WATER QUALITY MONITORING CONSULTATION NO. 24-0022-77
REDSTONE ARSENAL
REDSTONE ARSENAL, ALABAMA
31 JANUARY - 4 FEBRUARY 1977

SERVING THE ARMY IN ITS PREVENTIVE MEDICINE PROGRAM

SENTINEL OF HEALTH

US ARMY
ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MD 21010

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

HSE-EW-C/WP

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I. AUTHORITY.

A. AR 40-5, Health and Environment, 25 September 1974.

B. AR 200-1, Environmental Protection and Enhancement, 7 December 1973.

C. Letter, AJTMD-P, US Army Medical Department Activity, Redstone Arsenal, 11 February 1976, subject: Request for Mission Services for FY 77, with indorsement thereto.

II. REFERENCES. See Appendix A for a listing of references.

III. PURPOSE. To evaluate the operation and adequacy of installation drinking water and wastewater monitoring programs and to provide assistance in problem areas, as time and resources permitted.

IV. GENERAL.

A. Abbreviations and Definitions. A glossary of definitions, terms and units along with appropriate abbreviations is available in Appendix B.

B. Personnel Contacted. Installation personnel contacted included the following:

1. Mr. Paul Hancock, Facilities Engineer, RASA.

2. Mr. Edward Sebastian, Deputy Facilities Engineer, RASA.

3. Mr. John Norton, Chief, Master Plan, Construction and Environmental Office, FED, RASA.

4. Mr. James Hiley, Project Coordinator, Master Plan, Construction and Environmental Office, FED, RASA.

5. Mr. Hugh Montgomery, Environmental Coordinator, FED, RASA.

6. Mr. Charles Knott, Chief, Utilities Branch, FED, RASA.

7. Mr. Louis Lindemeyer, Chief, Maintenance Unit, FED, RASA.

8. Mr. Ronald Harmon, Chief, Utilities Branch, FED, RASA.

9. Mr. William Schroder, General Engineer, FED, RASA.

10. Mr. Jimmie Reid, Chemist, Sanitation Section, FED, RASA.

11. Miss Patricia Ricard, Laboratory Technician, Sanitation Section, FED, RASA.

12. Mr. John Hames, STP Operator, Sanitation Section, FED, RASA.

13. Mr. Herman Miskelly, STP Operator, Sanitation Section, FED, RASA.

14. 1LT Thomas Allen, Environmental Science Officer, HEV Activity, MEDDAC, RAS.

C. Water and Sewage System.

1. Water System. Two WTP (No. 1 and No. 3) and three wells provide drinking water for RAS through four separate water distribution systems. The two WTP provide water for the main distribution system (main post) and each well supplies its own small distribution system in the outlying areas. The Tennessee River serves as the water source for the two WTP.

2. Sewage System. Three STP (No. 1, No. 3 and No. 4) treat domestic wastewater from the main post area. In addition, there are other STP that treat domestic wastewater from the outlying areas, with the largest being an Imhoff tank (Building 8018) and three package STP (Buildings 7289, 7813 and 8716). A detailed description of the complete RAS sewage system is available in a previous Agency study (reference 6, Appendix A).

V. FINDINGS AND DISCUSSION.

A. Monitoring Program. Future NPDES wastewater monitoring requirements, STP and WTP operational control monitoring, receiving stream monitoring and the drinking water surveillance program at RAS were accomplished (or are to be accomplished) in the STP (No. 3 and No. 4), WTP (No. 1 and No. 3) and MEDDAC laboratories.

1. General. The USEPA, Region IV, has issued one NPDES permit to RAS which addresses six STP, two WTP and other industrial discharges (such as boiler and cooling tower blowdowns, vehicle wash racks, etc.). The installation is planning to apply for NPDES permits for an additional package STP (Building 7813), and two GOCO facilities (Thiokol Corporation and Raytheon Corporation - both RAS responsibility). Another GOCO facility, General Aniline and Film Corporation, has been issued a NPDES permit since the last Agency visit (reference 6, Appendix A) and is presently accomplishing required monitoring. There are also other STP and industrial wastewater discharges which are not NPDES permitted (reference 6, Appendix A). Monitoring is required to begin 1 July 1977 for all discharges under RAS responsibility.

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6 JUN 1977

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ABSTRACT

This consultation was conducted to assist with development and refinement of analytical techniques and procedures to support National Pollutant Discharge Elimination System monitoring requirements, operational monitoring of the sewage and water treatment plants, receiving stream monitoring and the potable water surveillance program. The Facilities Engineering Division and the US Army Medical Department Activity were not capable of conducting all analyses required in wastewater, receiving stream, and potable water programs due to; an inadequate number of receiving stream stations sampled, inadequacy in surveying possible wastewater discharges, inadequate monitoring by the Facilities Engineering Division of the main post water distribution system, lack of sampling and flow measuring equipment, and inadequacies in the supporting laboratories. Recommendations to correct these deficiencies include: increasing the number of receiving stream stations sampled; surveying wastewater discharges; initiating Facilities Engineering Division monitoring of the main post water distribution system; procuring composite samplers and installing flow measuring devices; changing the analytical methodology for chlorine and fluoride residuals, and pH; improving the analytical techniques for 5-day biochemical oxygen demand and fecal coliform; and procuring equipment for determining fluoride.

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2. NPDES Monitoring Requirements. The NPDES monitoring requirements for the permitted STP and WTP discharges are listed in Appendix C.

a. STP. Except for the package STP (Building No. 7289), which required grab sampling, all other STP require flow proportioned composite sampling. Flow proportional composite samplers are on order; however, the samplers do not have refrigeration capability. Refrigeration is required for the collection of ammonia nitrogen and BOD_5 samples. There is no flow measuring device at the Imhoff tank (Building 8018); however, a work order for its installation has been initiated. Monitoring has been initiated at STP No. 1, No. 3, No. 4, the Imhoff tank and the package STP (Building 7813) (not permitted), in accordance with the permit requirements. No monitoring has been initiated at the package STP (Buildings 7289 and 8716) because of a project to connect the two STP discharges to tile fields by October 1977. However, until this project is completed, NPDES monitoring will be required.

b. Industrial Wastewaters.

(1) WTP. Appendix C, paragraph 5, lists 1 July 1977 NPDES monitoring requirements for WTP No. 1 and No. 3 discharges (filter backwashes).

(2) Other Discharges. Other industrial discharges, such as boiler and cooling tower blowdowns, vehicle wash racks, etc., are required to be NPDES permitted by 1 July 1977 and monitoring initiated by that date. However, as of this visit, RASA had not surveyed discharges to determine which ones should be NPDES permitted and monitored. USAEHA has initiated a survey of miscellaneous discharges at the request of RASA. According to RASA personnel, the WTP No. 3 laboratory will accomplish the analytical portions of the other industrial wastewater NPDES permit monitoring requirements.

c. Report Requirements. The NPDES permit requires quarterly reporting of monitoring data, with the first report due on 28 November 1977. FED personnel were instructed in the proper completion of these reports during the consultation visit.

3. Operational Control Monitoring.

a. STP. Operational control monitoring being accomplished at STP No. 1, No. 3, No. 4, the Imhoff tank, and the package STP (Building No. 7813) is shown in Tables 1, 2 and 3. The Imhoff tank and package STP (Building No. 7813) do not have flow measuring devices. In addition, the sludge digesters (STP No. 1, No. 3 and No. 4) are sampled and analyzed for alkalinity and volatile acids on a weekly basis.

TABLE 1. OPERATIONAL MONITORING AT RAS STP NO. 1, NO. 3 and NO. 4

Parameter	Frequency of Sample Collection and Analyses Influent	Primary Effluent	Final Effluent
Ammonia Nitrogen	-	-	2W
BOD_5	3W	3W	3W
Chlorine Residual	-	-	H
Dissolved Oxygen	D	-	D
Fecal Coliform	-	-	3W
Flow*	C	-	C
pH	D	-	D
Settleable Solids	D	D	D
Suspended Solids	3W	3W	3W

* Flow recorded at influent of STP No. 1 and No. 4 and effluent of STP No. 3.

TABLE 2. OPERATIONAL MONITORING AT RAS IMHOFF TANK

Parameter	Frequency of Sample Collection and Analyses Influent	Effluent
BOD_5	3W	3W
Chlorine Residual	-	D
Fecal Coliform	-	3W
pH	D	D
Suspended Solids	3W	3W
Flow*	-	-

* No flow measuring device is available; however, a work order for its installation has been initiated.

TABLE 3. OPERATIONAL MONITORING AT RAS STP (BUILDING NO. 7813)

Parameter	Frequency of Sample Collection and Analyses Influent	Effluent
BOD_5	3W	3W
Dissolved Oxygen	D	D
Flow*	-	-
pH	D	D
Suspended Solids	3W	3W

* No flow measuring device is available.

b. WTP. The WTP operational control monitoring requirements of TB MED 229 [at least daily sampling and analyses for chlorine and fluoride (since fluoridation is practiced) residual in the drinking water prior to distribution] were being met at WTP No. 1 and No. 3. Additionally, the USEPA 1 July 1977 requirement (40 CFR 141.22) to monitor turbidity daily for surface water sources was being accomplished. The operational control monitoring program being accomplished at WTP No. 1 and No. 3 is shown in Tables 4 and 5.

TABLE 4. OPERATIONAL MONITORING AT RAS WTP NO. 1

Parameter	Frequency of Sample Collection and Analyses Raw	Tap
Chlorine Residual	-	H
Fluoride Residual	-	3D
pH	D	D
Temperature	D	D
Total Coliform	D	D
Turbidity	D	D

TABLE 5. OPERATIONAL MONITORING AT RAS WTP NO. 3

	Frequency of Sample Collection and Analyses			
Parameter	Raw	Settled	Filtered	Tap
Alkalinity	D	D	D	D
Carbon Dioxide	D	D	D	D
Chloride	D	-	-	D
Chlorine Residual	-	-	-	H
Fluoride Residual	-	-	-	3D
Hardness	D	D	D	D
pH	D	D	D	D
Temperature	D	-	D	-
Total Coliform	D	D	D	D
Turbidity	D	D	D	D

4. Drinking Water Surveillance Program.

a. Main Post Distribution System.

(1) WTP. FED (WTP No. 1 or No. 3) personnel do not conduct a monitoring program for chlorine and fluoride residuals in the main post water distribution system as required by TB MED 229. TB MED 229 requires the monitoring of chlorine (daily) and fluoride (weekly) residuals at multiple points in the water distribution system (considering the system geometry, i.e., dead-ends, and places of little water usage and movement). The absence of a drinking water surveillance program in the main post water distribution system has been discussed during a previous Agency study (reference 6, Appendix A).

(2) MEDDAC. The drinking water surveillance program carried out by the MEDDAC on the main post water distribution system does not completely meet the requirements of TB MED 229. TB MED 229 requires MEDDAC sampling and analyses of the water distribution system, to include total coliform, and chlorine and fluoride (since fluoridation is practiced) residuals, and (optionally) total bacterial plate count. The MEDDAC program consists of sampling eight to nine points in the water distribution system on a weekly basis, resulting in 33 points being sampled monthly. The parameters being determined are pH, total coliform, and total and free available chlorine residuals on all samples, and fluoride residual on one sample per month. During this visit, fluoride was not being determined because of an inoperable portable colorimeter.

b. Outlying Water Distribution Systems.

(1) FED. The FED program of weekly analyses for total chlorine residual in each outlying water distribution system is adequate.

(2) MEDDAC. The MEDDAC program of monthly analyses for pH, total coliform, and free and available chlorine residuals in each outlying water distribution system is adequate.

5. Receiving Stream Monitoring. The receiving stream monitoring (monitoring effect of STP discharges) being accomplished at RAS included sampling and analyses for alkalinity, BOD_5, dissolved oxygen, pH and total dissolved solids. The seven sampling stations, located above and below STP discharges, are two points each on Indian Creek (receives STP No. 3 discharge) and McDonald Creek (receives STP No. 4 discharge), and three points on Huntsville Spring Branch (receives STP No. 1 discharge). This monitoring program does not meet the requirements of a program previously recommended by this Agency (reference 5, Appendix A). Reference 5, Appendix A recommended boundary sampling for monitoring the effect of all RAS discharges (not just STP discharges). Reference 5, Appendix A also recommended the monitoring of the Tennessee River at two points.

B. <u>Supporting Laboratories</u>.

1. General. The following paragraphs are concerned with the ability of the STP, WTP and MEDDAC laboratories to support RAS monitoring programs. Since the MEDDAC laboratory is considered capable of supporting its portion of the monitoring programs, it will be referred to only when necessary to recommend improvements. Monitoring program analyses at RAS are completed in the following laboratories: STP No. 3 laboratory accomplishes analyses for STP No. 1 and No. 3, and the Imhoff tank; STP No. 4 laboratory accomplishes analyses for STP No. 4 and the package STP (Building No. 7813); WTP No. 1 laboratory accomplishes analyses for WTP No. 1; and WTP No. 3 laboratory accomplishes analyses for WTP No. 3, and STP No. 1, No. 3 and No. 4 (ammonia nitrogen analyses), and the receiving stream monitoring program.

2. Analysts. STP and WTP operators, one chemist and two laboratory technicians accomplish RAS monitoring program analyses. The chemist and laboratory technicians work in the WTP No. 3 laboratory. The chemist is responsible for assisting the STP and WTP operators in establishing laboratories capable of accomplishing NPDES permit and operational monitoring analyses. In addition to the RAS monitoring programs, the chemist and laboratory technicians are responsible for other analytical work, such as the characterization of photographic wastes, metals analyses, steam plant (flue gas and scale) studies and soil testing.

3. Personnel Qualifications and Training.

a. Personnel Qualifications.

(1) STP Personnel. The STP personnel (four operators and one apprentice) are capable of accomplishing STP operational monitoring and NPDES analyses; however, their analytical skills require improvement. The chemist, through instruction, can assist in improving the analytical skills of the STP personnel.

(2) WTP Personnel. The WTP personnel (13 operators and 1 supervisor, 2 laboratory technicians and 1 chemist) are capable of accomplishing their portion of RAS monitoring programs.

b. Training. RAS has sent STP and WTP operators to operationally-oriented courses. However, environmental chemistry or microbiologically-oriented courses (required for analytical capability development) have not been attended. USEPA courses No. 100.4, Inorganic Analyses for Permit Compliance; No. 100.5, Organic Analyses for Permit Compliance; and No. 120.4, Bacteriological Tests for Permit Compliance, are appropriate. The USEPA contact in this regard is Mrs. Quinlan, National Training Center, USEPA, Cincinnati, OH 45268, telephone: (513) 684-7501. The STP laboratory personnel have a greater need for training than WTP laboratory personnel, due to the complexity of the analyses being accomplished in the STP laboratory.

4. Analytical Methods.

a. STP Laboratories. The STP laboratories (STP No. 3 and No. 4) were not utilizing USEPA (40 CFR 136 as amended by 41 FR 52780) approved methods for the determination of chlorine residual. Procedural errors were being made in the determination of BOD_5 and fecal coliform. Only one pH buffer was used to calibrate the pH meter, instead of the two (those covering the range of expected values) recommended by Standard Methods[1] (page 464). In addition, the laboratories had no quality assurance program to provide simple checks of the accuracy of analyses being conducted.

(1) Chlorine Residual. A color comparator kit was used to determine chlorine residual (NPDES permit requirement) instead of the USEPA approved (40 CFR 136 as amended by 41 FR 52780) DPD (colorimetric or titrimetric) and iodometric (amperometric or starch-iodine end point) methods. Equipment, glassware and chemicals to determine chlorine residual by the iodometric method (starch-iodine end point) were available.

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1 APHA, Standard Methods for the Examination of Water and Wastewater, 14th ed. (1975)

(2) BOD_5. In the determination of BOD_5, samples were improperly seeded (after dechlorination), the temperature of the dilution water was outside the required 20 ± 1°C range, STP No. 1 samples were often found to be supersaturated (resulting in initial dissolved oxygen values greater than 9.0 mg/l), and BOD_5 values were incorrectly calculated for the final effluent samples (due to calculation errors involving seed correction).

(a) Dechlorination and Seeding. In dechlorinating final effluent samples, the dechlorinated samples (after addition of sodium sulfite) were not checked to be certain that all chlorine residual was eliminated (Standard Methods[1], page 546). In seeding samples, one ml of settled wastewater was added to all samples (including seed blank) whether they were final effluent (dechlorinated) or influent samples. Only one seed dilution was setup instead of a series of seed dilutions (Standard Methods[1], page 547). The seed dilution with the 40 to 70 percent oxygen depletion in 5 days is used to calculate the seed correction. In seeding samples, sufficient seed must be added to produce a seed correction of at least 0.6 mg/l (Standard Methods[1], page 545). The seeding of STP No. 1 effluent samples did not result in a 0.6 mg/l seed correction, therefore; a larger volume of seed is required for those samples. In addition, in calculation BOD_5 values, the analyst did not take into account the seed correction for all samples.

(b) Dilution Water. The temperature of the dilution water was not checked to insure that it was the required 20 ± 1°C (Standard Methods[1], page 546). The temperature of the dilution water can be reduced by incubation in the BOD_5 incubator (set at 20 ± 1°C) overnight. In addition, at the STP No. 4 laboratory, dilution water was being made up once a week (on Monday) for use during that week (through Thursday). Standard Methods[1] (page 546) requires the daily preparation of dilution water.

(c) Supersaturated Samples. For supersaturated samples, Standard Methods[1] (page 546) recommends bringing the samples to 20°C and then agitating the samples by vigorous shaking, or by aerating with compressed air, until the dissolved oxygen is 9.0 mg/l or less.

(3) Fecal Coliform. In the fecal coliform determinations, only one dilution (5 ml) per sample was run. This low dilution resulted in the growth of fewer than 20 colonies (for chlorinated effluent). Standard Methods[1] (page 938) recommends selection of dilutions that yield counts of between 20 and 60 colonies.

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[1] APHA, Standard Methods for the Examination of Water and Wastewater, 14th ed. (1975)

(4) Quality Assurance Program. The STP laboratories (No. 3 and No. 4) can establish a relatively simple quality assurance program by splitting samples into equal portions, and having each laboratory conduct the same analyses as the other. Comparison of the analytical results will indicate the relative accuracy of each STP laboratory. The USEPA[2] recommends that such a program approach 20 percent of the basic analytical workload.

b. WTP Laboratories. The WTP No. 3 laboratory was determining fluoride by a non-USEPA approved method. In addition, the WTP laboratories have no quality assurance program to provide simple checks of the accuracy of analyses being conducted.

(1) Fluoride. Fluoride was being determined in the WTP No. 1 laboratory by a color comparator method. TB MED 229 requires fluoride analysis by a standard method. Appropriate methods of analyses have been published by the USEPA (40 CFR 141.23). These methods include: "Electrode Method," Standard Methods[3] (pages 172-174); USEPA Methods[4] (pages 65-67); "Colorimetric Method with Preliminary Distillation," Standard Methods[3] (pages 171-172 and 174-176); or USEPA Methods[4] (pages 59-60).

(2) Quality Assurance Program. The WTP laboratories can establish a quality assurance program similar to the one discussed for the STP laboratories. In addition, the chemist and laboratory technician are qualified to establish a more extensive quality assurance program. Such a program can be established by running replicate samples (sometimes spiked with known concentrations) along with standard concentration samples. The USEPA[2] recommends that this type of quality assurance program be 20 percent of the basic workload.

c. MEDDAC Laboratory. Fluoride was being determined by a color comparator method instead of the TB MED 229 and USEPA approved methods [see paragraph VB4b(1)]. In addition, pH was being determined colorimetrically. Determining pH colorimetrically results in a low degree of accuracy. The electrometric (pH meter) method is the only method with a high degree of accuracy.

5. Sample Preservation. All samples were being preserved by USEPA approved methods, or analyzed within the prescribed holding period.[4]

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[2] USEPA, Handbook for Analytical Quality Control in Water and Wastewater Laboratories (June 1972)
[3] APHA, Standard Methods for the Examination of Water and Wastewater, 13th ed. (1971)
[4] USEPA, Methods for Chemical Analysis of Water and Wastes (1974)

6. Laboratory Facilities.

a. Space Availability.

(1) STP Laboratories. STP No. 3 and No. 4 laboratories, with 230 ft^2 (21.4 m^2) and 170 ft^2 (15.8 m^2) of available floor space, respectively, are barely adequate to support RAS monitoring programs.

(2) WTP Laboratories.

(a) WTP No. 1 Laboratory. The WTP No. 1 laboratory, with 480 ft^2 (44.6 m^2) of available floor space, is adequate to support present and future (NPDES) monitoring requirements.

(b) WTP No. 3 Laboratory. The WTP No. 3 laboratory, with 500 ft^2 (46.5 m^2) of available floor space, is adequate to support operational control and NPDES monitoring requirements (those discharges presently permitted) and other required analytical work (paragraph VB2). However, if it is determined that many other industrial wastewater discharges must be permitted [paragraph VA2b(2)], resulting in the analyses of complex[2] parameters such as phenol, surfactants and metals, additional floor and bench space would be required. Additional space is available in a 10 feet by 10 feet (3.05 m X 3.05 m) storage room; however, there is only 10 linear feet (3.05 m) of usable space along the east wall of the room. Metal determinations would require still additional space.

(3) MEDDAC Laboratory. The MEDDAC laboratory, with 120 ft^2 (11.1 m^2) of available floor space, is barely adequate. The available bench top space is not adequate for supporting the equipment required for determining fluoride.

b. Laboratory Furniture.

(1) STP Laboratories. The available STP laboratory furniture appears adequate to support present and future wastewater monitoring requirements.

(2) WTP Laboratories.

(a) STP No. 1 Laboratory. The available WTP No. 1 laboratory furniture appears adequate.

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[2] USEPA, Handbook for Analytical Quality Control in Water and Wastewater Laboratories (June 1972)

(b) WTP No. 3 Laboratory. The available WTP No. 3 laboratory furniture appears adequate for supporting present and future NPDES monitoring requirements. However, additional laboratory furniture would be required for supporting future monitoring requirements, if discharges are located and permitted. Ten feet (3.05 m) of laboratory benches would be required if the WTP No. 3 storage room is utilized as a laboratory work area.

(3) MEDDAC Laboratory. The MEDDAC laboratory furniture is not adequate. Additional furniture is required to support the equipment required for determining fluoride by the USEPA approved methods (paragraph VB4c).

c. Laboratory Equipment

(1) STP Laboratories. In the STP No. 3 and No. 4 laboratories, the drying oven does not maintain the required 103 to 105°C temperature range and the analytical balance has not been calibrated in 2 years. In addition, only one pH buffer (pH 7) was available to calibrate the pH meter. At the STP No. 4 laboratory, it is questionable if the fecal coliform incubator maintains the required 44.5 ± 0.2°C temperature. The thermometer being used cannot accurately (only to nearest 1°C) measure the temperature of the incubator water.

(2) WTP Laboratories.

(a) WTP No. 1 Laboratory. Equipment (analytical balance, drying oven, glass fiber filters and gooch crucibles) is required to determine suspended solids by the USEPA (40 CFR 136 as amended by 41 FR 52780) approved method. However, this equipment is only available at the WTP No. 3 laboratory.

(b) WTP No. 3. At the WTP No. 3 laboratory, equipment is required if additional analyses such as phenol, metals and surfactants must be accomplished (due to additional NPDES permitted industrial wastewater discharges). The equipment required to accomplish these analyses by USEPA (40 CFR 136 as amended by 41 FR 52780) approved methods includes: distillation apparatus and spectrophotometer for phenol (if accomplished in WTP No. 3 laboratory); atomic absorption spectrophotometer for metals (if accomplished in WTP No. 3 laboratory); and separatory funnels and spectrophotometer for surfactants (if accomplished in WTP No. 3 laboratory). Metal analyses, from special studies, have been previously accomplished by two laboratories at RAS. These two laboratories, with metal analysis capability, could be requested to accomplish future NPDES metal analyses. Equipment is available for determining future and/or expected NPDES parameters such as pH, suspended solids, ammonia nitrogen, and oil and grease.

(3) MEDDAC Laboratory. To determine fluoride by the USEPA approved methods (40 CFR 141.23), a specific ion meter, with fluoride and reference

electrodes, or distillation apparatus and a spectrophometer are required. In addition, a pH meter is required. The MEDDAC laboratory can procure a combination specific ion-pH meter, with fluoride, pH and reference electrodes instead of separate specific ion and pH meters.

d. Utilities.

(1) STP Laboratories.

(a) STP No. 3 Laboratory. Except for distilled water and vacuum, the utilities (distilled water, electricity, lighting and vacuum) in the STP No. 3 laboratory appear adequate. Distilled water is provided from the WTP No. 1 or No. 3 laboratories since the STP No. 3 laboratory does not have a still. Presently, a water faucet, with vacuum device, supplies the vacuum. The arrangement wastes water, ties up the water faucet, and does not supply the vacuum required in the analysis of suspended solids.

(b) STP No. 4 Laboratory. Except for vacuum, the utilities in the STP No. 4 laboratory appear adequate. A water faucet with vacuum device, supplies the vacuum.

(2) WTP Laboratories.

(a) WTP No. 1 Laboratory. Except for distilled water, lighting and vacuum, the utilities (air conditioning, distilled water, electricity, gas, lighting and vacuum) in the WTP No. 1 laboratory appear adequate. Presently, a water faucet, with vacuum device, supplies the vacuum. The water still had recently been taken to the WTP No. 3 laboratory for utilization, because their still had shorted out.

(b) WTP No. 3 Laboratory. The WTP No. 3 laboratory, with the utilization of the WTP No. 1 water still, has adequate utilities.

e. Safety Equipment.

(1) STP Laboratories.

(a) STP No. 3 Laboratory. No safety equipment (fire extinguisher and eyewash lavage) was available in the STP No. 3 laboratory.

(b) STP No. 4 Laboratory. A carbon dioxide fire extinguisher was the only safety equipment available in the STP No. 4 laboratory.

(2) WTP Laboratories.

(a) WTP No. 1 Laboratory. An eyewash lavage was the only safety equipment readily available for use. The closest fire extinguisher is located at least 50 feet (15.3 m) from the WTP No. 3 laboratory.

(b) WTP No. 3 Laboratory. The safety equipment in the WTP No. 3 laboratory is adequate; however, the carbon dioxide fire extinguisher lies on the floor and is not easily accessible.

VI. CONCLUSIONS. RAS future NPDES monitoring requirements, STP and WTP operational control monitoring, receiving stream monitoring and drinking water surveillance programs were not accomplished (or will not be accomplished) because of deficiencies. These deficiencies included: lack of composite samplers; lack of flow measuring devices; inadequacy in number of samples collected and receiving streams sampled; inadequacy in surveying industrial discharges; no FED monitoring of the main post water distribution system; and inadequacies in the MEDDAC, STP and WTP laboratories. The laboratory inadequacies were attributable to: improper analytical techniques and/or methods for BOD_5, chlorine residual, fecal coliform, fluoride and pH; shortage of available bench top and floor space; lack of equipment for determining fluoride, pH and other possible NPDES parameters; and the absence of quality assurance checks.

VII. RECOMMENDATIONS.

A. Survey all STP and industrial discharges to determine if additional NPDES permits are required [paragraphs VA1 and VA2b(2)].

B. Expedite the procurement of flow proportional composite samplers (presently on order) and procure refrigeration units (paragraph VA2a).

C. Expedite the installation of flow measuring devices at the Imhoff tank (Building 8018) and package STP (Building 7813) (paragraphs VA2a and VA3a).

D. Initiate, by 1 July 1977, NPDES monitoring of STP (Buildings 7289 and 8716), and WTP No.1 and No. 3 discharges (paragraphs VA2a and VA2b).

E. Initiate daily FED monitoring for chlorine and fluoride residuals in the main post water distribution system, as required by TB MED 229 [paragraph VA4a(1) of this report].

F. Increase MEDDAC monitoring of fluoride residual in the main post water distribution system to a weekly basis [paragraph VA4a(2)].

G. Improve the analytical skills of STP and WTP personnel (those accomplishing analyses).

1. Intensify the program which has the chemist instructing the STP personnel [paragraphs VB2 and VB3a(1)].

2. Establish a training program to allow STP and WTP personnel to attend environmental chemistry and microbiological courses on a yearly basis (paragraph VB3b). The relative priority of training personnel (based on need) should be as follows: first, STP personnel; and second, WTP personnel.

H. Correct STP No. 3 and No. 4 laboratory procedural deficiencies for BOD_5 and fecal coliform (STP No. 4 only), and change the method of analysis for chlorine residual to the iodometric method (starch-iodide end point) (paragraph VB4a).

I. Change the MEDDAC and WTP No. 3 laboratories' method of analysis for fluoride residual to the specific ion electrode method [paragraphs VB4b(1) and VB4c].

J. Initiate STP and WTP laboratory quality assurance programs [paragraphs VB4a(4) and VB4b(2)].

K. Change the MEDDAC laboratory's method of analysis for pH to the pH meter method (paragraph VB4c).

L. Procure and install laboratory benches if the WTP No. 3 storage room is utilized for NPDES analyses [paragraph VB6b(2)(b)].

M. Procure a small laboratory table or bench, and a specific ion-pH meter (with electrodes) for the MEDDAC laboratory [paragraphs VB6b(3) and VB6c(3)].

N. Procure 103-105°C drying ovens for the STP No. 3 and No. 4 laboratories [paragraph VB6c(1)].

O. Procure pH buffer solutions and calibrate the pH meters at the STP and WTP No. 1 laboratories by utilizing two pH buffers (paragraph VB6c).

P. Establish a program of calibrating WTP No. 3, and STP laboratory analytical balances on a yearly basis (paragraph VB6c).

Q. Check the STP No. 4 laboratory incubator to insure that it maintains the required temperature range; and (if necessary) procure a new incubator [paragraph VB6c(1)].

R. Procure portable vacuum pumps for the STP and WTP No. 1 laboratories [paragraphs VB6d(1) and VB6d(2)(a)].

S. Procure and install water stills in the STP No. 3 and WTP No. 1 laboratories [paragraphs VB6d(1)(a) and VB6d(2)(a)].

T. Procure and install bench lamps in the WTP No. 1 laboratory to increase illumination [paragraph VB6d(2)(a)].

U. Procure and install Class A/B fire extinguishers in the STP No. 3 and WTP No. 1 laboratories (29 CFR 1910.157).

V. Procure and install eyewash lavages in the STP laboratories (29 CFR 1910.151).

W. Accomplish possible future NPDES monitoring requirements (recommendation A) by:

1. Contracting analyses, if laboratory space is not available [paragraph VB6a(2)(b)].

2. Procuring the required equipment (if laboratory space is available) for determining all parameters except metals. Metal analyses should be contracted if other RAS laboratories cannot accomplish the workload [paragraphs VB6a(2)(b) and VB6c(2)(b)].

VIII. CONSULTATION AND ASSISTANCE.

A. This Agency will provide further consultation and assistance in the implementation of the recommendations made in this report upon request. Requests for such assistance should be directed through appropriate channels to Commander, USA Health Services Command, ATTN: HSPA-H, Ft Sam Houston, TX 78234, in accordance with paragraph 1-5, AR 40-5.

B. Technical consultation can be obtained informally by contacting the Chief, Water Quality Engineering Division (AUTOVON 584-3845/3554).

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APPENDIX B

ABBREVIATIONS AND DEFINITIONS

A/E	Architect/Engineer
APHA	American Public Health Association
BOD_5	Biochemical oxygen demand, 5-day, at 20°C
C	Continuous
CFR	Code of Federal Regulations
D	Daily
3D	Three times per day
DPD	N,N-Diethyl-p-phenylenediamine
FED	Facilities Engineering Division
FR	Federal Register
GOCO	Government-owned, contractor-operated facility
H	Hourly
8-HC	8-Hour composite
24-HC	24-Hour composite
HEV	Health and Environment
Kg	Kilogram
MEDDAC	US Army Medical Department Activity
mg/l	Milligram per liter
ml	Milliliters
NPDES	National Pollutant Discharge Elimination System
pH	Negative logarithm of hydrogen ion concentration $[-\log(H^+)]$
RAS	Redstone Arsenal, Redstone Arsenal, Alabama
RASA	Redstone Arsenal Support Activity, RAS
STP	Sewage treatment plant
USAEHA	US Army Environmental Hygiene Agency
USEPA	US Environmental Protection Agency
W	Weekly
2W	Twice weekly
3W	Three times per week
WTP	Water treatment plant

APPENDIX A

REFERENCES

1. Title 29, Code of Federal Regulations (CFR), 1976 ed., Part 1910, Occupational Safety and Health Standards.

2. Title 40, CFR, 1976 ed., Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants, as amended by 41 Federal Register (FR) 52780, 1 December 1976.

3. Title 40, CFR, 1976 ed., Part 141, National Interim Primary Drinking Water Regulations.

4. TB MED 229, Sanitary Control and Surveillance of Water Supplies at Fixed and Field Installations, 29 August 1975.

5. Letter, HSE-EW-C, this Agency, 10 January 1975, subject: Water Quality Monitoring Consultation No. 24-060-74/75, Redstone Arsenal, Huntsville, AL, 8-12 April 1974, with attached report.

6. Letter, HSE-EW-S/WP, this Agency, 18 January 1977, subject: Potable/Recreational Water Quality and Wastewater Engineering Survey No. 24-0606-77, Redstone Arsenal, Alabama, 28 July-4 August 1976, with attached report.

APPENDIX C

NPDES PERMIT MONITORING REQUIREMENTS

TABLE 1. STP NO. 1, NO. 3 AND NO. 4

	Monitoring Requirements		
Parameter	Measurement Frequency	Sample Type	Sampling Point
Ammonia Nitrogen	W	24-HC	Effluent
BOD_5	2W	24-HC	Effluent
Chlorine Residual	D	Grab	Effluent
Dissolved Oxygen	D	Grab	Effluent
Fecal Coliform	W	Grab	Effluent
Flow	D	-	Influent or Effluent
pH	D	Grab	Effluent
Suspended Solids	2W	24-HC	Effluent

TABLE 2. PACKAGE STP (BUILDING 8716)

	Monitoring Requirements		
Parameter	Measurement Frequency	Sample Type	Sampling Point
BOD_5	M	24-HC	Effluent
Chlorine Residual	D	Grab	Effluent
Fecal Coliform	M	Grab	Effluent
Flow	D	-	Influent or Effluent
pH	D	Grab	Effluent
Suspended Solids	M	24-HC	Effluent

For BOD_5 and suspended solids, the arithmetic mean of the values of the effluent expressed in Kg/day (lb/day) collected in a period of 30 consecutive days shall not exceed 15 percent of the per capita loadings of 0.08 Kg/day (0.17 lbs/day) and 0.09 Kg/day (0.20 lbs/day), respectively (85 percent removal).

TABLE 3. PACKAGE STP (BUILDING 7289)

Parameter	Monitoring Requirements Measurement Frequency	Sample Type	Sampling Point
BOD_5	M	Grab	Effluent
Chlorine Residual	D	Grab	Effluent
Fecal Coliform	M	Grab	Effluent
Flow	M	-	Influent or Effluent
pH	D	Grab	Effluent
Suspended Solids	M	Grab	Effluent

For BOD_5 and suspended solids, the arithmetic mean of the values of the effluent expressed in Kg/day (lbs/day) collected in a period of 30 consecutive days shall not exceed 15 percent of the per capita loadings of 0.08 Kg/day (0.17 lbs/day) and 0.09 Kg/day (0.20 lbs/day) respectively (85 percent removal).

TABLE 4. IMHOFF TANK (BUILDING 8018)

Parameter	Monitoring Requirements Measurement Frequency	Sample Type	Sampling Point
BOD_5	W	24-HC	Influent and Effluent
Chlorine Residual	D	Grab	Effluent
Fecal Coliform	W	Grab	Effluent
Flow	D	-	Influent or Effluent
pH	D	Grab	Effluent
Suspended Solids	W	24-HC	Influent and Effluent

In addition to the specified limits, the monthly average effluent BOD_5 and suspended solids concentration shall not exceed 15 percent of the respective monthly average influent concentrations.

TABLE 5. WTP NO. 1 AND NO. 3

Parameter	Monitoring Requirements Measurement Frequency	Sample Type
Flow	2W	-
pH	2W	Grab
Suspended Solids	2W	8-HC