TABLE I

Hammermill Tests on Mill Effluents
9-26-66

	South Clarifier Entering	South Clarifier Leaving	Pulp Mill Effluent	No. 4 Wood Room Effluent	Spent Liquor To Well
pH	4.55	4.6	2.8	7.1	4.6
Alkalinity (mg/l)	1	2		84	370
Acidity (mg/l)			440		
Color (as sampled)	lt green	lt green	2000	530	9000
Color at 7.5 pH			9800	530	39000
Turbidity ppm	230	200	190	480	none
Settleable Solids (ml/l)	33	29	26	10	none
5-Day BOD (mg/l)	400	390	650	140	21200
COD (mg/l)		660	2420	580	92600
Susp Solids (mg/l)	429	351	303	964	none
Vol Susp Solids (mg/l)	267	241	290	556	none
Dis Solids (mg/l)	720	732	2550	344	66900
Vol Dis Solids (mg/l)	316	398	1260	164	44700
Flow Rate during sampling period (mgd)	4.29	2.59	17.17	0.4	0.694

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TABLE 2

Hammermill Tests on Samples From Lake
9-26-66

Station No.		Coordinates	Sample Depth Ft.	Temp °C	pH	Alk ppm	D.O. ppm	S.S.L. cc/l	Five Day BOD mg/l	Turb ppm	Color	Dis Solids ppm
1	A	80°03'-42°12'	5	17	8.4	96	8.7	0.01		3	6	
	B		4	18	8.4	96	9.0	0.00	0.8	3	6	190
2	A	4.34 - 9.23	3.5	15	7.9	93	8.2	0.05	2.2	10	25	200
	B		5	17	8.4	95	9.4	0.01	1.3	5	10	
3	A	3.8 - 8.8	4	15	7.6	91	7.6	0.15	4.5	10	50	
	B		5	17	7.1	84	8.3	0.70	26	10	110	275
4	A	3.35 - 8.95	4	16	7.0	79	8.6	0.72	25	8	120	
	B		5	17	7.0	81	8.8	0.90	29	15	150	280
5	A	3.25 - 9.02	5	16	8.1	94	8.9	0.05	2.5	4	25	
	B		5	17	7.55	90	8.5	0.29	8.6	7	80	235
6	A	3.10 - 9.10	5	16	7.2	83	8.8	0.56	18	7	140	275
	B		5	17	7.6	89	8.4	0.25	7.8	4	75	
7	A	2.95 - 9.15	4.5	17	7.6	90	8.4	0.20	6.7	7	60	
	B		5	17	7.9	92	8.7	0.13	4.5	4	50	215
8	A	2.50 - 9.30	4	16	7.1	81	8.1	0.78	24	10	170	300
	B		5	17	7.9	93	8.7	0.07	2.4	3	35	
9	A	1.7 - 9.7	5	16	8.2	94	9.0	0.01	0.8	3	15	200
	B		5	17	8.2	94	9.1	0.03	1.5	6	20	
10	A	3.80 - 9.10	5	16	8.3	95	9.1	0.01	1.1	5	15	205
	B		5	16	7.85	91	8.7	0.10	2.9	5	40	

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AR101950

Comparison of Tests Reported by Departm
made by Hammermill on Separ

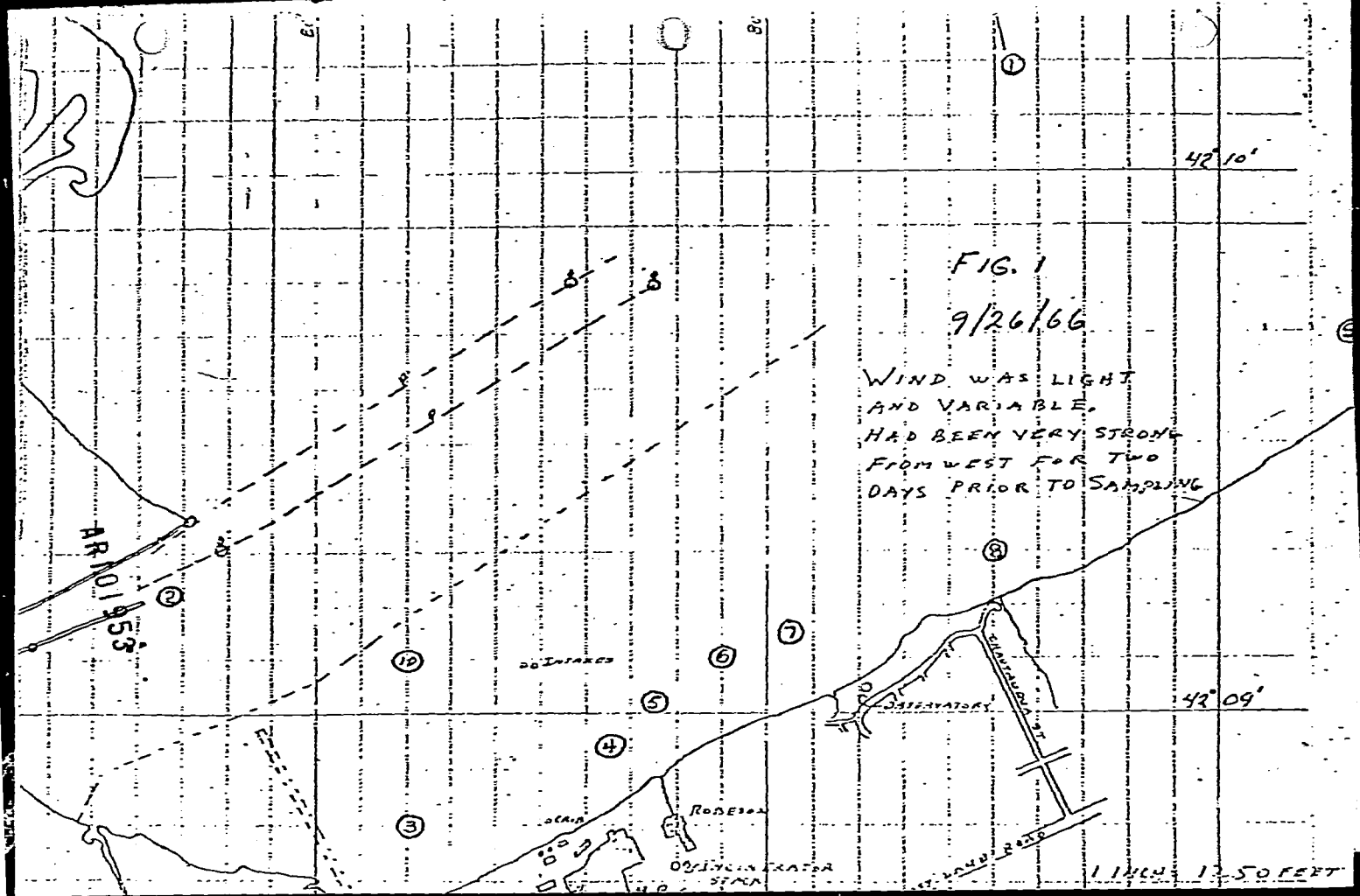
		pH		Dis. Oxygen			Color		Turbidi	
				State		H.P.				
		State	H.P.	Wink.	Probe	Probe	State	H.P.	State	H
1	A	6.9	8.4	8	8.5	8.7	0	6	5	3
	B		8.4	10	9.7	9.0		6		3
2	A	6.9	7.9	9	8.3	8.2	10	25	5	1
	B		8.4	9	9.3	9.4		10		5
3	A	6.4	7.6	7	7.6	7.6	140	50	5	1
	B		7.1	6	8.0	8.3		110		1
4	A	6.4	7.0	8	7.8	8.6	180	120	10	8
	B		7.0	7	9.5	8.8		150		1
5	A	6.7	8.1	8	8.5	8.9	30	25	5	4
	B		7.55	9	9.0	8.5		80		7
6	A	6.5	7.2	8	8.5	8.8	45	140	5	7
	B		7.6	9	9.0	8.4		75		4
7	A	6.7	7.6	4	8.1	8.4	110	60	10	7
	B		7.9	8	8.7	8.7		50		4
8	A	6.2	7.1	3	7.0	8.1	140	170	10	1
	B		7.9	8	8.8	8.7		35		3
9	A	6.8	8.2	9	9.1	9.0	10	15	5	3
	B		8.2	10	9.7	9.1		20		6
10	A	6.8	8.3	9	9.3	9.1	10	15	5	5
	B		7.85	9	9.0	8.7		40		5

AR101951

Comparison of Tests Reported by Department of Health with Tests made by Hammermill on Separate Samples

		pH		Dis. Oxygen			Color		Turbidity		Alkalinity		BOD		Sus. Solids		Dis. Solids	
				State		H.P.												
		State	H.P.	Wink.	Probe	Probe	State	H.P.	State	H.P.	State	H.P.	State	H.P.	State	H.P.	State	H.P.
1	A	6.9	8.4	8	8.5	8.7	0	6	5	3	96	96	0.5	0.8	20	--	(210)	190
	B		8.4	10	9.7	9.0		6		3		96						
2	A	6.9	7.9	9	8.3	8.2	10	25	5	10	94	93	1.6	2.2	30	--	(230)	200
	B		8.4	9	9.3	9.4		10		5		95		1.3				
3	A	6.4	7.6	7	7.6	7.6	140	90	5	10	82	91	20	4.5	40	--	(310)	275
	B		7.1	6	8.0	8.3		110		10		84		25				
	A	6.4	7.0	8	7.8	8.6	180	120	10	8	76	79	32	25	70	--	(350)	280
	B		7.0	7	9.5	8.8		150		15		81		29				
	A	6.7	8.1	8	8.5	8.2	30	25	5	4	92	94	10	2.5	60	--	(180)	235
	B		7.55	9	9.0	8.5		80		7		90		8.6				
6	A	6.5	7.2	8	8.5	8.8	45	140	5	7	92	83	8.0	18	90	--	(180)	275
	B		7.6	9	9.0	8.4		75		4		89		7.8				
7	A	6.7	7.6	4	8.1	8.4	110	60	10	7	84	90	19	6.7	110	--	(260)	215
	B		7.9	8	8.7	8.7		50		4		92		4.5				
8	A	6.2	7.1	3	7.0	8.1	140	170	10	10	84	81	21	24	100	--	(250)	300
	B		7.9	8	8.8	8.7		35		3		93		2.4				
9	A	6.8	8.2	9	9.1	9.0	10	15	5	3	94	94	2.0	0.8	90	--	(150)	200
	B		8.2	10	9.7	9.1		20		6		94		1.5				
10	A	6.8	8.3	9	9.3	9.1	10	15	5	5	94	95	2.8	1.1	120	--	(100)	205
	B		7.85	9	9.0	8.7		40		5		91		2.9				

AR101952


42° 10'
42° 09'
FIG. 1
9/26/66
WIND WAS LIGHT
AND VARIABLE.
HAD BEEN VERY STRONG
FROM WEST FOR TWO
DAYS PRIOR TO SAMPLING
INTAKES
OBSERVATORY
ROBESON
INCINERATOR
STACK
1 INCH = 1250 FEET

AR101953

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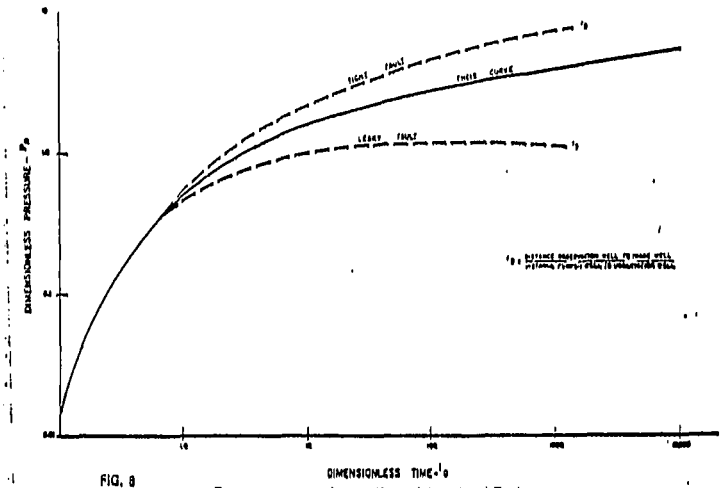

FIG. 8

Pd versus to curve for Aquifer and Associated Fault

The existence of pervious or leaking confining strata, or the presence of barrier conditions as faults, or facies changes in the aquifer may necessitate the abandonment of a disposal project. Such situations can be detected by pump tests and by plotting the data against a type Theis curve. Figure 8 illustrates a situation where pump tests can identify either a tight or leaky fault.

If the plot of Figure 8 tends to flatten out from the plot of the type curve, a leaking condition probably exists. A tight fault, on the other hand, will cause the curve to straighten or steepen from the type plot.

From: Ontario Energy and Resources Management Paper # 68-2, December 1968
"Subsurface Disposal of Liquid Wastes in Ontario" By D.D. McClean, pages 27-29

Vol. 38, No. 12 DEEP WELL DISPOSAL, ERIE, PA 1923

HAMMERMILL NO. 1 INJECTION PRESSURE VS. GALLONS INJECTED

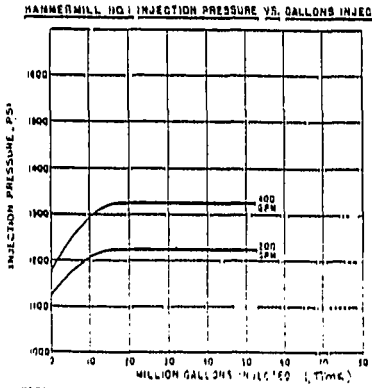

FIGURE 5.—Injection pressure vs. flow rate for Well No. 1. (Psi × 0.07 = kg/sq cm; mgd × 3,785 = cu m; gpm × 3.8 = l/min.)

From: Journal of Water Pollution Control Federation Vol. 38 No. 12, December 1966
"Deep Well Disposal of Giant Hardwood Pulping Liquors", Page 1923
By R. W. Brown and C. W. Spalding (Hammermill Paper Co., Erie, Pa.)

NOTE:
IN THE HAMMERMILL WASTE DISPOS. PROJECT AT ERIE, PA., THE INJECTION PRESSURE CURVE FLATTENED OUT WITH TIME INDICATING LEAKAGE!!
JT. WALKER

AR101954

HAMMERMILL SURVEY
September 26, 1966

Analytical Results of Hammermill Discharges

	Wood room Effluent	Paper mill Raw	Paper mill Treated	Pulp mill combined effluent minus spent liquor to deep wells	Spent liquor to deep wells	City Sewage Treatment
Flow – MGD	0.4	4.35	2.65	17.12	0.69	33
Appearance	Dk. gray	Yellowish green	Green	Dark brown	Red-brown	Slightly [illegible]
Color	280	70	65	1600	11,000	20
Turbidity	350	320	280	220	5,000	30
pH	5.9	4.5	4.5	3.0	4.3	6.2
Alkalinity	72	6	6	—	250	150
Acidity, pH 4	—	—	—	164	—	—
Acidity, Hot, pH 8	0	43	56	500	—	—
Sulfates	165	145	133	330	0	56
B.O.D.	127	320	325	384	14,350	9.0
C.O.D.	—	—	—	—	76,610	—
Total Solids	1300	1320	1460	3440	67,160	460
Total Suspended Solids	880	460	460	520	2,420	90
Settleable Solids	9.0	32.0	34.0	26.0	.2	—
Lignin	0	0	0	0	4,850	0
Bacteriological						
Coliforms MPN/100ml	240,000+ / 240,000+	—	78 / 240,000+	2.2 / 2.2	2.2 / 2.2	2.2 / 240,000+
Time	11:00am / 3:00pm	—	11:00am / 3:00pm	5:00pm / 5:00pm	11:00am / 3:00pm	11:00am / 1:15pm

NOTE: Samples other than bacteriological were composited at 20 minute intervals from 10:00 a.m. to 6:00 p.m. Sewage works effluent collected on 9/29/66 – chemical composited – one-half bottle collected at each time shown for bacteriologicals.

The woodroom, paper mill and pulp mill samples produced a similar UV spectra which resembles lignin, but was not intense enough to be positively identified as lignin.

HAMMERMILL SURVEY
September 26, 1966

Waste Reduction

B.O.D. - POPULATION EQUIVALENT

	Flow MGD	Standard Wastes Avg. of eight consecutive operating hours		Allowable discharge	Strength of discharge as surveyed	% Reduction
Wood room effluent	0.4	33,000		4,950	2,500	92
Paper Mill effluent (a)	2.65	53,100		7,960	42,300(a)	20(a)
Paper Mill effluent (b)					34,200(b)	36(b)
Pulp Mill effluent						
Bleach wastes:	17.12	323,000:	810,000	121,500	323,000	60
Spent liquor:	0.69	487,000:				
TOTAL		896,100		134,410	367,800(a) 359,700(b)	59(a) 60(b)

B.O.D. - POUNDS PER EIGHT HOURS

Wood room effluent	0.4	1,870		281	141	92
Paper Mill effluent (a)	2.65	3,010		452	2,395(a)	20(a)
Paper Mill effluent (b)					1,940(b)	36(b)
Pulp Mill effluent						
Bleach wastes:	17.12	18,290:	45,840	6,870	18,290	60
Spent liquor:	0.69	27,550:				
TOTAL		50,720		7,603	20,826(a) 20,371(b)	59(a) 60(b)

AR101956

Waste Reduction (Contd.)

SUSPENDED SOLIDS - POUNDS PER EIGHT HOURS

	Flow MGD	Standard Wastes Avg. of eight consecutive operating hours		Allowable Discharge	Strength of discharge as surveyed	% Reduction
Wood room effluent	0.4	5,500		550	978	82
Paper Mill effluent (a)	2.65	12,050		1,205	3,390(a)	72(a)
Paper Mill effluent (b)					1,557(b)	87(b)
Pulp Mill effluent						
Bleach wastes:	17.12	24,750:	29,510	2,951	21,750	16
Spent liquor:	0.69	4,760:				
TOTAL		47,060		4,706	29,114(a)	38(a)
					27,285(b)	42(b)

COLOR - UNITS

	Flow MGD	Color Units to flow - raw		Color Units to flow - effluent	% Reduction
Wood room effluent	0.4	5		5	
Paper Mill:					
Raw	4.35	15			
Effluent	2.65			8	47
Pulp Mill:					
Bleach wastes:	17.12	1,315:	1,682	1,315	22
Spent liquor:	0.69	367:			
TOTAL		1,702		1,322	23

NOTE: (a) calculated from results of survey, (b) calculated from monthly reports for Feb. thru Aug. 1966. Standard raw waste characteristics are those established by the Sanitary Water Board with the exception of the pulping process. Standard wastes shown for pulp are those obtained from this survey. Bleach wastes as shown above includes all pulp mill waste discharging to the Lake with the exception of spent liquor to deep wells.

The above is based on a production of 330 tons/day - pulp; and 425 tons/day - paper.

AR101957

September 26, 1966
Analytical Results of Lake Samples

	Stations										
	1	2	3	4	5	6	7	8	9	10	City of Chestnut Waterworks Intake
Appearance	Clear	Clear	Brownish Yellow	Brnish Yellow	v. pale brown	light brown	Brown	Brown	v. pale brown	v. pale brown	Clear
Color	0	10	140	180	30	45	110	140	10	10	—
Turbidity	5	5	5	10	5	5	10	10	5	5	5
pH	6.9	6.9	6.4	6.4	6.7	6.5	6.7	6.2	6.3	[illegible]	6.1
Alkalinity	96	94	82	76	92	92	84	84	94	94	96
Sulfates	19.2	53	62	28.6	33.4	33.4	53	53	14.4	14.4	18
B.O.D.	.5	1.6	20	32	10	8.0	19	21	2.0	2.0	1.3
Tot. Solids	230	260	350	420	240	270	370	350	240	220	200
Tot. Suspended Solids	20	30	40	70	60	90	110	100	90	120	10
Lignin	0	0	0	0	0	0	0	0	0	0	0
Foaming Tendency	None	None	None	None	None	None	None	None	None	None	None
Bacteriological											
Coliforms MPN/100ml	2.2 — 2.2	1,100 — 68	Broken — 54,000	24,000 — 2,400	9,200 — 790	3,500 — Broken	35,000 — 2,400	3,500 — 950	460 — 68	460 — Broken	2.2 — 2.2
Time	10:30am — 4:15pm	11:15am — 6:50pm	11:30am — 6:40pm	Noon — 6:10pm	12:15pm — 6:00pm	12:30pm — 5:45pm	12:35pm — 5:30pm	1:00pm — 5:05pm	1:35pm — 4:45pm	2:00pm — 6:20pm	11:00am — 1:30pm

NOTE: Samples other than bacteriological are composites- one-half bottle collected at each time shown for bacteriologicals. Waterworks samples collected on 9/29/66.

ART 0 F958

Efficiency of Deep Well Disposal

Basis: Data taken on 9/26/66

References: D. T. Jackson letter to Mr. Heine January 13, 1966

Pulp production:	Tons/day	%	Collection Efficiency	Maximum Available
Hardwood Neutracel--batch	200	61	95%	52%
Hardwood Neutracel--continuous	130	39	55%	21%
		Total		73%

% Injected:

Using formula in Section 3 of reference.
Lbs./day B.O.D. injected = 82,650
Lbs./day B.O.D. to lake = 54,870

$$\% \text{ injected} = \frac{82,650}{0.77\,(54,870) + 82,650} = 66\%$$

Using corrected formula--

$$\% \text{ injected} = \frac{82,650}{0.77\,(54,870 + 82,650)} = 73\%$$

Corrected formula is based on fact that total B.O.D. produced is that injected plus that discharged to lake. The fraction due to spent pulping liquor (77%) is then applied to this total.

AR101959

(9) System Compressibility (3.2×10^{-6} psi^{-1}), c

This value of compressability was obtained from a plot of water compressability as a function of temperature and pressure, Figure 2-21 in An Introduction to the Technology of Subsurface Wastewater Injection, EPA-600/2-77-240. As above, formation temperature was assumed at 73°F. Pressure was taken as the initial formation pressure.

(10) Formation Volume Factor (1), β

This ratio of the volume of injected fluid at reservoir pressure compared to the volume at S.T.P. can for liquids be considered to be 1.0 for all practicle purposes. See Radius of Pressure Influence of Injection Wells, EPA-600/2-79-170, page 4.

(11) Skin Factor (0), s

This factor is assumed zero for all points outside of a wells skin or invasion zone. See Radius of Pressure Influence of Injection Wells, EPA-600/2-79-170, page 4.

The formula used in this calculation is found in Radius of Pressure Influence of Injection Wells, EPA-600/2-79-170, page 6. It is further referenced to Matthews and Russell, Pressure Buildup and Flow Tests in Wells, Soc. Petroleum Engineers Monograph Vol. 1. 1967.

The formula is:

$$P_r = P_i + 70.6 \frac{q\mu\beta}{kh} \left[E_1 \left(\frac{39.5\ \phi\mu c\ r^2}{k\ t} \right) \right]$$