEPTEMBER	1986

	00310 5 DAY 20°C BOD			00610 Ammonia	00530 Total Suspended Residue			FECAL COLIFORM	00556 OIL + GREASE	00600 TOTAL NITROGEN	00665 TOTAL PHOSPHORUS
DATE	INFLUENT mg/L	EFFLUENT mg/L	%	EFFLUENT mg/L	INFLUENT mg/L	EFFLUENT mg/L	%	EFFLUENT MF/100 ML	EFFLUENT mg/L	EFFLUENT mg/L	EFFLUENT mg/L
1											
2	96	6	94		46	2	96	0			
3									0		
4	132	6	95	0.15	93	4	96	0			
5											
6											
7											
8										8.00	
9	216	8	96		530	3	99	.14			
10											
11	156	6	96		70	2	97				
12											
13											
14											
15											
16	96	7	93		26	3	88	0			
17		---									
18	44	7	84	0.12	30	5	83				
19											
20											
21											
22											
23	36	7	81		LAB	ERROR	---	6			
24									0		
25	164	7	96		84	6	93	0			
26											
27											
28											
29											
30	LAB	ERROR	---		62	1	98'	4500			
31											
TOTAL	940	54		0.27	941	26					
AVERAGE	118	7	94	0.14	118	3	97	6.26	0	8.00	
MAXIMUM	216	8		0.15	530	6		4500	0	8.00	
MINIMUM	36	6		0.12	26	1		0	0	8.00	
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT				—		30		200	30		
TOTAL 1-20	740	40	558		795	19	559				
AVG 1-20	123	7	93		133	3	93				

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: Sept Year: 86

INSTRUCTIONS:
1. Each day at approximately ____, collect samples of plant effluent and run each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.436,000	0830	21°	6.8	6.0	10.6	S.E. Hill
2	.435,000	0830	22°	7.0	2.0	8.3	S.E. Hill
3	.485,000	0830	22°	6.6	1.5	7.5	S.E. Hill
4	.467,000	0830	22°	6.8	1.5	7.5	S.E. Hill
5	.458,000	0830	22	6.7	3.0	7.7	Rebecca E. Norris
6	.417,000	0830	22	6.8	4.0	7.5	Rebecca E. Norris
7	.482,000	0830	23	6.6	4.0	7.6	Rebecca E. Norris
8	.475,000	0830	23	6.7	2.0	7.3	Rebecca E. Norris
9	.469,000	0830	22	6.6	1.5	7.7	S.E. Hill
10	.490,000	0830	23	6.9	1.5	7.8	S.E. Hill
11	.465,000	0830	23	6.8	4.0	7.8	S.E. Hill
[illegible]	.412,000	0830	23°	6.8	2.0	7.4	S.E. Hill
[illegible]	.454,000	0830	23	6.8	5.0	9.3	Stanley E. Hill
[illegible]	.453,000	0830	23°	6.6	6.0	9.5	Stanley E. Hill
15	.451,000	0830	22°	6.8	1.5	7.6	Stanley E. Hill
16	.430,000	0830	23°	6.8	1.5	7.6	Stanley E. Hill
17	.426,000	0830	22	6.8	4.0	7.9	Rebecca E. Norris
18	.423,000	0830	21	6.6	5.0	8.1	Rebecca E. Norris
19	.402,000	0830	22°C	6.5	1.5	8.0	Robert G. Barnett
20	.392,000	0830	21°C	6.4	6.0	8.1	Robert G. Barnett
21	.412,000	0930	22°C	6.5	1.5	7.1	Robert G. Barnett
22	.359,000	0930	22°C	6.6	2.5	8.2	Robert G. Barnett
23	.379,000	0830	22°C	6.4	3.0	8.0	Robert G. Barnett
24	.386,000	0830	22°C	6.6	5.0	7.6	Robert G. Barnett
25	.366,000	1000	23°C	6.6	6.0	8.1	Robert G. Barnett
26	.385,000	0830	24	6.8	5.0	7.5	Rebecca E. Norris
27	.254,000	0830	24	6.7	4.0	7.8	Rebecca E. Norris
28	.522,000	0830	24	6.9	4.0	6.5	Rebecca E. Norris
29	.385,000	0830	23	6.6	3.0	7.5	Rebecca E. Norris
30	.417,000	0830	23	6.8	4.0	8.2	Stanley E. Hill
31							
Total	12777000		673	[illegible]	101.5	237.3	Stephen V. Crews
Ave.	.425900		22		3.4	7.9	Stephen V. Crews
Max.	.522,000		24	7.0	6.0	10.6	Stephen V. Crews
Min.	.254000		21	6.4	1.5	6.5	Stephen V. Crews

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/A (REV. 9-86)

PLANT	NPDES PERMIT NO.	MONTH	YEAR
CAMP JOHNSON STP	NC0003239	October	1986

	00310 5 DAY 20°C BOD			00610 AMMONIA	00530 TOTAL SUSPENDED RESIDUE			COLIFORM	00556 OIL + GREASE	00600 TOTAL NITROGEN	00665 TOTAL PHOSPHORUS
DATE	INFLUENT mg/L	EFFLUENT mg/L	%	EFFLUENT mg/L	INFLUENT mg/L	EFFLUENT mg/L	%	EFFLUENT MF/100 ml	EFFLUENT mg/L	EFFLUENT mg/L	EFFLUENT mg/L
1									1.8		
2	44	7	84	0.88	30	3	90	12			
3											
4											
5											
6											
7	156	19	88		50	4	92	6			
8											
9	80	7	91		48	3	94	8			
10											
11											
12											
13											
14	68	4	94		108	5	95	4			
15											
16	76	10	87	1.7	43	4	91	0			
17											
18											
19											
20									1.0		
21	112	8	93		162	8	95	12			
22											
23	76	12	84		28	7	75	0			
24											
25											
26											
27											
28	72	10	86		28	1	96	2			
29											
30	180	9	95	0.36	82	3	96	6			
31											
TOTAL	864	86		2.94	579	38			2.8		
AVERAGE	96	10	90	0.98	64	4	94	4.1	1.4		
MAXIMUM	180	19		1.7	162	8		12	1.8		
MINIMUM	44	4		0.36	28	1		0	1.0		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30		—		30		70	30		

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: October Year: 1986

RUCTIONS:
Each day at approximately ____, collect samples of plant effluent and run each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed ~~and~~ signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	371,000	0830	24	7.0	4.0	8.3	Stanley E. Hill
2	453,000	0830	24	7.0	4.0	7.4	Stanley E. Hill
3	347,000	0830	23	6.8	1.5	7.2	Stanley E. Hill
4	462,000	0830	23	6.9	8.0	9.2	Stanley E. Hill
5	467,000	0830	24	6.8	6.8	8.4	Stanley E. Hill
6	391,000	0830	23	6.8	3.0	7.6	Stanley E. Hill
7	391,000	0830	23	6.8	1.5	8.0	Stanley E. Hill
8	342,000	0830	22	6.8	4.0	7.9	Rebecca E. Norris
9	306,000	0830	22	6.8	3.0	8.2	Rebecca E. Norris
10	429,000	0900	22	7.0	2.0	7.1	Stanley E. Hill
11	371,000	0830	20	6.7	8.0	10.0	Stanley E. Hill
[illegible]	357,000	0830	20	6.8	5.0	9.1	Stanley E. Hill
[illegible]	399,000	0830	22	6.8	8.0	10.1	Stanley E. Hill
14	372,000	0830	23	6.8	2.0	7.4	Stanley E. Hill
15	575,000	0830	22	6.8	2.5	7.6	Stanley E. Hill
16	435,000	0830	21	6.8	4.0	8.6	Stanley E. Hill
17	344,000	0830	20	6.8	4.0	8.9	Rebecca E. Norris
18	344,000	0830	20	6.9	4.0	8.7	Rebecca E. Norris
19	406,000	0830	19	6.8	3.0	9.1	Rebecca E. Norris
20	376,000	0830	19	7.0	3.0	8.9	Rebecca E. Norris
21	395,000	0830	18°	7.0	5.0	9.4	Stanley E. Hill
22	404,000	0830	18°	6.8	4.0	8.2	Stanley E. Hill
23	394,000	0850	19°	6.9	4.0	8.0	Stanley E. Hill
24	390,000	0830	20°	6.9	5.0	8.1	Stanley E. Hill
25	323,000	0850	21°	6.9	5.0	7.7	Stanley E. Hill
26	430,000	0830	21°	6.8	6.0	8.2	Stanley E. Hill
27	439,000	0830	20°	7.0	5.0	8.6	Stanley E. Hill
28	421,000	0830	20°	7.0	5.0	8.6	Stanley E. Hill
29	432,000	0830	19°	6.8	4.0	8.4	Rebecca E. Norris
30	377,000	0830	20	6.7	6.0	8.3	Rebecca E. Norris
31	316,000	0830	18°	7.0	1.5	7.6	Stanley E. Hill
Total	12259,000				~~133~~	2472	McArthur Farrow
Ave.	~~395,451~~				4.2	7.9	McArthur Farrow
Max.	~~462,000~~				8.0	10.1	McArthur Farrow
Min.	306,000				1.5	7.1	McArthur Farrow

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

395,452

575,000

131.0

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
NCBCL 11345/8 (REV. 9-86)

PLANT	NPDES PERMIT NO.	MONTH	YEAR
CAMP JOHNSON	NC0003239	November	1986

DATE	00310 5 DAY 20°C BOD INFLUENT mg/L	EFFLUENT mg/L	%	00610 AMMONIA EFFLUENT mg/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT mg/L	EFFLUENT mg/L	%	COLIFORM EFFLUENT MF/100 ml	00556 OIL + GREASE EFFLUENT mg/L	00600 TOTAL NITROGEN EFFLUENT mg/L	00665 TOTAL PHOSPHORUS EFFLUENT mg/L
1											
2											
3											
4	116	10	91		.50	1	98	0			
5									0.9		
6	48	9	81		56	5	91	6			
7											
8											
9											
10											
11	324	12	96		380	4	99	0			
12											
13	84	7	92	2.57	36	3	92	0			
14											
15											
16											
17											
18	176	10	94		44	1	98	0			
19											
20	172	11	94		32	2	94	0			
21											
22											
23											
24											
25	LE	LE	LE		24	2	92	0			
26											
27	64	9	86	0.13	40	4	90	12			
28									0		
29											
30											
31											
TOTAL	984	68		2.70	662	22			0.9		
AVERAGE	[redacted]	9	93	1.35	83	3	96	1.71	0.5		
MAXIMUM	324	12		2.57	380	5		12	0.9		
MINIMUM	48	7		0.13	24	1		6	0		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30		--		30		200	30		

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: November Year: 86

INSTRUCTIONS:
Each day at approximately ____, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.112,000	0830	20°	7.0	4.0	8.1	Stanley E Hill
2	.440,000	0830	22°	7.0	1.5	7.3	Stanley E Hill
3	.438,000	0830	19°	7.0	5.0	8.0	Stanley E Hill
4	.413,000	0830	18°	7.0	[illegible]	8.6	Stanley E Hill
5	.384,000	0900	20°	7.0	[illegible]	8.0	Stanley E Hill
6	492,000	0830	21°	7.0	[illegible]	7.6	Stanley E Hill
7	388,000	0830	21°	7.1	4.0	7.8	Rebecca E. Norris
8	.346,000	0830	22°	7.2	3.0	7.6	Rebecca E. Norris
9	410,000	0830	22°	7.0	4.0	7.4	Rebecca E. Norris
10	.364,000	0830	21°	7.1	4.0	7.9	Rebecca E. Norris
11	.435,000	0830	19°	7.0	5.0	9.1	Stanley E Hill
12	.381,000	0830	20°	7.0	6.0	8.3	Stanley E Hill
13	.426,000	0830	18°	7.0	4.0	8.5	Stanley E Hill
	.463,000	0830	17°	7.1	4.0	8.7	Stanley E Hill
	.498,000	0830	17°	7.0	4.0	8.7	Stanley E Hill
16	.379,000	0830	17°	7.0	5.0	9.1	Stanley E Hill
17	.296,000	0830	20°	7.1	5.0	8.2	Stanley E Hill
18	.292,000	0830	19°	7.1	4.0	8.5	Stanley E Hill
19	.423,000	0830	19°	7.0	5.0	8.5	Rebecca E. Norris
20	.305,000	0830	18°	7.0	4.0	8.5	Rebecca E. Norris
21	.375,000	0830	17°	7.1	4.0	8.0	Stanley E Hill
22	.404,000	0830	17°	7.0	1.5	7.8	Stanley E Hill
23	.300,000	0830	19°	7.2	3.0	8.2	Stanley E Hill
24	.374,000	0830	20°	7.0	4.0	7.6	Stanley E Hill
25	.527,000	0830	20°	7.0	4.0	8.3	Stanley E Hill
26	325,000	0830	20°	7.0	0.4	7.1	Stanley E Hill
27	343,000	0830	19°	7.0	4.0	7.9	Stanley E Hill
28	.343,000	0830	19°	7.0	5.0	7.5	Rebecca E. Norris
29	.346,000	0830	19°	6.9	3.0	7.6	Rebecca E. Norris
30	.291,000	0830	17°	6.8	6.0	8.2	Rebecca E. Norris
31							
Total	11,198,000 ← 11.403		555°	[illegible]	119.4	242.4	McArthur Farrow
Ave.	~~373,266~~ ← .380		18°	[illegible]	3.9	8.0	McArthur Farrow
Max.	527,000	0900	22°	7.2	6.0	9.1	McArthur Farrow
Min.	~~291,000~~ .112	0830	17°	6.8	0.4	7.3	McArthur Farrow

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/1 (REV. 9-86)

PLANT				NPDES PERMIT NO.				MONTH		YEAR
CAMP JOHNSON				NC0003239				DECEMBER		1986

DATE	00310 5 DAY 20°C BOD INFLUENT mg/L	EFFLUENT mg/L	%	00610 AMMONIA EFFLUENT mg/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT mg/L	EFFLUENT mg/L	%	FECAL COLIFORM EFFLUENT MF/100 ML	00556 OIL & GREASE EFFLUENT mg/L	00600 TOTAL NITROGEN EFFLUENT mg/L	00665 TOTAL PHOSPHORUS EFFLUENT mg/L
1											
2	108	18	(83)		76	10	87	2			
3											
4	160	11	93		32	2	94	0			
5											
6											
7											
8											
9	140	12	91		82	4	95	0			
10											
11	84	7	92		28	1	96	0			
12											
13											
14											
15											
16	88	7	92		40	1	98	10			
17											
18	LAB	ERROR	–		20	1	95	12			
21											
22	48	10	(79)		30	6	(80)	6			
23	108	12	89		48	4	92	4			
24											
25											
26											
27											
28											
29											
30	56	8	86		33	4	88	2			
31											
TOTAL	792	85			389	33					
AVERAGE	99	11	89		43	4	92	2.83 G.M.			
MAXIMUM	160	18			82	10		12			
MINIMUM	48	7			20	1		0			
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30		—		30		200	30		

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: December Year: 86

INSTRUCTIONS:

[illegible] Each day at approximately ____, collect samples of plant effluent and [illegible] each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	346,000	0830	17	6.8	5.0	8.9	Rebecca E. Morris
2	503,000	0830	20	7.0	3.0	8.1	Stanley E Hill
3	[illegible]	0830	18°	7.0	5.0	8.6	Stanley E Hill
4	333,000	0830	17°	7.1	4.0	8.6	Stanley E Hill
5	451,000	0830	16°	7.0	4.0	8.5	Stanley E Hill
296 6	296,000	0830	16°	7.0	5.0	8.6	Stanley E Hill
7	330,000	0850	17°	7.0	5.0	9.3	Stanley E Hill
8	317,000	0830	17°	7.1	5.0	8.7	Stanley E Hill
341 9	341,000	0830	18°	7.2	4.0	8.7	Stanley E Hill
10	312,000	0830	19°	6.9	5.0	8.3	Rebecca E. Morris
11	340,000	0830	18°	7.2	4.0	8.3	Rebecca E. Morris
12	311,000	0830	17°	7.1	4.0	8.7	Stanley E Hill
45 13	446,000	0830	17°	7.0	4.0	9.0	Stanley E Hill
[illegible]	252,000	0900	16°	7.2	0.2	8.6	Stanley E Hill
[illegible]	340,000	0830	18°	7.0	4.0	8.7	Stanley E Hill
45 16	343,000	0830	16°	7.1	4.0	9.1	Stanley E Hill
17	344,000	0830	17°	7.0	4.0	8.8	Stanley E Hill
18	359,400	0830	18°	7.0	4.0	8.6	Stanley E Hill
19	326,100	0830	15	6.9	4.0	8.9	Rebecca E. Morris
20	345,400	0830	14	7.0	3.0	8.8	Rebecca E. Morris
21	352,600	0830	14	6.8	4.0	9.1	Rebecca E. Morris
22	327,900	0830	13	6.8	3.0	9.3	Rebecca E. Morris
23	344,500	0830	17°	7.0	3.0	9.5	Stanley E Hill
24	346,000	0830	18°	7.0	1.5	8.6	Stanley E Hill
25	331,000	0830	20°	7.1	1.5	8.4	Stanley E Hill
26	327,000	0830	19°	6.4	4.0	9.5	Stanley E Hill
27	345,000	0830	17°	7.0	2.0	9.1	Stanley E Hill
28	342,000	0830	16°	7.0	4.0	9.4	Stanley E Hill
29	343,000	0830	15°	7.0	1.5	9.1	Stanley E Hill
30	342,200	0830	16°	7.1	4.0	9.3	Stanley E Hill
31	340,300	0830	15°	6.4	3.0	8.9	Robert E. Barnett
Total	~~10,722,400~~	~~0830~~	~~524~~	[illegible]	112.7	274.2	Johnny Taylor
Ave.	~~345,884~~		16.8	[illegible]	3.6	8.8	Johnny Taylor
Max.	503,000		20°	7.2	5.0	9.5	Johnny Taylor
Min.	252,000		13°	6.4	0.2	8.1	Johnny Taylor

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

OK

.3348

10,3374

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/A (REV. 9-86)

PLANT	NPDES PERMIT No.	MONTH	YEAR
CAMP JOHNSON	NC0003239	January	1987

DATE	00310 5 DAY 20°C BOD Influent mg/L	00310 5 DAY 20°C BOD Effluent mg/L	00310 5 DAY 20°C BOD %	00610 Ammonia Effluent mg/L	00530 Total Suspended Residue Influent mg/L	00530 Total Suspended Residue Effluent mg/L	00530 Total Suspended Residue %	Fecal Coliform Effluent MF/100 ml	00556 Oil + Grease Effluent mg/L	00600 Total Nitrogen Effluent mg/L	00665 Total Phosphorus Effluent mg/L
1	64	10	84		154	17	89	0			
2											
3											
4											
5											
6	28	16	50		22	6	73	4			
7											
8	84	15	82	5.0	130	6	98	0			
9											
10											
11											
12											
13	128	18	86		92	6	93	0			
14											
15	80	15	81		38	6	84	0			
16											
17											
18											
19	96	15	84	1.0	230	9	96	0			
20											
21											
22											
23	76	18	76	4.8	114	10	95	4			
24											
25											
26	208	17	92	3.9	516	10	98	6			
27											
28											
29											
30	84	27	68	5.6	36	8	78				
31											
TOTAL	84[illegible]	151		20.3	1332	78					
AVERAGE	94	17	82	4.1	148	9	94	1.77			
MAXIMUM	203	27		5.6	516	17		6			
MINIMUM	28	10		1.0	22	6		0			
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30		—		30		200	30		

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: January Year: 1987

INSTRUCTIONS:

1. Each day at approximately ___, collect samples of plant effluent and run each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.332,300	0830	16°C	6.6	4.5	9.2	Robert E Barnett
2	.326,400	0815	16°C	6.6	3.0	8.6	Tom D. Kennedy
3	.324,100	0800	16°C	6.6	4.0	9.0	Tom D Kennedy
4	.381,500	0840	1[illegible]	6.6	6.0	9.2	Tom D Kennedy
5	.340,000	0815	15	6.7	4.0	9.0	Pamela C Snodgrass
6	.345,000	0830	15.0	6.9	6.0	9.4	Stanley E Hill
7	.365,400	0830	16°	7.1	4.0	9.5	Stanley E Hill
8	.356,800	1015	16°	7.1	5.0	9.5	Stanley E Hill
9	.325,000	0830	15°	6.9	4.0	9.6	Rebecca E. Norris
10	.342,600	0830	16	7.0	3.0	9.5	Rebecca E. Norris
11	.331,000	0830	15	6.9	4.0	9.2	Rebecca E. Norris
12	.327,000	0830	15	7.1	4.0	9.6	Rebecca E. Norris
	.341,000	0830	15.0	7.1	4.0	9.1	Stanley E Hill
	.339,100	0830	16°	7.0	5.0	9.4	Stanley E Hill
15	.347,000	0830	18	6.9	6.0	9.2	Michael J. Vincent
16	344,000	0830	17	7.1	4.0	8.7	Stanley E Hill
17	326,000	0830	17°	6.9	4.0	9.1	Stanley E Hill
18	326,000	0830	17°	7.0	4.0	9.5	Stanley E Hill
19	.344,000	0830	18°	7.0	1.5	8.6	Stanley E Hill
20	348,000	0830	18°	7.2	6.0	8.1	Stanley E Hill
21	341,400	0830			4.0		Rebecca E. Norris
22	333,000	0830			2.0		Rebecca E. Norris
23	.345,000	0830	17°	7.3	2.5	8.4	Stanley E Hill
24	.337,000	0830			4.0		Stanley E Hill
25	.336,000	0830			5.0		Stanley E Hill
26	.340,000	0830	15.0	7.0	4.0	9.6	Stanley E Hill
27	.337,000	0830			5.0		Stanley E Hill
28	343,000	0830			3.0		Stanley E Hill
29	.341,500	0830			4.0		Stanley E Hill
30	.339,600	0800	16°	6.7	4.0	9.0	Carl C Valentine
31	.337,800	0830			5.0		Rebecca E. Norris
Total	~~10,543,500~~	~~[illegible]~~		[illegible]	123	211	
Ave.	~~340,113~~	~~[illegible]~~		[illegible]	4.0	9.2	
Max.	381,500			7.3	6.0	9.6	
Min.	324,100			6.6	1.5	8.1	

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
NCBCL 11345/1 (REV. 9-86)

PLANT	NPDES PERMIT NO.	MONTH	YEAR
CAMP JOHNSON	NC0063011	FEB.	1987

DATE	00310 5 DAY 20°C BOD Influent mg/L	00310 5 DAY 20°C BOD Effluent mg/L	%	00610 Ammonia Effluent mg/L	00530 Total Suspended Residue Influent mg/L	00530 Total Suspended Residue Effluent mg/L	%	Fecal Coliform Effluent MF/100 ml	00556 Oil & Grease Effluent mg/L	00600 Total Nitrogen Effluent mg/L	00665 Total Phosphorus Effluent mg/L
1											
2	204	22	89	5.2	96	8	92	0			
3											
4											
5											
6	128	26	80	5.3	190	8	96	0			
7											
8											
9	204	23	89	4.2	218	5	98	0			
10											
11											
12											
13	96	28	71	7.1	104	9	91	0			
14											
15											
16				1.4							
17	172	18	90		78	11	86	0			
18											
19											
20	156	37	76	6.5	45	10	78	0			
21											
22											
23	128	28	94	5.3	74	13	82	0			
24											
25											
26											
27	204	37	82	6.7	98	12	88	0	0		
28											
29											
30											
31											
TOTAL	1448	219		41.7	903	76			0		
AVERAGE	181	27	85	5.2	113	10	91	0	0		
MAXIMUM	204	37		7.1	218	13		0	0		
MINIMUM	96	18		1.4	45	5		0	0		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30		NL		30		[illegible]	30		

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: February Year: 1997

INSTRUCTIONS:
Each day at approximately ___, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	354,200				3.0		Rebecca E. Norris
2	340,000		18	7.0	4.0	8.9	Rebecca E. Norris
3	347,000				5.0		Stanley E Hill
4	344,000				5.0		Stanley E Hill
5	333,000				4.0		Stanley E Hill
6	348,000	0830	17	6.9	4.0	9.0	Stanley E Hill
7	226,100				4.0		Stanley E Hill
8	345,700				0.2		Stanley E Hill
9	341,000	0830	16	7.0	4.0	9.6	Stanley E Hill
10	338,000				5.0		Rebecca E Norris
11	348,500				4.0		Rebecca E. Norris
12	346,800				2.5		Stanley E Hill
13	361,500	0830	16	7.0	4.0	8.7	Stanley E Hill
[illegible]	309,700				4.0		Stanley E Hill
[illegible]	264,800				4.0		Stanley E Hill
16	389,500	0830	15	7.1	4.0	10.2	Stanley E Hill
17	318,000				4.0		Stanley E Hill
18	374,600				4.0		Stanley E Hill
19	298,200				4.0		Stanley E Hill
20	337,900	0830	14	6.9	4.0	9.7	Rebecca E. Norris
21	348,000	0830			4.0		Rebecca E. Norris
22	325,800	0830			4.0		Rebecca E. Norris
23	339,000	0830	15	6.8	5.0	7.3	Rebecca E. Norris
24	338,900				4.0		Stanley E Hill
25	359,100				4.0		Stanley E Hill
26	330,900				4.0		Stanley E Hill
27	350,300	0830	15	7.0	4.0	9.3	Stanley E Hill
28	365,100				4.0		Stanley E Hill
29							
30							
31							
Total	9.4236		126	[redacted]	111.7	74.7	
Ave.	.3366		16	[redacted]	4.0	9.3	
Max.	.3651		18	7.1	5.0	10.2	
Min.	.2648		14	6.8	0.2	8.7	

I hereby certify that the data contained herein was obtained by tests run qualified personnel in accordance with all applicable procedures and related quality control.

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL : 6415/6 (REV. 9-86)

PLANT				NPDES PERMIT NO.				MONTH		YEAR	
CAMP JOHNSON				NC0063011				MARCH		1987	

DATE	00310 5 DAY 20°C BOD Influent mg/L	00310 5 DAY 20°C BOD Effluent mg/L	%	00610 Ammonia Effluent mg/L	00530 Total Suspended Residue Influent mg/L	00530 Total Suspended Residue Effluent mg/L	%	Coliform Effluent MF/100 ml	00556 Oil & Grease Effluent mg/L	00600 Total Nitrogen Effluent mg/L	00665 Total Phosphorus Effluent mg/L
1											
2	184	16	91	2.4	206	11	95	0			
3											
4											
5											
6	84	17	80	4.9	72	6	92	0			
7											
8											
9	156	13	92	4.3	168	8	95	0			
10											
11									0		
12											
13	120	15	88	5.4	48	8	83	0			
14											
15											
16	116	12	90	5.2	48	6	88	0			
17											
18											
19											
20	145	16	89	5.7	192	6	97	2			
21											
22											
23	56	12	78	4.7	26	9	65	0	6.2		
24											
25											
26											
27	124	18	85	7.1	150	7	95	4			
28											
29											
30	236	16	93	6.3	260	8	97	0			
31											5.2
TOTAL	1221	135		46.0	1170	69			62		5.2
AVERAGE	136	15	89	5.1	130	9	93	1.30 GM	3.1		5.2
MAXIMUM	236	18		7.1	260	11		4	6.2		5.2
MINIMUM	56	12		2.4	26	6		0	0		5.2
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		14.0	30		

C.J.

RESULTS OF COMPLIANCE MONITORING

Plant: CAMP JOHNSON Month: MARCH Year: 1987

INSTRUCTIONS:

. Each day at approximately ___, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.
Record actual time tests were run in column 3.
. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
. Completed and signed forms will be returned to NREAD not later than the th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1					7.0		Stanley E Hill
2		0830	17	7.1	2.0	8.7	Stanley E Hill
3		0830			4.0		Rebecca E Norris
4		0830			5.0		Rebecca E Norris
5		0830			4.0		Stanley E Hill
6		0830	16°	7.0	4.0	8.9	Stanley E Hill
7	SEE OTHER SHEET				4.0		Stanley E Hill
8					4.0		Stanley E Hill
9		0830	17°	7.0	4.0	8.1	Stanley E Hill
10					5.0		Stanley E Hill
11					4.0		Stanley E Hill
12					4.0		Stanley E Hill
13		0830	15	6.8	4.0	8.9	Rebecca E Norris
14		0830			5.0		Rebecca E Norris
15		0830			4.0		Rebecca E Norris
16		0830	16°	6.8	4.0	9.4	Rebecca E Norris
17					4.0		Stanley E Hill
18					4.0		Stanley E Hill
19					4.0		Stanley E Hill
20		0830	16°	7.0	4.0	9.5	Stanley E Hill
21					4.0		Stanley E Hill
22					4.0		Stanley E Hill
23		0830	17°	7.0	2.5	9.3	Stanley E Hill
24		0830			0.0		Rebecca E Norris
25		0830			5.0		Rebecca E Norris
26					5.0		Rebecca E Norris
27		0830	19°	6.9	4.0	7.7	Stanley E Hill
28					6.0		Stanley E Hill
29					8.0		Stanley E Hill
30		0845	19°	7.1	4.0	8.0	[illegible]
31					8.0		Stanley E Hill
Total			152	[redacted]	128.5	78.5	
Ave.			17	[redacted]	4.1	8.7	
Max.			19	7.1	8.0	9.5	
Min.			16	6.8	0.0	7.7	

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
NCBCL 11345/A (REV. 9-86)

PLANT CAMP JOHNSON	NPDES PERMIT No. NC0063011	MONTH APRIL	YEAR 1987

DATE	00310 5 DAY 20°C BOD Influent mg/L	Effluent mg/L	%	00610 Ammonia Effluent mg/L	00530 Total Suspended Residue Influent mg/L	Effluent mg/L	%	F Coliform Effluent MF/100 ml	00556 Oil & Grease Effluent mg/L	00600 Total Nitrogen Effluent mg/L	00665 Total Phosphorus Effluent mg/L
1											
2											
3	340	26	92	10.2	126	12	90	2			
4											
5											
6	200	15	93	6.6	134	14	90	0			
7											
8									5.7		
9											
10	152	21	86	0.12	182	16	91	0			
11											
12											
13	208	13	94	6.1	102	9	91	0			
14											
15											
16											
17	176	19	89	8.2	116	7	94	0			
18											
19											
20	180	10	94	3.3	82	4	95	0			4.6
21											
22											
23											
24	368	18	94	6.8	214	7	97	0			
25											
26											
27	150	14	91	4.6	246	6	97	0	0.3		
28											
29											
30											
31											
TOTAL	1714	136		45.9	1202	75		-	6.0		4.6
AVERAGE	214	17	92	5.7	150	9	94	1.09	3.0		4.6
MAXIMUM	340	26		10.2	246	16		2	5.7		4.6
MINIMUM	152	10		0.12	82	4		0	0.3		4.6
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		14	30		

INSTRUCTIONS:

1. Complete this form in ink, neatly and clearly or it will be typed.
2. Head the form with plant name, permit number, month & year. Indicate Total or Fecal Coliform heading. Add the appropiate monthly limits at the bottom.
3. At the end of the month, calculate totals, averages, maximums and minimums.
4. Submit completed forms to laboratory supervisor by the 10th of the following month.

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson   Month: April   Year: 1987

INSTRUCTIONS:

1. Each day at approximately ___, collect samples of plant effluent and [illegible] each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed ~~and~~ signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	324800				4.0		Stanley E. Hill
2	319300				5.0		Stanley E. Hill
3	334000	0830	15	6.9	4.0	8.9	Rebecca E. Norris
4	342300	0830			5.0		Rebecca E. Norris
5	326000	0830			4.0		Rebecca E. Norris
6	327600	0830	16°	6.8	5.0	8.6	Rebecca E. Norris
7	331800	0830			5.0		Stanley E. Hill
8	533000				4.0		Stanley E. Hill
9	614000				4.0		Stanley E. Hill
10	604000	0830	17°	7.0	4.0	8.5	Stanley E. Hill
11	522000				6.0		Stanley E. Hill
12	~~758700~~ 587,000	08			8.0		Stanley E. Hill
13	562000	~~0830~~	18°	7.0	2.0	7.4	Stanley E. Hill
[illegible]	504000	0830			4.0		Rebecca E. Norris
[illegible]	677000	0830			3.0		Rebecca E. Norris
16	616000				4.0		Stanley E. Hill
17	649000	0830	18°	7.0	4.0	8.0	Stanley E. Hill
18	571000				6.0		Stanley E. Hill
19	591000				4.0		Stanley E. Hill
20	644000	0830	19°	7.0	4.0	9.1	Stanley E. Hill
21	744000				4.0		Stanley E. Hill
22	675000				4.0		Stanley E. Hill
23	629000				4.0		Stanley E. Hill
24	628000	0830	18°	6.6	5.0	7.8	Rebecca E. Norris
25	270000	0830			5.0		Rebecca E. Norris
26	533000	0830			5.0		Rebecca E. Norris
27	575000	0830	17°	7.0	4.0	8.2	Rebecca E. Norris
28	555000				4.0		Stanley E. Hill
29	400000				4.0		Stanley E. Hill
30	300000				4.0		Stanley E. Hill
31							
Total	~~15185300~~ 15288800		138	[redacted]	132.0	66.5	McArthur Jones
Ave.	~~506177~~ 509626		17	[redacted]	4.4	8.3	McArthur Jones
Max.	~~677000~~ 744000		19	7.0	8.0	9.1	McArthur Jones
Min.	~~150,400~~ 270000		15	6.6	2.0	7.4	McArthur Jones

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

OK
C.S.

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY

MCBCL 11345/6 (REV. 9-86)

PLANT	NPDES PERMIT No.	MONTH	YEAR
CAMP JOHNSON	NC0063011	MAY	1987

DATE	00310 5 DAY 20°C BOD INFLUENT mg/L	EFFLUENT mg/L	%	00610 AMMONIA EFFLUENT mg/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT mg/L	EFFLUENT mg/L	%	COLIFORM EFFLUENT MF/100 mL	00556 OIL + GREASE EFFLUENT mg/L	00600 TOTAL NITROGEN EFFLUENT mg/L	00665 TOTAL PHOSPHORUS EFFLUENT mg/L
1	324	16	95	6.6	148	7	95	0			
2											
3											
4	810	15	98	4.6	505	5	99	0			
5									2.8		
6											
7											
8	160	14	91	6.0	158	6	96	0			
9											
10											
11	84	10	88	6.6	34	8	76	0			
12											
13											
14											
15	144	17	88	6.4	128	8	94	Cl_2 IN SAMPLE			
16											
17											
18	156	22	86	6.8	100	4	96	0			
19											
20											
21									0.6		
22	116	14	88	6.2	68	7	90	0			
23											
24											
25	HOLIDAY →										
26											
27											
28											
29	467	10	98	2.7	333	3	99	6			
30											
31											
TOTAL	2261	118		45.9	1474	48			3.4		
AVERAGE	283	15	95	5.7	184	6	97	1.29 GM	1.7		
MAXIMUM	467	22		6.8	505	8		6	2.8		
MINIMUM	84	10		2.7	34	3		0	0.6		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		14	30		

INSTRUCTIONS:

1. Complete this form in ink, neatly and clearly or it will be typed.
2. Head the form with plant name, permit number, month & year. Indicate Total or Fecal Coliform heading. Add the appropiate monthly limits at the bottom.
3. At the end of the month, calculate totals, averages, maximums and minimums.
4. Submit completed forms to laboratory supervisor by the 10th of the following month.

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: May Year: 1987

INSTRUCTIONS:
1. Each day at approximately ___, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed ~~and~~ and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	632,000	0930	19	7.0	2.5	7.8	Stanley E Hall
2	535,000				4.0		Stanley E Hall
3	600,000				4.0		Stanley E Hall
4	550,000	0830	20	6.9	4.0	7.8	Stanley E Hall
5	550,000	0815			4.0		Rebecca E. Morris
6	523,000	0700			4.0		Rebecca E. Morris
7	519,000	0815			5.0		Tom H [illegible]
8	607,000	0850	19	6.7	4.0	8.0	Earl C Wardlow
9	160,100	0845			5.0		Roland Hinson
10	537,000	0800			6.0		Roland Hinson
11	574,000	0815	20	6.6	6.0	8.4	Roland Hinson
12	498,000	0830			4.0		ET Charlie Westmoreland
13	554,000	0830			5.0		ET Charlie Westmoreland
14	519,000	0820			5.0		ET Charlie Westmoreland
15	340,000	0830	20	6.6	4.0	7.3	Rebecca E. Morris
16	513,000	0830			4.0		Rebecca E. Morris
17	493,000	0830			4.0		Rebecca E. Morris
18	539,000	0830	21	7.0	3.0	6.1	Rebecca E. Morris
19	619,000				4.0		Stanley E Hall
20	625,000				4.0		Stanley E Hall
21	632,000				4.0		Stanley E Hall
22	611,000	~~[illegible]~~	20	6.7	4.0	6.4	[illegible]
23	576,000	0530	20	6.8	4.0	8.1	[illegible]
24	519,000				4.0		Stanley E Hall
25	536,000				5.0		Stanley E Hall
26	674,000	0830			5.0		Rebecca E. Morris
27	635,000	0830			5.0		Rebecca E. Morris
28	555,000				4.0		Stanley E Hall
29	765,000	0830	23°	6.9	3.0	7.5	Stanley E Hall
30	496,000				4.0		Stanley E Hall
31	665,000				4.0		Stanley E Hall
Total	~~16,784,100~~		182		131.5	67.4	
Ave.	~~541,423~~		20		4.2	7.5	
Max.	765,000		23	7.0	6.0	8.4	
Min.	160,100		19	6.6	2.5	6.1	

I hereby certify that the data contained herein ~~was~~ was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

16,950,200

54,780 CS.

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/6 (REV. 9-86)

PLANT	NPDES PERMIT No.	MONTH	YEAR
CAMP JOHNSON	NC0063011	JUNE	1987

	00310 5 DAY 20°C BOD			00610 AMMONIA	00530 TOTAL SUSPENDED RESIDUE			COLIFORM	00556 OIL & GREASE	00600 TOTAL NITROGEN	00665 TOTAL PHOSPHORUS
DATE	INFLUENT mg/L	EFFLUENT mg/L	%	EFFLUENT mg/L	INFLUENT mg/L	EFFLUENT mg/L	%	EFFLUENT MF/100 mL	EFFLUENT mg/L	EFFLUENT mg/L	EFFLUENT mg/L
1	188	7	97	1.1	120	3	98	0			
2											
3									5.3		
4											
5	573	19	97	3.3	344	9	97	0			
6											
7											
8	324	14	96	1.4	122	6	95	0			2.2
9											
10											
11											
12	276	1	99	3.2	108	11	90	0			
13											
14											
15	200	16	92	5.0	202	6	97	0			
16											
17											
18											
19	324	11	97	6.7	441	5	99	2			
20											
21											
22	345	18	95	2.1	313	6	98	0			
23											
24											
25									0		
26	184	12	93	3.0	182	3	98	0			
27											
28											
29	135	10	93	2.0	102	4	96	0			
30											
31											
TOTAL	2549	108		27.8	1934	53			5.3		2.2
AVERAGE	283	12	96	3.1	215	6	97	1.08	2.7		2.2
MAXIMUM	573	19		6.7	441	11		2	5.3		2.2
MINIMUM	135	1		1.1	102	3		0	0		2.2
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT						30			30		

INSTRUCTIONS:

Complete this form in ink, neatly and clearly or it will be typed.

Head the form with plant name, permit number, month & year. Indicate Total or Fecal n Coliform heading. Add the appropiate monthly limits at the bottom.

3. At the end of the month, calculate totals, averages, maximums and minimums.
4. Submit completed forms to laboratory supervisor by the 10th of the following month.

RE[illegible]LTS OF COMPLIANCE MONITO[illegible]NG

Plant: Camp Johnson Month: June Year: 87

[illegible]NSTRUCTIONS:

[illegible] Each day at approximately ____, collect samples of plant effluent and [illegible] each test listed in columns 4-7, by established procedures.

[illegible] Record actual time tests were run in column 3.

3. Record the results in the correct column, on the appropriate line and sign your name in column 8.

4. Coulmn 2 will be taken from the plant sheets at the end of the month.

5. Completed ~~and~~ signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Chlorine / Cl_2 DPD	(7) Dissolved / D.O.-by Winkler	(8) Signature
1	.734 000	0830	23°	7.0	2.0	8.0	Stanley E. Hill
2	.871 000				2.5		Stanley E. Hill
3	.627 000				4.0		Stanley E. Hill
4	.735 000			-	4.0		Stanley E. Hill
5	.605 000	0830	22°	6.8	5.0	7	Rebecca S. Morris
6	.560 000	0830			5.0		Rebecca S. Morris
7	.650000	0830			5.0		Rebecca S. Morris
8	.694000	0830	23°	7.1	3.0	7.4	Rebecca S. Morris
9	.699000				2.5		Stanley E. Hill
10	.579000				4.0		Stanley E. Hill
11	.635000				4.0		Stanley E. Hill
12	.615000	0830	25°	7.0	4.0	7.5	Stanley E. Hill
13	.368000				0.4		Stanley E. Hill
[illegible]	.903000				1.5		Stanley E. Hill
[illegible]	.807000	0930	24°	7.0	4.0	7.4	Stanley E. Hill
16	.694000				4.0		Rebecca S. Morris
17	.541000				5.0		
18	.502000				4.0		Stanley E. Hill
19	.364000	0830	24°	7.0	4.0	7.5	Stanley E. Hill
20	.501000				6.0		Stanley E. Hill
21	.513000				4.0		Stanley E. Hill
22	.414000	0830	25°	7.0	4.0	7.4	Stanley E. Hill
23	657000				4.0		Stanley E. Hill
24	.774000				4.0		Stanley E. Hill
25	.664000				4.0		Stanley E. Hill
26	.610000	0830	24	7.0	5.0	6.5	[illegible]
27	.720000	0800	24	6.8	2.0	6.0	[illegible]
28	.650000	0830			4.0		Roland Hinson
29	.704000	0845	24°	6.6	4.0	7.2	Keith Hall
30	.625000				4.0		Stanley E. Hill
31							
Total	19.301 000		238	[illegible]	1129	720	McArthur Faircloth
Ave.	643 367		24 ~~23~~°	[illegible]	3.8	7.2	McArthur Faircloth
Max.	903 000		25°	7.0	6.0	8.0	McArthur Faircloth
Min.	364 000		22°	6.6	0.4	6.0	McArthur Faircloth

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related [illegible]lity control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/6 (REV. 9-86)

PLANT	NPDES PERMIT No.	MONTH	YEAR
CAMP JOHNSON (MONFORD POINT)	NC0063011	JULY	1987

	00310 5 DAY 20°C BOD			00610 Ammonia	00530 Total Suspended Residue			Coliform	00556 Oil + Grease	00600 Total Nitrogen	00665 Total Phosphorus
DATE	INFLUENT mg/L	EFFLUENT mg/L	%	EFFLUENT mg/L	INFLUENT mg/L	EFFLUENT mg/L	%	EFFLUENT MF/100 mL	EFFLUENT mg/L	EFFLUENT mg/L	EFFLUENT mg/L
1											
2											
3											
4											
5											
6	247	10	96	4.6	260	9	97	0			
7											
8									7.9		
9											
10	267	17	93	3.5	230	10	96	0			
11											
12											
13	255	14	95	3.7	180	7	96	0			
14											
15											
16											
17	344	17	95	2.6	92	7	92	0		12.75	
18											
19											
20	332	SAMPLE ERROR	96	3.0	186	4	98	0			
21									0.1		
22											
23											
24	275	17	94	4.5	213	7	97	10			
25											
26											
27	279	13	85	2.7	363	12	97	0			
28											
29											
30											
31	260	13	95	4.6	358	6	99	2			
TOTAL	2259	101		29.2	1885	62		2	8	12.75	
AVERAGE	282	14	94	3.7	236	9	97	~~0.25~~	4	12.75	
MAXIMUM	344	17		4.6	363	~~12~~ 12		2	7.9	12.75	
MINIMUM	247	10		2.6	92	4		0	0.1	12.75	
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT						30			30		

↓ 1.09   CS 1/6/87

INSTRUCTIONS:
1. Complete this form in ink, neatly and clearly or it will be typed.
2. Head the form with plant name, permit number, month & year. Indicate Total or Fecal Coliform heading. Add the appropiate monthly limits at the bottom.
3. At the end of the month, calculate totals, averages, maximums and minimums.
4. Submit completed forms to laboratory supervisor by the 10th of the following month.

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: July Year: 87

INSTRUCTIONS:

1. Each day at approximately ____, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.647,000	0830			4.0		Stanley E Hill
2	.632,000	0830			4.0		Stanley E Hill
3	.958,000	0830			4.0		Stanley E Hill
4	.684,000	0830			4.0		Stanley E Hill
5	.726,000	0830			4.0		Stanley E Hill
6	.612,000	0830	24°	6.8	3.0	7.6	Stanley E Hill
7	.745,000	0830			5.0		Rebecca E. Norris
8	.667,000	0830			2.0		Rebecca E. Norris
9	.624,000	0830			4.0		Stanley E Hill
10	.538,000	0830	27°	6.8	4.0	6.6	Stanley E Hill
11	.674,000	0830			6.0		Stanley E Hill
12	.731,000	0830			4.0		Stanley E Hill
13	.677,000	0830	26°	6.8	4.0	7.1	Stanley E Hill
[illegible]	.648,000	0830			4.0		Stanley E Hill
[illegible]	.449,000	0830			4.0		Stanley E Hill
16	.461,000	0830			4.0		Stanley E Hill
17	.525,000	0830	25°	6.8	5.0	6.8	Rebecca E Norris
18	.467,000	0830			4.0		Rebecca E Norris
19	.505,000	0830			4.0		Rebecca E Norris
20	.517,000	0830	25°	6.6	[illegible]	6.8	Rebecca E Norris
21	.673,000	0830			4.0		Stanley E Hill
22	.717,000	0830			4.0		Stanley E Hill
23	.674,000	0830			4.0		Stanley E Hill
24	.653,000	0830	26°	6.8	4.0	7.1	Stanley E Hill
25	.616,000	0830			5.0		Stanley E Hill
26	.655,000	0830			4.0		Stanley E Hill
27	.861,000	0830	27°	6.9	2.0	7.1	Stanley E Hill
28	.638,000	0830			5.0		Rebecca E Norris
29	.524,000	0830			4.0		Rebecca E Norris
30	.473,000	0830			4.0		Stanley E Hill
31	.447,000	0830	26°	6.8	4.0	7.4	Stanley E Hill
Total	~~19,468,000~~ > Correct		206		126.0	~~57~~ 56.5	
Ave.	~~628,000~~		26		4.0	7.1	
Max.	958,000		27°	6.9	6.0	7.6	
Min.	447,000		24	6.8	2.0	6.6	

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

~~$ 9,288.00 mm~~

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY + MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
ACF [illegible] 11345/6 (REV. 9-86)

PLANT	NPDES PERMIT NO.	MONTH	YEAR
CAMP JOHNSON (Montford Point)	NC0063011	Aug	198[illegible]

DATE	00310 5 DAY 20°C BOD INFLUENT mg/L	EFFLUENT mg/L	%	00610 AMMONIA EFFLUENT mg/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT mg/L	EFFLUENT mg/L	%	COLIFORM EFFLUENT MF/100 mL	00556 OIL + GREASE EFFLUENT mg/L	00600 TOTAL NITROGEN EFFLUENT mg/L	00665 TOTAL PHOSPHORUS EFFLUENT mg/L
1											
2											
3	346	13	96	4.9	304	2	99	2			
4									0.1		
5											
6											
7	272	17	94	5.5	178	6	97	0			
8											
9											
10	496	15	97	3.1	229	6	[illegible]	~~0~~ 6			
11											
12											
13											
14	204	12	94	5.9	102	9	91	0			
15											
16											
17	180	5	97	3.0	178	6	97	0			
18									0.7		
19											
20											
21	323	11	97	5.1	407	6	98	0			
22											
23											
24	229	6	97	3.4	115	6	96	0			
25											
26											
27											
28	150	13	91	2.3	118	7	94	0			
29											
30											
31	130	12	91	2.1	175	10	94	0	0.8		
TOTAL	2330	104		31.9	1806	[illegible]		—	[illegible]		
AVERAGE	259	12	95	3.9	201	6	97	1.36	[illegible]		
MAXIMUM	496	17		5.9	407	[illegible]		6	0.8		
MINIMUM	130	5		2.3	102	2		0	0.1		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT						30			30		

INSTRUCTIONS:
1. Complete this form in ink, neatly and clearly or it will be typed.
2. Head the form with plant name, permit number, month & year. Indicate Total or Fecal Coliform heading. Add the appropiate monthly limits at the bottom.
3. At the end of the month, calculate totals, averages, maximums and minimums.
4. Submit completed forms to laboratory supervisor by the 10th of the following month.

RESULTS OF COMPLIANCE MONITORING

Plant: Arne Johnson Month: August Year: 87

INSTRUCTIONS:
1. Each day at approximately ____, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.532,000				2.5		Stanley E Hill
2	.758,000				4.0		Stanley E Hill
3	.642,000	0830	26°	6.8	4.0	6.8	Stanley E Hill
4	.669,000				4.0		Stanley E Hill
5	.615,000				4.0		Stanley E Hill
6	.635,000				4.0		Stanley E Hill
7	.627,000	0830	25°	6.8	4.0	6.1	Rebecca E. Morris
8	.535,000	0830			4.0		Rebecca E. Morris
9	.631,000	0830			4.0		Rebecca E. Morris
10	.788,000				5.0		Rebecca E. Morris
11	.918,000				4.0		Stanley E Hill
12	.704,000				4.0		Stanley E Hill
13	.711,000				2.5		Stanley E Hill
14	.752,000	0830	23°	6.9	4.0	6.8	Stanley E Hill
15	.714,000				4.0		Stanley E Hill
16	.688,000				4.0		Stanley E Hill
17	.801,000	0830	24°	6.9	4.0	7.6	Stanley E Hill
18	.694,000	0830			4.0		Rebecca E. Morris
19	.883,000	0830			5.0		Rebecca E. Morris
20	.586,000				0.8		Stanley E Hill
21	.519,000	0830	25°	6.8	4.0	7.1	Stanley E Hill
22	.660,000				4.0		Stanley E Hill
23	.860,000				5.0		Stanley E Hill
24	.790,000	0830	24°	6.9	4.0	8.0	Stanley E Hill
25	.758,000				4.0		Stanley E Hill
26	.786,000				4.0		Stanley E Hill
27	.762,000				4.0		Stanley E Hill
28	.838,000	0830	25°	7.0	5.0	7.2	Rebecca E. Morris
29	.727,000	0830			4.0		Rebecca E. Morris
30	.634,000	0830			4.0		Rebecca E. Morris
31	.795,000	0830	24°	6.7	3.0	7.0	Rebecca E. Morris
Total	22,012,000		196°	[redacted]	120.8	56.6	Stephen V. Cruz
Ave.	.710,064		25		3.9	7.1	Stephen V. Cruz
Max.	.918,000		26°	7.0	5.0	8.0	Stephen V. Cruz
Min.	.519,000		23°	6.7	0.8	6.1	Stephen V. Cruz

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY + MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
NCBCL 11345/6 (REV. 9-86)

PLANT	NPDES PERMIT No.	MONTH	YEAR
CAMP JOHNSON	NC-0063011	SEPTEMBER	1987

	00310 5 DAY 20°C BOD			00610 AMMONIA	00530 TOTAL SUSPENDED RESIDUE			COLIFORM	00556 OIL + GREASE	00600 TOTAL NITROGEN	00665 TOTAL PHOSPHORUS
DATE	INFLUENT mg/L	EFFLUENT mg/L	%	EFFLUENT mg/L	INFLUENT mg/L	EFFLUENT mg/L	%	EFFLUENT MF/100 ml	EFFLUENT mg/L	EFFLUENT mg/L	EFFLUENT mg/L
1											
2											
3											
4	332	14	[illegible]	3.2	430	8	98	0			
5											
6											
7	HOLIDAY	—	—	—	—	—	—	—	—		
8											
9											
10											
11	225	4	98	3.1	260	6	98	0	1.6	9.8	
12											
13											
14	296	7	98	2.4	353	2	99	0			
15											
16											
17											
18	300	4	99	2.6	212	6	97	0			
19											
20											
21	403	8	98	2.2	153	5	97	0			
22											
23											
24											
25	255	12	95	3.1	280	4	99	0			
26											
27											
28	182	13	93	8.8	89	3	97	0	3.1		
29											
30											
31											
TOTAL	[illegible]	[illegible]		25.4	1787	34			4.7	9.8	
AVERAGE	285	9	97	3.6	295	5	98	0	2.4	9.8	
MAXIMUM	403	14		8.8	430	8		0	3.1	9.8	
MINIMUM	182	4		2.2	99	2		0	1.6	9.8	
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		1000	30		

INSTRUCTIONS:
1. Complete this form in ink, neatly and clearly or it will be typed.
Head the form with plant name, permit number, month & year. Indicate Total or Fecal Coliform heading. Add the appropiate monthly limits at the bottom.
At the end of the month, calculate totals, averages, maximums and minimums.
4. Submit completed forms to laboratory supervisor by the 10th of the following month.

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: Sept Year: 87

INSTRUCTIONS:
1. Each day at approximately ___, collect samples of plant effluent and run each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.620,000				4.0		Stanley E Hill
2	.635,000				4.0		Stanley E Hill
3	.596,000				4.0		Stanley E Hill
4	.564,000	0830	24°	6.9	4.0	7.3	Stanley E Hill
5	.736,000				4.0		Stanley E Hill
6	.714,000				4.0		Stanley E Hill
7	* 1,207,000	0830	24°	7.0	1.5	7.2	Stanley E Hill
8	.709,000	0830			4.0		Rebecca E Norris
9	.503,000	0830			4.0		Rebecca E Norris
10	.646,000				4.0		Stanley E Hill
11	.801,000	0830	25°	6.8	2.5	7.1	Stanley E Hill
12	.658,000				4.0		Stanley E Hill
13	.981,000				4.0		Stanley E Hill
14	.796,000	0830	25°	6.8	4.0	7.3	Stanley E Hill
	.776,000				4.0		Stanley E Hill
	.752,000				4.0		Stanley E Hill
17	.701,000				4.0		Stanley E Hill
18	678,000	0830	25°	6.4	4.0	7.1	Rebecca E Norris
19	.590,000 ~~660,000~~	0830			4.0		Rebecca E Norris
20	.660,000 ~~640,000~~	0830			4.0		Rebecca E Norris
21	.640,000 ~~686,000~~	0830	25°	6.5	4.0	7.9	Rebecca E Norris
22	.686,000 ~~707,000~~				4.0		Stanley E Hill
23	.707,000 ~~722,000~~				4.0		Stanley E Hill
24	.722,000 ~~627,000~~				1.5		Stanley E Hill
25	.627,000 ~~505,000~~	0830	22°	6.9	4.0	7.6	Stanley E Hill
26	.505,000 ~~649,000~~				4.0		Stanley E Hill
27	.649,000 ~~848,000~~				4.0		Stanley E Hill
28	.848,000 ~~785,000~~	0830	22°	7.0	4.0	8.3	Stanley E Hill
29	.785000 ~~572~~	0830			4.0		Rebecca E Norris
30	.572,000	0830			4.0		Rebecca E Norris
31							
Total	21064000				113.5		
Ave.	702,133				4.0		
Max.	1,207,000				4.0		
Min.	503,000				1.5		

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

* Excessive Rain

MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/8 (REV. 9-86)

PLANT: CAMP JOHNSON

NPDES PERMIT NO.: NC0063011

MONTH: OCTOBER

YEAR: 198'

DATE	00310 5 DAY 20°C BOD Influent mg/L	5 DAY 20°C BOD Effluent mg/L	BOD %	00610 Ammonia Effluent mg/L	00530 Total Suspended Residue Influent mg/L	Total Suspended Residue Effluent mg/L	TSR %	Coliform Effluent MF/100 ml	00556 Oil • Grease Effluent mg/L	00600 Total Nitrogen Effluent mg/L	0066 Total Phosph Efflu mg/
1					106	11	90	0	2.3		
2	162	14	91	4.8							
3											
4					112	7	94	0			
5	198	13	93	4.0							
6											
7											
8					121	9	93	32			
9	204	23	89	[illegible]							
10											
11											
12											
13											
14											
15					428	8	98	0		15.04	
16	340	21	94	5.9							
17											
18					251	14	94	0			
19	245	13	95	3.3							
20											
21											
22					180	9	95	0			
23	236	19	92	7.2							
24											
25					268	12	92	0			
26	530	17	97	3.8					2.3		
27											
28											
29					50	5	90	228			
30	172	23	87	9.7							
31											
TOTAL	2087	143		42.8	1516	75	95	3.24	4.6	15.04	
AVERAGE	261	18	93	5.4	190	9		223	2.3	15.04	
MAXIMUM	530	23		9.7	428	12		[illegible]	2.3	15.04	
MINIMUM	162	13		3.3	50	5			2.3	15.04	
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	
MONTHLY LIMIT						30			30		

INSTRUCTIONS:
1. Complete this form in ink, neatly and clearly or it will be typed.
2. Head the form with plant name, permit number, month & year. Indicate Total or in Coliform heading. Add the appropiate monthly limits at the bottom.
3. At the end of the month, calculate totals, averages, maximums and minimums.
4. Submit completed forms to laboratory supervisor by the 10th of the following mc

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: Oct Year: 87

INSTRUCTIONS:

1. Each day at approximately ___, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed ~~and~~ signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (^oC)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.461000	0830	16°C	MF ~~6.9~~	5.0	~~7.7~~ MF	Roland Hussin
2	.622000	0830	16°C	6.3	5.0	8.2	Roland Hussin
3	.511000	0830	17°C	MF ~~[illegible]~~	5.0	~~[illegible]~~ MF	Roland Hussin
4	.573000	~~0800~~	17°C	MF ~~[illegible]~~	1.0	~~7.0~~ MF	[signature]
5	.432000	~~0815~~	16°C	6.4	3.0	8.7	[signature]
6	.652000	~~0845~~	16	MF ~~6.4~~	3.0	~~[illegible]~~ MF	[signature]
7	.473 000	~~[illegible]~~	16	MF ~~[illegible]~~	4.0	~~[illegible]~~ MF	[signature]
8	.773000	0900	15	MF ~~[illegible]~~	4.0	~~[illegible]~~ MF	[signature]
9	.618 000	0830	16°	6.7	5.0	7.7	Rebecca E. Norris
10	.572000	0830			4.0		Rebecca E. Norris
11	.486 000	0830			5.0		Rebecca E. Norris
12	.562000	0830			5.0		Rebecca E. Norris
13	.582000	0830			4.0		Stanley E. Hill
	.561 000	0830			4.0		Stanley E. Hill
	.460 000	0830			4.0		Stanley E. Hill
16	.600 000	0830	18°	7.0	3.0	8.3	Stanley E. Hill
17	.710 000	0830			4.0		Stanley E. Hill
18	.635 000	0820			0.0		Stanley E. Hill
19	.716 000	0830	18°	6.9	4.0	8.0	Stanley E. Hill
20	.634000	0830			4.0		Rebecca E. Norris
21	.527 000	0830			4.0		Rebecca E. Norris
22	.417000	0810			4.0		Stanley E. Hill
23	.568 000	0830	16°	6.9	4.0	8.1	Stanley E. Hill
24	.539 000	0820			4.0		Stanley E. Hill
25	.553 000	0835			5.0		Stanley E. Hill
26	.820 000	0830	18°	6.9	4.0	8.3	Stanley E. Hill
27	.722 000	0810			4.0		Stanley E. Hill
28	.604 000	0815			4.0		Stanley E. Hill
29	.704 000	0810			4.0		Stanley E. Hill
30	.604 000	0830	16°	6.8	4.0	7.3	Rebecca E. Norris
31	.548 000	0830			4.0		Rebecca E. Norris
Total	18.279,000			[illegible]	135.0	65.6	McArthur Farrow
Ave.	589 ~~[illegible]~~ .645			[illegible]	4.3	8.2	McArthur Farrow
Max.	~~773 000~~ .820			7.0	8.0	8.7	McArthur Farrow
Min.	.417000			6.3	3.0	7.3	McArthur Farrow

I hereby certify that the data contained herein was obtained by tests run b qualified personnel in accordance with all applicable procedures and relate [illegible]ality control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY

MCBCL 11345/8 (REV. 09/87)

PLANT	NPDES PERMIT NO	MONTH	YEAR
AMP JOHNSON	NC0063011	NOVEMBER	1987

DATE	00310 5 DAY 20°C BOD INFLUENT MG/L	EFFLUENT MG/L	%	00610 AMMONIA EFFLUENT MG/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT MG/L	EFFLUENT MG/L	%	31616 FECAL COLIFORM EFFLUENT MF/100 ML	00556 OIL & GREASE EFFLUENT MG/L	00600 TOTAL NITROGEN EFFLUENT MG/L	00665 TOTAL PHOSPHOROUS EFFLUENT MG/L
1											
2	530	14	97	3.3	173	4	98	CL2			
3											
4											
5											
6	520	7	99	9.2	366	12	96	0			
7											
8											
9	420	14	97	6.1	245	-	97	5			
10											
11											
12											
13	336	24	93	8.3	457	4	99	2	3.2		
14											
15											
16	840	20	98	6.1	370	1	99	0			
17											
8											
9											
20	220	28	87	8.0	130	12	91	2			
21											
22											
23	144	23	85	9.0	147	10	93	0			
24											
25									3.2		
26	HOLIDAY										
27	154	12	92	1.6	124	6	95	2			
28											
29											
30	425	15	96	1.7	275	8	97	0			
31											
TOTAL	3589	157		53.3	2237	64			6.4		
AVERAGE	399	17	93.8	5.9	254	7	96.1	1.59	3.2		
MAXIMUM	840	28		9.2	457	12		5	3.2		
MINIMUM	144	7		1.6	124	1		0	3.2		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		14	30		

INSTRUCTIONS:

1. COMPLETE THIS FORM IN INK, NEATLY AND CLEARLY OR IT WILL BE TYPED.
2. EAD THE FORM WITH PLANT NAME, PERMIT NUMBER, MONTH & YEAR. INDICATE TOTAL OR FECAL IN COLIFORM HEADING. ADD HE APPROPRIATE MONTHLY LIMITS AT THE BOTTOM.
3. AT THE END OF THE MONTH, CALCULATE TOTALS, AVERAGES, MAXIMUMS AND MINIMUMS.
4. SUBMIT COMPLETED FORMS TO LABORATORY SUPERVISOR BY THE 10TH OF THE FOLLOWING MONTH.

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: November Year: 87

INSTRUCTIONS:

[illegible] Each day at approximately ____, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.627,000	0830			3.0		Rebecca E. Norris
2	.563 000	0830	17	6.6	4.0	8.4	Rebecca E. Norris
3	.591 000				4.0		Stanley E. Hill
4	.587 000				4.0		Stanley E. Hill
5	.807 000				4.0		Stanley E. Hill
6	.601 000	0830	17°	6.9	4.0	8.7	Stanley E. Hill
7	.611 0.00				4.0		Stanley E. Hill
8	.335 000				5.0		Stanley E. Hill
9	.588 000	0830	19°	6.8	5.0	7.6	EJ (Charles) [illegible]
10	.628 000	0830			6.0		Rebecca E. Norris
11	.505 000	0830			4.0		Rebecca E. Norris
12	.616 000				4.0		Stanley E. Hill
13	.612 000	0830	15°	7.0	4.0	9.1	Stanley E. Hill
[illegible]	.560 000				4.0		Stanley E. Hill
15	.579 000				4.0		Stanley E. Hill
16	.570 000	0830	17°	7.0	4.0	9.5	Stanley E. Hill
17	.618 000				4.0		Stanley E. Hill
18	.604 000				4.0		Stanley E. Hill
19	.604 000	0830			4.0		Rebecca E. Norris
20	.505 000	0830	16°	6.9	4.0	8.6	Rebecca E. Norris
21	.467 000				5.0		Barry Aldridge
22	.499 000	0830			4.0		Rebecca E. Norris
23	.504 000	0830	15°	6.9	3.0	9.2	Rebecca E. Norris
24	.568 000	0830			3.0		Stanley E. Hill
25	.578 000				4.0		Stanley E. Hill
26	.482 000				3.0		Stanley E. Hill
27	.563 000	0830	14°	6.8	5.0	9.1	Stanley E. Hill
28	.851 000				4.0		Stanley E. Hill
29	.722 000				1.5		Stanley E. Hill
30	.618 000	0830	17°	6.8	4.0	9.0	Stanley E. Hill
31							
Total	17,583,000		147°	[redacted]	119.5	79.2	McAtt Farrow
Ave.	.586,100		16°	[redacted]	4.0	8.8	McAtt Farrow
Max.	.851,000		19°	7.0	6.0	9.5	McAtt Farrow
Min.	335,000		14°	6.6	1.5	7.6	McAtt Farrow

I hereby certify that the data contained herein was obtained by tests run by [illegible]ualified personnel in accordance with all applicable procedures and related quality control.

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY

MCBCL 11345/8 (REV. 09/87)

PLANT	NPDES PERMIT NO.	MONTH	YEAR
CAMP JOHNSON	NC 0063011	DECEMBER	1987

DATE	00310 5 DAY 20°C BOD INFLUENT MG/L	EFFLUENT MG/L	%	00610 AMMONIA EFFLUENT MG/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT MG/L	EFFLUENT MG/L	%	31616 FECAL COLIFORM EFFLUENT MF/100 ML	00556 OIL & GREASE EFFLUENT MG/L	00600 TOTAL NITROGEN EFFLUENT MG/L	00665 TOTAL PHOSPHOROUS EFFLUENT MG/L
1											
2											
3											
4	248	14	94	9.4	295	12	96	0	3.0		
5											
6											
7	[illegible]24	18	94	7.1	306	8	97	0			
8	284	18	94	7.7	128	10	92	0			
9	395	26	93	6.3	502	13	97	0			
10	547	18	97	7.5	24[illegible]	11	95	0			
11	350	24	93	5.5	1[illegible]	11	93	0			
12											
13											
14	176	23	87	6.4	55	10	82	0			
15									3.9		
16											
17											
18	378	28	93	9.0	605	14	98	0			
19											
20											
21	165	13	92	3.2	69	9	87	0			
22											
23											
24											
25	HOLIDAY										
26											
27											
28	174	12	93	2.9	145	6	96	0			
29											
30											
31											
TOTAL	3041	194		65	2498	104			6.9		
AVERAGE	304	19	94	6.5	250	10	96	0	3.5		
MAXIMUM	547	28		9.4	605	14		0	3.9		
MINIMUM	165	12		2.9	55	6		0	3.0		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		1000	30		

INSTRUCTIONS:

1. COMPLETE THIS FORM IN INK, NEATLY AND CLEARLY OR IT WILL BE TYPED.
2. HEAD THE FORM WITH PLANT NAME, PERMIT NUMBER, MONTH & YEAR. INDICATE TOTAL OR FECAL IN COLIFORM HEADING. ADD THE APPROPRIATE MONTHLY LIMITS AT THE BOTTOM.
3. AT THE END OF THE MONTH, CALCULATE TOTALS, AVERAGES, MAXIMUMS AND MINIMUMS.
4. SUBMIT COMPLETED FORMS TO LABORATORY SUPERVISOR BY THE 10TH OF THE FOLLOWING MONTH.

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: December Year: 87

INSTRUCTIONS:

Each day at approximately ____, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed ~~and~~ signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.609	0830			4.0		Rebecca E. Norris
2	.573	0830			2.0		Rebecca E. Norris
3	.538	0830			4.0		Stanley E. Hill
4	.534	0830	15°	7.0	4.0	9.0	Stanley E. Hill
5	.489	0830			4.0		Stanley E. Hill
6	.547	0830			6.0		Stanley E. Hill
7	.520	0830	14°	7.0	4.0	9.5	Stanley E. Hill
8	.367	0830	13°	7.0	4.0	8.5	Stanley E. Hill
9	.442	0830	13°	7.0	4.0	7.6	Stanley E. Hill
10	.868	0830	14°	6.4	4.0	6.8	Elizabeth J. Weston
11	.377	0830	15°	6.8	4.0	8.2	Rebecca E. Norris
12	.337	0830			4.0		Rebecca E. Norris
	.385	0830			4.0		Rebecca E. Norris
	.449	0830	15°	6.8	4.0	8.9	Rebecca E. Norris
15	.420	0830			4.0		Stanley E. Hill
16	.363	0830			4.0		Stanley E. Hill
17	.373	0830			4.0		Stanley E. Hill
18	.330	0830	13°	7.0	4.0	8.6	Stanley E. Hill
19	.287	0830			4.0		Stanley E. Hill
20	.322	0830			5.0		Stanley E. Hill
21	.333	0830	13°	7.0	4.0	9.2	Stanley E. Hill
22	.343	0830			4.0		Rebecca E. Norris
23	.321	0830			4.0		Rebecca E. Norris
24	.320	0830			4.0		Stanley E. Hill
25	.321	0830			4.0		Stanley E. Hill
26	.333	0830			4.0		Stanley E. Hill
27	.359	0830			4.0		Stanley E. Hill
28	.446	0830	15°	7.0	3.0	9.6	Stanley E. Hill
29	.351	0830			3.0		Stanley E. Hill
30	.378	0830			4.0		Stanley E. Hill
31	.333	0830			4.0		Stanley E. Hill
Total	12.468		140°		123.0	85.9	Stephen V. Crews
Ave.	.402 ~~.400~~		14°		3.98	8.6	Stephen V. Crews
Max.	.609		15°	7.0	6.0	9.6	Stephen V. Crews
Min.	.287		13°	6.4	2.0	6.8	Stephen V. Crews

hereby certify that the data contained herein was obtained by tests run ualified personnel in accordance with all applicable procedures and rela uality control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/8 (REV. 09/87)

PLANT					NPDES PERMIT NO.				MONTH		YEAR
AMP JOHNSON					NC 0063011				JANUARY		1988
	00310 5 DAY 20°C BOD			00610 AMMONIA	00530 TOTAL SUSPENDED RESIDUE			31616 FECAL COLIFORM	00556 OIL & GREASE	00600 TOTAL NITROGEN	00665 TOTAL PHOSPHOROUS
DATE	INFLUENT MG/L	EFFLUENT MG/L	%	EFFLUENT MG/L	INFLUENT MG/L	EFFLUENT MG/L	%	EFFLUENT MF/100 ML	EFFLUENT MG/L	EFFLUENT MG/L	EFFLUENT MG/L
1											
2											
3											
4	144	31	78	5.1	154	12	92	0	5.3		
5											
6											
7											
8	224	32	86	8.0	196	16	92	0			
9											
10											
11	447	23	95	7.4	228	9	96	0			
12								24			
13								0		16.69	
14											
15	128	33	74	10.1	121	12	90	2			
16											
17											
18	HOLIDAY										
19											
20								0			
21								62			
22	367	36	90	10.6	194	5	97	0			
23											
24								0			
25	290	32	90	9.7	111	12	89	0			1.3
26								36			
27								10	11.4		
28								0			
29	278	33	88	10.9	244	13	95	455			
30											
31											
TOTAL	1878	220		61.8	1248	79			16.7	16.69	1.3
AVERAGE	268	31	86	8.8	178	11	93	3.79	8.4	16.69	1.3
MAXIMUM	447	36		10.9	244	16		455	11.4	16.69	1.3
MINIMUM	144	23		5.1	111	5		0.	5.3	16.69	1.3
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		1000	30		

INSTRUCTIONS:

1. COMPLETE THIS FORM IN INK, NEATLY AND CLEARLY OR IT WILL BE TYPED.
2. HEAD THE FORM WITH PLANT NAME, PERMIT NUMBER, MONTH & YEAR. INDICATE TOTAL OR FECAL IN COLIFORM HEADING. ADD THE APPROPRIATE MONTHLY LIMITS AT THE BOTTOM.
3. AT THE END OF THE MONTH, CALCULATE TOTALS, AVERAGES, MAXIMUMS AND MINIMUMS.
4. SUBMIT COMPLETED FORMS TO LABORATORY SUPERVISOR BY THE 10TH OF THE FOLLOWING MONTH.

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: January Year: 88

INSTRUCTIONS:
1. Each day at approximately ____, collect samples of plant effluent and run each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.366000	0830			4.0		Rebecca E Morris
2	.395000	0830			4.0		Rebecca E Morris
3	.769000	0830			4.0		Rebecca E Morris
4	.556000	0830	14°	6.8	4.0	9.5	Rebecca E Morris
5	.599000	0830			2.0		Stanley E Hill
6	473000	0830			2.0		Stanley E Hill
7	.648000	0830			2.0		Stanley E Hill
8	.516000	0830	12°	7.0	0.8	9.1	Stanley E Hill
9	.490000	0830			1.5		Stanley E Hill
10	.470000	0830			1.0		Stanley E Hill
11	.524000	0830	14°	6.8	1.0	9.8	Rebecca E Morris
12	.476000	0830			1.0		Rebecca E Morris
13	.401000	0830			1.0		Stanley E Hill
14	.550000	0830			1.5		Stanley E Hill
15	.550000	0830	12°	7.0	1.0	9.6	Stanley E Hill
16	.523000	0830			1.0		Stanley E Hill
17	.477000	0830			1.5		Stanley E Hill
18	.501000	0830			2.0		Stanley E Hill
19	.550000	0830			1.0		Stanley E Hill
20	.636000	0830			0.4		Stanley E Hill
21	.659000	0830			0.6		Rebecca E Morris
22	.514000	0830	14°	6.8	1.0	8.4	Rebecca E Morris
23	.512000	0830			1.0		Rebecca E Morris
24	.525000	0830			1.0		Rebecca E Morris
25	.582000	0830	15°	6.9	1.5	9.0	Stanley E Hill
26	.523000	0830			1.0		Stanley E Hill
27	.504000	0830			0.8		Stanley E Hill
28	.535000	0830			1.0		Stanley E Hill
29	.585000	0930	13°	7.0	1.0	9.3	Stanley E Hill
30	.576100	0830			0.8		Stanley E Hill
31	672000	0830			1.5		Stanley E Hill
Total	~~16,612,000~~		94°	[redacted]	83.9	64.7	Johnny P Taylor
Ave.	~~535,870~~		13°	[redacted]	2.7	9.2	Johnny P Taylor
Max.	.769,000		15°	7.0	4.0	9.8	Johnny P Taylor
Min.	.366,000		12°	6.8	0.4	8.4	Johnny P Taylor

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

TOTAL 16,657,000
AVE .537,323

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/8 (REV. 09/87)

PLANT	NPDES PERMIT NO.	MONTH	YEAR
CAMP JOHNSON	NC-0063011	FEBRUARY	1988

DATE	00310 5 DAY 20°C BOD INFLUENT MG/L	EFFLUENT MG/L	%	00610 AMMONIA EFFLUENT MG/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT MG/L	EFFLUENT MG/L	%	31616 FECAL COLIFORM EFFLUENT MF/100 ML	00556 OIL & GREASE EFFLUENT MG/L	00600 TOTAL NITROGEN EFFLUENT MG/L	00665 TOTAL PHOSPHOROUS EFFLUENT MG/L
1	502	27	95	8.2	274	10	96	30			
2									7.9		
3								80			
4								170			
5	300	42	86	9.7	356	12	97	85			
6											
7											
8	244	25	90	9.0	172	12	93	20			
9								800			
10								810			
11								8000			
12	325	46	86	10.2	141	8	94	2500			
13											
14											
15											
16								110			
17								100			
18								520			
19	375	46	88	13.5	221	12	95	2000			
20											
21											
22	254	28	89	11.4	192	11	94	2500			
23											
24								1			
25								40	1.2		
26	302	38	87	9.7	225	11	95	38			
27											
28											
29	370	30	92	9.7	241	14	94	27			
30											
31											
TOTAL	2672	281		81.4	1822	90			9.1		
AVERAGE	334	35	89	10.2	228	11.0	94.8	234	4.6		
MAXIMUM	502	46		13.5	356	12		3000	7.9		
MINIMUM	244	25		8.2	141	8		0	1.2		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		1000	30		

INSTRUCTIONS:

1. COMPLETE THIS FORM IN INK, NEATLY AND CLEARLY OR IT WILL BE TYPED.
2. HEAD THE FORM WITH PLANT NAME, PERMIT NUMBER, MONTH & YEAR. INDICATE TOTAL OR FECAL IN COLIFORM HEADING. ADD THE APPROPRIATE MONTHLY LIMITS AT THE BOTTOM.
3. AT THE END OF THE MONTH, CALCULATE TOTALS, AVERAGES, MAXIMUMS AND MINIMUMS.
4. SUBMIT COMPLETED FORMS TO LABORATORY SUPERVISOR BY THE 10TH OF THE FOLLOWING MONTH.

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: Feb Year: 88

INSTRUCTIONS:

1. Each day at approximately ____, collect samples of plant effluent and [illegible] each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.634,000	0830	15°	7.0	1.0	9.1	Stanley E Hill
2	.651,000	0830			1.0		Rebecca E Moore
3	.570,000	0830			1.0		Rebecca E Moore
4	.530,000	0830			0.6		Stanley E Hill
5	.529,000	0830	14°	7.0	0.2	8.2	Stanley E Hill
6	.603,000	0830			1.0		Stanley E Hill
7	.663,000	0830			1.0		Stanley E Hill
8	.711,000	0830	13°	7.0	0.4	9.1	Stanley E Hill
9	.678,000	0830			1.0		Stanley E Hill
10	.687,000	0830			0.4		Stanley E Hill
11	.591,000	0830			0.4		Stanley E Hill
12	.455,000	0830	14°	6.8	0.5	7.5	Rebecca E Moore
13	.427,000	0830			0.5		Rebecca E Moore
[illegible]	.426,000	0830			0.6		Rebecca E Moore
[illegible]	.502,000	0830			0.6		Rebecca E Moore
16	.462,000	0830			0.5		Earl C Woolbridge
17	.407,000	0830			0.9		Earl C Woolbridge
18	.450,000	0830			0.6		Stanley E Hill
19	.418,000	0830	14°	7.0	0.4	7.7	Stanley E Hill
20	.500,000	0830			0.6		Stanley E Hill
21	.487,000	0830			0.8		Stanley E Hill
22	.528,000	0830	13°	7.0	0.4	8.4	Stanley E Hill
23	.490,000	0830			0.6		Rebecca E Moore
24	.517,000	0830			0.6		Rebecca E Moore
25	.484,000	0830	13°		1.0		Stanley E Hill
26	.440,000	0830	13°	7.1	1.0	8.1	Stanley E Hill
27	.471,000	0830			1.5		Stanley E Hill
28	506,000	0830			1.5		Stanley E Hill
29	.508,000	0830	14°	7.1	1.0	8.6	Stanley E Hill
30							
31							
Total	15,325,000		123°		21.8	66.7	Stephen V. Crews
Ave.	.528,448		13.7°		0.75	8.3	Stephen V. Crews
Max.	.711,000		15°	7.1	1.5	9.1	Stephen V. Crews
Min.	.418,000		13°	6.8	0.2	7.5	Stephen V. Crews

I hereby certify that the data contained herein was obtained by tests run [illegible]ualified personnel in accordance with all applicable procedures and rela[illegible] [illegible]ality control.

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/8 (REV. 09/87)

PLANT	NPDES PERMIT NO.	MONTH	YEAR
AMP JOHNSON	NC-0063011	MARCH	1988

DATE	00310 5 DAY 20°C BOD INFLUENT MG/L	EFFLUENT MG/L	%	00610 AMMONIA EFFLUENT MG/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT MG/L	EFFLUENT MG/L	%	31616 FECAL COLIFORM EFFLUENT [redacted] ML	00556 OIL & GREASE EFFLUENT MG/L	00600 TOTAL NITROGEN EFFLUENT MG/L	00665 TOTAL PHOSPHOROUS EFFLUENT MG/L
1								[redacted]			
2								[redacted]			
3								[redacted]			
4	125	[redacted]	74	[redacted]	94	[redacted]	84	[redacted]			
5		[redacted]		[redacted]		[redacted]		[redacted]			
6		[redacted]		[redacted]		[redacted]		[redacted]			
7	118	[redacted]	88	[redacted]	151	[redacted]	91	[redacted]			
8		[redacted]		[redacted]		[redacted]		[redacted]	2.7		
9		[redacted]		[redacted]		[redacted]		[redacted]			
10		[redacted]		[redacted]		[redacted]		[redacted]			
11	305	[redacted]	94	[redacted]	292	[redacted]	94	[redacted]			
12		[redacted]		[redacted]		[redacted]		[redacted]			
13		[redacted]		[redacted]		[redacted]		[redacted]			
14	[illegible]	[redacted]	95	[redacted]	241	[redacted]	95	[redacted]			
15		[redacted]		[redacted]		[redacted]		[redacted]			
16		[redacted]		[redacted]		[redacted]		[redacted]			
17		[redacted]		[redacted]		[redacted]		[redacted]			
18	524	[redacted]	94	[redacted]	685	[redacted]	99	[redacted]			
19		[redacted]		[redacted]		[redacted]		[redacted]			
20		[redacted]		[redacted]		[redacted]		[redacted]			
21	605	[redacted]	96	[redacted]	925	[redacted]	98	[redacted]			
22		[redacted]		[redacted]		[redacted]		[redacted]	5.9		
23		[redacted]		[redacted]		[redacted]		[redacted]			
24		[redacted]		[redacted]		[redacted]		[redacted]			
25	160	[redacted]	84	[redacted]	96	[redacted]	86	[redacted]			
26		[redacted]		[redacted]		[redacted]		[redacted]			
27		[redacted]		[redacted]		[redacted]		[redacted]			
28	288	[redacted]	94	[redacted]	117	[redacted]	83	[redacted]			
29								[redacted]			
30								[redacted]			
31								[redacted]			
TOTAL	2206	209		88.1	2601	115		[redacted]	8.6		
AVERAGE	276	[redacted]	90	[redacted]	325	[redacted]	91.9	[redacted]	4.3		
MAXIMUM	605	[redacted]		[redacted]	925	[redacted]		[redacted]	5.9		
MINIMUM	125	[redacted]		[redacted]	94	[redacted]		[redacted]	2.7		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30		—		30		1000	30		

INSTRUCTIONS:

1. COMPLETE THIS FORM IN INK, NEATLY AND CLEARLY OR IT WILL BE TYPED.
2. HEAD THE FORM WITH PLANT NAME, PERMIT NUMBER, MONTH & YEAR. INDICATE TOTAL OR FECAL IN COLIFORM HEADING. ADD THE APPROPRIATE MONTHLY LIMITS AT THE BOTTOM.
3. AT THE END OF THE MONTH, CALCULATE TOTALS, AVERAGES, MAXIMUMS AND MINIMUMS.
4. SUBMIT COMPLETED FORMS TO LABORATORY SUPERVISOR BY THE 10TH OF THE FOLLOWING MONTH.

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: March Year: 88

INSTRUCTIONS:

Each day at approximately ____, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.

2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed ~~and~~ signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.470	0830			0.8		Stanley E Hall
2	.377	0830			0.8		Stanley E Hall
3	.513	0830			0.8		Stanley E Hall
4	.581	0830	14°	7.0	1.0	7.3	Rebecca E Morris
5	.424	0830			1.5		Rebecca E Morris
6	.430	0830			2.0		Rebecca E Morris
7	.500	0830	15°	7.1	2.0	8.1	Rebecca E Morris
8	.504	0830			1.5		Stanley E Hall
9	.616	0830			2.0		Stanley E Hall
10	.857	0830			1.5		Stanley E Hall
11	.621	0840	16°	6.9	4.0	8.5	Stanley E Hall
12	.632	~~0830~~			4.0		Stanley E Hall
	.850	0830			3.0		Stanley E Hall
	.581	0830	16°	7.0	1.5	8.3	Stanley E Hall
15	.549	0830			2.0		Rebecca E Morris
16	.558	0830			2.0		Rebecca E Morris
17	.576	0830			2.5		Stanley E Hall
18	.649	0830	15°	7.0	2.0	7.7	Stanley E Hall
19	.351	0830			3.0		Stanley E Hall
20	.471	0830			5.0		Stanley E Hall
21	.554	0830	15°	7.0	2.0	8.3	Stanley E Hall
22	.472	0830			0.6		Stanley E Hall
23	.525	0830			2.0		Stanley E Hall
24	.520	0830			2.5		Stanley E Hall
25	.486	0830	17°	6.7	4.0	8.2	John H Ambrose
26	[illegible]	0830	18°	6.6	6.0	7.4	Albert F. Sautter Jr.
27	.401	08H5	17°	6.9	5.0	7.0	Albert F. Sautter Jr.
28	.470	0830	15°	6.8	4.0	7.6	Albert F. Sautter Jr.
29	.593	0830	17°	6.6	4.0	7.6	John H Ambrose
30	.568	0800			4.0		James Thompson
31	.603	0830	17°	6.6	4.0	7.6	John H Ambrose
Total	16.737		192	[redacted]	81.0	936	Tom H Kennedy
Ave.	.540		16		2.6	7.8	Tom H Kennedy
Max.	.857		18	7.1	4.0	8.5	Tom H Kennedy
Min.	.351		14	6.6	0.8	7.3	Tom H Kennedy

I hereby certify that the data contained herein was obtained by tests run qualified personnel in accordance with all applicable procedures and rela: uality control.

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/8 (REV. 09/87)

[redacted]	NPDES PERMIT NO.	MONTH	YEAR
CAMP JOHNSON	NC0063011	APRIL	1988

DATE	00310 5 DAY 20°C BOD INFLUENT MG/L	EFFLUENT MG/L	%	00610 AMMONIA EFFLUENT MG/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT MG/L	EFFLUENT MG/L	%	31616 FECAL COLIFORM EFFLUENT MF/100 ML	00556 OIL & GREASE EFFLUENT MG/L	00600 TOTAL NITROGEN EFFLUENT MG/L	00665 TOTAL PHOSPHOROUS EFFLUENT MG/L
1	273	21	92	11.7	162	13	92	0			
2											
3											
4	510	14	97	8.1	143	10	93	0			
5								0	1.2		2.8
6								0			
7								0			
8	493	50	90	18.8	642	18	97	0			
9											
10											
11	1160	27	98	17.8	1230	13	99	0			
12								0			
13								0			
14								2			
15	262	32	88	20.0	120	16	[illegible]	2		15.3	
16											
[redacted]											
[redacted]	254	4	98	9.4	296	6	98	10			
19								8			
20								0	0.5		
21								1			
22	1200	14	99	10.1	2887	20	99	0			
23											
24											
25	153	16	90	8.3	1458	16	99	0			
26								20			
27								8			
28								2			
29	1640	23	99	13.3	2327	13	99	0			
30											
31											
TOTAL	5945	201		117.5	9465	125					
AVERAGE	661	22	94.6	13.0	1052	14.0	95.9	1.85	0.85	15.3	2.8
MAXIMUM	1640	50		20.0	2887	20		20	1.2	15.3	2.8
MINIMUM	153	4		8.1	143	6		0	0.5	15.3	2.8
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		1000	30		

INSTRUCTIONS:

[redacted]OMPLETE THIS FORM IN INK, NEATLY AND CLEARLY OR IT WILL BE TYPED.

[redacted]EAD THE FORM WITH PLANT NAME, PERMIT NUMBER, MONTH & YEAR. INDICATE TOTAL OR FECAL IN COLIFORM HEADING. ADD THE APPROPRIATE MONTHLY LIMITS AT THE BOTTOM.

3. AT THE END OF THE MONTH, CALCULATE TOTALS, AVERAGES, MAXIMUMS AND MINIMUMS.
4. SUBMIT COMPLETED FORMS TO LABORATORY SUPERVISOR BY THE 10TH OF THE FOLLOWING MONTH.

RESULTS OF COMPLIANCE MONITORING

Plant: Camp Johnson Month: April Year: 88

INSTRUCTIONS:

Each day at approximately ____, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Coulmn 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.533,~~000~~	0830	17	6.7	4.0	7.5	Rebecca E Norris
2	.390,~~000~~	0830	17°	6.7	4.0	7.7	John H Amerost
3	.384,~~000~~	1000	17	6.8	4.0	7.4	Leitha Hall
4	.478	0850	19°	7.0	1.7	7.4	James C Pate
5	.314	0800	18°	7.0	4.0	7.2	Rebecca E Norris
6	.738	0800	18°	6.6	4.0	5.3	Rebecca E Norris
7	.456	0830	18°	7.0	4.0	5.5	Stanley E Hill
8	.776	0830	16°	7.0	4.0	7.4	Stanley E Hill
9	.611	0830	17°	7.0	4.0	7.9	Stanley E Hill
10	.476	0830	18°	7.0	4.0	7.7	Stanley E Hill
11	.405	0830	17°	7.0	4.0	8.5	Stanley E Hill
12	.537	0830	17°	7.0	4.0	7.5	Stanley E Hill
13	.870	0850	17°	7.0	4.0	7.9	Stanley E Hill
14	.460	0830	16°	7.0	4.0	8.1	Stanley E Hill
15	.448	0830	17°	6.5	4.0	7.5	Rebecca E Norris
16	.456	0830	18°	6.6	4.0	8.1	Rebecca E Norris
17	.507	0800	18	7.0	4.0	7.4	Amos O Boatz
18	.554	0830	17°	6.8	4.0	7.6	Rebecca E Norris
19	.592	0830	18°	7.0	4.0	7.0	Stanley E Hill
20	.528	0830	17°	6.9	3.0	8.2	Stanley E Hill
21	.492	0830	18°	7.0	4.0	7.7	Stanley E Hill
22	.497	0830	18°	6.9	4.0	7.9	Stanley E Hill
23	.486	0830	19°	7.0	5.0	7.6	Stanley E Hill
24	.630	0830	19°	7.0	5.0	7.9	Stanley E Hill
25	.746	0830	17°	6.9	2.0	7.5	Stanley E Hill
26	.493	0830	18°	6.8	4.0	7.8	Rebecca E Norris
27	.527	0830	17°	6.7	3.0	7.9	Rebecca E Norris
28	.459	0830	18°	7.0	2.5	6.7	Stanley E Hill
29	.440	0830	16°	6.8	4.0	7.2	Stanley E Hill
30	.255	0850	17°	6.9	4.0	8.4	Stanley E Hill
31							
Total	15.578		510	[redacted]	114.2	227.3	[signature]
Ave.	.519000		17		3.8	7.6	[signature]
Max.	.870000		19	7.0	5.0	8.5	[signature]
Min.	.255000		16	6.5	1.7	5.3	[signature]

I hereby certify that the data contained herein was obtained by tests run ualified personnel in accordance with all applicable procedures and rela ality control.

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY

MCBCL 11345/8 (REV. 09/87)

PLANT	NPDES PERMIT NO.	MONTH	YEAR
…HP JOHNSON	NC-0063011	MAY	1988

DATE	00310 5 DAY 20°C BOD INFLUENT MG/L	5 DAY 20°C BOD EFFLUENT MG/L	%	00610 AMMONIA EFFLUENT MG/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT MG/L	TOTAL SUSPENDED RESIDUE EFFLUENT MG/L	%	31616 FECAL COLIFORM EFFLUENT MF/100 ML	00556 OIL & GREASE EFFLUENT MG/L	00600 TOTAL NITROGEN EFFLUENT MG/L	00665 TOTAL PHOSPHOROUS EFFLUENT MG/L
1											
2	320	22	93	11.2	1195	10	99	2			
3								4			
4								0			
5								0			
6	267	23	91	10.3	150	21	86	0			
7											
8											
9	430	17	96	11.1	297	19	94	0			
10								0	2.7		
11								0			
12								0			
13	1150	13	99	7.4	2989	16	99	0			
14											
15											
16	790	15	98	4.5	1900	11	99	0			
17											
18											
19											
20	670	14	98	6.8	1120	11	99	0			
21											
22											
23	360	18	95	9.8	590	14	98	0			
24											
25									2.8		
26											
27	534	25	95	10.2	302	10	97	800			
28											
29											
30											
31											
TOTAL	4521	147		71.3	8543	112					
AVERAGE	565	18	95.6	8.9	1068	14	96.4	1.83	2.75		
MAXIMUM	1150	25		11.2	2989	21		800	2.8		
MINIMUM	267	13		4.5	150	10		0	2.7		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		1000	30		

INSTRUCTIONS:

1. COMPLETE THIS FORM IN INK, NEATLY AND CLEARLY OR IT WILL BE TYPED.
2. HEAD THE FORM WITH PLANT NAME, PERMIT NUMBER, MONTH & YEAR. INDICATE TOTAL OR FECAL IN COLIFORM HEADING. ADD THE APPROPRIATE MONTHLY LIMITS AT THE BOTTOM.
3. AT THE END OF THE MONTH, CALCULATE TOTALS, AVERAGES, MAXIMUMS AND MINIMUMS.
4. SUBMIT COMPLETED FORMS TO LABORATORY SUPERVISOR BY THE 10TH OF THE FOLLOWING MONTH.

RESULTS OF COMPLIANCE MONITORING

Plant: *Camp Johnson* Month: *May* Year: *1988*

NSTRUCTIONS:

Each day at approximately ___, collect samples of plant effluent and each test listed in columns 4-7, by established procedures.

Record actual time tests were run in column 3.

Record the results in the correct column, on the appropriate line and sign your name in column 8.

Coulmn 2 will be taken from the plant sheets at the end of the month.

Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) Cl_2 DPD	(7) D.O.-by Winkler	(8) Signature
1	.581	0830	17°	7.0	5.0	7.0	Stanley E. Hill
2	.486	0830	17°	7.0	4.0	8.5	Stanley E. Hill
3	.515	0830	18°	7.0	4.0	7.7	Stanley E. Hill
4	.561	0830	19°	7.0	2.5	7.5	Stanley E. Hill
5	.662	0830	19°	7.0	4.0	7.3	Stanley E. Hill
6	.526	0830	17°	6.9	3.0	7.4	Rebecca E. Norris
7	.512	0845	18°	6.8	2.0	7.3	Earl Walker Jr
8	.430	0830	18°	6.7	2.0	7.0	Amos Abbott
9	.486	0830	18	6.6	4.0	8.0	[illegible]
10	.620	0830	19°	6.8	2.5	6.5	Stanley E. Hill
11	.510	0830	19°	6.9	2.5	6.5	Stanley E. Hill
12	.487	0830	20°	6.8	2.0	6.4	Stanley E. Hill
13	.534	0830	21°	6.9	4.0	8.0	Stanley E. Hill
[illegible]	.452	0830	21°	6.8	4.0	7.6	Stanley E. Hill
[illegible]	.646	0830	21°	7.0	4.0	7.4	Stanley E. Hill
16	.576	0830	20°	7.0	2.5	7.8	Stanley E. Hill
17	.799	0830	22	6.7	4.0	6.8	Rebecca E. Norris
18	.706	0830	20	7.0	2.5	8.1	Rebecca E. Norris
19	.625	0830	20°	6.9	2.0	6.8	Stanley E. Hill
20	.636	0830	21°	7.0	2.5	7.7	Stanley E. Hill
21	.415	0830	22°	6.9	4.0	7.5	Stanley E. Hill
22	.873	0830	22°	7.1	0.0	6.5 FILTER F	Stanley E. Hill
23	.530	0830	22°	7.0	2.5	7.8	Stanley E. Hill
24	.548	0830	22°	7.2	0.4	6.5	Stanley E. Hill
25	.513	0830	21°	7.0	3.0	7.1	Stanley E. Hill
26	.308	0830	18°	7.0	0.4	7.0	Stanley E. Hill
27	.566	0830	18°	6.9	4.0	7.3	Rebecca E. Norris
28	.884	0830	17°	7.0	1.5	7.8	Rebecca E. Norris
29	.524	0830	18°	7.0	4.0	7.2	Rebecca E. Norris
30	.594	0830	20°	6.9	4.0	8.2	Rebecca E. Norris
31	.642	0850	21°	6.9	1.0	7.5	Stanley E. Hill
Total	17.775		606	[illegible]	87.3	227.9	McArthur Farrow
Ave.	.573		20	[illegible]	2.8	7.4	McArthur Farrow
Max.	.884		22	7.2	5.0	8.5	McArthur Farrow
Min.	.308		17	6.7	0.0	6.4	McArthur Farrow

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

OPERATOR IN RESPONSIBLE CHARGE
or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY

MCBCL 11345/8 (REV. 09/87)

PLANT	NPDES PERMIT NO	MONTH	YEAR
CAMP JOHNSON	NC-0063011	JUNE	1988

DATE	00310 5 DAY 20°C BOD INFLUENT MG/L	00310 5 DAY 20°C BOD EFFLUENT MG/L	%	00610 AMMONIA EFFLUENT MG/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT MG/L	00530 TOTAL SUSPENDED RESIDUE EFFLUENT MG/L	%	31616 FECAL COLIFORM EFFLUENT MF/100 ML	00556 OIL & GREASE EFFLUENT MG/L	00600 TOTAL NITROGEN EFFLUENT MG/L	00665 TOTAL PHOSPHOROUS EFFLUENT MG/L
1											
2											
3	720	10	99	6.1	1071	15	99	12			
4											
5											
6	670	16	98	6.4	816	8	99	0			
7											
8									6.9		
9											
10	940	13	99	9.2	2427	6	99	2			
11											
12											
13	830	11	99	7.1	3289	13	99	Ø			
14											
15											
16											
17	216	12	94	8.0	555	13	97	Ø			
18											
19											
20	455	25	95	4.1	307	13	96	Ø			
21									9.5		
22											
23											
24	325	19	94	6.2	605	9	99	Ø			
25											
26											
27	770	13	98	5.8	1054	7	99	Ø			
28											
29											
30											
31											
TOTAL	4986	119		52.9	10,124	84			16.4		
AVERAGE	623	15	97.0	6.6	1266	11	98.4	1.49	8.2		
MAXIMUM	940	25		9.2	3289	15		12	9.5		
MINIMUM	216	10		4.1	307	6		0	6.9		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		1000	30		

INSTRUCTIONS:

1. COMPLETE THIS FORM IN INK, NEATLY AND CLEARLY OR IT WILL BE TYPED.
2. HEAD THE FORM WITH PLANT NAME, PERMIT NUMBER, MONTH & YEAR. INDICATE TOTAL OR FECAL IN COLIFORM HEADING. ADD THE APPROPRIATE MONTHLY LIMITS AT THE BOTTOM.
3. AT THE END OF THE MONTH, CALCULATE TOTALS, AVERAGES, MAXIMUMS AND MINIMUMS.
4. SUBMIT COMPLETED FORMS TO LABORATORY SUPERVISOR BY THE 10TH OF THE FOLLOWING MONTH.

RESULTS OF COMPLIANCE MONITORING

MCBCL 11330/24

Plant: Camp Johnson Month: June Year 1988

INSTRUCTIONS:

1. Each day at approximately 0800, collect samples of plant effluent and run each test, listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Column 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) CL_2 DPD	(7) D.O.-by Winkley	(8) Signature
1	.632	0830	21°	7.0	2.5	7.7	Stanley E Hill
2	.610	0830	21°	6.9	2.0	7.1	Stanley E Hill
3	.687	0830	20°	7.0	2.0	7.5	Stanley E Hill
4	.698	0830	20°	7.0	4.0	7.8	Stanley E Hill
5	.738	0830	19°	6.8	4.0	6.5	Stanley E Hill
6	.556	0830	19°	7.0	2.5	8.4	Stanley E Hill
7	.524	0830	19°	7.0	4.0	8.0	Rebecca E Morris
8	.505	0830	20°	6.9	4.0	7.9	Rebecca E Morris
9	.548	0830	22°	7.0	2.5	6.0	Stanley E Hill
10	.537	0830	19°	6.9	4.0	7.3	Stanley E Hill
11	.526	0830	19°	6.7	6.0	8.0	Stanley E Hill
12	.567	0830	19°	6.9	4.0	7.6	Stanley E Hill
13	.560	0830	20°	6.9	4.0	8.0	Stanley E Hill
14	.601	0830	21°	6.7	4.0	7.6	Stanley E Hill
15	.575	0830	22°	6.8	4.0	7.0	Stanley E Hill
16	.598	0830	22°	6.9	2.5	7.0	Stanley E Hill
17	.570	0830	22°	6.8	4.0	7.2	Rebecca E Morris
18	.656	0830	22°	6.8	4.0	7.0	Rebecca E Morris
19	.489	0830	22°	6.8	4.0	6.9	Rebecca E Morris
20	.498	0930	23°	6.9	4.0	7.2	Rebecca E Morris
21	.623	0830	24°	7.0	4.0	7.0	Stanley E Hill
22	.632	0830	24°	7.0	4.0	6.8	Stanley E Hill
23	.537	0830	24°	7.0	4.0	6.9	Stanley E Hill
24	.630	0830	23°	7.0	2.0	6.6	Stanley E Hill
25	.540	0835	21°	6.4	4.0	7.4	[illegible]
26	.638	0830	21°	6.6	4.0	7.4	[illegible]
27	.639	0830	23°	7.0	0.6	6.8	Stanley E Hill
28	.600	0830	23°	7.0	4.0	7.1	Rebecca E Morris
29	.482	0830	23°	6.6	4.0	6.9	Rebecca E Morris
30	.570	0830	22°	6.8	2.5	7.2	Stanley E Hill
31							
Total	17566.000		640		105.1	217.8	[illegible]
Avg.	.585.533		21.3		3.5	7.3	[illegible]
Max.	.738.000		24.0	7.0	6.0	8.4	[illegible]
Min.	.482.000		19.0	6.4	0.6	6.0	[illegible]

I hereby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE or ORC's Supervisor

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/8 (REV. 09/87)

PLANT	NPDES PERMIT NO	MONTH	YEAR
AMP JOHNSON	NC-0063011	JULY	1988

DATE	00310 5 DAY 20°C BOD INFLUENT MG/L	EFFLUENT MG/L	%	00610 AMMONIA EFFLUENT MG/L	00530 TOTAL SUSPENDED RESIDUE INFLUENT MG/L	EFFLUENT MG/L	%	31616 FECAL COLIFORM EFFLUENT MF/100 ML	00556 OIL & GREASE EFFLUENT MG/L	00600 TOTAL NITROGEN EFFLUENT MG/L	00665 TOTAL PHOSPHOROUS EFFLUENT MG/L
1	540	22	96	6.9	7[illegible]	14	98	0			
2											
3											
4											
5											
6											
7									6.2		
8	420	17	96	6.0	250	11	96	Ø			
9											
10											
11	200	17	92	1.9	417	9	98	Ø			
12											
13											
14											
15	830	17	98	5.3	914	18	98	12		16.26	
16											
17											
18	670	23	96	5.1	948	11	99	2000			
19											
20											
21											
22	880	12	99	8.4	1002	6	99	Ø			1.8
23											
24											
25	477	15	97	2.8	533	6	99	Ø			
26									2.2		
27											
28											
29	182	14	92	1.2	167	9	95	Ø			
30											
31											
TOTAL	4199	137			4991	84			8.4		
AVERAGE	525	17	95.6	4.7	624	11	97.8	3.53	4.2	16.26	1.8
MAXIMUM	880	23		8.4	1002	18		2000	6.2	16.26	1.8
MINIMUM	182	12		1.2	167	6		0	2.2	16.26	1.8
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		1000	30		

INSTRUCTIONS:

1. COMPLETE THIS FORM IN INK, NEATLY AND CLEARLY OR IT WILL BE TYPED.
2. HEAD THE FORM WITH PLANT NAME, PERMIT NUMBER, MONTH & YEAR. INDICATE TOTAL OR FECAL IN COLIFORM HEADING. ADD THE APPROPRIATE MONTHLY LIMITS AT THE BOTTOM.
3. AT THE END OF THE MONTH, CALCULATE TOTALS, AVERAGES, MAXIMUMS AND MINIMUMS.
4. SUBMIT COMPLETED FORMS TO LABORATORY SUPERVISOR BY THE 10TH OF THE FOLLOWING MONTH.

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY LABORATORY REPORT
MONTHLY REPORT OF WASTE TREATMENT PLANT WATER QUALITY
MCBCL 11345/8 (REV. 09/87)

PLANT	NPDES PERMIT NO.	MONTH	YEAR
[illegible]MP JOHNSON	NC-0063011	AUGUST	1988

	00310			00610	00530			31616	00556	00600	00665
	5 DAY 20°C BOD			AMMONIA	TOTAL SUSPENDED RESIDUE			FECAL COLIFORM	OIL & GREASE	TOTAL NITROGEN	TOTAL PHOSPHOROUS
DATE	INFLUENT MG/L	EFFLUENT MG/L	%	EFFLUENT MG/L	INFLUENT MG/L	EFFLUENT MG/L	%	EFFLUENT MF/100 ML	EFFLUENT MG/L	EFFLUENT MG/L	EFFLUENT MG/L
1	170	13	92	3.5	738	8	99	Ø			
2											
3											
4											
5	460	16	97	3.7	549	36	93	20			
6											
7											
8	417	16	96	7.0	677	9	99	8			
9									4.7		
10											
11											
12	374	17	95	5.6	474	6	99	Ø			
13											
14											
15	197	13	93	5.6	408	7	98	Ø			
16											
17											
[illegible]											
19	247	11	96	7.5	154	11	93	Ø			
20											
21											
22	305	11	96	4.7	238	10	96	Ø			
23									6.1		
24											
25											
26	660	8	99	2.7	563	7	99	Ø			
27											
28											
29	255	9	96	8.4	514	12	98	Ø			
30											
31											
TOTAL	3085	114		42.7	4315	106			10.8		
AVERAGE	343	13.	95.6	4.7	479	12	97.1	1.76	5.4		
MAXIMUM	660	17		7.0	738	36		20	6.1		
MINIMUM	170	8		2.7	154	6		Ø	4.7		
COMP (C) GRAB (G)	C	C		C	C	C		G	G	C	C
MONTHLY LIMIT		30				30		1000	30		

INSTRUCTIONS:

1. COMPLETE THIS FORM IN INK, NEATLY AND CLEARLY OR IT WILL BE TYPED.
2. [illegible]AD THE FORM WITH PLANT NAME, PERMIT NUMBER, MONTH & YEAR. INDICATE TOTAL OR FECAL IN COLIFORM HEADING. ADD THE APPROPRIATE MONTHLY LIMITS AT THE BOTTOM.
3. AT THE END OF THE MONTH, CALCULATE TOTALS, AVERAGES, MAXIMUMS AND MINIMUMS.
4. SUBMIT COMPLETED FORMS TO LABORATORY SUPERVISOR BY THE 10TH OF THE FOLLOWING MONTH.

RESULTS OF COMPLIANCE MONITORING

MCBCL 11330/24

Plant: Camp Johnson Month: August Year 1988

[illegible]UCTIONS:

1. Each day at approximately 0830, collect samples of plant effluent and run each test, listed in columns 4-7, by established procedures.
2. Record actual time tests were run in column 3.
3. Record the results in the correct column, on the appropriate line and sign your name in column 8.
4. Column 2 will be taken from the plant sheets at the end of the month.
5. Completed and signed forms will be returned to NREAD not later than the 7th of the following month.

(1) Day	(2) Flow	(3) Time	(4) Temp (°C)	(5) pH-by Meter	(6) CL_2 DPD	(7) D.O.-by Winkley	(8) Signature
1	.600	0830	23°	6.7	4.0	6.5	Rebecca E. Morris
2	.537	0830	24°	6.8	2.5	6.1	Stanley E. Hill
3	.663	0830	24°	7.1	4.0	6.6	Stanley E. Hill
4	.677	0830	24°	7.0	3.0	6.6	Stanley E. Hill
5	.615	0830	23°	6.9	4.0	6.7	Stanley E. Hill
6	.450	0830	23°	6.8	4.0	6.1	Stanley E. Hill
7	.739	0830	24°	6.8	2.5	5.5 FILTER FLOODED	Stanley E. Hill
8	.648	0830	24°	7.0	3.0	7.2	Stanley E. Hill
9	.694	0830	24°	7.0	4.0	6.9	Rebecca E. Morris
10	.724	0830	22	7.0	2.0	7.4	Rebecca E. Morris
11	.574	0830	24°	7.0	4.0	6.6	Stanley E. Hill
[illegible]	.503	0830	24°	7.0	4.0	6.8	Stanley E. Hill
[illegible]	.323	0830	24°	7.0	4.0	6.9	Stanley E. Hill
14	.540	0830	24°	7.0	4.0	5.6 FILTER FLOODED	Stanley E. Hill
15	.525	0830	25°	7.0	4.0	7.5	Stanley E. Hill
16	.503	0830	24°	7.0	4.0	7.5	Stanley E. Hill
17	.542	0830	24°	7.0	4.0	7.1	Stanley E. Hill
18	.564	0830	25°	7.0	4.0	6.9	Stanley E. Hill
19	.593	0830	25°	6.5	3.0	7.2	Rebecca E. Morris
20	.492	0830	25°	6.9	4.0	7.0	Rebecca E. Morris
21	.573	0830	25°	6.9	3.0	7.1	Rebecca E. Morris
22	.492	0830	23°	6.9	3.0	6.9	Rebecca E. Morris
23	.522	0830	24°	7.0	4.0	6.8	Stanley E. Hill
24	.548	0830	24°	7.0	4.0	6.9	Stanley E. Hill
25	.583	0830	23°	6.8	2.0	7.6	Stanley E. Hill
26	.549	0830	24°	7.0	2.0	7.5	Stanley E. Hill
27	.527	0830	24°	7.0	4.0	7.3	Stanley E. Hill
28	.550	0830	25°	7.0	4.0	7.1	Stanley E. Hill
29	.598	0830	25°	7.0	3.0	7.2	Stanley E. Hill
30	.412	0830	24°	6.7	4.0	7.0	Rebecca E. Morris
31	.597	0830	22°	6.5	2.0	7.1	Rebecca E. Morris
Total	17.457		742		107.0	213.0	Stephen V. Crews
Avg.	.563		23.9		3.5	6.9	Stephen V. Crews
Max.	.739		25	7.1	4.0	7.6	Stephen V. Crews
[illegible]	.323		22	6.5	2.0	5.5	Stephen V. Crews

[illegible]eby certify that the data contained herein was obtained by tests run by qualified personnel in accordance with all applicable procedures and related quality control.

[signature]

OPERATOR IN RESPONSIBLE CHARGE or ORC's Supervisor

APPENDIX 4

Biological phosphorus removal: A technology evaluation

Mark J. Tetreault, Arthur H. Benedict, Christopher Kaempfer, Edwin F. Barth

In 1984, the U. S. Environmental Protection Agency (EPA) sponsored a study to evaluate the effectiveness and reliability of biological processes that depend on microorganisms to remove phosphorus. This study focused on field investigations at four full-scale wastewater treatment plants. Key objectives of the evaluation were to obtain information about the design, operation, and performance of biological phosphorus removal technologies; to document achievable effluent phosphorus concentrations; and to compare performance of the technologies based on full-scale operating experience. The study began in the spring of 1984 and continued until August 1985.

One of three proprietary processes is used by 28 of the 30 biological phosphorus removal facilities currently in operation, construction, or design—PhoStrip, anaerobic/oxic (A/O), and Modified Bardenpho (Bardenpho).[1] In April 1984, 5 of 11 plants in full-scale operation used PhoStrip; one was an A/O plant, and three were Bardenpho plants. Two operationally modified activated sludge plants were also identified. Two of the plants are privately owned; the others are municipally owned. Two PhoStrip and two operationally modified activated sludge plants were selected for detailed investigation. Operational modifications used at these plants involved shutting off the air supply in the first stage of the aeration basins to provide an initial anaerobic zone. Neither facility was designed for biological phosphorus removal.

BIOLOGICAL PHOSPHORUS REMOVAL

All full-scale applications of biological phosphorus removal technologies are modifications of the activated sludge process. These processes use an anaerobic contact period in a cyclic mode to select microorganisms that reduce effluent phosphorus through "luxury" uptake and storage. The A/O, Bardenpho, and operationally modified activated sludge processes are mainstream processes that remove phosphorus in the waste activated sludge. PhoStrip is a sidestream process that combines biological and chemical phosphorus removal. All of the processes can be adapted for combined phosphorus and nitrogen removal.

PhoStrip process. The anaerobic stripper tank and the lime reactor clarifier are key features of the PhoStrip process (Figure 1). A return activated sludge sidestream that contains 10 to 30% of the mainstream flow is treated by chemical precipitation of a phosphorus-rich supernatant.[2] Lime dosage mainly depends on the alkalinity of the wastewater. Chemical usage is reduced significantly over mainstream chemical precipitation processes because only a small portion of the waste stream requires treatment.

Sludge is retained in the stripper, which acts like a gravity thickener, for a solids detention time (SDT) of 5 to 20 hours. SDT is defined as the mass of solids in the stripper blanket divided by the mass of solids leaving the system in the underflow per day. Stripper solids are estimated from the sludge blanket depth and underflow solids concentration. In the stripper, biologically bound phosphorus is released from the sludge blanket into solution.

The soluble phosphorus (sol[illegible] is transferred to the stripper supernatant either by recycling [illegible]pper underflow to the stripper feed, or by elutriation. The elutriant can be primary, secondary, or reactor clarifier effluent. Treatment with lime in the reactor clarifier causes the phosphorus in the stripper supernatant to precipitate. After the underflow is stripped of phosphorus, it is returned to the aeration basin where biological phosphorus uptake occurs.

Operationally modified activated sludge process. The key feature of this process is the development of an initial anaerobic stage in an operating activated sludge system (Figure 2). Influent wastewater and recycled sludge are mixed in this zone to induce phosphorus release before aeration. Typically, the process uses a relatively short mean cell residence time (MCRT), less than 6 days. This concept emerged during the late 1960s and early 1970s at conventional activated sludge plants that recorded high phosphorus removals largely by happenstance.[3,4,5] The plants used long plug flow reactors, graduated aeration from inlet to outlet, and short MCRTs (1.5 to 6 days). Operators detected phosphorus release in the front end of the basins. Though not known at that time, heavy organic loadings and inadequate aeration were causing anaerobic conditions, which in turn caused phosphorus release.[6]

In this study, anaerobic conditions are operationally defined as an environment that contains less than 0.2 mg/L of both dissolved oxygen (DO) and oxidized nitrogen (NO_x-N). Anoxic conditions are operationally defined as an environment containing less than 0.2 mg/L DO, but greater than 0.2 mg/L oxidized nitrogen. One plant studied as part of this evaluation uses a plug flow basin; the other plant uses separate, completely mixed anaerobic and aerobic basins for effective phosphorus removal and operates at a 10-day MCRT.

Field investigations at four plants showed that nitrification and denitrification are compatible with effluent phosphorus levels of 1 mg/L or less.

Phosphorus removal mechanism. Biological phosphorus removal processes depend on a population of microorganisms that accumulate more phosphorus than is typically found in activated

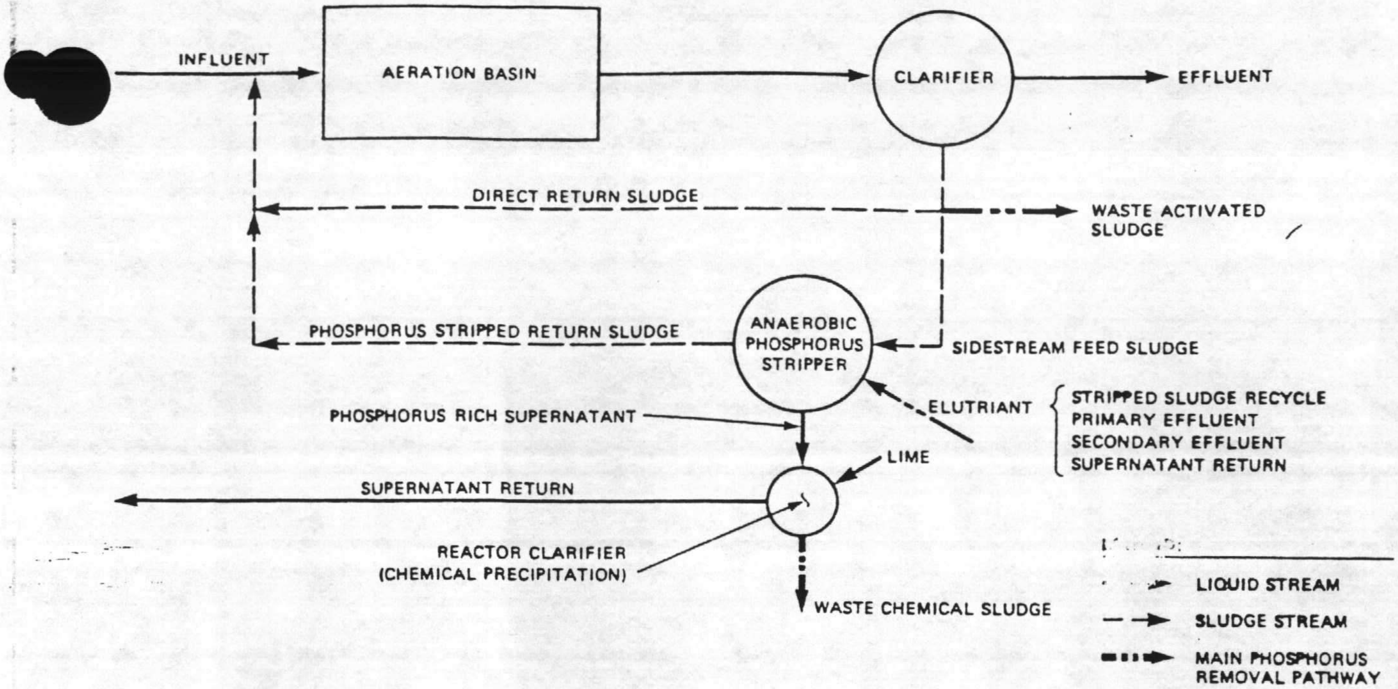


Figure 1—PhoStrip process schematic.

sludge biomass. Measurements of biomass as total suspended solids (TSS) that contain up to 7% phosphorus on a dry weight basis have been recorded for biological phosphorus removal process sludges.[3] For conventional activated sludge, biomass with 1.5 to 3% phosphorus is typical.[7] Several conditions are necessary for this luxury uptake to occur. These include anaerobic-aerobic staging;[8,9] phosphorus release in one anaerobic stage in the presence of a readily biodegradable organic substrate that is simultaneously absorbed during this stage;[10,11] and rapid soluble P uptake in the aerobic basin by polyphosphate-accumulating microorganisms.

Marais postulated a population selection theory to explain the presence of these organisms in the activated sludge biomass of mainstream processes.[6] According to this theory, polyphosphate accumulation serves as an energy reservoir to sustain the organisms during the anaerobic stressed state. In the anaerobic stage, these organisms gain an advantage over nonpolyphosphate-accumulating organisms by absorbing the organic substrate in the anaerobic basin for their exclusive use. Little soluble organic substrate enters the aerobic zone for the nonpolyphosphate-accumulating aerobic organisms to effectively compete with the polyphosphate-accumulating organisms.

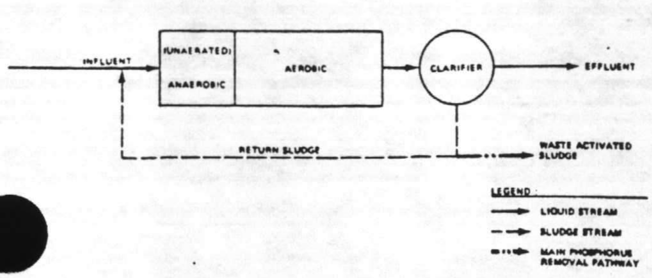


Figure 2—Operationally modified activated sludge process schematic.

It is not known yet if there are significant differences in the phosphorus accumulation mechanism between mainstream and sidestream processes. Unlike mainstream processes, it seems that in the PhoStrip process low molecular weight organics in the sidestream anaerobic reactor are formed by hydrolyzation of particulate organics and from lysed bacteria during the long SDT.[12] If so, phosphorus release in the PhoStrip stripper comes from both polyphosphate-accumulating microorganisms and lysed bacteria.

In mainstream processes, an anaerobic contact period of 1 to 2 hours is generally used to select for these polyphosphate-accumulating microorganisms.[8] An SDT of 5 to 20 hours is used in the PhoStrip process. NO_x-N or DO in the anaerobic reactor inhibits phosphorus release.[9] This reduced phosphorus release limits phosphorus uptake in the aerobic reactor and has a negative effect on process performance. DO concentrations greater than 2 mg/L have been noted as necessary for effective phosphorus uptake in the aerobic basin; concentrations greater than 4 mg/L did not significantly increase phosphorus uptake.[5,12,13]

Arvin identified simultaneous chemical precipitation of phosphorus caused by cations in the wastewater as another factor that contributes to improved performance.[14] Under anaerobic conditions, phosphorus release increases the driving force for phosphate precipitation at pH greater than 7. Denitrification can also occur within microfilms, which causes an increase in pH and creates microenvironments that are conducive to phosphorus precipitation.

Effluent phosphorus characteristics. Biological phosphorus removal is analogous to 5-day biochemical oxygen demand (BOD_5) removal in that the process converts soluble P to suspended biomass in the aeration basin. Thus, for effective treatment, the suspended biomass must be removed. To illustrate, for 0.7 mg/L effluent soluble P, 0.3 mg/L suspended phosphorus is required to achieve an effluent total phosphorus (total P) con-

centration of 1.0 mg/L. Figure 3 shows the relationship between effluent TSS, phosphorus content of the TSS, and suspended phosphorus for effluent TSS between 0 and 30 mg/L. If effluent TSS contain 5% phosphorus, an effluent TSS concentration of 6 mg/L or less would be required to achieve this treatment level. At a 3% phosphorus content, 10 mg/L TSS would be required. The relationship between effluent TSS, biomass phosphorus content, and soluble P residual is therefore important in defining achievable effluent phosphorus concentrations for the biological phosphorus removal technologies.

FULL-SCALE INVESTIGATIONS

Methodology. The evaluation focused on the sidestream PhoStrip process and mainstream anaerobic/aerobic operating modifications to the activated sludge process. Operating A/O and Bardenpho plants were not available for detailed investigation; therefore, these processes are not included directly in this evaluation. However, selected published information on the performance of full-scale A/O and Bardenpho plants is included for comparison.

The plants selected for study of the PhoStrip process were the Lansdale Wastewater Treatment Plant (Lansdale), Lansdale, Pa., and the Little Patuxent Wastewater Treatment Plant (Little Patuxent), Savage, Md. The operationally modified activated sludge plants selected were the Reedy Creek Improvement District Main Wastewater Treatment Plant (Reedy Creek) in Lake Buena Vista, Fla., and the DePere, Wisc., Wastewater Treatment Plant (DePere).

Plant selection was based on historical performance and availability of routine monitoring data, mass balance information, plant personnel, and laboratory resources. The investigations consisted of a review of facility planning and background information; collection of historical operating and performance data; and independent testing and analysis at each location to study specific aspects of the phosphorus removal process. An analytical quality control program was implemented to ensure consistent reporting of results from each plant. Table 1 shows the methods of analysis.[15,16] The two PhoStrip plants used filtrable orthophosphate (measured as P) as the measure of soluble phosphorus. The operationally modified activated sludge plants measured soluble P with the standard filtrable phosphorus procedure; this included a digestion step to reduce soluble polyphosphate to soluble orthophosphate. Soluble P is defined as the phosphorus filtrable through 0.45-μ pore size membrane filter according to "Standard Methods."[15] The actual soluble P concentration at the PhoStrip plants lies between the total P and orthophosphate concentrations because polyphosphate in the soluble form is not detected by the analysis for orthophosphate. However, in this study, orthophosphate is considered to constitute the soluble phosphorus fraction.

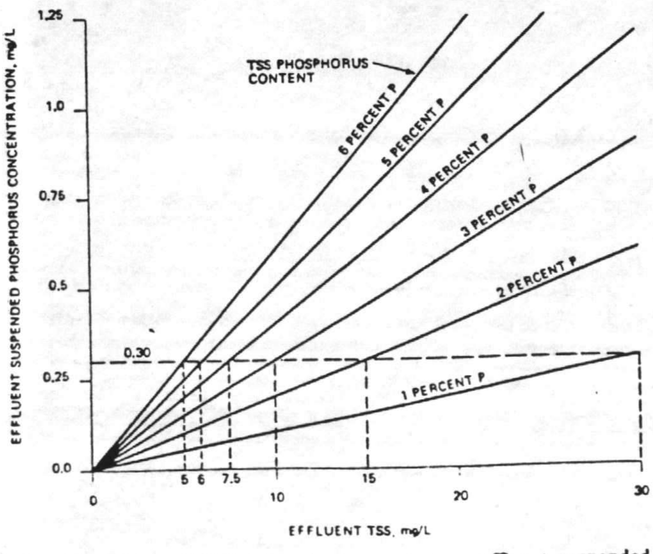


Figure 3—Effect of TSS phosphorus content on effluent suspended phosphorus concentration.

Table 1—Methods of analysis.

Measurement parameter	Method	Reference
Solids (residues)		
Total	209A	15
Total suspended	209D	15
Volatile suspended	209E	15
Phosphorus		
Total	424C, F, G	15
Filtrable*	424A, B, F, G	15
Filtrable ortho*	424A, F, G	15
Nitrogen		
Ammonia	417A, B, D	15
TKN	420; 417D	15
Nitrate	EPA 325.1	16
Nitrate plus nitrite	418C, E, 419	15
Biochemical oxygen demand	507	15

* Filtered through a 0.45 micrometer pore size membrane filter.

The study team conducted sampling programs over a 4- to 9-week period at each plant during June, July, and August 1984. The sampling programs emphasized evaluation of the biological phosphorus removal processes, but included other unit operations and processes where appropriate. Objectives were to define process operating conditions; achievable effluent phosphorus concentrations; a representative phosphorus mass balance; effects of nitrification and denitrification; effects of the biological removal processes on activated sludge settling characteristics; impacts of solids-handling operations; and relative phosphorus removals by chemical and biological methods in the PhoStrip process. The team also identified key operating problems at each plant and documented the methods used to resolve these problems.

Key plant features. Table 2 presents the unit processes and operations used at each plant. Figures 4 to 7 are flow schematics for each plant.

The 9450-m^3/d (2.5-mgd) Lansdale plant uses the PhoStrip process. There is no primary treatment at this facility; however, flow is equalized in an on-line basin with a 24-hour hydraulic residence time (HRT). In this paper, HRT is defined as the forward flow divided by the basin volume. Contact time is defined as the actual HRT or the total flow (forward plus recycle flows) divided by the basin volume. After preliminary treatment, wastewater flows to the activated sludge-PhoStrip system (Figure 4) for BOD_5 and phosphorus removal. Reactor clarifier overflow and secondary effluent are used to elutriate phosphorus in the stripper. Nitrification occurs in the activated sludge process; full nitrification occurs during the summer months. Separate-stage

Table 2—Wastewater plant unit processes and operations during field investigations.

Wastewater treatment plant	Unit process or operation			
	Prephosphorus removal	Phosphorus removal	Postphosphorus removal	Sludge handling
Lansdale, PA	Barscreening Comminution Grit removal On-line equalization	Plug-flow activated sludge PhoStrip	Nitrification trickling filters/clarification Suspended growth denitrification/post aeration/clarification Chlorination/dechlorination	Gravity thickeners with lime stabilization Vacuum filtration off-site disposal or liquid sludge spreading
Little Patuxent, MD	Bar screening Grit removal Off-line flow equalization Primary clarification	Step-feed activated sludge (July 1984) Plug flow activated sludge (April 1985) PhoStrip	Suspended growth nitrification/clarification Coagulation/flocculation Filtration[a] Chlorination/dechlorination and postaeration	Aerobic digestion (biological sludges) Gravity thickening with chemical sludge Filter press dewatering Off-site disposal
Reedy Creek, FL	Comminution Grit removal (aerated only) Primary sedimentation	Plug flow activated sludge Anaerobic/aerobic zones	Chlorination Wetlands treatment	Dissolved air flotation (waste activated sludge) Aerobic digestion primary and thickening waste activated sludges) Land spreading
DePere, WI	Grit removal	Completely mixed activated sludge Anaerobic/aerobic tanks in series	Multimedia filtration[a] Chlorination	Dissolved air flotation Sludge storage Plate frame filter press dewatering Incineration

[a] Tertiary phosphorus removal processes.

nitrification and denitrification are also used. Waste biological sludges are combined with the waste chemical sludge from the PhoStrip process, gravity thickened, stabilized with lime, and then dewatered or spread on land.

The Little Patuxent facility, a 56 800-m³/d (15-mgd) plant, also uses the PhoStrip process with high-rate activated sludge (Figure 5). Additional treatment includes primary sedimentation, separate-stage nitrification, chemical coagulation/flocculation, and filtration for residual TSS and phosphorus removal (see Table 2). Partial nitrification occurs in the first-stage activated sludge system. Reactor clarifier overflow is used as an elutriant in the stripper. During the field investigation the activated sludge system was operated in a step-feed mode. However, in November 1984, the process was converted to plug flow operation to improve phosphorus uptake. Operating changes in the PhoStrip process were also implemented at this time. Primary and waste biological sludges were aerobically digested before gravity thickening with the waste chemical sludge. Thickened sludge is dewatered by belt filter presses before final disposal.

The 22 700-m³/d (6.0-mgd) Reedy Creek plant serves the Walt Disney World Complex. Primary effluent is combined with return activated sludge and distributed to four parallel plug flow basins (Figure 6). The first third of each basin is unaerated, which results in DO and NO_x-N concentrations less than 0.2 mg/L. Back-mixing provides sufficient agitation to maintain solids suspension in the unaerated zone. Nitrification and denitrification also occur in this single-sludge system. Waste activated sludge is thickened by dissolved air flotation (DAF) and combined with primary sludge for aerobic digestion. Digested sludge is spread on land.

The 53 750-m³/d (14.2-mgd) DePere plant uses a converted contact-stabilization activated sludge system. Operators shut off air flow to the stabilization tank to provide an initial anaerobic basin for phosphorus release before treatment in a completely-

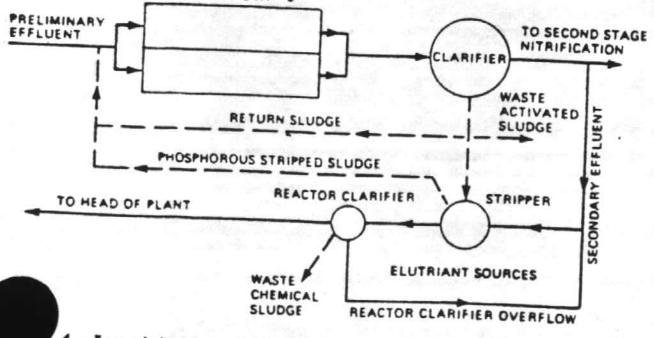


Figure 4—Lansdale biological phosphorus removal process schematic.

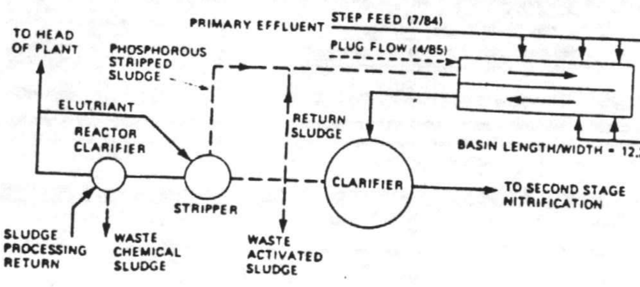


Figure 5—Little Patuxent biological phosphorus removal process schematic.

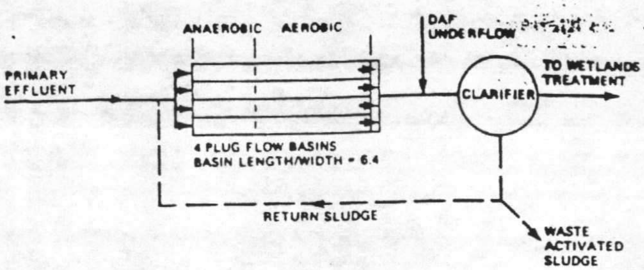


Figure 6—Reedy Creek biological phosphorus removal process schematic.

mixed aeration basin (contact tank) for BOD_5 and phosphorus removal, and nitrification (Figure 7). Basin contents are mixed with turbine aerators operated without air. This plant has no primary treatment; raw wastewater is degritted and aerated before secondary treatment. Waste activated sludge is thickened in DAF units and stored. Periodically, stored waste sludge is chemically conditioned, dewatered in a plate-and-frame filter press, and incinerated.

Table 3 summarizes influent phosphorus and BOD_5 concentrations to the biological phosphorus removal process at each plant during the field investigations. Process influent was primary effluent at the Little Patuxent and Reedy Creek plants. The Lansdale plant process influent was degritted wastewater that was aerated and stored (equalized) for a minimal HRT of 24 hours before the biological phosphorus removal process. Process influent at the DePere plant was degritted wastewater. As Table 3 shows, the plants operated below design hydraulic loadings during the field investigations.

Data for July 1984 and April 1985 are presented for the Little Patuxent plant. A comparison of these two sets of data shows the effects of the operational changes made in November 1984 that improved performance. Data for the July 1984 period are based on the monthly operating reports and results from special studies conducted as part of the field investigation. Data for the April 1985 period are based only on monthly operating reports. These data typify performance during a 6-month period beginning in November 1984. Approximately 20% total P removal occurred through preliminary or primary treatment processes.

Treatment effectiveness. Table 4 presents final and process effluent concentrations for BOD_5, total P, and soluble P or orthophosphate. Suspended phosphorus concentrations are also included in Table 4; these values were calculated from the recorded total P and orthophosphate or soluble P concentrations. Figures 4 through 7 and Table 3 describe tertiary treatment processes. Except for the Little Patuxent plant July 1984 1.7 mg/L secondary effluent total P, all plants achieved 1 mg/L or less total P in both the biological phosphorus removal process and final effluents.

As Table 4 shows, the biological phosphorus removal process effluent and final effluent quality, excluding nitrogen, was better than advanced secondary standards (BOD_5 less than 25, TSS less than 25, and total P less than 1). Final effluent quality was better than advanced waste treatment standards (BOD_5 less than 10, TSS less than 10, and total P less than 1). This degree of overall treatment performance was required to achieve the low effluent total P at these plants. Because phosphorus removal is associated with BOD_5 uptake in both the anaerobic and aerobic basins, phosphorus removal is maximized for a certain set of operating conditions by maximizing BOD_5 removal. The low residual BOD_5 in the biological phosphorus process effluents (all but one result less than 8 mg/L) show that BOD_5 removal was greater than 90%.

Table 5 presents phosphorus removals per unit of BOD_5 removed in the biological phosphorus removal process. Overall removal including that from chemical removal in the PhoStrip processes is also shown. These unit removals are based on the difference between influent BOD_5 and total P, and effluent orthophosphate or soluble P and carbonaceous BOD_5. Unit biological removals that represent the amount of phosphorus removed in the waste activated sludge for the PhoStrip processes were calculated from mass balances conducted during the field investigations.

Values between 0.04 and 0.08 mg phosphorus per mg BOD_5 (mg P/mg BOD_5) have been reported for mainstream biological phosphorus removal processes.[13] The unit values shown in Table 5 indicate that enhancement was similar at each plant.

TSS concentrations that averaged less than 15 mg/L (except in July 1984 at Little Patuxent, 26 mg/L TSS), resulted in low suspended phosphorus concentrations of 0.1 to 0.8 in the biological phosphorus removal process effluent. Final effluent suspended phosphorus ranged between 0.1 and 0.6 mg/L; TSS were between 2 and 8 mg/L. Total P removal through the biological phosphorus removal processes ranged between 74 and 94%; suspended phosphorus accounted for more than 50% of effluent total P at the Little Patuxent and Reedy Creek plants. Average overall total P removal through the plants ranged between 88 and 97%.

The DePere plant and the Little Patuxent plant (in April 1985) met their permit limitations of 1.0 and 0.3 mg/L total P, respectively (see Table 4). The Reedy Creek plant does not have a total P limitation; phosphorus is removed because of a potential total P effluent limit of 0.65 mg/L. The Lansdale plant was out of compliance with the strict permit limitation of 0.07 mg/L total P (0.2 mg/L PO_4); however, the plant can achieve an effluent total P less than 1 mg/L, which is the limit set in a revised draft permit. The Little Patuxent plant was out of compliance with the 0.3 mg/L total P permit limit for the entire 13-month historical review period that ended in August 1984.

Table 6 presents nitrification and total nitrogen (total N) removal data for each of the plants. As the table shows, nitrification was almost complete in the biological phosphorus removal processes of all but the Little Patuxent plant; average ammonia nitrogen (NH_3-N) removals were 89 to 98%. Average total N removals through the biological phosphorus removal processes were between 14 and 83%; based on mass balances, 73% and 34% of the overall total N removal through the Reedy Creek and DePere plants, respectively, was attributed to denitrification.

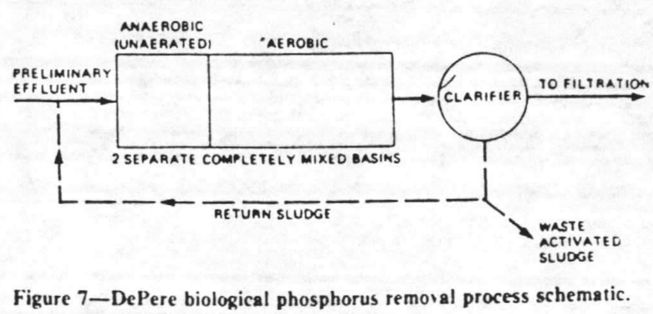


Figure 7—DePere biological phosphorus removal process schematic.

Table 3—Phosphorus and BOD_5 concentrations during field investigations.

Plant	Flow: m^3/d (mgd)	Flow: Percent of design	Raw wastewater total P concentration, mg/L	Process influent concentration, mg/L: Total P	Soluble P	Ortho P	BOD_5	Soluble BOD_5
Lansdale	8 350 (2.2)	88	6.4	5.4	—	3.1	41[a]	—
Little Patuxent								
July 1984	47 300 (12.5)	83	8.2	6.6	—	3.7	103	38
April 1985	40 880 (10.8)	72	8.8	7.0	—	4.8	92	—
Reedy Creek	18 150 (4.8)	80	—[b]	6.7	5.3	—	155	85
DePere	13 250 (3.5)	49[c]	6.4	5.1	1.9	—	150	86

[a] Inhibited BOD_5.
[b] Sampling error, total P concentration greater than 6.7 mg/L.
[c] Based on only one parallel treatment train in operation.

The remaining total N removed was contained in the waste activated sludge. All plants except for Little Patuxent were operated to nitrify. These results indicate that nitrification and nitrogen removal can occur simultaneously at these plants while they continue to produce less than 1 mg/L effluent total P. However, biological phosphorus process effluent contained between 5.8 and 21.0 mg/L total N, which indicates that total N was not reduced to advanced treatment levels (that is, 2 mg/L total N) at these facilities without tertiary treatment for nitrogen removal. This means that combined biological nutrient removal to advanced levels was not accomplished in a single-stage treatment system.

Historical performance summary. Figure 8 presents a cumulative frequency plot of biological phosphorus removal process performance based on historical average monthly data collected from each plant. This performance is representative of secondary effluent quality achievable under optimum operating conditions.

The Lansdale plant performance is based on 14 months of PhoStrip operation. It does not include 7 months of operation during which the PhoStrip process was in a start-up mode or was shut down for maintenance; effluent total P was greater than 2 mg/L during these periods.

The Little Patuxent plant data is based on the improved performance between November 1984 and April 1985 (six data points). During this period, process effluent total P averaged less than 1.3 mg/L. Before this period, process effluent total P averaged 2.0 mg/L and ranged between 1.4 and 3.2 mg/L for the 13-month period ending in August 1984. Both effluent total P and orthophosphate for these two plants are shown in Figure 8. Comparison of the total P and orthophosphate performance curves for the PhoStrip plants shows that suspended phosphorus constitutes a significant portion of the total effluent concentration. These results also show that the PhoStrip process produced an effluent containing less than 1 mg/L total P 83 to 93% of the time on a monthly basis, and orthophosphate concentrations less than 0.5 mg/L 78% of the time.

Total P data presented for the operationally modified biological phosphorus removal processes represent 16 and 12 months of operation for the Reedy Creek and DePere plants, respectively. Effluent soluble P is not measured at these plants. Effluent total P is measured after multimedia filtration at DePere. After filtration, TSS are typically less than 1 mg/L; thus, virtually all suspended phosphorus is removed. Therefore, the total P in the filtered effluent is almost entirely soluble. Effluent total P was always less than 1 mg/L and less than 0.65 mg/L 80% of the

Table 4—Performance during field investigations.

Plant	Biological phosphorus process effluent, Concentration, mg/L: BOD_5	TSS	Total P	Soluble P	Orthophosphate	Suspended phosphorus	Total P removal, %	Final effluent concentration, mg/L: BOD_5	TSS	Total P	Soluble P	Orthophosphate	Suspended phosphorus	Overall Total P removal, %	Permit limit for Total P, mg/L
Lansdale	3	4	0.8	—	0.7	0.1	85	1	5	0.8[a]	—	0.8	0.1	88	0.07[b]
Little Patuxent															
July 1984	16	26	1.7	—	0.9	0.8	74	2	8	0.7[c]	—	0.1	0.6	91	0.3
April 1985	6	11	0.5	—	0.1	0.4	93	2	4	0.3[c]	—	0.1	0.2	97	0.3
Reedy Creek	3	13	0.9	0.4	—	0.5	82	2	2	0.6[d]	—	—	—	91	1.0
DePere	7	7	0.3	0.1	—	0.2	94	3	2	0.3[e]	0.3	—	0.1	95	—

[a] After separate stage nitrification and denitrification
[b] 0.2 mg/L as $PO_4 - P$
[c] After filtration and addition of sodium aluminate for chemical phosphorus removal.
[d] After wetlands treatment.
[e] After filtration.

Table 5—Phosphorus removals per BOD_5 removed.

Plant	Process	Unit removal, mg phosphorus removed per mg BOD_5 removed: Biological[a]	Overall[b]
Lansdale	PhoStrip	0.041	0.124
Little Patuxent	PhoStrip		
July 1984		0.033	0.058[c]
April 1985		0.033	0.078[c]
Reedy Creek	Operationally modified activated sludge	0.041	—
DePere	Operationally modified activated sludge	0.034	—

[a] Removed in waste activated sludge.
[b] Includes chemical phosphorus removal.
[c] Based on effluent filtered BOD_5.

time for the operationally modified activated sludge processes. This historical performance analysis and the phosphorus removal performance during the field investigations show that the biological phosphorus removal processes can consistently and reliably achieve less than 1 mg/L effluent total P without tertiary treatment.

Operating conditions. Table 7 summarizes operating conditions during the field investigations at the PhoStrip plants. The Lansdale stripper operated at a 20-hour SDT; the Little Patuxent SDT was between 7 and 8 hours. Testing indicated that the Lansdale stripper operated under anoxic conditions; nitrified secondary effluent used as an elutriant cycled NO_x-N to the stripper. Stripper overflow contained up to 3.6 mg/L NO_x-N. A DO profile through the depth of the stripper showed that DO increased from 0.15 mg/L at the bottom of the stripper sludge blanket to 0.5 mg/L at the top of the stripper. Measurements at the Little Patuxent plant in July 1984 showed that the stripper operated anaerobically with less than 0.2 mg/L influent DO and NO_x-N.

Total return sludge flows (direct return plus stripped sludge flows) to the activated sludge process averaged between 16 and 57% of the mainstream flows for the periods studied. Additionally, in April 1985, the Little Patuxent plant began to recycle stripper underflow to supplement reactor clarifier overflow used for elutriation. This operational change was implemented along with increased return sludge feed to the stripper. Under these conditions, the average stripper overflow total P increased from 9.5 mg/L (July 1984) to 20.0 mg/L. Average lime dosage to the stripper overflow ranged from 100 to 160 mg/L between pH 9 and 9.5; 59 to 83% of the total P contained in the stripper overflow was removed in the chemical sludge.

Lansdale's activated sludge process operates at a low food-to-microorganism ratio (F:M), 0.16 kilogram BOD_5 per kilogram mixed liquor volatile suspended solids per day (kg BOD_5/kg MLVSS · d). The Little Patuxent plant has a high F:M, 0.5 kg BOD_5/kg MLVSS · d. During the field investigation, the activated sludge system at the Little Patuxent plant was operated in the step-feed mode. This mode of operation, along with low DO (less than 2 mg/L) in the aeration basin limited the phosphorus uptake in the basin. Additionally, phosphorus release occurred in the secondary clarifiers. These factors resulted in poor process performance; the average total P concentration was 2.0 mg/L for the 13-month period. In November 1984 the following operational improvements were implemented:

- Operation of the activated sludge system in the plug flow mode (Figure 4),
- Increased DO in the aeration basin, up to 4 mg/L at the effluent end of the basin to improve phosphorus uptake in the basin and prevent phosphorus release in the secondary clarifiers, and
- Increased return sludge recycle ratio to maintain a minimum sludge blanket in the secondary clarifiers.

Chemical phosphorus removal in the PhoStrip process was also increased from 100 kg/d (221 lb/day) to 164 kg/d (361 lb/day). Unit biological phosphorus removal remained the same at 0.033 mg P/mg BOD_5.

Biological sludge production was 1.0 kg volatile suspended solids (VSS) per kg BOD_5 removed at the Lansdale plant and 0.7 kg VSS/kg BOD_5 at the Little Patuxent plant. Higher sludge production at the Lansdale plant, which does not provide primary sedimentation, was attributed to a higher nondegradeable VSS component in the preliminary treated effluent.

Both of the PhoStrip facilities have experienced lime scaling problems in the elutriation return piping system from the reactor clarifiers. When scaling occurs, the Lansdale plant temporarily substitutes ferric chloride and polymer for lime to precipitate phosphorus and to remove lime scale from the elutriation piping. The Little Patuxent plant shuts down one of the two stripper-reactor clarifier units and recarbonates the system on a batch basis to remove lime scale from the elutriation piping.

Operationally modified activated sludge. Table 8 presents the operating conditions for the mainstream activated sludge process operated in the anaerobic/aerobic mode. The Reedy Creek plant operated at an F:M of 0.33 kg BOD_5/kg MLVSS · d, based on the biomass under aeration. The anaerobic contact period, based on influent plus sludge recycle flows, was 1.9 hours with a 6-hour aerobic HRT. The DePere plant was operated with a 3.8-hour anaerobic contact period at a low aeration basin F:M of 0.12 kg BOD_5/kg MLVSS · d. The aerobic basin HRT was 14 hours; aerobic contact time was 7.6 hours. This long HRT is because the DePere plant is hydraulically loaded at only 50% of the design capacity. Both activated sludge systems were operated to nitrify with an MCRT of 7.2 days for Reedy Creek and 10.6 days for DePere.

Influent ratios of BOD_5-to-total P, soluble BOD_5-to-soluble P, chemical oxygen demand-to-total Kjeldahl nitrogen (COD:

Table 6—Secondary effluent nitrogen oxidation and removal.

Plant	Concentration, mg/L: NH_3-N	Total N	Removal, %: NH_3-N	Total N
Lansdale	0.2	14.2	98	31
Little Patuxent				
July 1984	11.2	19.8	27	18
April 1985	9.5	21.0	44	14
Reedy Creek	0.7	5.8	97	83
DePere	1.4	8.6	89	67

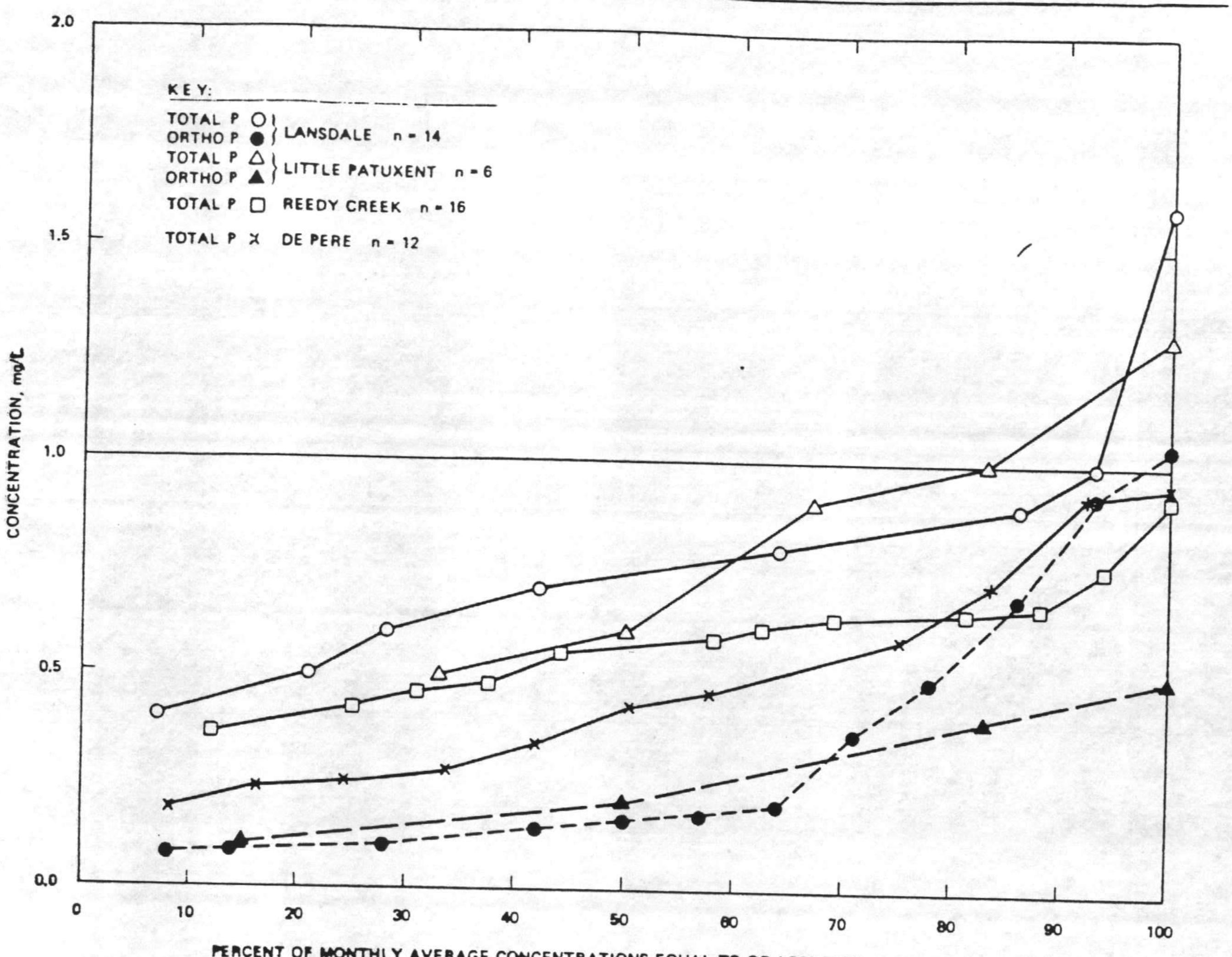


Figure 8—Biological phosphorus process performance reliability.

TKN), and BOD_5-to-TKN are also presented in Table 8. These values for both plants are more than the reported threshold values for the four ratios respectively, 20, 10, 10, and 4, necessary to achieve low effluent phosphorus concentrations.[2,11] These favorable wastewater characteristics are key factors in the process performance of these plants. The high carbonaceous substrate-to-total P ratios indicate that sufficient substrate is available for phosphorus assimilation in the biomass; COD:TKN is an empirical indication that there is sufficient substrate available for denitrification to occur in the anaerobic reactors in excess of the substrate required during phosphorus release. Biological sludge measurements indicated a phosphorus content of 3.8 and 2.4% on a dry weight basis for the Reedy Creek and DePere sludges, respectively. The Reedy Creek sludge 3.8% phosphorus content indicates that enhancement occurs in this system. The 2.4% phosphorus content of the DePere biomass is only marginally higher than conventional activated sludge. However, because the DePere plant does not provide primary treatment, biomass has a low volatile content (average VSS, 64%). Because the phosphorus content of inert solids is normally low, overall phosphorus content of the sludge is reduced. On a VSS basis, which is a better indication of the active biomass, the DePere sludge contains 3.8% phosphorus and the Reedy Creek sludge contains 4.8% phosphorus.

Biological sludge production at the DePere plant was 0.9 kg VSS/kg BOD_5 removed and at the Reedy Creek plant, 0.7 kg VSS/kg BOD_5 removed. The DePere plant does not provide primary sedimentation, thus the high sludge production for the low F:M system (0.12 kg BOD_5/kg MLVSS·d) was attributed to a high nondegradable VSS component in the preliminary treated effluent. Before operationally modifying the activated sludge process for phosphorus removal at DePere, chemicals were added to the activated sludge process to precipitate phosphorus and achieve less than 1 mg/L effluent total P. Phosphorus removal performance has not changed since conversion to the anaerobic/aerobic biological phosphorus removal process. Before operation in the anaerobic/aerobic mode, the Reedy Creek plant typically produced 3 to 5 mg/L secondary effluent total P.

FACTORS AFFECTING PERFORMANCE

Before this study, the PhoStrip process had been described as the only biological phosphorus removal process that could reliably achieve an effluent orthophosphate concentration less than

Table 7—PhoStrip plant operating conditions.

	Lansdale	Little Patuxent July 1984	Little Patuxent April 1985
PhoStrip process			
Stripper			
SDT, hours	20	8	7
Feed flow, % of mainstream flow	14	22	34
Elutriation flow, % of feed flow	124	121	50
Elutriation rate,[a] L/g TSS·d	0.14	0.72	0.25
Underflow, % of mainstream flow	10	14	21
Recycle, %	0	0	78
Overflow, % of mainstream flow	23	35	31
Total P, mg/L	20.6	9.5	20.0
Orthophosphate, mg/L	16.4	7.2	17.0
Reactor clarifier overflow			
Total P, mg/L	3.6	3.9	7.2
Orthophosphate, mg/L	0.9	0.9	1.2
Overflow rate, $m^3/m^2 \cdot d$ (gpd/sq ft)	65 (1600)	46 (1120)	34 (840)
Lime dosage, mg/L	100	160	100
pH	9.0	9.5	9.5
Activated sludge process			
F:M, kg BOD_5/kg MLVSS·d	0.16	0.5[b,c]	0.5
MLSS, mg/L	1900	2950[b]	2000
P:VSS, percent	3.3	4.0	4.6
MCRT, days	6.5	3.7[b,c]	2.8
HRT, hours	4.6	2.6	3.0
Return sludge recycle ratio	0.16	0.32	0.57
DO, mg/L	2–3	1.3	2–5
Sludge production,[d] kg VSS/kg BOD_5	1.0	0.7	—

[a] Based on mass of solids in stripper.
[b] Estimated from solids balance.
[c] Calculated based on estimated MLSS.
[d] Based on removed carbonaceous BOD_5.

1 mg/L.[2,7,13] The proprietary mainstream biological phosphorus removal processes had been described as capable of achieving effluent orthophosphate concentrations of less than 2 mg/L, based primarily on performance at the Largo, Fla., A/O plant and the Palmetto, Fla., Bardenpho plant.[2,7,13]

The results of this investigation show that both the PhoStrip and mainstream operationally modified activated sludge process can produce both effluent total P and orthophosphate or soluble P concentrations less than 1 mg/L.

PhoStrip process. The PhoStrip process has significant operational flexibility because substantial phosphorus removal occurs through chemical precipitation, which is controlled by the stripper feed rate and other operating parameters. Phosphorus removal can occur at lower BOD_5:total P than are necessary for mainstream processes that rely entirely on biological phosphorus removal. If BOD_5:total P is too low there will be inadequate phosphorus uptake in the aeration basin. Several factors must be controlled to achieve an orthophosphate concentration less than 1 mg/L.

Stripper operation. Key stripper operating and design parameters are the SDT, elutriation rate, and elutriant source. A sufficient SDT is required to release phosphorus in the stripper. Unlike mainstream biological phosphorus processes where readily degradable organics are in the process influent, it seems that low molecular weight organics formed by hydrolysis of particulate organics from lysed bacteria are needed as substrate for phosphorus to be released during the relatively long SDT of 5 to 20 hours.[6] When NO_x-N is in the return sludge or elutriant streams, the SDT must be increased to allow for concurrent denitrification and phosphorus release to occur. Table 7 contains operating data from the field investigations; stripper feed ranged between 14 and 34% of the mainstream flow, which spans the recommended design range.

Comparison of the April 1985, Little Patuxent plant data with the Lansdale plant field investigation data (Table 7) shows that the performance of the two strippers was approximately the same. Overflows from both strippers contained approximately 20 mg/L total P and 17 mg/L orthophosphate. The Little Patuxent plant operated at an 8-hour SDT under anaerobic conditions, and elutriation was accomplished by recirculation of the stripper feed (78% of the stripper feed flow) and reactor clarifier overflow (50% of the stripper feed flow). In contrast, the Lansdale Plant used a combined elutriant flow (30% secondary effluent and 70% reactor clarifier overflow) that was 124% of the stripper feed flow. The anoxic SDT was 20 hours. Under these operating conditions, the elutriation rate was 0.25 L/g TSS·d based on the solids in the sludge blanket for the Little Patuxent Plant, compared to 0.14 L/g TSS·d at the Lansdale Plant. Thus, phosphorus

Table 8—Operating conditions at operationally modified activated sludge plants.

	Reedy Creek	DePere
Influent ratios		
BOD_5:total P	23	29
Soluble BOD_5:soluble P	16	47
COD:TKN	11	—
BOD_5:TKN	4.7	5.8
HRT, hours		
Anaerobic	3.0	7.5
Aerobic	6.0	15.0
Contact period,[a] hours		
Anaerobic	1.9	3.8
Aerobic	3.8	7.6
Sludge, % phosphorus	3.8	2.4
Activated Sludge System		
F:M, kg BOD_5/kg MLVSS·d[b]	0.33	0.12
MLSS, mg/L	2100	3000
MCRT, days[c]	7.2	10.6
Return sludge recycle ratio	0.59	0.81
DO, mg/L	2–4[d]	4
Sludge production, kg VSS/kg BOD_5[e]	0.7	0.9

[a] Based on influent plus recycle flows (total flow).
[b] Based on aerobic basin volume only.
[c] Based on overall reactor(s) volume.
[d] Effluent end of basin.
[e] Based on removed carbonaceous BOD_5.

release was similar at the two facilities under quite different ripper operating conditions.

As Table 7 shows, stripper performance at the Little Patuxent lant in July 1984 was poor. It seems that the high elutriation rate of 0.72 L/g TSS · d was excessive for the rate at which orthophosphate was released to the elutriation stream. The reactor clarifier overflow was diluted to an orthophosphate concentration of 7.2 mg/L because of the high elutriation flow and low SDT.

The choice of elutriant streams is important in the design and operation of the stripper. Reactor clarifier overflow and secondary effluent contain low phosphorus concentrations necessary to elutriate the phosphorus released from the sludge blanket.[2] These elutriant sources also typically contain significant DO concentrations and little organic substrate. When nitrification occurs in the activated sludge system, secondary effluent also contains NO_x-N. Under these conditions, an extended SDT is required to lyse cells used as a carbon source for both denitrification and phosphorus release; a 50% increase in SDT has been recommended for design.[2] Typically, SDT can be varied over a wide range by adjusting the sludge blanket depth between 2 and 6 m (7 to 20 ft).

The PhoStrip system can remove nitrogen by denitrifying the nitrified secondary effluent that is used as an elutriant in the stripper. The Lansdale plant has operated in this manner.

Use of primary effluent as an elutriant produces a stream with significant concentrations of readily degradable organics that could increase phosphorus release. Under these conditions, a lower SDT could achieve a specific stripper overflow phosphorus ncentration. An extended SDT would not be required to lyse ls for a substrate source. Therefore, a definitive study of the fects of waste stream characteristics on elutriation may help determine whether operational flexibility could be increased by varying the elutriant characteristics and flows. Thus, various operating modes can be adopted in the activated sludge-PhoStrip system, depending on treatment performance objectives such as nitrification, denitrification, and phosphorus removal.

Mass balance analysis of activated sludge-PhoStrip systems showed that waste chemical sludge accounted for 67% of the overall total P removal at the Lansdale plant; the remaining 33% was accounted for in the waste activated sludge. During July 1984, only 42% of the total P removal at the Little Patuxent plant was accounted for in the waste chemical sludge. In April 1985, during the improved performance period, waste chemical sludge accounted for 58% of the total P removal. This result shows increased chemical phosphorus removal caused the improved performance.

Average mixed liquor suspended phosphorus-to-VSS ratios (P:VSS) ranged between 3.3 and 4.6% at the two PhoStrip plants. These values convert to 2.3 (Lansdale) and 3.9% (Little Patuxent) phosphorus on a TSS basis. The Lansdale plant has lower values because 67% of the phosphorus was removed chemically at this plant, while less than 60% of the removed phosphorus at Little Patuxent was in the waste chemical sludge.

Typically, P:VSS between the stripped sludge and stripper feed differed between 0.3 and 0.6%. A special microbiological analysis of activated sludge mixed liquor and stripper underflow om the Lansdale Plant was conducted using Neisser staining hniques. The results showed intracellular polyphosphate nules were reduced significantly in the stripped underflow when compared to quantities in the mixed liquor. This finding confirms phosphorus release by microorganisms in the stripper and phosphorus uptake by microorganisms in the aeration basin.

Mainstream removal processes. Both operationally modified activated sludge plants and mainstream proprietary processes can achieve effluent orthophosphate and soluble P concentrations less than 1 mg/L.[13] An A/O demonstration plant at Pontiac, Michigan, has an effluent total P concentration consistently less than 0.8 mg/L based on 12 months of operation.[17] A Bardenpho plant in Kelowna, British Columbia, Canada, has produced an effluent with a median orthophosphate concentration of 0.77 mg/L for a 2-year period ending in December 1984.[18] The plant was in compliance with the permitted total P limitation of 2.0 mg/L (after filtration) 90% of the time. However, Oldham noted that experiments, such as diverting all influent through one of the two modules, conducted at the Kelowna plant negatively affected overall system performance.[18]

The performance records at these plants and the field investigations at the two operationally modified activated sludge plants show that mainstream biological phosphorus removal processes can reliably achieve effluent orthophosphate and soluble P concentrations less than 1 mg/L under certain operating conditions. However, the Bardenpho process has yet to demonstrate the ability to achieve less than 1 mg/L effluent total P 90% of the time. Several factors affect this performance.

Wastewater characteristics. The BOD_5:total P (or soluble BOD_5:soluble P) is the major parameter that affects wastewater treatability for mainstream biological phosphorus removal processes. Enhanced biological phosphorus removal requires enough readily degradable organic substrate to permit phosphorus release under anaerobic conditions and subsequent phosphorus uptake in the aerobic reactor. Soluble BOD_5 is a better indicator of the amount of readily degradable organic substrate available than BOD_5, so soluble BOD_5:soluble P generally provides a better indicator of wastewater treatability for biological phosphorus removal. Figure 9 shows the effect of these parameters on effluent soluble P and orthophosphate. The figure includes data from literature citations and information from a site visit to the Largo A/O plant as well as from this evaluation.

Typically, the anaerobic contact period at these facilities was 0.5 to 2 hours. However, the contact period at the DePere plant was 3.8 hours. This plant, with high influent BOD_5:total P and soluble BOD_5:soluble P of 29 and 47, respectively, had an average residual soluble P concentration of 0.1 mg/L during the 5-week field investigation. Based on BOD_5:total P for the facilities in Figure 9, a value greater than 20 or 25 is necessary to consistently achieve an effluent orthophosphate or soluble P concentration less than 1 mg/L. The threshold soluble BOD_5:soluble P to meet the 1 mg/L soluble criterion is 12 to 15. For BOD_5:total P and soluble BOD_5:soluble P below these values, orthophosphate and soluble P vary widely up to 4.5 mg/L.[19]

Figure 10 presents the relationship between influent soluble BOD_5:soluble P and biomass phosphorus content on a dry weight (TSS) basis. As the figure shows, phosphorus content decreases with an increasing soluble BOD_5:soluble P because of the limited phosphorus available per unit of biomass. Therefore, biological phosphorus removal plants with high influent soluble BOD_5:soluble P (greater than 25) can achieve excellent process performance, and produce low residual orthophosphate or soluble P concentrations and the associated low TSS phosphorus content. For example, Table 9 compares the parameters for the

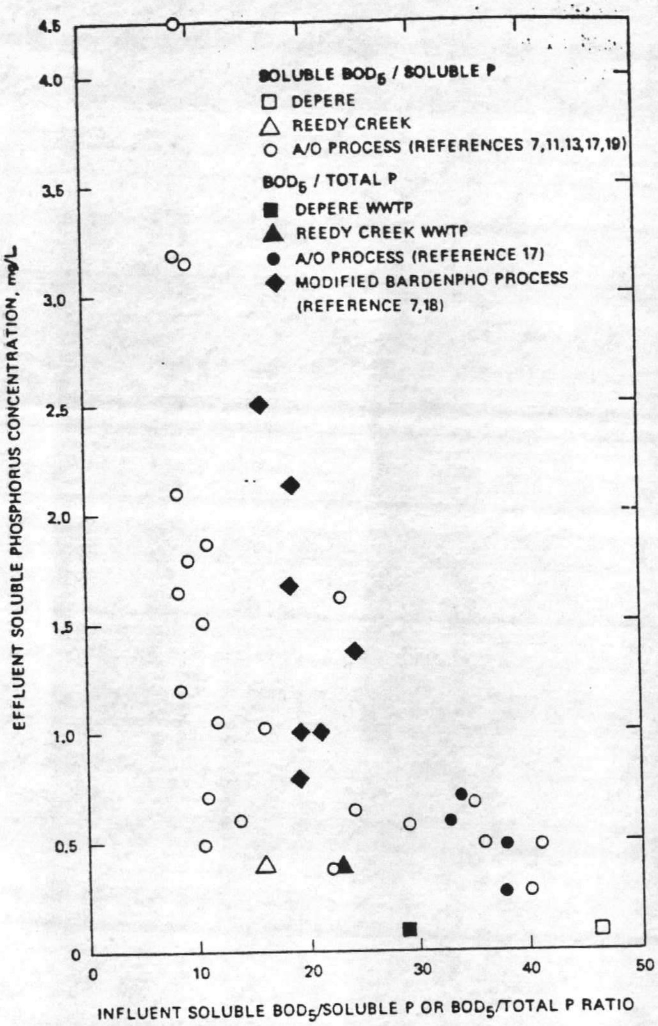


Figure 9—Relationship between influent BOD_5:total P, soluble BOD_5:soluble P, and effluent phosphorus concentration.

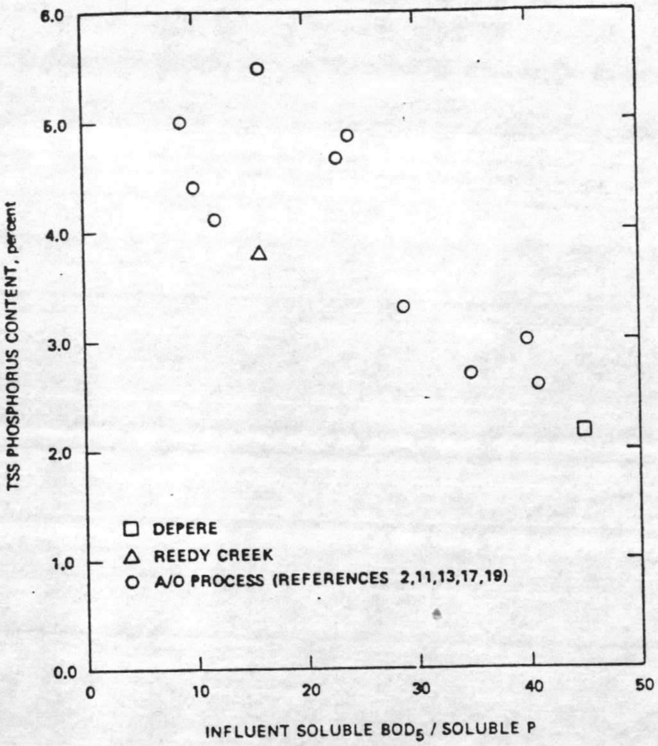


Figure 10—Effect of influent soluble BOD_5:soluble P on TSS phosphorus content.

two operationally modified activated sludge plants. The DePere plant with very high soluble BOD_5:soluble P has both low effluent soluble P and suspended (TSS-related) phosphorus. Thus, with equal secondary clarifier performance, lower effluent total P is caused by lower suspended phosphorus concentrations.

No standard definition exists for readily degradable organics. Soluble BOD_5 is used because it is readily measurable with standard tests associated with activated sludge processes. The process influent soluble BOD_5 fraction depends on the level of preliminary and primary treatment, as well as raw wastewater characteristics. As shown in Table 4, soluble BOD_5 constituted 37 to 55% of the BOD_5 in the biological phosphorus removal process influents. The Kelowna Bardenpho plant reported improved process performance when primary sludge thickener supernatant was used to supplement primary effluent as a source for readily degradable organics.[18]

Anaerobic contact. The anaerobic contact period at the Reedy Creek plant was 1.9 hours during the field investigation. The anaerobic zone contains 33% of the volume of the plug flow basin. The anaerobic and aerobic zones are not physically separated. The boundary between zones is defined operationally at the point where DO and NO_x-N concentrations rapidly increase to more than 0.2 mg/L.

At the DePere plant, the contact period typically averages 3.5 to 4 hours. In a special study, NO_x-N measurements indicated that this basin operated anoxically. NO_x-N concentrations ranged between 1.4 and 6.0 mg/L for 4 of the 6 days of testing (3 grab samples per day) and DO ranged between 0.14 and 0.32 mg/L. Nine-hour composite samples collected during the special study showed that soluble BOD_5 uptake and phosphorus release were occurring under the anoxic conditions. The concentrations of NO_x-N measured in the basin have been inhibitory to phosphorus release in previous studies.[6,7] Results indicated that phosphorus release was greatest when average basin NO_x-N concentration was lowest. However, nitrogen data inconsistencies make these NO_x-N measurements suspect. However, the grab samples, collected at 8 a.m. each test day, may not be representative of average basin conditions.

If NO_x-N measurements are valid, sufficient organic substrate could be available for both denitrification and phosphorus release to occur simultaneously. Anaerobic conditions within the bio-

Table 9—Effect of wastewater characteristics on effluent total P.

	Reedy Creek	DePere
Soluble BOD_5:soluble P	16	47
Effluent soluble P, mg/L	0.4	0.1
TSS, % total P	3.8	2.4
Effluent total P, mg/L	0.9	0.3
Effluent TSS, mg/L	13	7

logical flocs could permit phosphorus release. If sufficient soluble BOD$_5$ is available, denitrification may occur outside the flocs while residual soluble BOD$_5$ penetrates the interior of the flocs in a microenvironment devoid of NO_x-N. Thus, phosphorus release would occur under anaerobic conditions within the floc even though bulk fluid conditions are anoxic. This phenomenon would be analogous to the occurrence of denitrification under bulk aerobic conditions, which is common in oxidation ditches and other activated sludge processes.[20] Therefore, if these assumptions are accurate, only plants with very high influent BOD$_5$:total P or soluble BOD$_5$:soluble P could achieve phosphorus release under anoxic conditions. Additional study is required to validate these observations because of the generally acknowledged negative effects of NO_x-N on phosphorus release and the limited data base collected at DePere.

Aerobic reactor considerations. All of the plants investigated, with the exception of DePere, operated in the plug flow mode. DePere uses a completely mixed aeration basin. The Little Patuxent plant changed from step feed to plug flow to improve phosphorus uptake. Aeration basin HRT ranged between 2.6 and 14 hours. As noted earlier, operation of the Little Patuxent activated sludge system in the step-feed mode was affected by low DO that limited phosphorus uptake, a short actual HRT of less than 2 hours, and influent feeding near the effluent end of the basin.

At all the plants investigated, plant operators typically maintained DO concentrations greater than 2 mg/L. At the Little Patuxent and Reedy Creek plants, DO was increased to 3 to 5 mg/L at the effluent ends of the basins for biomass oxygenation before sedimentation to prevent phosphorus release in the sludge blankets. Sludge blankets of less than 1 ft were used in the secondary clarifiers, but analytical data indicated that some denitrification occurred. Phosphorus release, however, was not detected, except at the Little Patuxent plant.

The DePere plant maintained DO concentrations greater than 4 mg/L as a safety factor against intermittent shock organic loads received at the plant from local industries. The DePere facility was the only plant that experienced typical diurnal load fluctuations. Flow equalization is used at the PhoStrip plants to dampen diurnal flow and load fluctuations. At the Reedy Creek plant hydraulic loads remain fairly constant during park operation, 14 to 16 hours per day.

Nitrification and denitrification effects. All of the plants investigated operated with simultaneous nitrification in the biological phosphorus removal process. During the field investigation, all plants (except the Little Patuxent plant) completely nitrified (Table 6). Recycle of NO_x-N in return sludge to the anaerobic zone (or stripper tank) of a biological phosphorus removal process inhibits process performance. An explanation for this may be that organic substrate is used for denitrification and is not available for phosphorus release. Additionally, in nitrifying mainstream processes, longer MCRTs are necessary to achieve nitrification, which reduces sludge production and, in turn, lowers phosphorus removal. Although the results of the field investigations showed that nitrification had negative effects on phosphorus removal, the two processes are not necessarily incompatible. The degree of denitrification varied in both biological phosphorus removal technologies evaluated. However, at the Little Patuxent plant, all total N removal was attributed to assimilation into the biomass wasted from the system.

Figure 11 presents a linear regression between effluent NO_x-N and orthophosphate or soluble P concentrations derived from data collected during the field investigations, data from historical operation at the Lansdale plant, and results from the Pontiac, Mich., A/O demonstration study. The 0.77 correlation coefficient shows a clear correlation between these parameters. This regression analysis indicates that residual concentrations of soluble P or orthophosphate less than 0.5 mg/L require NO_x-N concentrations less than 10 mg/L. Thus, nitrification reduced phosphorus removal at these facilities, but only at phosphorus concentrations less than 1 mg/L. Figure 11 applies only to mainstream plants with high BOD$_5$:total P (or soluble BOD$_5$:soluble

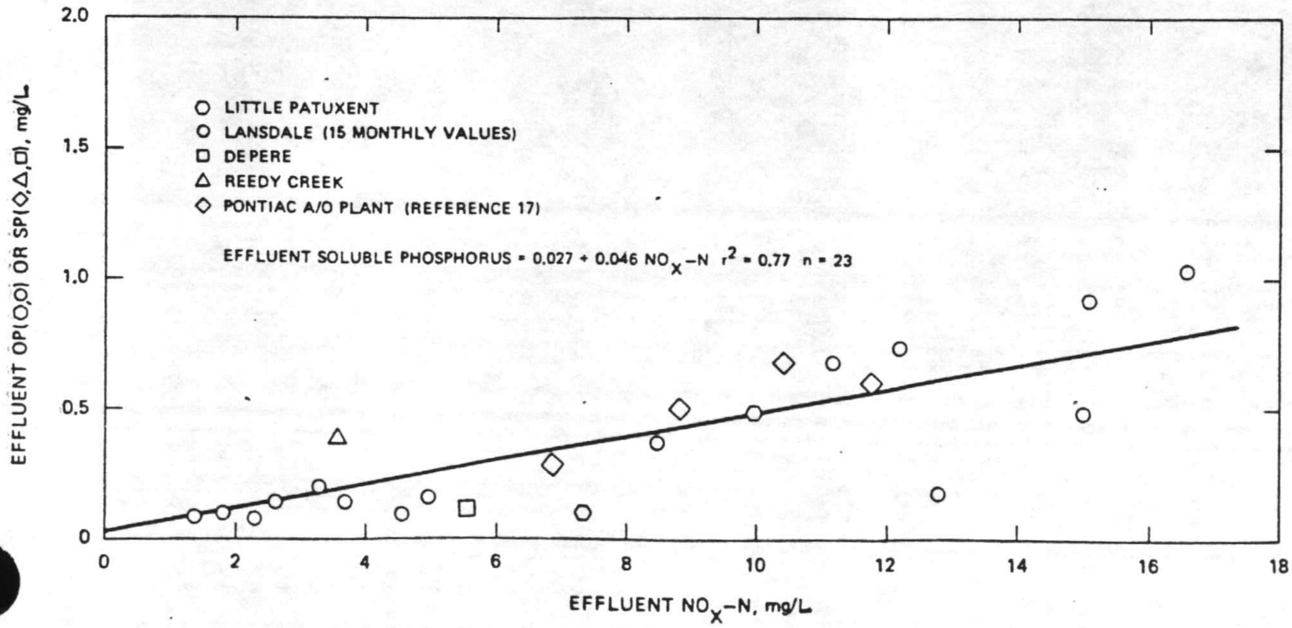


Figure 11—Effect of effluent NO_x-N on effluent orthophosphate or soluble P concentration.

P) and to the PhoStrip process. Nitrification may significantly reduce phosphorus removal in mainstream biological phosphorus processes with low BOD_5:total P.

Secondary clarification. Suspended phosphorus concentrations in the secondary effluents were effectively reduced by TSS removals during secondary clarification. Clarifiers were of conventional design with relatively small 3- to 4-m (10- to 12-ft) diameter center wells. Table 10 provides a summary of clarifier performance and related data. Generally, these data indicate the processes operated in the typical range of 16 to 32 $m^3/m^3 \cdot d$ (400 to 800 gpd/sq ft) for secondary clarification. However, under these conditions, actual effluent TSS concentrations were close to advanced wastewater treatment levels of less than 10 mg/L. The Little Patuxent plant (at 35 $m^3/m^2 \cdot d$) in July 1984 was the exception, with 26 mg/L TSS. TSS removal performance improved in April 1985, with an effluent concentration of 11 mg/L. Generally, the average sludge volume index (SVI) was less than 100 mL/g, although the average at the Reedy Creek plant was 152 mL/g.

The average secondary effluent TSS at the Lansdale Plant was 8 mg/L for the 14-month historical period under PhoStrip operation, versus 11 mg/L TSS for a 7-month period when the PhoStrip process was not operational. Mixed liquor settling tests with a Kemmerer sampler indicated excellent settleability. After 30 minutes of settling, supernatant contained 2 mg/L TSS. Plant personnel noted that settleability fluctuates with changes in PhoStrip operation, which indicates that the anoxic SDT produces organisms that settle rapidly. Secondary effluent TSS concentrations were normally less than 10 mg/L during PhoStrip operation. Microbiological analysis of mixed liquor showed levels of filamentous organisms that indicated good settling sludge.

The Reedy Creek plant applied 1 mg/L chlorine to the return sludge stream to control filamentous organism growth that yielded an average SVI of 152 mL/g for the study period. The reactor mode and operation may be the cause of the poorer settling characteristics of the mixed liquor solids. Filamentous organism growth and bulking has been noted in anaerobic/aerobic systems with an anaerobic HRT greater than 30% of the total HRT, and in aerobic plug flow reactors with low DO concentrations.[21]

Biological phosphorus removal processes must be evaluated for the need for effluent filtration to remove suspended phosphorus. As noted earlier, suspended phosphorus is primarily a function of the biomass phosphorus content. Clarifier performance at the plants evaluated during the field investigations indicated TSS concentrations less than 10 mg/L could be reached with conventional clarifiers designed for secondary treatment. These findings suggest that conventionally designed secondary clarifiers can achieve these low TSS concentrations. Deep tanks, large flocculator center wells, and minimum sludge blankets will optimize clarifier performance and adequately reduce TSS without filtration.[22]

Solids handling. All of the plants processed solids effectively and minimized phosphorus recycling back to the mainstream process. Biological sludges were thickened aerobically or combined with the waste chemical sludge from the PhoStrip process and gravity thickened. Two plants used DAF units for thickening. Two facilities used aerobic digestion to stabilize sludges; anaerobic digestion was not used. Additionally, the PhoStrip plants used the waste chemical sludge streams to partition phosphorus from the liquid stream and prevent recycling to the head of the plant. Sludge processing return water at the Little Patuxent plant was recycled to the PhoStrip reactor clarifier for chemical phosphorus precipitation.

Phosphorus recycling from the solids handling processes was minimal. Mass balances performed for the biological phosphorus removal processes showed that percentages of influent total P recycled to the plant were 1% in the Landsdale plant, 9% in the Little Patuxent plant (July 1984), less than 1% in the Reedy Creek plant, and 3% in the DePere plant.

The data for Little Patuxent includes recycle of the tertiary filter backwash. Solids processing of thickened waste activated sludge and scum at the DePere plant occurs periodically (approximately every 5 weeks) on a batch basis. During this operation, chemical conditioning wastewater, filtration returns, and flue gas scrubbing water all recycle phosphorus to the head of the plant, which causes effluent total P concentration increases up to 1.4 mg/L. Phosphorus released from the sludge during storage in the holding tank is chemically conditioned with ferric chloride and lime before dewatering and incineration. This prevents recycling most of the phosphorus back to the head of the plant. The effluent total P typically returns to normal within 4 days after sludge processing.

DISCUSSION

The results of the field investigations and recent experience reported at other biological phosphorus removal facilities indicate that these technologies can achieve less than 1 mg/L effluent total P. The PhoStrip process was demonstrated to achieve this level of treatment at low influent BOD_5:total P. Influent BOD_5:total P for the PhoStrip plants studied as part of this evaluation were 8 and 14.

Mainstream processes are more limited by the influent wastewater characteristics. Process influent BOD_5:total P and soluble BOD_5:soluble P are the chief empirical parameters that show the applicability of mainstream biological phosphorus removal

Table 10—Secondary clarifier performance parameters.

Plant	Side water depth, m (ft)	Effluent TSS, mg/L	Secondary clarifier overflow rate, $m^3/m^2 \cdot d$ (gpd/sq ft)	SVI mL/g
Lansdale	4.6 (15)	4	15 (380)	70
Little Patuxent				
July 1984	4.9 (16)	26	35 (860)	52
April 1985		11	31 (760)	112
Reedy Creek	3.9 (10)	13	15 (360)	152
DePere[a]	4.3 (14)	7	20 (480)	71

[a] Data for the first of two clarifiers in series.

processes to specific wastewaters. Figure 9 indicates that influent BOD_5:total P greater than 20 to 25 or soluble BOD_5:soluble P greater than 12 to 15 is required for an effluent concentration less than 1 mg/L orthophosphate or soluble P. At lower ratios, effluent orthophosphate and soluble P vary greatly because of factors the ratios do not characterize.

For BOD_5:total P less than 20 to 25, mainstream process applications should include separate nitrification facilities to reduce effects from NO_x-N recycle. Lower MCRT will provide additional sludge production for enhanced phosphorus removal. Based on this technology evaluation, nitrification need not affect the ability to produce an effluent with less than 1 mg/L total P for influent BOD_5:total P greater than 25. However, the design of the anaerobic zone must provide for denitrification. An HRT greater than 1 to 2 hours may be required. Excessive recycle of NO_x-N to this zone would inhibit phosphorus release.

In evaluating the plant performances during the field investigations, it is important to note that actual flows at each plant were less than design values and effluent TSS concentrations were less than those permitted. Effluent total P concentrations projected to the permitted TSS, based on actual soluble P or orthophosphate concentrations and the percent phosphorus associated with effluent TSS, are presented in Table 11. The projected concentrations indicate that suspended phosphorus would compose 40 to 80% the effluent total P. Thus, TSS removal is critical to achieve an effluent total P concentration of less than 1 mg/L, regardless of the type of technology applied.

CONCLUSIONS

- Field investigations at four full-scale facilities showed that the PhoStrip and operationally modified activated sludge processes can achieve effluent total P concentrations less than 1 mg/L under nitrifying conditions without tertiary treatment.
- Effective removal of both soluble and suspended phosphorus were required to achieve an effluent total P concentration less than 1 mg/L. BOD_5 and TSS removals to advanced treatment levels accompanied these low residual phosphorus concentrations.
- The PhoStrip process can meet this treatment level at lower BOD_5:total P than mainstream processes because of the operational flexibility of sidestream chemical phosphorus removal.
- Good performance in the operationally modified activated sludge processes was attributed to favorable influent wastewater characteristics, with BOD_5:total P greater than 20 and soluble BOD_5:soluble P greater than 12 to 15. Lower ratios could reduce phosphorus removal in these processes.
- Nitrification and denitrification were compatible with phosphorus removal at the plants investigated. Nitrification affected performance, but only in situations where effluent total P was less than 1 mg/L. Total nitrogen removal to less than 6 mg/L required tertiary treatment.
- Sufficient phosphorus uptake in aeration basins was ensured by DO concentrations greater than 2 mg/L. Sludge blanket levels were maintained at less than 1 ft in secondary clarifiers to minimize anaerobic conditions that permit phosphorus release.
- Effective solids processing at each facility reduced phosphorus recirculation to the mainstream process.

Table 11—Projected effluent total P concentrations.

Plant	Soluble P or orthophosphate, mg/L	Permitted TSS, mg/L	TSS % phosphorus	Projected total.P, mg/L
Lansdale	0.7	20	2.3	1.2
Little Patuxent	0.1	10	3.9	0.5
Reedy Creek	0.4	20	3.8	1.2
DePere	0.1	10	2.4	0.4

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Authors. M. J. Tetreault is project engineer and A. H. Benedict is project manager for Brown and Caldwell, Pleasant Hill, California. C. Kaempfer is project manager for Robert E. Lee and Associates, Inc., Green Bay, Wisconsin. E. F. Barth is president of Barth Tec, Inc., Cincinnati, Ohio. Correspondence should be addressed to Mark J. Tetreault, Brown and Caldwell, Box 8045, Walnut Creek, CA 94596.

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