1. Keywords

    ACID
    CAUSTIC
    ETCHANT
    HEAVY METALS
    INDUSTRIAL WASTE 2502
    INDUSTRIAL WASTE TREATMENT
    INDUSTRIAL WASTEWATER
    PHOTOGRAPHIC WASTE
    PRETREATMENT
    SANITARY
    SILVER WASTE
    WASTEWATER DISPOSAL METHOD AND EQUIPMENT

2. Start Date: FY 78 Quarter 4
   End Date: FY 79 Quarter 1

3. HQ Division: 24 - WATER QUALITY ENGINEERING DIV

4. Phase:

5. Program NO: 32

6. Survey Type: WZ - WATER QUALITY ENGIN STUDY 2

7. INSTALLATION OR SOURCE OF INFORMATION (CITY & STATE OR COUNTY ARE ESSENTIAL)
   XS - COMM & EL. MAT READ. COMD

8. Authors:

9. ARLOC/Activity: 34558 000 - FORT MONMOUTH
   Location: OCEANPORT
   State: NJ

10. Project Control Number: 24-0135-79

11. Title: INDUSTRIAL WASTE

12. DSA: 61

AEHA

UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010

WATER QUALITY ENGINEERING SPECIAL STUDY NO. 32-24-0135-79
INDUSTRIAL WASTE
FORT MONMOUTH, NEW JERSEY
24 JULY - 4 AUGUST 1978

DEPARTMENT OF THE ARMY Mr. Hasselkus/pj/584-3816

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

14 NOV 1978

HSE-EW-S/WP

SUBJECT: Water Quality Engineering Special Study No. 32-24-0135-79, Industrial Waste, Fort Monmouth, NJ, 24 July - 4 August 1978

Commander
USA Materiel Development and
Readiness Command
ATTN: DRCSG
5001 Eisenhower Avenue
Alexandria, VA 22333

A summary of the pertinent findings and recommendations of the inclosed report follows:

A special study was conducted at Fort Monmouth, NJ, to characterize the industrial wastes emanating from the Hexagon Building in the Charles Wood Area and to determine pretreatment modes, if any, required prior to discharge to the Northeast Monmouth County Regional Sewerage Authority interceptor. Due to the low level of activity in the Hexagon building, the industrial waste stream is very weak. Thus, no pretreatment is recommended. If activity increases significantly, minimal pretreatment and increased use of the scavenger now under contract to Fort Monmouth are recommended.

FOR THE COMMANDER:

Robert J. Jameson, LTC, MSC

for JOHN P. PIERCY, P.E.
COL, MSC
Director, Environmental Quality

1 Incl
as (10 cy)

CF:
HQDA (DASG-PSP)
HQDA (DAEN-MPO-U)
HQDA (DAEN-ZCE)
Cdr, HSC (HSPA-P)
Supt, AHS (HSA-IHE)
Cdr, CERCOM (DRSEL-PL-ST)(2 cy)
Cdr, MEDDAC, Fort Monmouth (PVNTMED Actv) (2 cy)
C, USAEHA-Rgn Div North
Dist Engr, USA Engr Dist, New York

CONTENTS

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

HSE-EW-S/WP

WATER QUALITY ENGINEERING SPECIAL STUDY NO. 32-24-0135-79
INDUSTRIAL WASTE
FORT MONMOUTH, NEW JERSEY
24 JULY - 4 AUGUST 1978

1. AUTHORITY.

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

b. AR 200-1, Environmental Protection and Enhancement, 20 January 1978.

c. Letter, DRSEL-PL-ST, Fort Monmouth, 8 November 1977, subject: Request for AEHA Services, and indorsements thereto.

2. REFERENCES.

a. Title 40, Code of Federal Regulations (CFR), 1977 ed., Part 413, Electroplating Point Source Category, as amended by 42 Federal Register (FR) 35834, 12 July 1977.

b. Water Quality Engineering Special Study No. 24-016-75/76, Sanitary and Industrial Wastewater, Fort Monmouth, New Jersey, 23 September - 9 October 1974, 15-17 April 1975, 10-12 June 1975.

c. Letter, HSE-EW-S, USAEHA, 7 August 1975, subject: Discharge Criteria - Northeast Monmouth County Regional Sewerage Authority (NMCRSA).

d. Northeast Monmouth County Regional Sewerage Authority, Rules and Regulations, General Information, adopted August 1970.

3. PURPOSE. To characterize the industrial wastewaters emanating from the Hexagon Building and determine their sources; to determine the necessity for and methods of pretreatment prior to discharge to the regional sewer in support of a programmed Corps of Engineers' project.

4. GENERAL.

a. Abbreviations and Definitions. A glossary of abbreviations, units and technical terms used in this report is included in Appendix A.

b. Background. Fort Monmouth is an Army installation located approximately 50 miles south of New York City. The Charles Wood Area is located within 1 mile west of the main post. The Hexagon Building, the source of industrial wastes and subject of this study, is located on the western edge of the Charles Wood Area (see Figure 1).

c. Organization. Major activities at Fort Monmouth include research, development, procurement and materiel control of communications-electronics equipment. Fort Monmouth, a DARCOM installation, had as its host organization ECOM, until the 19 June 1978 reorganization. The host command is now CERCOM, with tenant organizations ERADCOM, CORADCOM and AVRADCOM.

d. Area Under Study. The Hexagon Building contains a wide variety of laboratories where experimentation with such materials as batteries, crystals and photochemicals is conducted. There are also many shops, such as photo-processing, metal surface preparation, painting and etching. Normally, a wide variety of waste products would be seen in the effluent streams from the Hexagon, but a reorganization has greatly reduced the level of activity in the building. Industrial wastewater from the Hexagon is discharged to either of two sumps which are filled with limestone chips. The discharges from these two sumps then flow to the sanitary sewer and on to the NMCRSA interceptor (see Figure 2).

e. Study Program.

(1) The study was conducted by a chemical engineer, an environmental engineer and an engineering technician.

(2) Sampling was conducted at the points shown on Figure 2.

(3) A 24-hour composite using an ISCO sampler was taken at sample points 1, 2, and 3, the sump in the courtyard of the Hexagon, the sump outside the Hexagon and the influent monitoring station to the NMCRSA interceptor, respectively.

(4) Continuous pH monitoring was conducted at all three points.

(5) Flow was measured using Manning Dippers with quick-insert Palmer-Bowlus flumes at sample points 1 and 2. The NMCRSA totalizer was read daily at sample point 3.

(6) A room-by-room inventory was made inside the Hexagon to pinpoint [illegible] potential sources of industrial waste.

(7) After preparation and preservation, samples were transported [illegible] to USAEHA where all analyses were completed. Procedures used in [illegible] determinations are described in Appendix B.

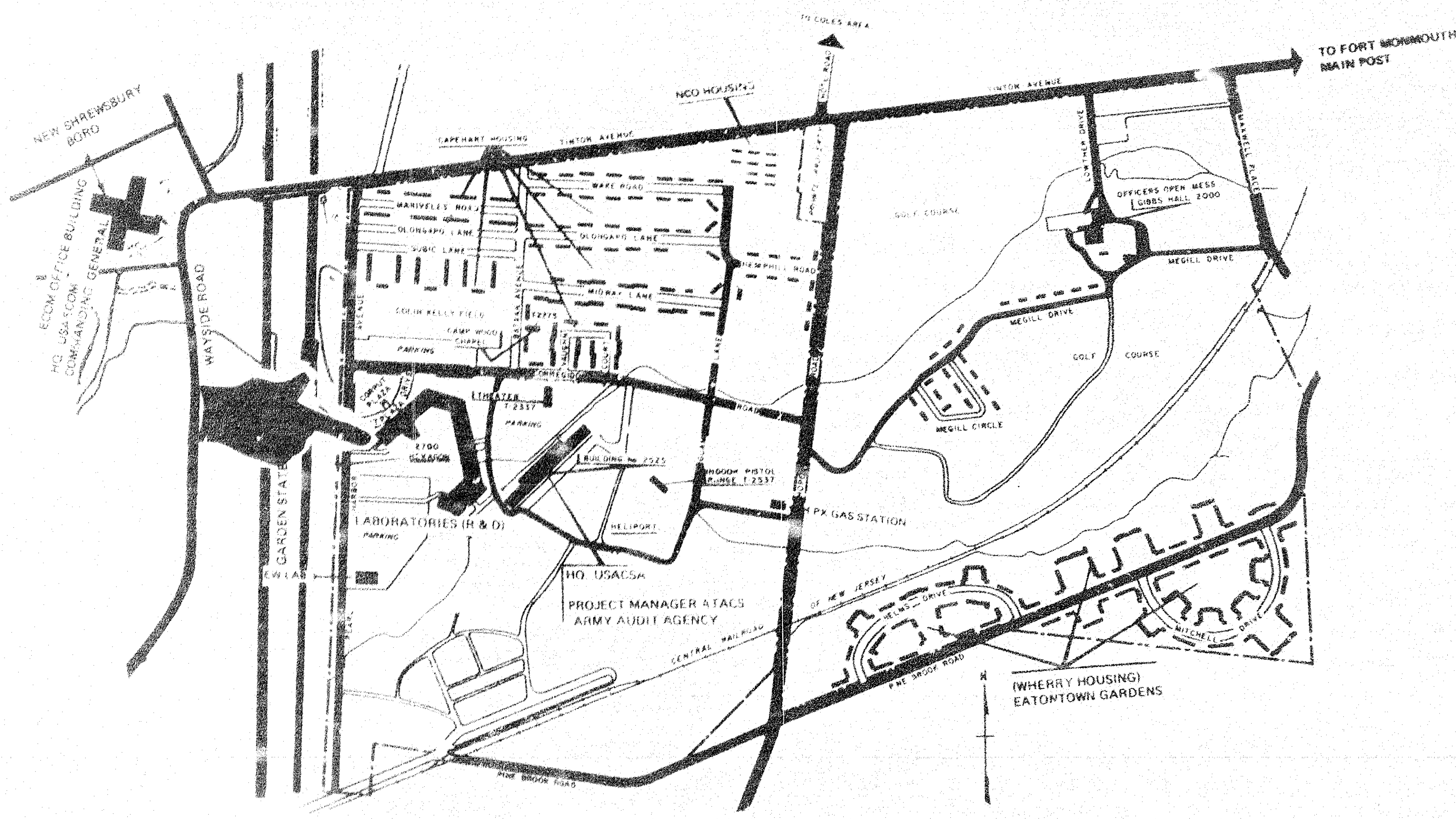


FIGURE 1. LOCATION OF THE HEXAGON BUILDING

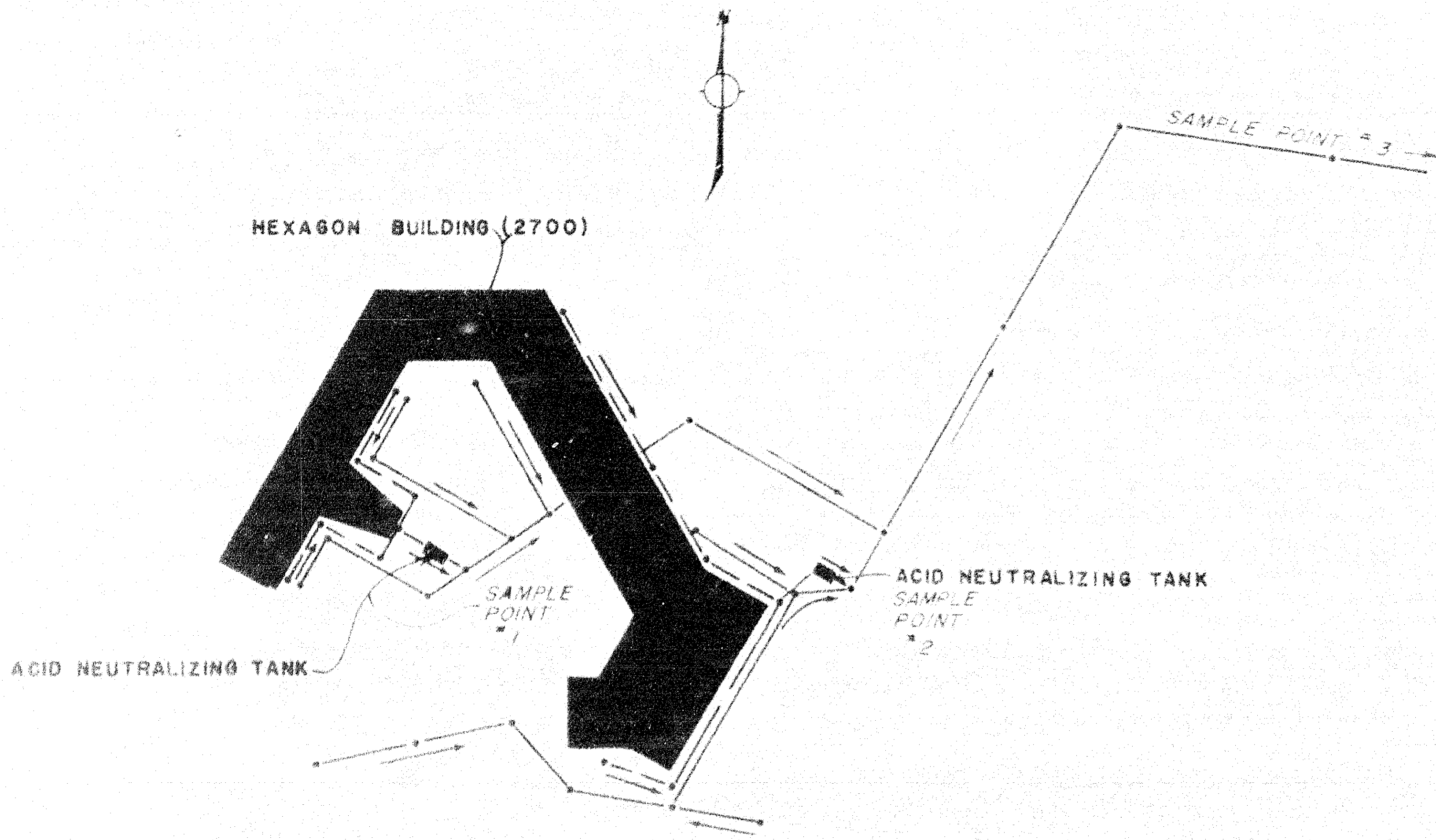


FIGURE 2. HEXAGON BUILDING—SEWER DETAIL.

5. FINDINGS AND DISCUSSION.

a. General. This Agency last studied the effluents from the Hexagon Building as part of study no. 24-016-75/76 (reference 2b) in 1974. At that time, the laboratories and shops at the Hexagon were extremely busy. This was reflected in their effluents, which contained a wide variety of pollutants, often in copious quantities. During this study, we found that the situation had changed drastically. A reorganization has left the Hexagon Building nearly devoid of activity. This, of course, had a profound effect on the nature of the effluent streams. In addition, process changes and the use of a scavenger to remove many of the concentrated solutions have helped to reduce the pollutant levels in the waste streams.

b. Effluent Streams. Figure 2 depicts the three sample points discussed in paragraph 4e. Appendix C contains the daily analytical and flow data for these points, as well as analytical data for a number of grab samples taken during the study. Little can be said about these data. What is remarkable is the extremely low level of significant industrial pollutants in the two industrial waste streams and, consequently, in the mixed sanitary-industrial wastewater. Table 1 makes some comparisons that illustrate this situation.

(1) The first column, "reasonable levels," represent a combination of criteria developed by this Agency, and deemed mutually acceptable by Fort Monmouth and the consulting engineers for the NMCRSA (reference 2c), and pretreatment standards found in 40 CFR Part 413 (reference 2a). The more stringent requirement is stated where there is commonality. It is suggested that, if these numbers are met, no problem with the NMCRSA need be anticipated.

(2) The second column shows the actual standards for acceptable waste in the contract between Fort Monmouth and the NMCRSA. Unlike the first column, the NMCRSA standards provide little input for a designer of pretreatment facilities (see reference 2c).

(3) The third column shows the extreme (usually maximum) values for the various parameters during our 1974 study. These values are for what was the influent to the Charles Wood Area STP. As can be seen from the data, the Fort Monmouth waste was in marginal compliance with regard to pH and suspended solids, grossly noncomplying with regard to copper, and noncomplying for total metals (because of the copper).

TABLE 1. COMPARISON OF CHARLES WOOD AREA WASTE (SAMPLE POINT 3) WITH AVAILABLE CRITERIA

	Reasonable Levels	NMCRSA Criteria	Fort Monmouth Extreme 1974	Fort Monmouth Extreme 1978	NMCRSA Discharge
Cyanide, amenable to chlorination, mg/l	0.08	-	-	-	-
Cyanide, total mg/l	0.24	2	0.2	-	-
pH, standard units	6 - 9	5.5 - 9.5	8.5 - 5.6	9.0 - 6.0	9.0 - 6.0
Temperature, °F	90	150	75	-	-
Grease and Oil, mg/l	100	100	-	24	-
Biochemical Oxygen Demand, mg/l, avg	240	†	109	-	30
Biochemical Oxygen Demand, mg/l, max	350	†	190	-	45
Phenols, mg/l	5	*	0.22	1.3	-
Chlorides, mg/l	150	-	-	47	-
Sulfates, mg/l	250	†	-	57	-
Chromium, hexavalent, mg/l	0.09	-	-	-	-
Chromium, total, mg/l	0.5	*	0.13	<0.025	-
Copper, mg/l	0.6	*	25	0.076	-
Nickel, mg/l	0.5	-	-	<0.10	-
Zinc, mg/l	1.5	*	-	0.125	-
Lead, mg/l	0.4	-	0.16	<0.10	-
Cadmium, mg/l	0.5	-	0.008	-	-
Total metals, mg/l	3.9	*	-	-	-
Suspended Solids, mg/l, avg	240	†	195	85	30
Suspended Solids, mg/l, max	350	†	358	164	45
Iron, mg/l	-	*	-	5.78	-
Dissolved Solids, mg/l	-	†	485	424	-
Chemical Oxygen Demand, mg/l	-	†	-	-	-
Chlorine Demand, mg/l	-	†	-	-	-
Total Organic Carbon, mg/l	-	*	300	53	-

* In such quantities as to be inimical to the sewage treatment process.
† Excessive, unusual.

(4) The fourth column shows the present situation. It is clear that pollutant concentrations have dropped drastically. The pH values shown reflect readings taken from continuous pH recorder strip charts. Although the pH is still marginal, the excursions from neutrality are infrequent and of short duration. All other parameters have moved well within acceptable limits, except for total metals. This is caused by high concentrations of iron.

(5) The final column shows the discharge permit criteria that the NMCRSA must meet. Nothing in the Fort Monmouth, Charles Wood Area discharge would appear to put them in jeopardy.

c. Impact of the Hexagon Industrial Wastes. The impact of the Hexagon industrial wastes was small at the time of this study. There are three major reasons for this.

(1) The reorganization and associated actions have reduced the industrial waste input. Although the flow, averaging about 30,000 gpd, is not much less than 4 years ago (there are still large quantities of cooling and rinse water), the reduced work level has reduced the input of contaminants. Figures 3 and 4 illustrate the change in the Hexagon effluent. Figure 3, extracted from reference 2b, shows a profile of pH during our 1974 study. The pronounced and frequent variations could be related to the many concentrated contaminants discharged during this active period. Figure 4 shows the rough pH variation, again from continuous recordings, during this study. There was little in the streams other than water.

(2) Prior to the reorganization, Fort Monmouth, on the recommendation of this Agency (reference 2b) hired a scavenger to dispose of concentrated wastes. The most significant of these are etchants and organic solvents. This helps to explain the decrease in metals and organic carbon.

(3) By its silence, the NMCRSA is implying that the industrial wastes from the Hexagon are not significantly impacting the NMCRSA treatment facility. No sanctions, penalties or warnings have been received by Fort Monmouth.

d. Grab Samples. When the study team encountered waste of special interest, an attempt was made to collect a grab sample. The results of these samples are presented in Appendix C, Table 4.

(1) The first such grab sample was a white cloudy liquid encountered at sample point 1. We were able to collect a small quantity, and the analysis was inconclusive. We surmise that it many have been a diluted version of the paint spray booth wash [see paragraph 5d(5)].

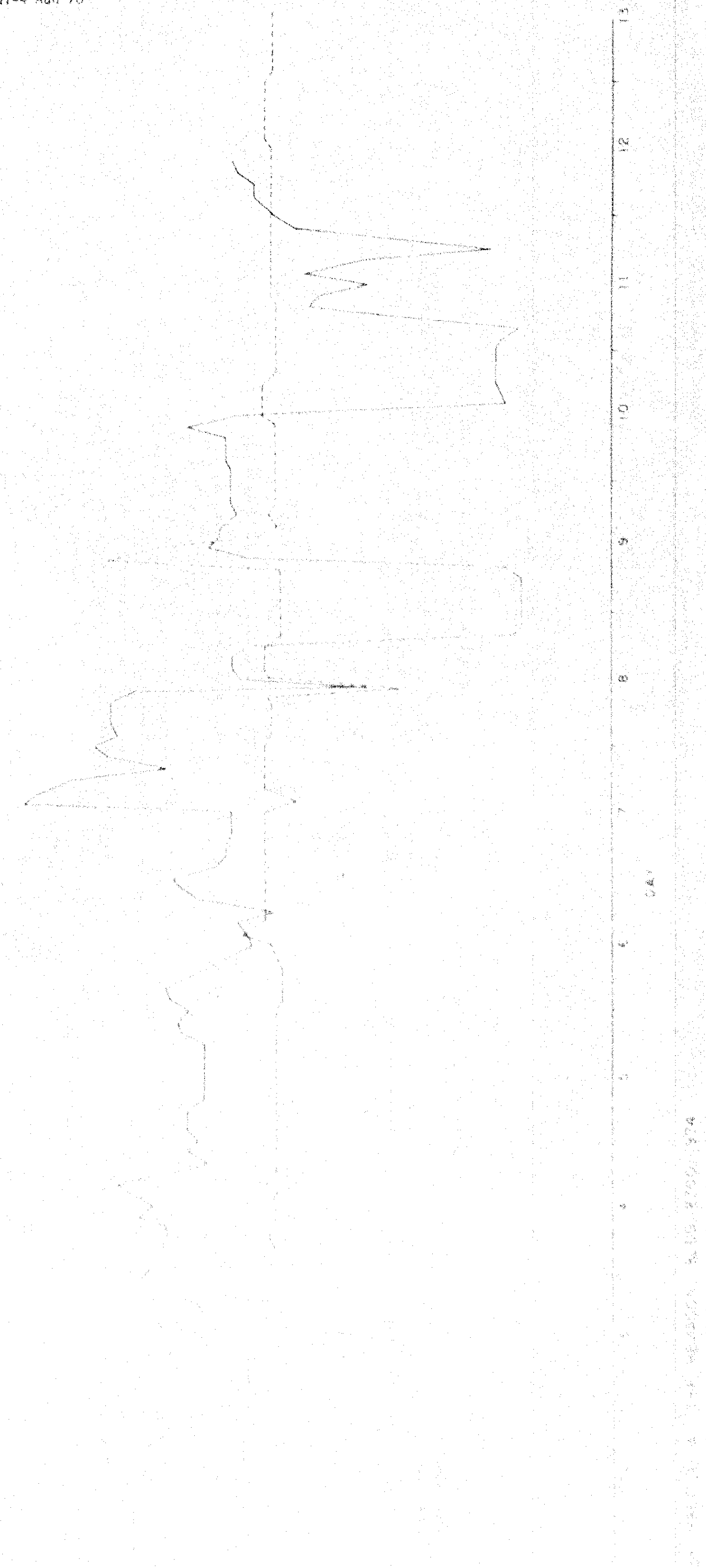

4
5
6
7
8
9
10
11
12
13

FIGURE 4 pH PROFILE AT THE HEXAGON BLDG 2700 - 1978

(2) The second grab, also collected at sample point 1, is a rinse from spent ferric chloride etchant, contaminated with copper, which turned the flow at sample point 1 dark red for a short period. This was the residue from the etchant tank in room 4D203. The spent etchant is presently being pumped to a drum, along with the solution resulting from two rinses of the tank. This is removed by the scavenger. What is left in the tank is washed down the drain.

(3) Sample points 1 and 2 were each monitored by two automatic samplers. One took a 24-hour composite into a large bottle. The other took discrete samples into 500 ml bottles. Each bottle, then, contained the sample taken in 1 hour (four samples at 15-minute intervals). The sample noted in the third column of Table C-4 was one of these discrete samples. It was amber in color and of low pH. The lack of sample quantity made analytical work difficult. It may have been some etchant or an acidic compound used in metal surface preparation.

(4) During investigations within the building, the metal fabrication area was visited (room 1B213A). Tanks of very strong alkaline and acid cleaners and water rinse tanks are used for metal surface preparation. Normally, dragout from the rinse tanks flows to the industrial waste lines, but two or three times per year the two acid and two caustic tanks are considered spent and are purged to the industrial waste sewer. At the time of the study the two alkali tanks, each 32-33 gallons, were empty. The acid tanks, also 32-33 gallons, were awaiting minor plumbing repairs so that they could be purged. The fourth column of Table C-4 represents a grab from one of these tanks. Both the caustic and acid cleaners are manufactured by Oakite®. The sample obtained was contaminated Oakite 34. This was clearly the most significant of the grab samples. Mixing 66 gallons of this material with the interceptor's daily flow would put the waste over the limit for chromium (Table 1). Should the NMCRSA happen to grab a sample at their monitoring station (sample point 3) as a slug of this type reaches it, they would note volatile solids, pH, sulfate, and nitrate/nitrite. These materials should not be discharged to the industrial sewer.

(5) The paint spray booth in room 1B207 was being purged, and a sample of this waste was collected. Analysis shows this to be of little significance when diluted with the other wastes. The paint spray booths are washed out infrequently.

® Oakite Products, Inc., 50 Valley Road, Berkely Heights, N.J. 07922.

e. The Scavenger. A number of the concentrated wastes from the Hexagon are removed by RADIAC Research Corporation of Brooklyn, NY. The individual generating the waste is required to notify the contracting officer by DF when the waste will be available for removal, the type of waste and any safety considerations. The contracting officer will then have the waste picked up and delivered to a storage area. When a sufficient quantity is collected, the contractor is notified. He then comes to Fort Monmouth, sorts and transfers the waste to 30-gallon drums and removes it. The current contract is for 49 dollars/30 gallons. Approximately 150 thirty-gallon drums were removed in CY 1977 and, up to the time of the study, 197 drums had been removed in 1978. The cost may appear high, but should be weighed against possible surcharges which could be levied by the NMCRSA, or the cost of pretreatment of this wide variety of wastes. The major problem has been lack of riggers to move the wastes to the pickup site.

f. Operations Within the Hexagon. The room-by-room inventory of operations in the Hexagon provided a large volume of information, most of which is included in Appendix D. A brief summary of those findings that impact on industrial waste disposal follows:

(1) The photooptics laboratory, CSTAL, appears to present little problem with regard to industrial wastes. Silver recovery should be practiced with equipment currently available.

(2) Given the removal of spent etchant and organic solvents by a scavenger, ETDL produces little wastewater which is discharged to the industrial wastewater collection lines. The ETDL uses only small quantities of chemicals yearly and discharges even less. Many of the laboratories store chemicals they do not use at all.

(3) Of the remaining activities in the Hexagon, only two are significant in terms of industrial waste. These are the etching facility, rooms 3A41P-500, and the photographic and reproduction facility, rooms 1B126-200. Wastes from both of these have been reduced by improved operations and use of the scavenger.

g. Industrial Waste Pretreatment. At the levels of operation observed during the study, the industrial waste generated does not warrant pretreatment. Should activities increase dramatically, some pretreatment may be appropriate. Unless a new and very exotic operation begins discharging, a combination of very minimal treatment and judicious use of the scavenger should suffice. The New York District Corps of Engineers is developing a project to pretreat these industrial wastes, at an estimated cost of $300,000. An alternative to such an expensive project would be to utilize the existing but inactive Charles Wood Area STP. The industrial waste from the Hexagon would be diverted to this facility for pretreatment consisting of equalization, sedimentation and if necessary, pH adjustment before being discharged to the NMCRSA. This plan, presented conceptually in Figure 5, is capable of providing adequate treatment at a more attractive price. Prior to disposal of any sludges generated by pH adjustment and sedimentation, guidance should be obtained from the Solid Waste Management Division of this Agency. Address inquiries to Commander, US Army Environmental Hygiene Agency, ATTN: HSE-ES, Aberdeen Proving Ground, MD 21010.

h. Cooling Towers. Another project under consideration by the New York District Corps of Engineers concerns connection of cooling tower washout wastewater to the sanitary sewer. There are four air conditioning cooling towers, operated by the Facilities Engineer, located on the roof of the Hexagon Building. They hold approximately 1200 gallons in the sump and an additional 1000 gallons in the distribution system. Automatic bleed-off from these systems is to the sanitary sewer and make-up water is provided automatically in unknown quantities. Each tower is drained and cleaned annually. All four towers were cleaned in the 2 weeks prior to and the first week of the study. During the cleaning operation the tower is drained onto the roof from which the wastewater flows to a storm sewer and on to Wampum Creek. Chemical addition includes 2-3 pints/week/tower of Ecolochem DCA-50® deposit control agent and an unknown quantity of Ecolochem TCI® scale and corrosion control agent. A fifth cooling tower serves a refrigeration unit in the climatic control laboratory. This system is of approximately 1000 gallon capacity, and is drained three times per year to the roof. This system is also equipped with an automatic bleed-off to the sanitary sewer. Two chemicals are added in unknown quantities, O'Bricket Boiler Water Treatment® and Ionac Biocide Formula 1451®. Chemical analyses of the cooling waters, conducted by Ecolochem in 1976, are shown in Table 2. These data and those shown in reference 2b are sufficient to indicate no problem with connecting to the sanitary sewer. If industrial wastewater pretreatment is provided for other wastes, the wastewater from annual cleaning could be tied into the industrial wastewater lines.

® Ecolochem DCA-50 and TCI are a registered trademark of Ecolochem, Chesapeake, VA

® O'Bricket Boiler Water Treatment is a registered trademark of O'Brien Industries, Inc., Livingstone, NJ

® Ionac Biocide Formula 1451 is a registered trademark of the Ritter Plaudler Corp, Birmingham, NJ

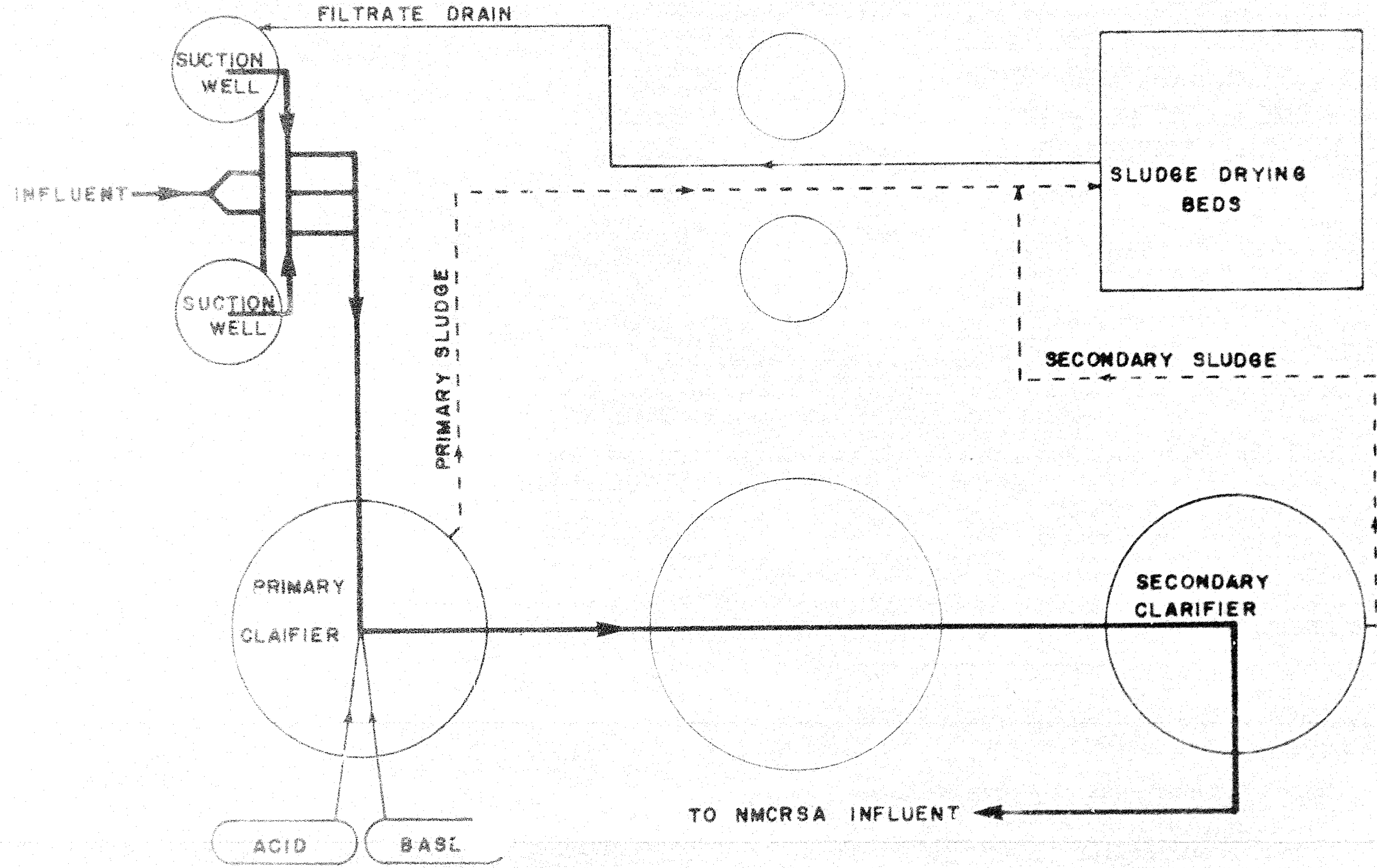


FIGURE 5. PROPOSED MODIFICATION TO THE CHARLES WOOD STP FOR PRETREATMENT OF INDUSTRIAL WASTES.

Water Quality Engr Sp Study No. 32-24-0135-79, 24 Jul-4 Aug 78

TABLE 2. COOLING TOWER WATER ANALYSES*

			Results in parts per million (except pH)			
Sample Source: HEX-ECOM		Make-up	M.R. # 31	M.R. # 32	M.R. # 43	M.R. # 44
Phenolphthalein Alkalinity	P	0	0	0	0	0
Total Alkalinity	M	30	25	30	55	60
Chloride	Cl	24	180	90	84	168
Total Dissolved Solids	TDS	100	500	360	300	700
Total Hardness	$CaCO_3$	75	290	200	180	340
pH			6.7	7.1	7.8	8.1

* Analyses performed by Ecolochem, Chesapeake, VA

i. <u>Laboratory Fume Hoods</u>. Three laboratory hoods in the basement of the Hexagon Building are equipped with wet scrubbers. These scrubbers were intended to utilize once through water at a rate of 3 gpm and discharge it to the storm sewage system and subsequently to Wampum Creek. Currently, all three scrubbers are operating without water; therefore, there is no discharge to the storm sewer. The hoods, located in rooms 0A407, 0A415 and 0A502 are used primarily to vent inorganic acids, gaseous hydrogen and small quantities of phosphorus and arsenic. A project is pending to tie the wastewater from these scrubbers to the sanitary sewer system. This would serve no purpose unless the scrubbers for the fume hoods are operated with water scrubbing medium.

6. CONCLUSIONS.

a. The quantities of pollutants in the Hexagon industrial waste streams have dropped to low levels due to reduced activity, fewer pollution-generating operations, and the use of a scavenger to remove some of the concentrated wastes. The industrial waste as it is now composed should be acceptable to the NMCRSA without pretreatment, with the exception of acid and caustic tank dumps in room 1B213A [see paragraph 5d(4)]. Use of the scavenger has reduced the pollutant loading in the Hexagon industrial waste stream. Difficulties in moving the wastes from the Hexagon to the pickup point could cause problems, however.

b. At the current levels of operation at the Hexagon, industrial wastewater pretreatment is deemed unnecessary. If operations increase, minimal pretreatment may be required. The connection of the cooling tower washdown water to the sanitary sewer should present no problem. Tie-in of the scrubber water from the Hexagon basement to the sanitary sewer is unnecessary at this time, because the fume hoods are running dry; it would be necessary only if the scrubbers will be operated with water scrubbing medium.

7. RECOMMENDATIONS.

a. Make the "design to" treatment levels the same as those shown in column 1 of Table 1, any pretreatment of the Hexagon industrial is deemed necessary. If the current level of activity is to continue at the Hexagon, do not pretreat the industrial waste. If it is determined that pretreatment is necessary, attempt to utilize some combination of the existing facilities at the Charles Wood Area STP (see paragraph 5g).

b. Make arrangements to have the spent acid and caustic wastes in room 1B213A pumped to drums and removed by the scavenger. Provide the necessary manpower to quickly and safely move the concentrated wastes collected in the Hexagon to the scavenger pickup point.

c. Use the existing silver recovery units at the photooptics lab, CSTAL [see paragraph 5f(1)].

d. Insure that chemicals stored in the various ETDL's that are not being used are disposed of properly [see paragraph 5f(2)]. Disposal guidance for those chemicals that cannot be used, sold or given to the scavenger can be obtained from the Solid Waste Management Division of this Agency, AUTOVON 584-2024. Address inquiries to Commander, US Army Environmental Hygiene Agency, ATTN: HSE-ES, Aberdeen Proving Ground, MD 21010.

e. Connect the cooling tower cleanout effluent to the sanitary sewer; however, withhold the project to connect the scrubbers from the laboratory fume hoods to the sanitary sewer until it can be determined if and when they will begin wet operation.

8. CONSULTATION AND TECHNICAL ASSISTANCE. This Agency will provide assistance in implementing the recommendations contained in this report. Formal requests for assistance should be forwarded through Commander, US Army Health Services Command, ATTN: HSPA-P, Fort Sam Houston, TX 78234 to Commander, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD 21010. Technical advice may be obtained informally by contacting the Chief, Water Quality Engineering Division, US Army Environmental Hygiene Agency, AUTOVON 584-3554/3913.

for WILLIAM N. HASSELKUS
Chemical Engineer
Water Quality Engineering Division

APPROVED:

J. DON GEASLER
LTC, MSC
Chief, Water Quality Engineering Division

APPENDIX A

ABBREVIATIONS AND DEFINITIONS

AVRADCOM	Aviation Research and Development Command
CERCOM	Communications and Electronics Materiel Readiness Command
CORADCOM	Communications Research and Development Command
CSTAL	Combat Surveillance and Target Acquisition Laboratory
CY	Calendar Year
DF	Disposition Form
ERADCOM	Electronics Research and Development Command
gpd	Gallons per day
gpm	Gallons per minute
mg/l	Milligrams per liter
ml	Milliliters
NMCRSA	Northeast Monmouth County Regional Sewerage Authority
pH	Negative logarithm of hydrogen ion concentration
STP	Sewage treatment plant
TDS	Total dissolved solid
TKN	Total Kjeldahl nitrogen
TOC	Total Organic Carbon
TVS	Total Volatile Solids
DARCOM	US Army Materiel Development and Readiness Command
ECOM	US Army Electronics Command
USAEHA	US Army Environmental Hygiene Agency
ETDL	Electronics Technology and Devices Laboratory

APPENDIX B

ANALYTICAL TECHNIQUES

pH - Standard Methods[1]; 424, Glass Electrode Method, pgs 460-465.

Specific Conductance - Standard Methods[1]; 205, Conductivity, pgs 71-75.

TOC - Standard Methods[1]; 505, Combustion-Infrared Method, pgs 532-534.

TSS - Standard Methods[1]; 208D, Total Nonfiltrable Residue Dried at 103-105°C, pg 94.

TS - Standard Methods[1]; 208A, Total Residue Dried at 103-105°C, pgs 91-92.

TVS - Standard Methods[1]; 208F, Total Volatile and Fixed Residue at 550°C.

TDS - Standard Methods[1]; 208C, Total Filtrable Residue Dried at 103-105°C, pg 93.

G&O - Standard Methods[1]; 502A, Partition - Gravimetric Method, pgs 515-516.

Cl - Standard Methods[1]; 408B, Mercuric Nitrate Method, pgs 304-306.

SO_4 - Standard Methods[1]; 427C, Turbidimetric Method, pgs 496-498.

NO_2NO_3/N - Standard Methods[1]; 605, Cadmium Reduction Method, pgs 620-624.

Phenol - Analyst, Vol 100, No. 1127, Hydrazone Method for Determining Phenols in Waters, pgs 841-847.

Vol Acids - Modified Standard Methods[1]; 504B, Steam Distillation Method for Volatile Acids, pgs 529-530. Modification: Used 100 ml of sample.

NH_3/N - Manual of Methods for Chemical Analysis of Water and Wastes;[2] Nitrogen, Ammonia (Selective Ion Electrode Method) STORET No. 00610, pgs 165-167.

TKN - Manual of Methods for Chemical Analysis of Water and Wastes;[2] Nitrogen, Kjeldahl, Total, STORED No. 00625, pgs 175-181.

Hydroquinone - N. N. Bolynkin, et al. [Trudy Lemingradskago Instituta Kinoinzhenerov 16: 200-204 (1970)] Analysis of Developers in the Waste Waters of Motion Picture Film Duplicating Factories [CA 76049582Z] (Russ)

- I. A. Shevchuk et al [Ukr. Khim. Zh. 41(9): 962-5 (1975)] Reactions of Colored Associates of the Type Basic dye - Antimony (V) Chloride Acid Complex with Dihydric Phenols [CA 84025584r] (russ).

I. Extraction:

A. Acidify 50 ml aliquot to pH 2-5.

B. Extract once with 20 ml Chloroform/Ethylacetate (1/1).

C. Extract 2x with 10 ml Chloroform/Ethylacetate.

D. Hydroquine remains in aqueous phase throughout.

II. Measurement.

A. 10 ml aliquot of extract.

B. 5 ml color reagent (Crystal Violet - $SnCl_6$ complex in benzene diluted with benzene to $A_{595} \lessgtr 0.900$).

C. Extract 3 minutes in screw-top tubes.

D. Allow phases to separate and read A_{595} of benzene phase.

E. Loss of A_{595} indicates presence of dihydric phenols (hydroquinone, resorcinol, and catechol).

Metals, Total - Methods for Chemical Analysis of Water and Wastes.[2]

Cr pg 105; STORET No. TOTAL 01034
Cu pg 108; STORET No. TOTAL 01042
Pb pg 112; STORET No. TOTAL 01051
Ni pg 141; STORET No. TOTAL 01067
Fe pg 110; STORET No. TOTAL 01045
Zn pg 155; STORET No. TOTAL 01092

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

2. US Environmental Protection Agency, Manual of Methods for Chemical Analysis of Water and Wastes, 1974, EPA, Water Quality Office, Analytical Control Laboratory, Cincinnati, OH.

[illegible] Aug 78

APPENDIX C

DAILY RESULTS OF ANALYSES AND PHYSICAL MEASUREMENTS

	1	2	3	4	5	6	7	8	Median	Range Max	Range Min
[illegible]	[illegible]	6.8	6.3	6.8	6.5	6.9	6.4	6.6	6.7	7.1	6.3
[illegible]	[illegible]	[illegible]	460	473	219	223	277	238	263	473	219
[illegible]	[illegible]	[illegible]	344	293	151	220	237	313	254	344	151
[illegible]	[illegible]	[illegible]	327	225	149	220	222	293	223	327	149
[illegible]	[illegible]	[illegible]	[illegible]	154	84	153	134	212	131	212	84
[illegible]	[illegible]	[illegible]	7.3	15	0.06	0.55	0.11	0.96	0.47	15	0.06
[illegible]	[illegible]	[illegible]	11	19	0.39	0.65	0.90	2.0	1.0	19	0.39
[illegible]	[illegible]	[illegible]	20	48	4.6	2.9	16	7.1	7.6	48	2.9
[illegible]	[illegible]	[illegible]	35	39	20	20	21	21	23.0	39	20.
[illegible]	[illegible]	[illegible]	107	41	36	38	45	44	45	107	36.
[illegible]	[illegible]	[illegible]	0.44	<0.04	0.36	0.43	<0.04	0.41	0.42	1.2	<0.04
[illegible]	[illegible]	[illegible]	[illegible]	0.39	<0.01	<0.01	0.02	0.37	0.06	7.0	<0.01
[illegible]	[illegible]	[illegible]	0.06	0.04	0.01	<0.01	0.01	0.03	0.03	0.15	<0.01
[illegible]	[illegible]	-	[illegible]	4	-	-	-	4	4	7	4
[illegible]	[illegible]	[illegible]	17	68	2	<1	15	20	13.5	68	<1
[illegible]	[illegible]	[illegible]	[illegible]	<0.025	<0.025	<0.025	0.019	0.021	<0.025	0.054	<0.025
[illegible]	[illegible]	[illegible]	0.700	0.104	0.074	0.068	0.095	0.125	0.115	0.700	0.068
[illegible]	[illegible]	[illegible]	[illegible]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.19	<0.10
[illegible]	[illegible]	[illegible]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
[illegible]	[illegible]	[illegible]	5.90	1.35	0.35	0.23	0.57	1.02	1.11	5.90	0.23
[illegible]	[illegible]	[illegible]	0.339	0.105	0.070	0.045	0.133	0.125	0.110	0.339	0.045
[illegible]	[illegible]	[illegible]	[illegible]	6085	6085	8900	14200	-	8900	14200	6085

TABLE C-2. DAILY RESULTS, SAMPLE POINT 2

Parameter/Day	1	2	3	4	5	6	7	8	Median	Range Max	- Min
pH, std units	6.9	7.0	6.8	6.8	6.9	7.1	6.7	6.6	6.8	7.1	6.6
Sp cond, μmho/cm	299	286	259	259	282	280	276	275	278	299	259
Total solids, mg/l	263	243	207	181	204	230	300	233	232	300	181
TDS, mg/l	247	221	165	167	193	219	285	217	218	285	165
TVS, mg/l	125	117	90	91	87	122	198	165	120	198	87
Ammonia, mg/l	0.20	0.20	0.16	0.68	0.10	0.26	0.52	1.2	0.23	1.2	0.10
TKN, mg/l	1.1	1.2	1.6	0.87	0.70	1.2	1.2	1.8	1.2	1.8	0.70
TOC, mg/l	12.0	8.0	12.0	10.5	7.7	9.2	8.7	8.0	9.0	12	7.7
Chloride, mg/l	26	23	23	24	24	20	20	19	23	26	19
Sulfate, mg/l	49	40	40	38	44	46	44	41	43	49	38
Nitrate/nitrite, mg/l	0.66	0.65	0.52	0.59	0.61	0.52	0.54	0.52	0.57	0.66	0.52
Phenol, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	0.01	<0.01	<0.01	0.04	<0.01
Volatile acid, mg/l	0.06	0.03	0.04	0.01	<0.01	0.01	0.01	0.02	0.02	0.06	<0.01
Grease and oil, mg/l	-	-	8	6	-	-	-	3	6	8	3
Suspended Solids, mg/l	16	22	42	14	11	11	15	16	16	42	11
Chromium, mg/l	0.085	0.095	0.195	0.074	0.208	0.091	0.086	0.085	0.089	0.208	0.074
Copper, mg/l	0.336	0.324	0.680	0.750	0.251	0.260	0.259	0.299	0.312	0.750	0.251
Lead, mg/l	<0.10	<0.10	0.16	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0..	<0.10
Nickel, mg/l	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron, mg/l	2.78	2.71	<0.82	2.24	2.23	2.29	2.37	2.47	-	2.78	<0.82
Zinc, mg/l	0.078	0.125	0.146	0.092	0.078	0.045	0.082	0.096	0.093	0.146	0.045
Flow, gpd	-	31500	21900	20560	20560	20560	28260	-	23890	31500	20560

Water Quality Engr Sc Study No. 32-24-0138-79, 24 Jul-4 Aug 78

TABLE C-3. DAILY RESULTS, SAMPLE POINT 3

Parameter/Day	1	2	3	4	5	6	7	8	Median	Range Max	Range Min
pH, std unit	6.8	6.8	6.7	6.0	6.8	6.7	6.7	6.6	6.8	6.8	6.7
Sp cond, umho/cm	449	462	455	235	459	462	468	457	461	462	[illegible]
Total solids, mg/l	339	354	386	194	362	481	431	361	368	481	194
TDS, mg/l	264	190	262	180	225	424	318	299	266	424	[illegible]
FVS, mg/l	182	130	210	123	326	301	299	212	196	326	[illegible]
Ammonia, mg/l	14	12	12	0.24	13	12	13	14	13	14	0.24
TKN, mg/l	17	18	22	0.63	17	15	14	19	18	[illegible]	0.63
TOC, mg/l	49	38	49	7.4	52	53	47	43	49	53	7.4
Chloride, mg/l	37	38	40	22	41	47	45	39	40	47	[illegible]
Sulfate, mg/l	57	44	54	36	44	26	32	41	44	57	[illegible]
Nitrate/nitrite, mg/l	<0.04	<0.04	<0.24	4.5	<0.04	<0.04	<0.24	<0.04	<0.04	4.5	<0.04
Phenol, mg/l	1.3	0.32	1.3	0.36	0.37	0.25	0.36	0.45	0.4	1.3	[illegible]
Volatile acid, mg/l	0.93	0.10	0.69	<0.01	0.08	0.04	0.04	0.04	0.04	0.93	[illegible]
Grease & oil, mg/l	-	-	23	144	-	-	-	23	23	144	23
Suspended Solids, mg/l	70	164	124	14	17	57	115	92	81	164	14
Chromium, mg/l	<0.025	<0.025	<0.025	0.036	<0.025	<0.025	<0.025	<0.025	<0.025	[illegible]	[illegible]
Copper, mg/l	0.090	0.066	0.052	[illegible]	0.015	0.063	0.072	[illegible]	[illegible]	[illegible]	[illegible]
Lead, mg/l	<0.10	<0.10	<0.10	<0.11	<0.11	<0.10	<0.10	<0.11	<0.10	[illegible]	[illegible]
Nickel, mg/l	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	[illegible]	[illegible]
Iron, mg/l	1.33	1.49	1.5	5.78	1.41	1.49	1.75	1.62	1.53	[illegible]	[illegible]
Zinc, mg/l	0.270	[illegible]	0.125	0.019	0.020	0.081	0.125	0.103	0.091	[illegible]	[illegible]
Flow, gpd (x100)	4275	[illegible]	4342	4338	[illegible]	4025	4180	4347	4314	[illegible]	[illegible]

Water Quality Engr Sp Study No. 32-24-0135-79, 24 Jul-4 Aug 78

TABLE C-4. GRAB SAMPLE RESULTS

Parameter/Day	SP 1 1400 hrs 24 July 78	SP 1 1400 hrs 27 July 78	SP 1 Discrete 28 July 78	Acid Deoxidizer	Paint Spray Booth Wash
pH, std units	6.4	3.0	2.6	<1.0	8.6
Sp cond, µmho/cm	249	1500	1820	>100000	2380.
Total solids, mg/l	-	746	-	59000	1812.
TDS, mg/l	-	626	-	59000	1624.
TVS, mg/l	-	352	-	43150	648.
Ammonia, mg/l	-	3	-	*	0.70
TKN, mg/l	-	6.7	-	0.23	5.7
TOC, mg/l	15	27	-	73	41.
Chloride, mg/l	-	318	-	*	54.
Sulfate, mg/l	-	20	-	19200	69.
Nitrate, nitrite, mg/l	0.18	0.52	90	2260	0.05
Phenol, mg/l	0.01	2.3	0.02	0.03	0.04
Volatile acid, mg/l	0.29	0.05	-	0.05	0.13
Suspended Solids, mg/l	-	120	-	<1	188.
Chromium, mg/l	-	0.067	0.053	4720	1.06
Copper, mg/l	-	55	12	1168	0.250
Lead, mg/l	-	1.52	0.82	4.33	0.46
Nickel, mg/l	-	0.15	0.22	6.80	<0.10
Iron, mg/l	-	128	98	65	3.20
Zinc, mg/l	-	2.28	1.66	118	1.19

* Interference, no determination.

APPENDIX D

OPERATIONS WITHIN THE HEXAGON

1. Photooptics Laboratory, CSTAL. This activity conducts photoprocessing research, dealing with both black and white and color chemistry. Thus, the quantities of waste chemicals, coming from pilot-bench size operations, will be small. They will generally be 3-10 percent solutions of either commercial formulations or new formulations developed in the lab. Discharge will ordinarily be on the order of a few gallons per week. There is no silver recovery, although two units are in the area for research purposes. The laboratory operations are in rooms 4D108, 110 and 114 and in 4C111 and 113.

2. AVRADCOM. AVRADCOM has moved out of the Hexagon Building to Building 2525. They have no laboratory or shop activities in the Hexagon.

3. ETDL, CSTAL. This organization is involved with research and development of a wide variety of communications-electronics devices. They operate approximately 3 dozen small laboratories and shops thoughout the Hexagon. Each of these areas may at times discharge small amounts of acid, base, organic solvents or heavy metals to the industrial waste collection system. Between them they probably discharge no more than a few hundred gallons/month of concentrated pollutants. The only significant contributor of pollutants in the past was the etching facility, room 4D203, which discharged approximately 15-20 gallons of concentrated etching solution at a time. This ferric chloride etchant, heavily laden with copper, is now collected and held for pickup by a scavenger. Etchant solution may still find its way, at times, to the industrial waste lines because of problems with waste pickup (see paragraph 5e). Many of the other labs also collect their spent organic solvents for pickup by the scavenger. Table D-1 summarizes the activities of these laboratories.

4. Chemicals normally used in the ETDL. Although the new organizational scheme has upset normal activities in the various laboratories within ETDL, historical data were available that indicates the prior levels of usage of chemicals in the labs; Table D-2 summarizes these data. Two points should be made here:

TABLE D-1. SUMMARY OF OBSERVATIONS AT THE LABORATORIES AND SHOPS OF THE ELECTRONICS TECHNOLOGY AND DEVICES LABORATORY

Room	Activity	Discharges (all small quantities)
4C109	Reliability, environmental testing	Acid; freon
4C119	Same	Same
4D118	Same	Same
4D128	Semiconductor treatment, cleaning	Acetone, methyl alcohol, acids ammonium hydroxide; 1-2 gal/wk
4D130	Inactive	
4D134	Inactive	
4C131	Inactive	
4D203	Etching	Etchant rinse, trichloroethane, xylene, tin plate rinse
4C203	Inactive	
4D206	Semiconductor testing	Cooling water
4D202	Ferrite preparation	
4D214A	Inactive	
4D302B	Fabricate Semiconductors	Cleaning solvents, acids
3D140	Chem Lab	
3C141	Part of same lab; 3D140	
3D203	Lithium battery development	Lithium salts, perchlorate; approx 50 gal/yr
2C129	Inactive	
2C131	Inactive	
2C133	Inactive	
2C141	Inactive	
2D128A	Inactive	
2D140	Lithium battery design	Caustic, trace cyanate
2D200	Rechargeable battery R&D, test	Acids
2D205	Same	Same
2C201	Organic battery research	Sulfuric acid, potassium hydroxide
2C205	Same	Same
2C207	Rechargeable battery R&D, test	Acids
2C311	Crystal etching	Acids
1B312	Manufacture and clean aluminum	Isopropyl alcohol, acids, potassium
1B314	circuits iodide; approx 1 gal/wk	Going to dry operation; plasma, x-ray
0A334	Dielectrics technology	
0A337	No discharge	Bottling organic solvents
0A405	Solid state materials research	Acetone
0A407	Chem lab	Acids
0A415	Chem lab	Bottling organic solvents
0A502	Crystal manufacture	Arsenic, phosphoric and other acids, methanol, acetone 20; gal/yr

TABLE D-2. CHEMICALS STORED/USED BY ET&D LABORATORY

Chemical	Amount Stored	Amount Used/Year
Arsenic	-	-
Phosphate (primarily aluminum)	5 lb	9 lb
Nitrates (metal)	11 lb	1 lb
Acid Solutions	39 lb	6 lb
Acid, solid	127 gal	65 gal
Acetate	11 lb	1 lb
Chloride (metal)	35 lb	7 lb
Sulfate/Sulfide (metal)	8 lb	2 lb
Oxides (metal)	53 lb	10 lb
Fluoride (metal, ammonium)	38 lb	12 lb
Cyanide, cyanate (metal)	5 lb	1 lb
Chromates (metal)	15	1 lb
Oxalates (metal)	12 lb	1 lb
Iodides (metal)	7 lb	1 lb
Carbonates (metal)	9 lb	5 lb
Hydroxides (metal)	48 lb	124 lb
Alcohols	77 gal	18 gal
Organic solvents	161 gal	83 gal
Inorganic solvents	25 gal	10 gal
Other (includes proprietary materials)	24 lb	14 lb
Metals (primarily mercury)	61 lb	6 lb

a. In addition to the usage being small, only a small portion of what is used is ever likely to find its way into the industrial sewer. Thus, even in active status ETDL is not likely to be much of a factor in industrial waste generation.

b. However, many of the labs are storing materials which they do not use at all. These could potentially be disposed of improperly.

5. Table D-3 summarizes findings in those remaining areas not covered above that did or could have discharges. Those rooms not specifically mentioned in this or the foregoing discussion may be assumed to be dry or inactive or both. Figures 1-5 reveal what appears to be happening in this building.

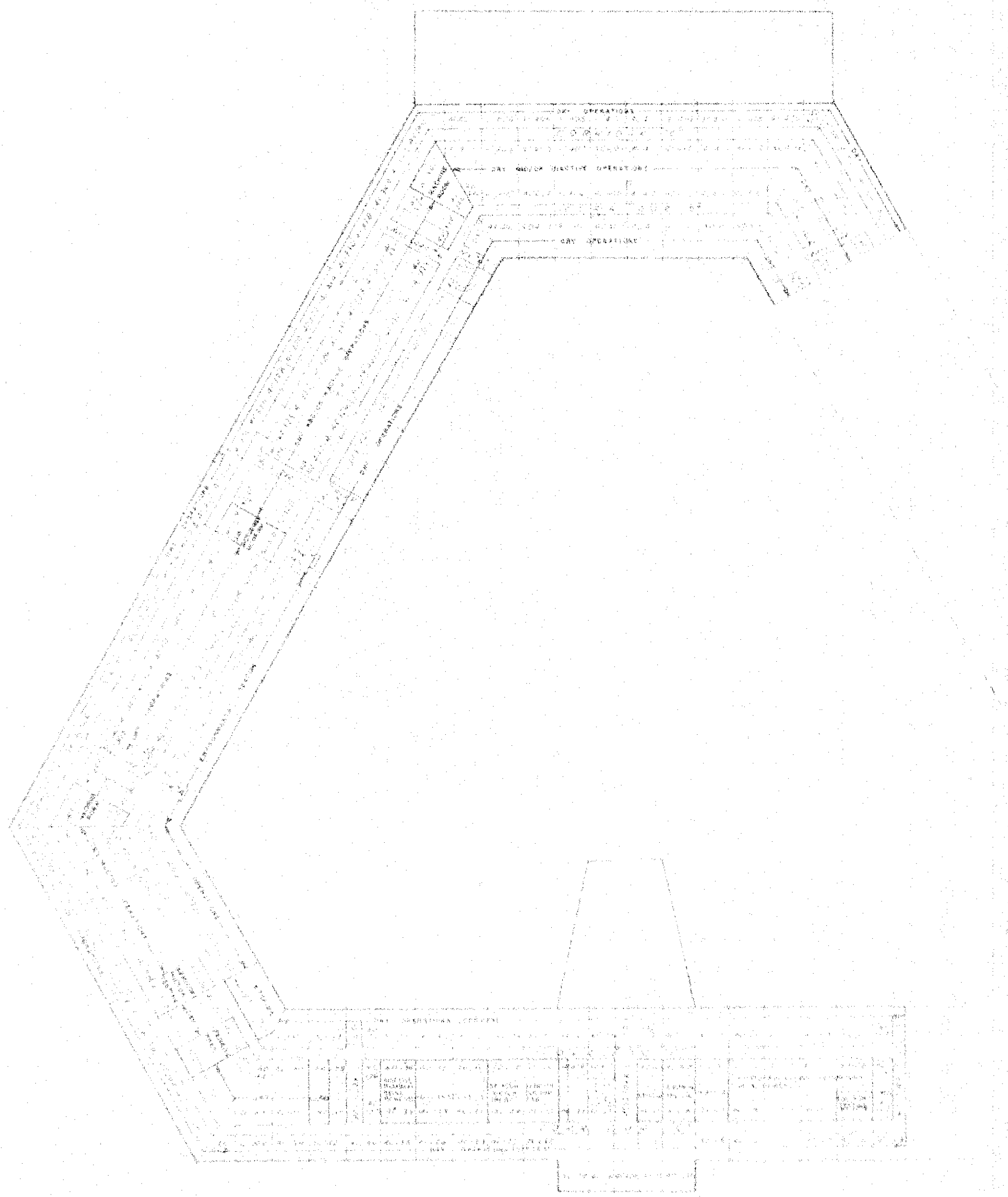
TABLE D-3. SUMMARY OF OBSERVATIONS IN THE REMAINDER OF THE HEXAGON BUILDING

Room	Activity	Discharges
4D303-315	Environmental testing	Cooling water
4C319	Air scrubber with drain	Scrubber water
3C143	Battery research	Acids
3D200	Cml Lab - inactive	
2D306	Crystal manufacture	Acids, solvents
1B311-313	Environmental testing	Cooling water
1B206-208	Paint shop	Paints, solvents
1B126-200	Photographic and Reproduction	Photographic chemicals*
0A418-500	Etching	Ammonium persulfate, copper†
0A338-402	Plastics Lab - inactive	
0A330-332	Ceramics Lab - inactive	

* Although this used to be a major source of waste, its impact has been reduced by the reduction-in-force, attrition and better processing techniques, such as new papers, rinse controllers, etc.
† Concentrated solutions go to the scavenger.

APPENDIX D

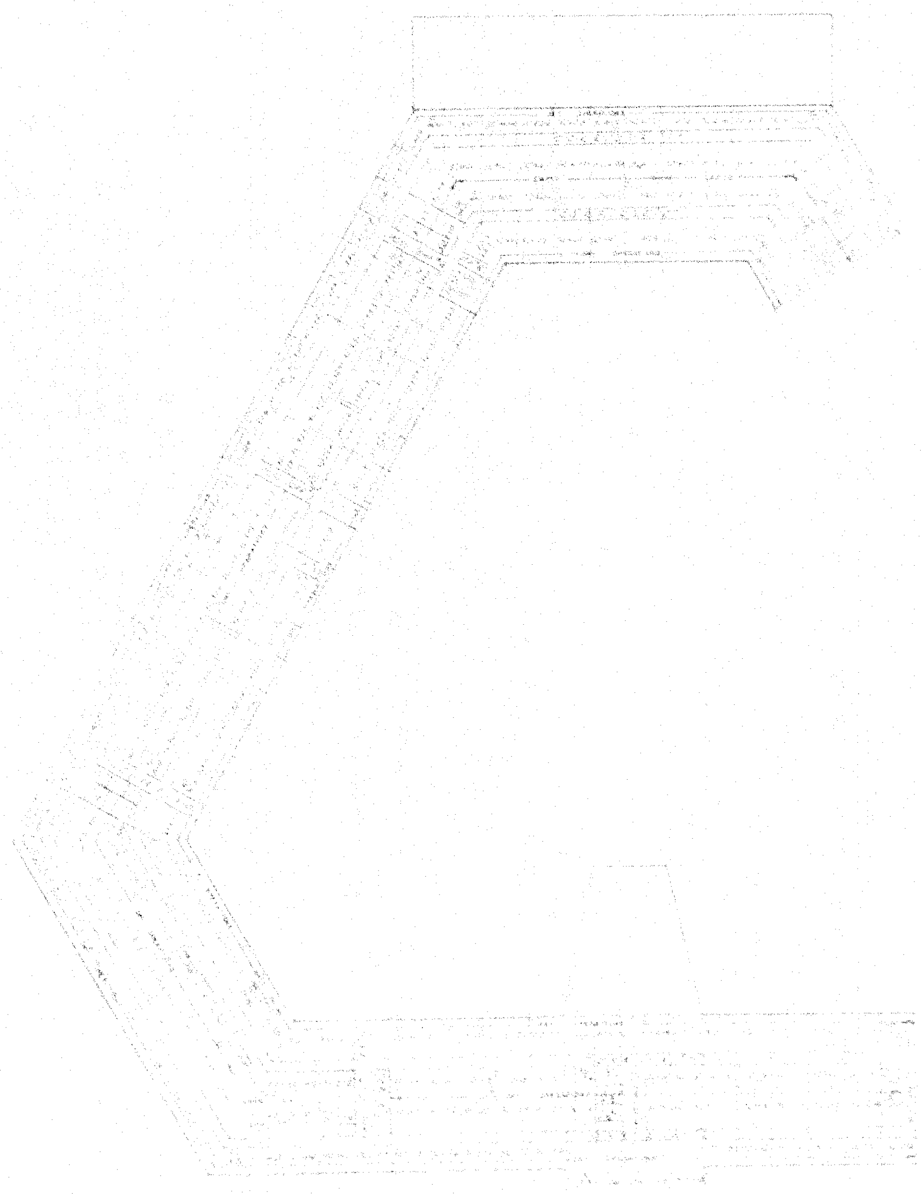
FIGURE 1. FOURTH FLOOR



FOURTH FLOOR

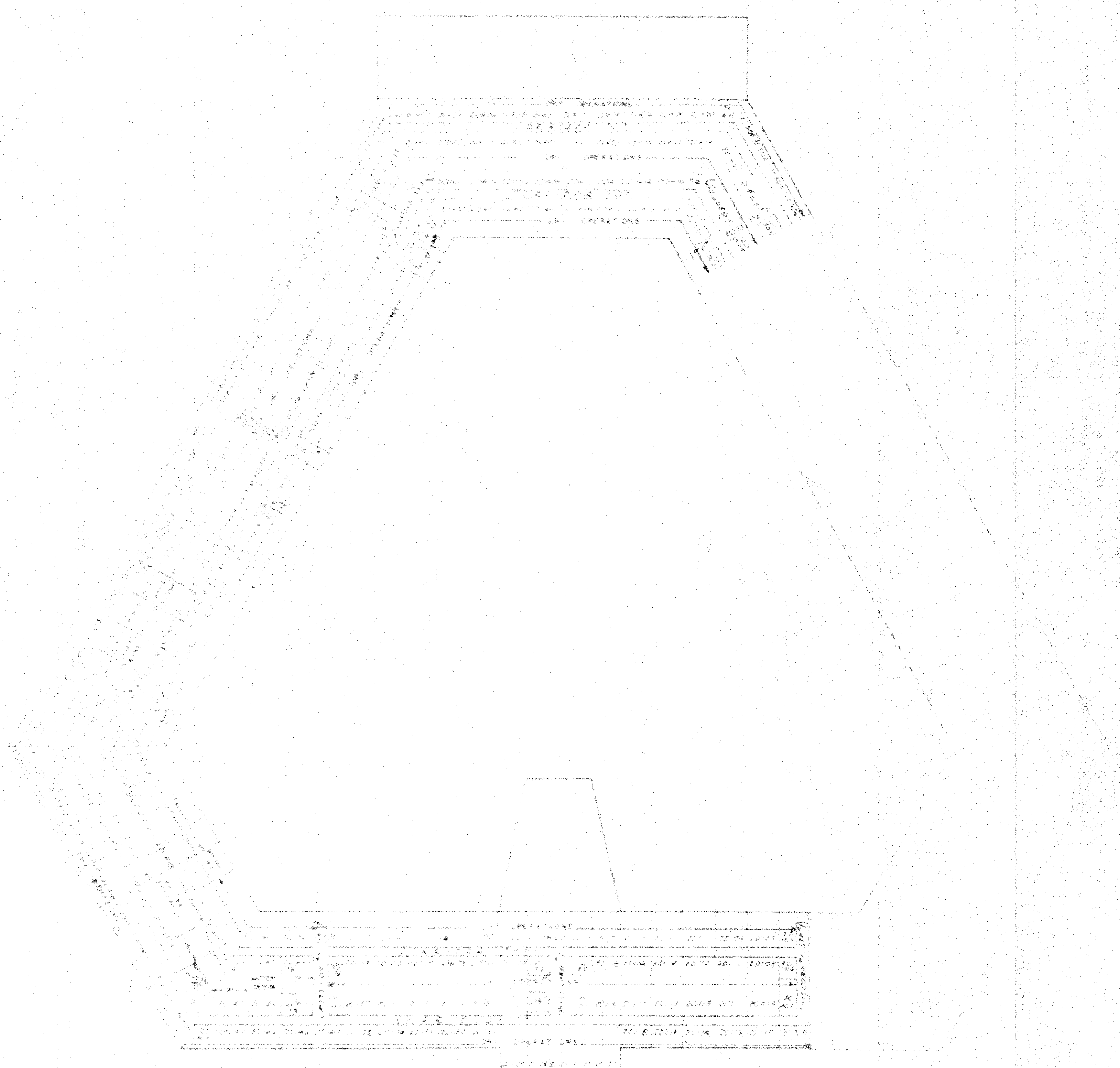
APPENDIX D

FIGURE 2. THIRD FLOOR



APPENDIX D

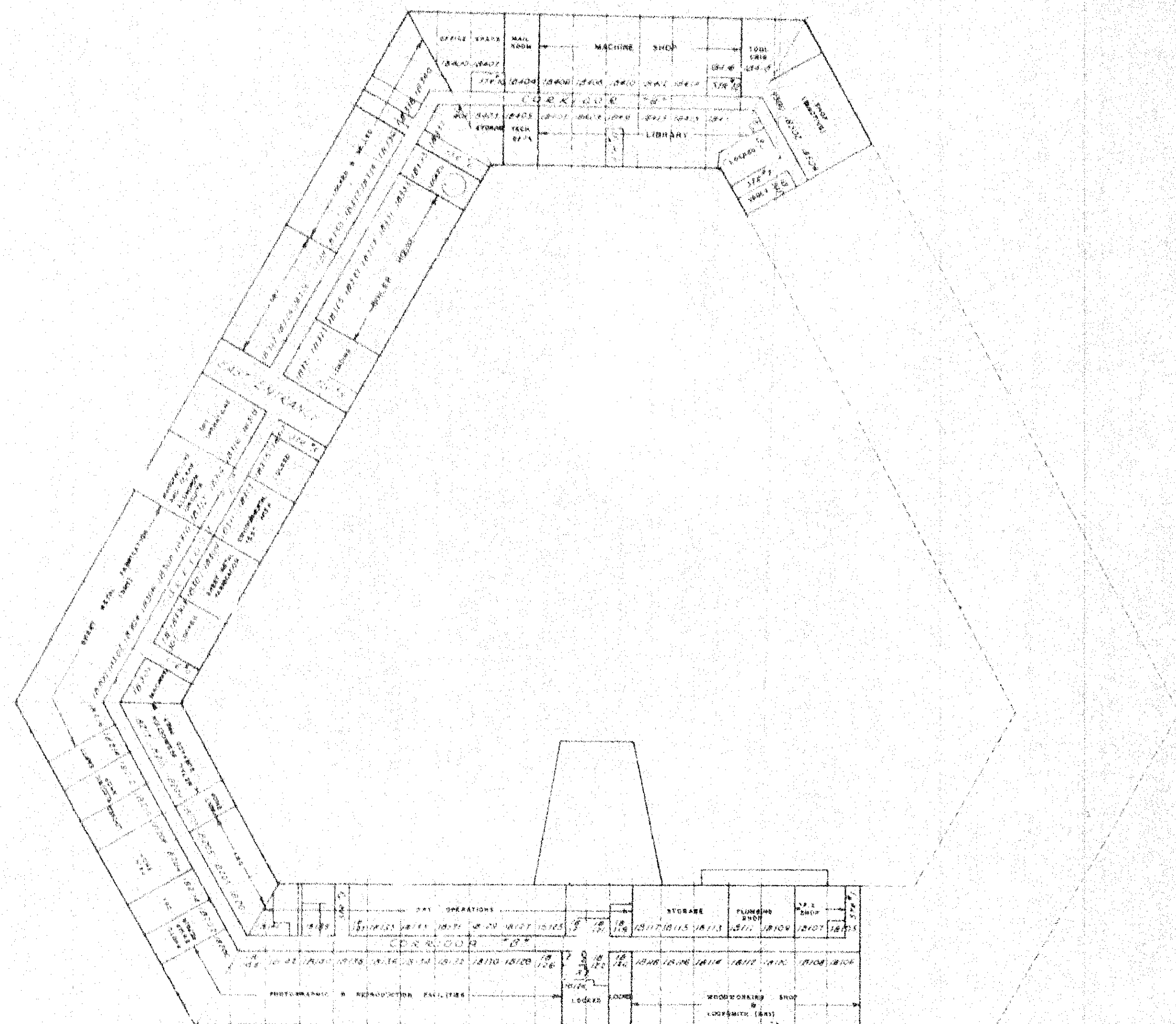
FIGURE 3 SECOND FLOOR



SECOND FLOOR

APPENDIX D

FIGURE 4. FIRST FLOOR



FIRST FLOOR

APPENDIX D

FIGURE 5. BASEMENT