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# Ecological Evaluation of Three Ponds and Three Streams, Andrews AFB DC

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## I. INTRODUCTION

Air Force Occupational and Environmental Health Laboratory (AFOEHL) personnel conducted an ecological survey at Andrews AFB on 29 May-1 Jun 90 and 4-7 Jun 90. The request for an ecological evaluation came from the Andrews Bioenvironmental Engineering Services (BES). During the past year, the Andrews Bioenvironmental Engineering Shop had detected excessive concentration levels of ammonia in the Henson Creek West. The background information received stated that urea pellets had once been used for deicing runways and could possibly be the cause of the high ammonia levels seen in Henson Creek West. We were asked to perform a survey to pinpoint the source of ammonia concentration, evaluate the extent of environmental stress and pollution in the creek and surrounding areas, and develop alternative remedial actions to correct any problems. The most recent data received from the base stated that there was little life and no fish in the surrounding pond, therefore, we were also asked to evaluate these ponds to determine if they were capable of supporting a normal fish community.

Upon arrival we observed three interconnecting ponds about 122 meters downhill from the flight line. Figures 1 & 2 show a schematic diagram of the flight line in comparison to the pond and streams. Stream A was fed by pond 2. Stream B was fed by two culverts, one a 60 inch pipe running under the length of the flight line; the other an 18 inch culvert perpendicular to the flight line. The two streams united downstream of an oil-water separator on stream B to form stream C. Stream C flows off base.

## II. DISCUSSION

### A. Sampling Strategy

The initial approach to accomplish the objectives was to perform a presurvey to determine the extent of the environmental problem. A presurvey was conducted from 29 May - 1 June 90. During the presurvey a total of 50 fish were collected from the ponds and examined for nitrogen stress and external parasites. In addition, screen samples for invertebrate density and diversity were performed on the streams. Sample sites and locations are described in Table 1.

The Ecological and Water Team arrived on 4 June 90. Water samples were collected from the streams and both sediment and water samples were collected from the ponds.

### B. Physical Characteristics

All three ponds were located approximately 122 meters down hill from the flight line. Figures 3 to 5 provide photographs of these ponds. The circumference of each pond was measured with a tape and the pH, temperature and dissolved oxygen levels were measured at various locations and depths. The depth was measured by using a weighted rope and the photic zone (depth of light penetration) measured by using a white, water sampling bottle. The results are summarized in Table 2.

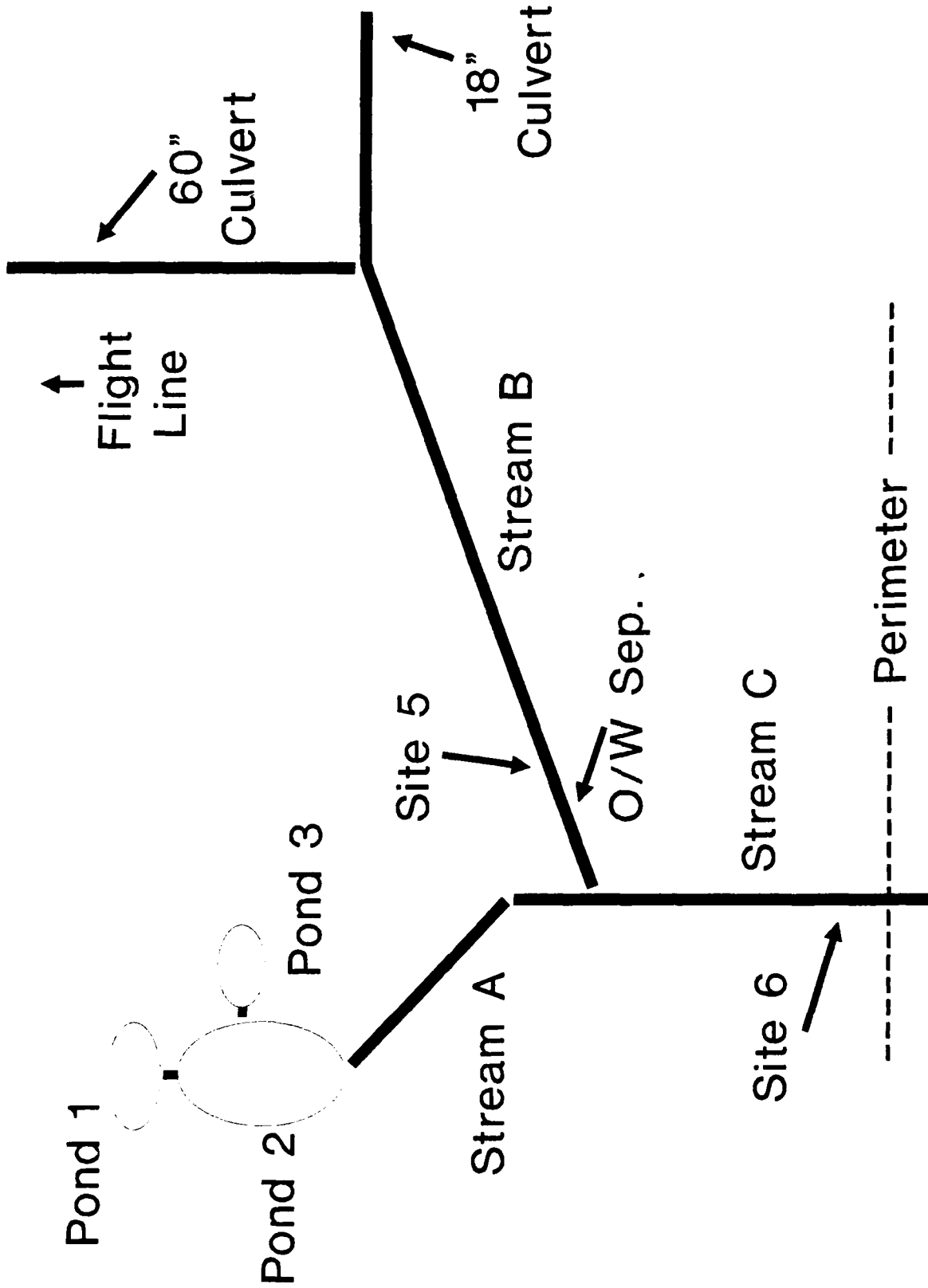


Figure 1. Schematic Diagram of Ponds and Streams  
Not to Scale

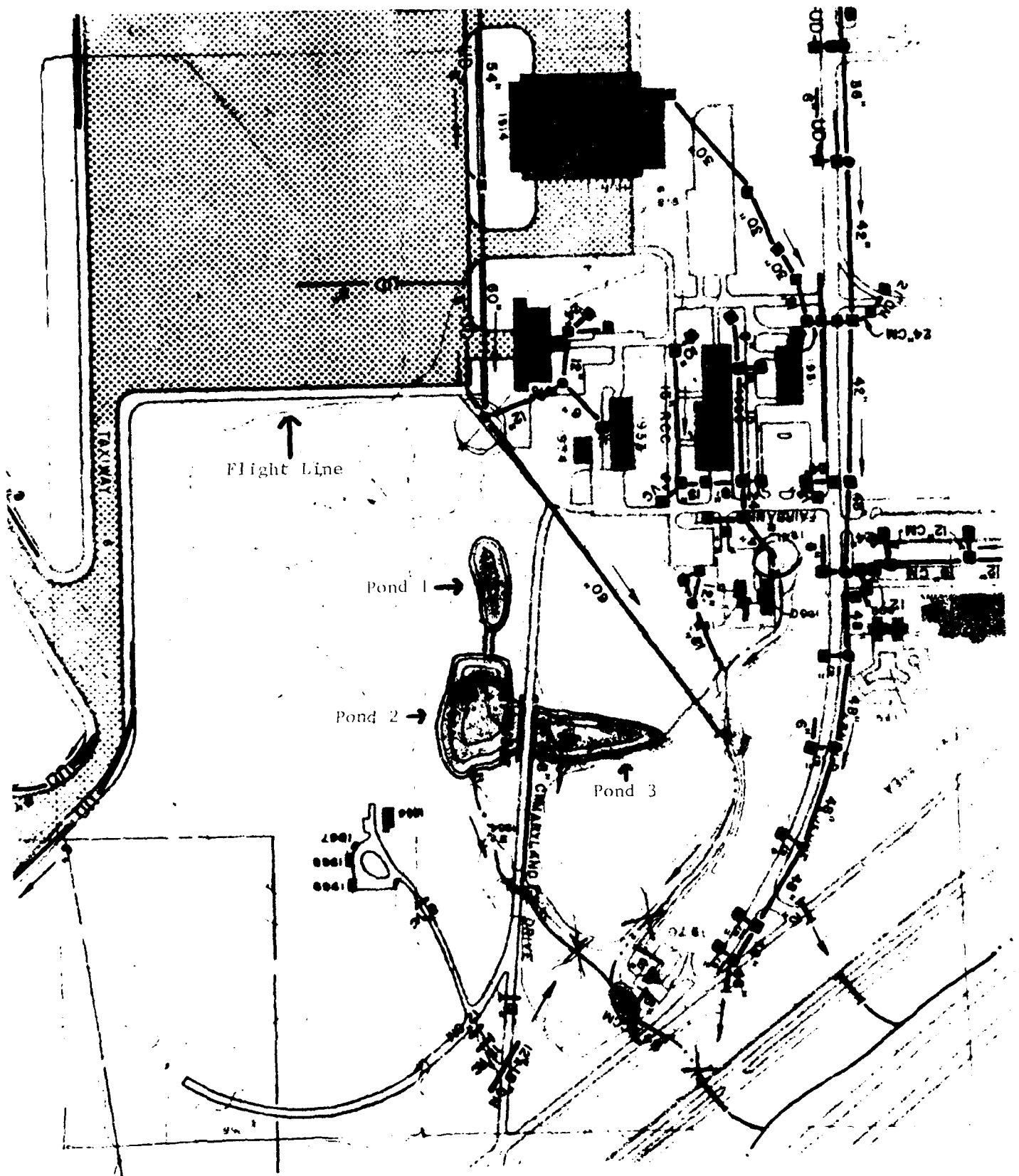


Figure 2. Location of Ponds

**Table 1. Sample Site and Location**

SITE NO.	SAMPLE SITE
1 (A,B,C)	Pond 1 (water) - Pond transected into three equal areas and three grab samples collected.
2 (A,B,C)	Pond 2 (water) - Pond transected into three equal areas and three grab samples collected.
3 (A,B,C)	Pond 3 (water) - Pond transected into three equal areas and three grab samples collected.
4	Stream A (water) - Composite sample collected. Stream A is fed by Pond 2.
5	Stream B (water) - Composite sample collected. Stream B is fed by two culverts.
6	Stream C (water) - Composite sample collected. Streams A and B unite to form Stream C.
7	Pond 1 (sediment) - Grab sample collected from center of Pond 1
8	Pond 2 (sediment) - Grab sample collected from center of Pond 2
9	Pond 3 (sediment) - Grab sample collected from center of Pond 3
10	Soil # 1 - Grab sample from flight line.
11	Soil # 2 - Grab sample from flight line.
12	Soil # 3 - Grab sample from flight line.
13	Soil # 4 - Grab sample from flight line.
14	Soil # 5 - Grab sample downhill from flight line.

**Table 2. Physical Characteristics Of 3 Ponds**

	POND 1	POND 2	POND 3
TEMPERATURE (C)	19-21	21-22	18-21
pH (range)	6.6-6.7	6.8-7.0	6.7-6.9
Dissolved Oxygen (Surface/depth)	5.5/5.4	10.9/10.9	4.7/6.2
Circumference (m)	207	283	Approx. 207
Deepest Point (m)	2	3.3	1.8
Depth of Photic Zone (m)	0.6	0.9	0.9
Estimated Shoreline Plant Cover (%)	75	50	75



**Figure 3. Pond 1**



**Figure 4. Pond 2**



**Figure 5. Pond 3**

The shoreline of Ponds 1, 2, and 3 appeared to have a variety of grasses, plants and trees. We observed a number of snakes, turtles, and frogs in and around the ponds. The general water quality of all ponds appeared to be good to excellent. Ponds 1 and 3 did have some characteristics that set them apart from pond 2; 50-75 % of the surface area of ponds 1 and 3 were covered with lily pads and other aquatic plants. We believe this accounted for the low dissolved oxygen levels observed. None of the ponds had oxygen levels low enough to cause significant problems at this time.

#### C. Aquatic Bioassay Testing

We collected a water (grab) sample from the ponds and from the site where the water leaves the base. A 96 hour aquatic bioassay test using fathead minnows (Pimephales promelas) was used. These samples were not found to be acutely toxic to our organisms.

#### D. Invertebrate Composition and Fish Analysis

1. Replicate benthic samples were collected from streams A, B, and C using a screen wash method. A two-meter area was disturbed one meter upstream from the collection screen. Material that had collected on the screen was preserved in isopropyl alcohol and transported back to AFOEHL for analysis.

2. A total of 50 fish were sampled from the pond. Species composition included 6 Micropterus salmoides (largemouth bass, including one weighing 2 kg), 12 Lepomis macrolophus (red ear sunfish) and 32 Lepomis macrochirus (bluegill).

3. Ninety-four specimens covering eight distinct families of aquatic invertebrates were recovered from stream A. A diversity index as discussed by Wilnm (1972) was 1.77 for this stream.

4. Seven larval Chironomids (Diptera: Chironomidae) were collected from stream B, with the corresponding index of 0.0.

5. Thirty-eight specimens were collected from Stream C with five taxa represented. The index for this stream was calculated at 1.17.

6. Fish were collected from Ponds 1, 2, and 3. All of the fish appeared healthy and free of external parasites. Ten fish were sacrificed and examined for nitrogen stress (brown-blood disease). There were no signs of nitrogen stress in any of the fish.

7. The data suggests that the pond is in good condition and fully capable of sustaining a variety of fish. The streams, on the other hand, pose a different problem. The diversity value of 0.0 for stream B suggests that a high level of contamination is present; or, that a contaminant bolus had recently passed through the stream. The fact that the stream is fed by a culvert running under the flight line suggests a ready source of industrial pollution. The pollutant is somewhat diluted by stream A prior to exiting the base as stream C. This dilution is enough to keep the stream C diversity index at a relatively high value.

#### E. Chemical Analysis

1. Two 24-hour composite water samples were taken from Streams A, B, and C and submitted to AFOEHL/SA for chemical analysis. Grab samples of both water and sediment were taken from each pond and submitted for chemical analysis. The results of these analysis can be found in Table 3.

2. The only analysis to produce abnormal results came from Stream B (Site 5) and Stream C (Site 6).

3. We obtained an ammonia level of 0.95 mg/L from stream B and an ammonia level of 0.53 mg/L from stream C. Stream B, as seen in Figure 1, is fed by a 60 inch culvert that accepts drainage from industrial operation shops located upstream. Stream C receives drainage from both streams A and B. The decrease in ammonia level seen in stream C was probably caused by a dilution effect caused by stream A mixing with stream B.

4. The ammonia level detected in the sediment of ponds 1, 2, and 3 were well within normal limits. Ammonia levels in ponds may vary due to release of ammonia from natural decomposition.

**Table 3. Analytical Results**

**Water Analysis - Pond 1 (Sites 1 A,B,C)**

TEST	RESULTS			UNITS
	A	B	C	
Ammonia	<0.2	<0.2	<0.2	mg/L
Kjeldahl nitrogen (total)	0.5	0.5	0.5	mg/L
Nitrates (as nitrogen)	<0.1	0.12	0.16	mg/L
Nitrites (as nitrogen)	<0.002	<0.02	<0.02	mg/L
Ortho Phosphate	---	<0.1	---	mg/L
Phosphorus (total)	---	0.11	---	mg/L

**Water Analysis - Pond 2 (Sites 2 A,B,C)**

TEST	RESULTS			UNITS
	A	B	C	
Ammonia	<0.2	<0.2	<0.2	mg/L
Kjeldahl nitrogen (total)	0.6	1.4	0.9	mg/L
Nitrates (as nitrogen)	0.18	0.16	0.16	mg/L
Nitrites (as nitrogen)	<0.02	<0.02	<0.02	mg/L
Ortho Phosphate	---	0.1	---	mg/L
Phosphorus (total)	---	0.14	---	mg/L

**Water Analysis - Pond 3 (Sites 3 A,B,C)**

TEST	RESULTS			UNITS
	A	B	C	
Ammonia	<0.2	<0.2	<0.2	mg/L
Kjeldahl nitrogen (total)	2.2	1.0	0.5	mg/L
Nitrates (as nitrogen)	<0.1	<0.1	<0.1	mg/L
Nitrites (as nitrogen)	<0.02	<0.02	<0.02	mg/L
Ortho Phosphate	<0.1	<0.1	<0.1	mg/L
Phosphorus (total)	0.1	0.1	1.0	mg/L

**SEDIMENT ANALYSIS**

TEST	POND 1	POND 2	POND 3	UNITS
	(Site 7)	(Site 8)	(Site 9)	
Ammonia	9.2	8.0	< 0.2	mg/L
Kjeldahl Nitrogen (total)	22.0	21.5	7.5	mg/L
Nitrates (as nitrogen)	< 0.1	< 0.1	< 0.1	mg/L
Nitrites (as nitrogen)	0.04	0.06	0.03	mg/L

### SOILS

TEST	SOIL #1 (Site 10)	SOIL #2 (Site 11)	SOIL #3 (Site 12)	SOIL #4 (Site 13)	SOIL #5 (Site 14)	UNITS
Ammonia	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	µg/g
Kjeldahal Nitrogen	0.75	0.48	0.33	0.23	0.18	mg/g
Nitrates	0.014	0.008	0.004	0.003	0.021	mg/g
Nitrites	0.0006	0.0004	0.0006	0.0004	0.0004	mg/g

Soil samples 1-4 were collected from end of the flight line where the snow and urea were normally piled after a snow storm. Each sample was taken 6 to 12 inches below the ground, 30 meters apart and 5 meters from the end of the flight line. Sample 5 was collected downhill from the flight line at the lowest drain-off level before entering the woods.

### STREAM ANALYSIS

TEST	STREAM A (SITE 4)	STREAM B (SITE 5)	STREAM C (SITE 6)	UNITS
Ammonia	< 0.2	0.95	0.53	mg/L
Kjeldahl Nitrogen	0.4	1.4	0.9	mg/L
Nitrates (as nitrogen)	0.52	2.2	2.4	mg/L
Nitrites (as nitrogen)	< 0.02	< 0.02	< 0.02	mg/L
Arsenic (ICP)	<100	<100	<100	µg/L
Barium (ICP)	<100	<100	<100	µg/L
Beryllium (ICP)	<100	<100	<100	µg/L
Cadmium (ICP)	<100	<100	<100	µg/L
Calcium (ICP)	10.8	12.3	12	mg/L
Chromium (ICP)	<100	<100	<100	µg/L
Copper (ICP)	<100	<100	<100	µg/L
Iron (ICP)	1121	1133	4513	µg/L
Manganese (ICP)	<100	<100	<100	µg/L
Nickel (ICP)	<100	<100	<100	µg/L
Zinc (ICP)	<100	<100	<100	µg/L
Aluminium (ICP)	224	132	554	µg/L
Cobalt (ICP)	<100	<100	<100	µg/L
Titanium (ICP)	<100	<100	<100	µg/L
Vanadium (ICP)	<100	<100	<100	µg/L
Molybdenum (ICP)	<100	<100	<100	µg/L
Mercury (ICP)	< 1	< 1	< 1	µg/L
Magnesium (ICP)	2	2.8	2.9	mg/L
Lead	< 20	< 20	< 20	µg/L
Potassium	1.6	1.9	1.6	mg/L
Silver	< 10	< 10	< 10	µg/L
Chemical Oxygen Demand	10	< 10	< 10	mg/L
Total Organic Carbon	---	5	---	mg/L
Oil & Grease (IR)	< 0.3	< 0.3	0.3	mg/L

STREAM ANALYSIS CONT'D

TEST	STREAM A (Site 4)	STREAM B (Site 5)	STREAM C (Site 6)	UNITS
Total Hydrocarbons	< 1	< 1	< 1	mg/L
Ortho phosphate	< 0.1	< 0.1	< 0.1	mg/L
Cyanide (total)	< 0.005	< 0.005	< 0.005	mg/L
Phenol	< 10	< 10	< 10	µg/L
Residue, Filterable	65	101	74	mg/L
Specific Conductance	82	130	90	µmhos
Surfactants - MBAS	< 0.1	< 0.1	< 0.1	mg/L
Bromodichloromethane	< 0.4	< 0.4	< 0.4	µg/L
Bromoform	< 0.7	< 0.7	< 0.7	µg/L
Carbon Tetrachloride	< 0.5	< 0.5	< 0.5	µg/L
Chlorobenzene	< 0.6	< 0.6	< 0.6	µg/L
Chloroethane	< 0.9	< 0.9	< 0.9	µg/L
Chloroform	< 0.3	< 0.3	< 0.3	µg/L
Chloromethane	< 0.8	< 0.8	< 0.8	µg/L
Chlorodibromomethane	< 0.5	< 0.5	< 0.5	µg/L
1,2-Dichlorobenzene	< 1	< 1	< 1	µg/L
1,3-Dichlorobenzene	< 0.5	< 0.5	< 0.5	µg/L
1,4-Dichlorobenzene	< 0.7	< 0.7	< 0.7	µg/L
Dichlorodifluoromethane	< 0.9	< 0.9	< 0.9	µg/L
1,1-Dichloroethane	< 0.4	< 0.4	< 0.4	µg/L
1,2-Dichloroethane	< 0.3	< 0.3	< 0.4	µg/L
1,1-Dichloroethene	< 0.3	< 0.3	< 0.3	µg/L
trans-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	µg/L
1,2-Dichloropropane	< 0.3	< 0.3	< 0.3	µg/L
Cis-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5	µg/L
Trans-1,3-Dichloropropen	< 0.5	< 0.5	< 0.5	µg/L
Methylene Chloride	< 0.4	< 0.4	< 0.4	µg/L
1,1,2,2-Tetrachloroethan	< 0.5	< 0.5	< 0.5	µg/L
Tetrachloroethylene	< 0.6	< 0.6	< 0.6	µg/L
1,1,1-Trichloroethane	< 0.5	< 0.5	< 0.5	µg/L
1,1,2-Trichloroethane	< 0.5	< 0.5	< 0.5	µg/L
Trichloroethylene	< 0.5	< 0.5	< 0.5	µg/L
Trichlorofluoromethan	< 0.4	< 0.4	< 0.4	µg/L
Vinyl Chloride	< 0.9	< 0.9	< 0.9	µg/L
Bromomethane	< 0.9	< 0.9	< 0.9	µg/L
2-Chloroethylvinyl ether	< 0.9	< 0.9	< 0.9	µg/L

III. CONCLUSION

A. The ecological conditions of pond 2 appeared to be excellent based on these findings and should continue to provide an excellent area to stock with game fish. Ponds 1 and 3 appeared to be in very good condition, but the increase in aquatic plant bloom (mostly lilly pads) has caused a lowering of the ponds dissolved oxygen (both ponds 1 and 3 averaged a dissolved oxygen of 5.5). A dissolved oxygen of 4 or less could cause stress on aquatic life or

could possibly result in future fish kills. The increase in aquatic plant life usually results from an increase in nutrients such as fertilizers or other nitrogen producing compounds. The information available to us did not suggest an increase of fertilizer use in the area. Since these ponds were downstream from the flight line where urea had been used, there exists the possibility that the nitrogen run-off from the breakdown of urea caused the increased aquatic plant life. We cannot absolutely rule out the possibility that the increase in aquatic plants is a naturally occurring process that will eventually rectify itself.

B. Andrews AFB's original request asked AFOEHL to evaluate the ponds to determine why there was little or no life and also determine if the practice of using urea as a deicing method was responsible for the fish kills that occurred in 1972, 1982, and 1985. We determined that the appearance of a lack of life in the pond was due to the time period in which the pond was originally examined. The pond in question was examined during the Feb-Mar 90 time frame; a cold period for this area. With the arrival of spring, pond life returned to normal. We spoke with personnel from Andrew's Environmental Support office concerning the past fish kills, but were only able to obtain bits and pieces of information mainly because there was never a follow-up study to determine the actual cause of these fish kills. However, we were able to obtain detailed information concerning the 1982 fish kill. We obtained this information from the Installation Restoration Program Records Search performed in June 1985 which was conducted by Engineering-Science, an Air Force contractor. This report stated that on 1 May 1982, a substantial fish kill was reported to have occurred in Meetinghouse Branch (on base). The incident was investigated by the Maryland office of Environmental Programs, Waste Management Administration Enforcement Division. The event was traced to Andrews AFB from a point extending three miles downstream. The kill included carp, eels, and snapping turtles. Further study by Andrews AFB personnel indicated that a contractor engaged in the cleaning of the base officer's club pool had been using hydrochloric acid and had discharged to the effected stream(s). It was determined that the discharge of the acid was the only reasonable cause for the event. Andrews AFB personnel are now providing the proper supervision of the contractor so that discharges are properly neutralized and diluted prior to release in order to maintain local stream quality.

C. The speculation by the Andrews Bioenvironmental Engineering Shop that the urea pellets for deicing the flight line had resulted in previous fish kills in the ponds cannot be substantiated at this time. The results of our ecological investigation do not show an increase in any of the chemical constituents that would suggest that the use of urea pellets had caused an increase of ammonia in the ponds. The high level of ammonia found in Stream B suggests three possible conclusions; (1) ammonia is originating upstream from industrial sites; (2) deicing chemicals are persisting in the soil leaching into the stream or (3) the stream is being contaminated from other unknown sources.

D. The recommended criteria establish by the USEPA for ammonia is 0.5 mg/liter for drinking water and 0.02 mg/liter for aquatic life. Table 3 (Stream Analysis) shows that both Streams B and C are in excess of the

recommended criteria for drinking water. The minimum detectable level for our laboratory instrumentation is 0.2 mg/liter which does not enable us to analytically determine if the streams meet the aquatic ammonia criteria of 0.02 mg/liter. However, the biological analyses of the streams show that Stream A is in excellent condition, Stream B is in poor condition and Stream C is in fair condition.

#### IV. RECOMMENDATIONS

A. We recommend that a systematic approach be taken to pinpoint the ammonia contamination. Andrews Bioenvironmental Engineering shop should first conduct a survey of all industrial shop's folders to determine if any of the substances being discharged could result in ammonia liberation. If any shops are identified during this screening process, their effluent should be tested for ammonia content. If the survey of shop folders does not yield results, then we recommend that Andrews Bioenvironmental Engineering shop test each industrial shop's effluent by collecting composite samples.

B. As final recommendations, we suggest the following:

1. Contact AFOEHL Ecology Function as soon as a fish kill occurs so that technical assistance can be provided and samples taken and forwarded to AFOEHL for analysis.

2. In order to determine if there is a problem as a result of using urea for deicing runways, discrete samples from Streams A, B, and C should be taken immediately after the snow melts. This prevents the loss of ammonia compounds. ISCO samplers should be set-up in Streams A and B prior to their merging with Stream C. A third ISCO sampler should be set-up in Stream C. If the urea is indeed contributing to the high ammonia concentrations observed in Streams B and C, we should observe a rapid increase in ammonia levels after the snow melts. Continued periodic monitoring may be required to confirm the source of ammonia contamination.

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Distribution List Cont'd

HQ USAF Academy/SGPB Colorado Springs CO 80840-5470	1
HQ USAF Academy/SGPM Colorado Springs CO 80840-5470	1
HQ AFLC/SGBE Wright-Patterson AFB OH 45433-5001	1
HQ AFLC/SGPB Wright-Patterson AFB OH 45433-5001	1
HQ AFSC/SGPM Andrews AFB DC 20334-5000	1
HQ ATC/SGPB Randolph AFB TX 78150-5001	1
HQ ATC/SGPM Randolph AFB TX 78150-5001	1
HQ MAC/SGPM Scott AFB IL 62225-5001	1
HQ TAC/SGPB Langley AFB VA 23665-5578	1
HQ TAC/SGPM Langley AFB VA 23665-5578	1
HQ SAC/SGPB Offutt AFB NE 68113-5001	1
HQ SAC/SGPM Offutt AFB NE 68113-5001	1
HQ AFSPACECOM/SGB Peterson AFB CO 80914-5001	1
HQ AFSPACECOM/SGPM Peterson AFB CO 80914-5001	1
HQ PACAF/SGPB Hickam AFB HI 96853-5001	1
HQ PACAF/SGPM Hickam AFB HI 96853-5001	1
HQ USAFE/SGPB APO New York 09094-5001	1
HQ AFRES/SGB Robins AFB GA 31098-6001	1

Distribution List Cont'd

HQ ANGSC/SGB Mail Stop 18 Andrews AFB DC 20331-6008	1
HQ AFCOMS/SGPM Kelly AFB TX 78241-6290	1
HQ 4AF/SGPB McClellan AFB CA 95652-5300	1