

A Water Quality Report-An Examination of Illegally
Connected Sanitary Sewers That Empty into Doan Brook

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A WATER QUALITY REPORT—AN EXAMINATION OF ILLEGALLY CONNECTED SANITARY SEWERS THAT EMPTY INTO DOAN BROOK

INTRODUCTION

Doan Brook carries storm water runoff and sanitary relief (overflow from storm sewers) from part of Cleveland Heights, Shaker Heights, and Beachwood, Ohio.

This report deals with the quality of the water flowing into the Doan Brook at the sewer outflows in Cleveland Heights and Shaker Heights.

Preliminary tests were conducted between January and April 1970. More frequent tests were made in April and May of 1970.

A log of observations was kept and samples taken at specific sewer outflows. These were tested for fluoride, surfactants, and, (with less frequency) for chloride, and total and ortho phosphates. Each of these ions is a component of sanitary sewage. The significance of each of these ions will be discussed later on the section entitled "Chemical Tests".

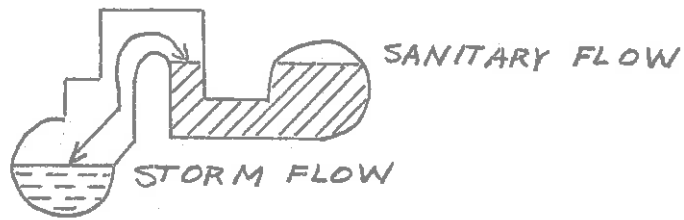
I hypothesized that extremely high concentrations of these ions would prove that sanitary sewage flows into Doan Brook. This is contrary to the belief that all sanitary sewage flows to a sewage treatment plant as the state and federal laws require.

Sanitary sewage or sanitary relief, as mentioned above normally overflows into the brook during storms when water exceeds the capacity of storm sewers. A diagram of the two kinds of sewers in the watershed will show how each overflows.



WHEN EITHER FLOW EXCEEDS
THE DESIGN, THE TWO MIX

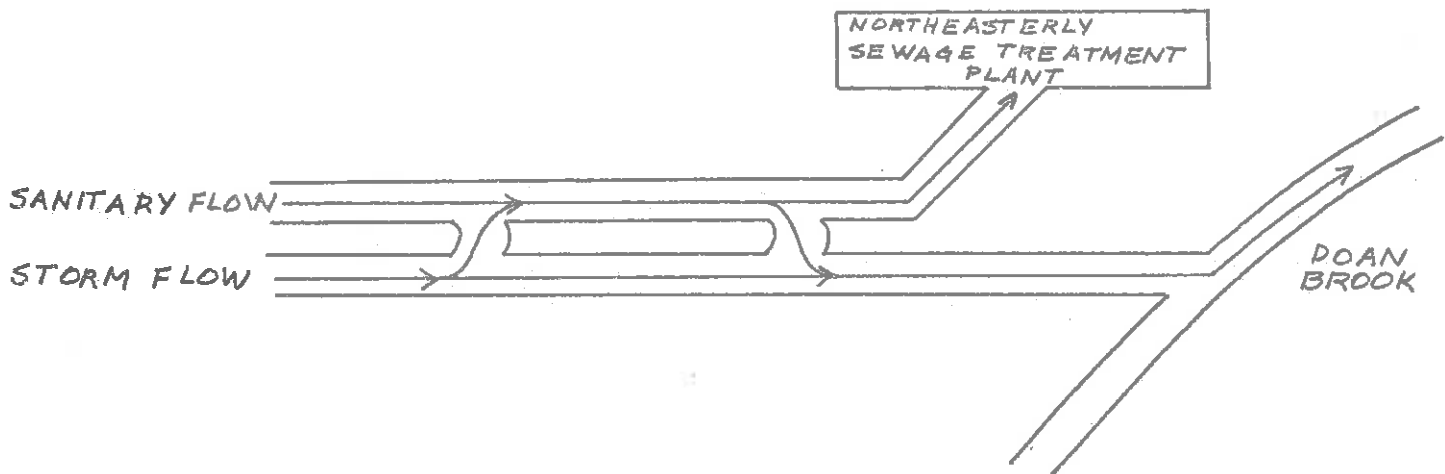
SEPERATE SEWERS AT AN OVERFLOW



HIGH PRESSURE DUE TO A LARGE FLOW OF EITHER SANITARY OR STORM WILL CAUSE MIXING.

The sewage in very large flows will proceed to the nearest point of low pressure where it can flow freely. Since the sanitary sewage must travel to the Northerly Filtration Plant, high pressure builds up within the sanitary sewer pipes. During large flows flood gates are opened and these volumes of sewage that exceed the capacity of the treatment facilities flow directly into Lake Erie.

In spite of this relief of pressure within the sanitary sewer pipes, some sewage continues to overflow into Doan Brook.



This situation is not ideal, but, sanitary sewage is diluted and it cannot approach the damage done by concentrated sanitary sewage. These effects are recorded in the Log of April 12, 1970, at Fairhill and Coventry and in photos of June 2, at Torrington South Branch.

I observed approximately 75 sewers over 6" diameter that empty into Doan

Brook. Of these, I selected seven for continued observation and testing. I selected these because they had elevated fluoride levels (approaching 1.00 parts per million) and because they showed physical signs of sanitary sewage such as suds, toilet paper, strong odor, continuous flow in dry weather, and had large colonies (fecal coliform) growing among the toilet paper granules.

The area of the Doan Brook Watershed that was surveyed is the area above a point on the brook .25 kilometers (approximately 700 ft.) west of Lower Shaker Lake, up the channel to the three sources near Warrensville Center Road. See The Doan Brook Journal, maps 1 and 2. The area surveyed is shown in a map from Hävers & Emerson Report (1) also called the Cleveland Report and in a section of the U.S. Geological Survey Shaker Heights Quadrangel map (2).

I have kept a Doan Brook Journal 1970 of all observations and tests. The Journal is the integral part of my report, however for convenience in publishing I have used The Abbreviated Journal, which includes the data essential for my conclusions. The complete Doan Brook Journal 1970 is now in possession of the University School Science Department.

METHODOLOGY

Chemical Tests

I used a Delta Scientific Model 260 Chemical Analysis System for tests for fluorides, surfactants, chlorides, and phosphates. Methods used were those listed in the Delta 260 No. 1512 procedure manual and included in appendix B of the Doan Brook Journal. Modifications of the Delta 260 procedures are included in this section.

A summary and explanation of Delta 260 procedures follows. Chemical testing procedures have been developed which cause a specific color reaction to take place when a water sample is treated with specific reagents. In the fluoride test, fluoride ions react with zirconium ions to create a zirconium lake precipitate which turns the solution deep red. With the Delta 260 Analyzer, a calibrated light and photocell, one can detect minute color changes. Solutions of known concentrations undergo a specific reaction. The color change as indicated by the meter

reading on the Analyzer will always occur when a sample tested has the same concentration as the solution of known concentration. An array of solutions of known concentrations was treated according to testing procedures and a meter reading for each concentration was recorded. These meter readings were collected in a graph called a calibration chart. On one axis the known concentrations are indicated. On the other axis is the meter reading. Tests on samples of unknown concentrations will produce color changes indicated by meter readings. Using the calibration chart one can interpolate from the meter reading what concentration will cause that meter reading. Since all tests are empirical and performed in exactly the same manner every time the tests are done, one finds very few errors.

FLUORIDES, Delta Test No. 260-13

Modifications: Spands Reagent was mixed as prescribed in Standard Methods for the Examination of Water and Wastewater (pages 144-6, American Public Health Association, inc. 1965). A new calibration curve was made.

Purpose: We tested for fluoride because tap water is fluoridated to a concentration between 1.1 and 1.2 parts per million. This concentration was determined from tests on tap water. Sanitary sewage has a high percentage of tap water. Natural runoff has a fluoride concentration between 0.00 ppm and 0.10 ppm.

SURFACTANTS, Delta Test No. 260-29

Modifications: Methylene Blue reagent was mixed as prescribed in Standard Methods. A new calibration chart was made.

Purpose: Surfactants are the Linear Alkylate Sulfonate (L.A.S.) or ABS Alkyl Benzene Sulfonate that are present in detergents. These ions create the piles of suds found in many areas of the brook. Natural drainage and tap water have less than 0.1 ppm ABS (This also was determined by testing.)

CHLORIDE, Delta Test No. 410-24

Modifications: None.

Purpose: We tested for chloride during the winter to determine interference on the

fluoride test from possible fluoride concentrations in the salt (the source of high chloride concentrations) put on the street to melt the snow.

PHOSPHATES, Delta Test No. 260-18/19

Modifications: None.

Purpose: Phosphates are the major cause of algal blooms in the Shaker Lakes as in Lake Erie. In the Doan Brook-Shaker Lakes System, like Lake Erie, the principal source of phosphates is untreated sanitary sewage. Average runoff from unfertilized land and storm drainage has had a concentration near .2 or .3 ppm total phosphates.

LOCATIONS OF TEST SITES

In January 1970, the Doan Brook Journal was started to record locations of sewer outflows and record observations of these outflows. Sewers were given test site identification numbers. With the aid of Councilman David Blaushield, the Doan Brook Committee received a 1962 Sewer Map of Shaker Heights. We were able to locate on the map the sewers that we had recorded. The map gave us a more precise location for each sewer. We also examined aerial photographs that belonged to the City Planner and Engineer of Cleveland Heights, Mr. Murphy.

We divided the Brook into four sections for sampling purposes. (See Map No. 2)

1. THE SOUTH STRETCH—from Van Aken Warrensville source to Lower Shaker Lake. Sewers No. 1 through No. 22.
2. THE NORTH BRANCH A—above Horseshoe Lake (Upper) from the source at Warrensville and Shelbourne to Horseshoe Lake. Sewers No. 101 through No. 123.
3. THE NORTH BRANCH B—above Horseshoe Lake (Upper) from the source 600 feet west of Warrensville between Shaker Blvd. and South Park. No. 51 through No. 62.
4. THE UPPER AND THE LOWER SHAKER LAKES—and the Brook between them. Sewers including those at NORTH PARK—SOUTH PARK, and FAIRHILL.

CONCLUSIONS

Based on the data summarized in THE ABBREVIATED JOURNAL, "An Evaluation of the Quality of Water at Six Sewer Outflows on Doan Brook,"

FAIRHILL—36" outflow at Coventry between Fairhill and North Park. On April 12, 1970, this outflow and 150 yards downstream was grossly polluted with sanitary waste. The DOAN BROOK JOURNAL 1970, April 12 describes the scene. An overflow, a bad connection, or a breakdown may have caused this leakage of sanitary sewage.

The DOAN BROOK COMMITTEE 1970, who witnessed and recorded this violation of pollution and health laws met with Mr. Murphy, City Engineer and Planner of Cleveland Heights. Mr. Murphy told us in a meeting with him on April 23, that he would remedy the situation as soon as possible. Since that time, the quality of water at the Fairhill outflow has improved greatly.

At the present time fluoride concentrations seem to indicate that diluted sanitary sewage regularly flows out of it.

EATON AND SOUTH PARK—sewer No. 59, 3' x 4' oval middle sewer. I have seen this sewer empty sanitary sewage, suds, and toilet paper into Doan Brook between storm overflow periods. On two occasions, May 9 and May 27, I saw suds floats cover the surface of the brook. These instances illustrate the contribution that this outflow makes to the suds problem below Horseshoe Lake. Constant presence of toilet paper will serve as a reminder of the health hazard that is created when people use this water later for recreation at the Shaker Lakes. High fluoride concentrations (.95 ppm) reflect the high concentrations of fluoride found in tap water and sanitary sewage. The consistently high total phosphate concentrations indicate that this outflow also contributes to overfertilization and algal blooms in the brook and in the lakes.

NORTH PARK & SOUTH PARK—60" cement pipe facing WSW at the hill below the intersection of North Park and South Park.

This sewer has fluoride concentrations averaging 1.00 ppm. It has been observed running constantly, like the other five sewers discussed in this conclusion, even during dry weather. Again toilet tissue and suds indicate that sanitary sewage empties into the brook from this outflow. The toilet paper coliform colonies will occur only in sanitary waste, therefore, by some means, sanitary sewage has mixed with storm sewage.

Because mixed sewage flows out of a storm pipe, I am of the opinion that the sewer may have a break in it, or that too many people use the sanitary sewers nearby and force some sewage out the overflow. I cannot be positive about how the sewage got there, but it is emptying into Doan Brook.

SOUTH PARK—SHAKER—No. 22, 18" metal pipe that is the source of a tributary of Doan Brook.

Frequent piles of suds and moderately elevated fluoride levels again show a mixture of sanitary and storm sewage during dry weather.

BIG TWIN—No. 20, 42" concrete sewer, south of No. 21.

Lower fluoride levels and the presence of suds without toilet paper at an overflow that runs slowly in dry weather suggests that this sewer, if combined at this point, is emptying sanitary sewage in less quantity and in a more diluted form into the brook.

MORE SUSPICIOUS SEWERS

Some other sewers are suspicious, but I have not sufficiently tested them to prove that they empty sanitary sewage into the brook.

No. 55, THE PARK DRIVE—has had coliform colonies, but the only fluoride test of it was .63 ppm on May 18.

No. 108, on the south wall of the culvert under the driveway, 18750 North Park had a fluoride average of .89 ppm in two tests.

No. 105, 18" concrete under North side of Eaton N.B.A. has fluoride average of 1.05 ppm and coliform as well as toilet paper.

- No. 117, 3' brick at East end of Courtland North Branch A at 6" off the floor had toilet paper in it and a fluoride average of 1.08 ppm.
- No. 119, 18" ceramic in the middle of the South wall of Sherbrooke culvert had slippery grey interior and .96 ppm fluoride average.
- No. 120, 18" ceramic in the middle of Chesterton culvert had a 1.11 fluoride average.
- No. 1, the origin of the South Branch at Van Aken, had fluoride of .65 ppm on 2/18/70, and a Surf of .96 ppm, and periodic toilet paper granule collection at overflow of 6' x 10' culvert.
- No. 16, 60" sewer on the South side of Lee Road. Culvert had fluoride of 1.89 ppm on 2/27/70.
- No. 17, 12" tile near Ashford had suds and fluoride of 1.33 ppm.

SUGGESTIONS

Since every one of the six outflows thoroughly tested (and possibly some of the others mentioned) empty some sanitary sewage into Doan Brook, I suggest that all of these outflows be checked for damage and leaks. In the case of Fairhill, North Park and South Park, Eaton and South Park, and Big Twin, I hope that they will be checked soon because they contribute significantly to the pollution of our public recreation land. Little Twin, and South Park and Shaker Blvd. and the others listed should not be neglected because they do not pollute as much. Citizens cannot neglect this problem that affects their health and welfare as well as their pursuit of happiness.

APPENDIX

Map No. 1 – map from the Havens and Emerson report

Map No. 2 – a section of the U.S. Geologic survey map of the Shaker Heights
Quadrangle (sample sites located)

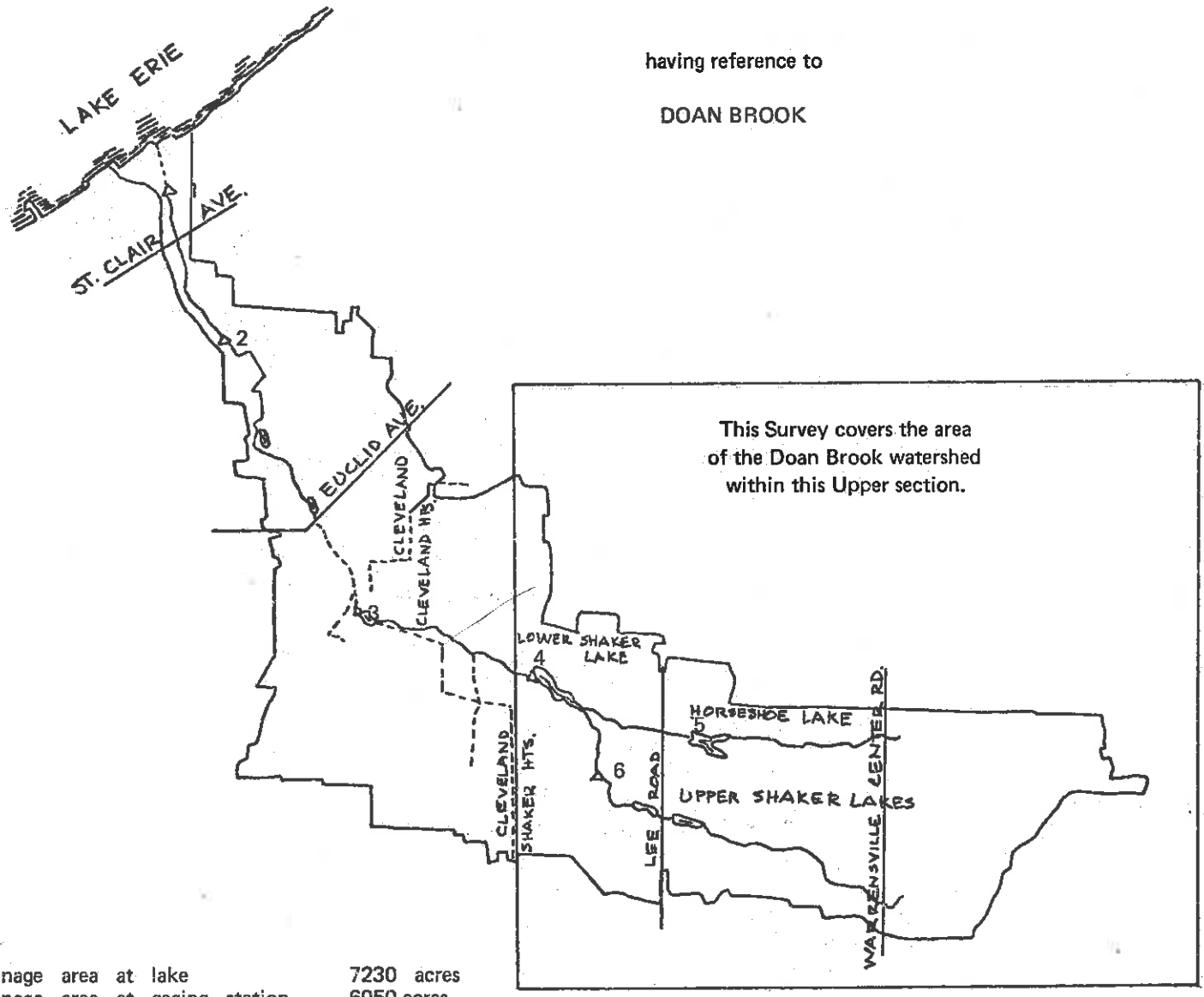
THE ABBREVIATED JOURNAL

LOG of April 12 and April 23, 1970



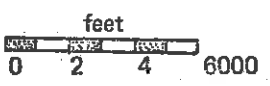
MAP NO. 1
 Excerpts from the HAVENS AND EMERSON REPORT
 (also called The Cleveland Report)

having reference to
 DOAN BROOK



Drainage area at lake	7230 acres
Drainage area at gaging station	6950 acres
Length of open channel	8.1 miles
Length of enclosed channel	1.3 miles
Average slope	60 ft./mile
Open space	1820 acres

Sampling Station



THE ABBREVIATED JOURNAL—summarizes the observations and chemical tests for each of the six sites that were selected as the sites most suspected of emptying sanitary sewage into Doan Brook.

A Key to the meaning of symbols in the Abbreviated Journal

In the Column	Means		
TOILET PAPER	x	"	floating shreds of toilet paper
	xx	"	toilet paper granules in sediment
	xxx	"	whole intact pieces of toilet paper
SUDS	x	"	small bubbles and scum or short lasting suds
	xx	"	small islands of suds or a pile less than 4" high
	xxx	"	suds completely covering a section of the brook or a large pile of suds over 4" tall
COLONY GROWTHS	x	"	patchy and thin colonies
	xx	"	colonies that are not 1/2" thick yet and do not cover a large area
	xxx	"	thick and large growths that may cover large areas inside of pipes or in sediment

THE ABBREVIATED JOURNAL

Location: Fairhill and Coventry (west of Coventry between NorthPark and Fairhill)

DATE	SURFAC-TANTS	FLUOR-IDES	TOTAL PO ₄	ORTHO PO ₄	TOILET PAPER	SUDS	DESCRIPTIONS & SEDIMENTS	COLONY GROWTHS
May 18			7.2		XX	islands XX	grey water, odor notice- able at street level	XX in a few places
19			.05	.25	X		cleaner water but still grey	X
20			.35			XX	grey, smelly, slow	X almost gone
21		.86	0		X	XX in some places	less grey, not extremely smelly	none
22		.83	0.05	1.15	XX		cloudy water, no suds	X scattered
24		.90	5.5		X		grey, toilet paper gran- ules among some of the sediment	X scattered
25		.74	13.0	1.1	X		high water level, grey	X scattered
26		.98	2.08		XXX		high flow, few floating leaves	
27					XX		clean water, but thick grey sediment	X
28							clear water, smelly, green sediment on grey	X
29							lighter grey	X few
31	.01	.69	.90		XXX		more green, one intact piece of toilet paper 4-6 sections	
April 12	.43	.96					See April 12, 1970 in the DOAN BROOK JOURNAL	XXXX
AVERAGE		<u>.85</u>						

THE ABBREVIATED JOURNAL
Location: North Park-South Park (SPNP)

DATE	SURFAC- TANTS	FLUOR- IDES	TOTAL PO ₄	ORTHO PO ₄	TOILET PAPER	SUDS	DESCRIPTIONS & SEDIMENTS	COLONY GROWTHS
March 1		1.00			X		chlorine odor	
May 11	0.04				X		dark grey inside pipe	
18			1.12				thin grey	
19			6.1	5.4				
20	0.02	1.20						
21		.98	.50		XX	X scum		XX in pipe
22		.98	.30	.35		scum		X
24		.94	.43		X			XX in pipe brown & grey
25		1.12	6.5	.2		scum	slippery green algae in pipe and on lip	X
26		.98	2.0			XX scum	same	
27					X	X scum	grey turbid water	
28					X	X	thin sediment	
29						X scum	the grey is thicker	
31	.10	.76	1.62		X in scum in side pipe	X thin scum on pool	thin grey green growth	
AVERAGE	.05	<u>1.00</u>	2.1					

THE ABBREVIATED JOURNAL
Location: No. 22 South Park—Shaker

DATE	SURFAC- TANTS	FLUOR- IDES	TOTAL PO ₄	ORTHO PO ₄	TOILET PAPER	SUDS	DESCRIPTIONS & SEDIMENTS	COLONY GROWTHS
March 1		.56				XX oil slick & scum	spongy brown bottom	
May 11	.00							
19			.28	1.9		X piled scum		
20			.00			XX 3" pile of suds	pool sample, slow flow	
21		.82	.00			X thin scum		
22		.86	.28	1.9		X	turbid pool	
24		.75	3.44			X		
25		.97	6.25	.52		6"x12' & more than 4" tall	rust	
26		.94	.5-			XXX	new pool sediment (rust)	
27						X	not turbid	
29						XX		
31	0.00	.56	.84			X very thin scum		
AVERAGE		<u>.78</u>						

THE ABBREVIATED JOURNAL
Location: No. 59 Eaton—South Park

DATE	SURFAC- TANTS	FLUOR- IDES	TOTAL PO ₄	ORTHO PO ₄	TOILET PAPER	SUDS	DESCRIPTIONS & SEDIMENTS	COLONY GROWTHS
May 4					XX	X	thick grey sediment	XX
9			more than 7.5		X	XXX	suds all along shore constantly being made, smells like Mr. Clean	
18			more than 7.5		XX		grey sediment	XX grey
19			6.1	5.4	XXX		increased sediment inside the pipe	
20			9.5		XXX		thick grey growth	XXX
21		.98	9.5		much XXX	X	same with piled up shreds of toilet paper	XX
22		1.04	3.6	3.0		X		X fewer
24		.99	1.5		XX	XX	toilet paper granules piled among sediment, cloudy water	
25		.82	6.15	0	XX	XX	same	X less
26		1.06	3.0		X	X	cloudy water, shreds in it	small
27					X	XXX	little scum	X increasing
28						X	scummy, cloudy grey, with a little algae with grey sediment	XX
29							grey green water sample	XXX thick grey
31	.19	.78	8.3		much XX		grey thick sediment	XXX
AVERAGE		<u>.95</u>						

THE ABBREVIATED JOURNAL

Location: No. 21 Big Twin

DATE	SURFAC- TANTS	FLUOR- IDES	TOTAL PO ₄	ORTHO PO ₄	TOILET PAPER	SUDS	DESCRIPTIONS & SEDIMENTS	COLONY GROWTHS
May 11	.02					X	dark green in center of flow	X
19			.50	.90			fresh dark green sediment, thick grey	X
20			.20		XX		thick grey	
21		.84	.20				dark grey and green	
22		.92	.50	1.40	XX		thin grey layer on dark green	
24		.60	.80					X
25		.74	10.9	1.9	XX		grey & white patches	XXX
26		.64	.65		XXX		new layer of grey	
27							more green has covered the grey	
29							thick, green, smelly	
31	.01	.80	1.25				green with odor more noticeable from distance	
AVERAGE	.015	<u>.76</u>	.61	excluding May 25 1.9 including May 25				

THE DOAN BROOK JOURNAL

April 12, 1970

Survey below Lower Shaker Lake:

We (Penny Allen, Hunt Augustus, Rick Sahley, and Charles Steffel) followed the southern and only visible outflow of Lower Lake to a point at which another stream joined it from the north. From this junction we followed the new-found stream to a 36" outflow near Coventry between North Park and Fairhill. We found toilet paper and one piece of scat in the water. The whole length of this stream was covered with a grey bacterial growth on piles of toilet paper granules. Noted also small clean flow of water leaking around the cement base of the origin of this stream. We took a sample immediately. We decided to meet Mr. Murphy of Cleveland Heights. We also wanted to discuss this matter with Dr. Skoch and Mrs. Knox. Rick Sahley has movies of this and Hunt took photographs.

MEETING WITH MR. MURPHY

He explained that this was not an outflow of Lower Lake as we might have suspected from the markings on the 1962 S.H. Sewer Map. The outflow that was marked on that Map had silted in and did little except to seep through the dam under Coventry. I remembered from one visit to Mr. Murphy that this was the sewer that emptied the storm sewage from Cleveland Heights in the area south of Cedar and between Stratford Road and a few blocks west of Coventry. He affirmed my guess as to which specific sewer we had found.

Mr. Murphy did explain that there could be three causes for this leakage of sanitary sewage into Doan Brook:

- 1) a broken sewer or a blocked sewer
- 2) or overflow from storm sewer
- 3) combined sewers built 30 to 60 years ago

He admitted that this sewer, under his responsibility, was broken and leaked waste material that was unsafe and unpleasant as well as illegal, into the brook.

He added, however, that his job as engineer and planner did not leave him enough time to examine all sewer outflows and that he would be glad to accept observations and data. He stated that Cleveland Heights, unlike Shaker Heights, has always had a separate sewer system. He assured us that this sewer was broken and it would be fixed as soon as possible.

NOTE: By the end of May 1970, Mr. Murphy's promise had been fulfilled.

We found for the most part clearer water, less odor and even a few earthworms living in the bottom of the stream.

SAMPLE TEST RESULTS: Fluoride .96, Surfactants .43