WATER QUALITY MONITORING
CHICAGO AREA CONFINED DISPOSAL FACILITY
FINAL REPORT ON OPERATIONS
APRIL 1986 TO JULY 1986

CORPS OF ENGINEERS CONTRACT NO.
DACW23-84-D0012
WORK ORDER 0010

Prepared By:

Daily & Associates, Engineers, Inc.
Peoria, Illinois

October 2, 1986

Job No. 5671.10

TABLE OF CONTENTS

Tables/Plates/Figures

Appendices

ABSTRACT

This report, prepared by Daily & Associates, Engineers, Inc., is in accordance with Contract No. DACW23-84-D-0012, Work Order No. 0010 Section 7.3. A description is provided for the sampling procedures and equipment utilized for monitoring the operations of the Chicago Confined Disposal Facility at Calumet Harbor. The 1986 operating season for dredge operations was initiated May 8, 1986 and concluded June 28, 1986. The monitoring program was started on April 23, 1986 and ended July 8, 1986 to provide background data before and after the dredge operations. The analytical test data is tabulated in Appendix A to the report. The log of operations for the 1986 operating season is shown in Appendix B.

The south filter was utilized almost exclusively for the 1986 season. The filter loadings are discussed in relationship to original design loading criteria.

During the period of May 8, 1986, through June 28, 1986, the Chicago Area Confined Disposal Faciity (CDF) was receiving maintneance dredgings from the Federal Channel at the Chicago River and Harbor. The dredging limits are shown in Plate No. 1. Material was dredged mechanically, transferred into scows and disposed of in the CDF along the northern dike wall between stations 5+00 and 15+00. Dredged material was transferred from the scows to the CDF using a sluice formed from railroad tank cars cut in half and welded together, see Figure 1. Water quality monitoring of the dredging and disposal operations were conducted in compliance with Illinois Environmental Protection Agency (IEPA) Water Pollution Control Permit No. 1982-EA-0325. The data obtained support the conclusion that the Facility Operations for the period of study produced an effluent consistent with Water Quality Standards designated in the operating permit. Also presented is the conclusion that no additional study and/or modification of the filters is warranted to achieve design levels of discharge quality.

A. Sampling Methods and Procedures

Sample locations are shown on Plates No. 2 and No. 3.

1. For Water Quality Stations 1, 4, 5, 6, 7, 8:

A custom built (by Daily Analytical) 5 liter PVC JUDAY SAMPLER was used to collect samples for all parameters, except Dissolved Oxygen. One 5 liter grab was taken from 1 meter above the bottom and 1 meter below surface. Each 5 liter aliquot was put into a 15 liter Nalgene carboy while in the boat. Temperatures and pH were measured in the boat. A YSI Model 51A Dissolved Oxygen Meter was used in the boat to measure Dissolved Oxygen "in situ" at 1 meter above bottom and 1 meter below surface. The meter was calibrated using the Winkler Azide

modification. This calibration was performed immediately prior to the first sampling point for that day. The water quality samples were collected beginning April 23, 1986.

2. For Turbidity Stations 9, 10, 11, 12, 13, 14:

A 1 liter PVC JUDAY SAMPLER was used to grab samples at mid depth, and 1 meter below the surface. Readings for Stations 9, 10, and 11 were taken near the CDF and transported to the dock for measurement. Samples for Stations 12, 13, and 14 were taken near the derrick barge and transported to the barge for measurement. Turbidity measurements were initiated on May 13, 1986.

3. For Filter Influent & Effluent Stations 2 and 3:

a. Station 2 - Sample was hand grabbed at influent well. The first sample was recovered May 13, 1986.

b. Station 3 - The filter effluent was sampled with a Manning Sampler, Model S-3000 automatic sampler. The sample suction line was submerged in the filter effluent pipe. The sampler was set to draw sample aliquots at four hour intervals and a weekly composite sample was collected. The sampler was turned off when no flow was present. The first sample was recovered on May 21, 1986.

4. Sediment - A sediment sample was hand grabbed by Contractor from scow while it was being unloaded. Sediment samples were collected beginning May 13, 1986.

B. Laboratory Equipment

- Lab Pure Water System, Milli-Q -- Lab pure water is generated by a Milli-Q system and can achieve up to 18 megohm water. The system is proceeded by a mixed-bed ion exchange resin and a 0.22 micron filter. The Milli-Q is a standard installation except that an extra "Organ-X" cartridge has been installed to further reduce the chance for "organics" contamination in the water. Cartridges are replaced when the system can no longer generate 8 megohm water.

- UV-VIS Spectrophotometer -- Daily Analytical currently has a Bosch and Lomb Spectronic 21. The instrument is in excellent condition. Stray light and wavelength calibration are accomplished quarterly using a Cobalt Nitrate at 512 NM and Copper Sulfate at 850 NM. Stray light is monitored by deviation from the straight line response and wavelength by comparison of the observed max with the published max.

- Dissolved Oxygen Meter -- Daily Analytical owns a Yellow Springs Instrument, Model 54, Dissolved Oxygen Meter. The meter is standardized, in duplicate, each time it is used against

Winkler titration. The titrant, Sodium Thiosulfate, is, in turn, standardized against Primary Standard Potassium Dichromate Solution.

- Specific Ion Electrode Meter -- Daily Analytical performs most Ammonia and Fluoride analyses by Specific Ion Electrode, either by Known Additions or Direct Read. The laboratory utilizes an Orion Ammonia Probe interfaced to an Orion 920. For Direct Read analyses, the system is calibrated at three points. For Known Additions analyses, the Relative Millivolt is set to Zero. Commercially available ampules are analyzed quarterly. USEPA ampules are analyzed annually.

- pH Meter -- Daily Analytical owns three pH/millivolt meters -- an Orion, Model 399A; a Chemtrix, Model 45AR; and an Orion 920. Meters are calibrated each day of use, at two pH levels. Meters are generally calibrated at pH 4 and 7 and 10. However, the instruments can be reliably calibrated at pH 4 and 10 with good linearity. Commercial ampules are analyzed quarterly and USEPA ampules are analyzed annually.

- Titrations -- Daily Analytical performs numerous analyses titrametrically. Acidity, Alkalinity and Chloride are examples of such. Ammonia and Cyanide are occasionally analyzed titrametrically. The Titrant is initially standardized, in triplicate, against a Primary Standard. It is restandardized prior to each series of analyses. Commercial and USEPA ampules are analyzed quarterly and annually, respectively.

- Turbidimeter -- Daily Analytical owns a HF Instrument, Model DRT 15, Turbidimeter. The instrument is zeroed and calibrated against 1.0 NTU of Formazin. Commercial and USEPA ampules are analyzed quarterly and annually, respectively.

- Atomic Absorption Spectrophotometer -- Daily Analytical owns two Atomic Absorption Spectrophotometers; a Perkin-Elmer 305A and a Perkin-Elmer 2380. These instruments are 14 years and 4 years old, respectively. The laboratory also has a Perkin-Elmer HGA-400 Graphite Furnace equipped with an AS-40 Autosampler. Electrodeless Discharge Lamps are used for certain elements. The Spectrophotometers basically require two calibration steps, the wavelength and response factors. The wavelength is calibrated against the light source. When an element has two or more absorption lines lying close together, care must be employed to use correct wavelength. The wavelength indicator on the instrument can assist in this. Alternately, any miscalibration is quickly apparent upon aspiration of the first standard. As such, wavelength calibration is self-correcting. Response factors, absorbence units per concentration unit, are calculated from at least three standards, bracketing the concentration of interest. As before, Commercial ampules are analyzed quarterly and USEPA ampules are analyzed annually.

- Balances -- Daily Analytical owns a Mettler, Model H-20, Semi-Micro Balance and a Model AE-160, Electronic Analytical Balance. Both are in excellent condition. The instruments are zeroed before every use and after every fourth weighing. Daily Analytical also has a Mettler, Model PC-180, and a Model PE-3600 Top Loader and several Triple Beams. All balances are serviced annually.

C. Quality Test Methods and Procedures

1. Blanks were prepared by filling preserved Sample Bottles with Lab Pure Water. Blanks were treated as routine samples and analyzed along side the Field Samples. Results were reported on Table 3 of the periodic reports (not included with this report).

2. A duplicate sample was collected in the field for randomly selected monitoring station on each scheduled sampling day. This sample was collected with a complete set of bottles, identical to the original sample. Results of this duplicate analysis were reported with the periodic reports.

3. Once the samples had been returned to the lab, one sampling station was selected for spiking (not duplicate sample). Spikes were made for all parameters except Dissolved Oxygen and pH. As with the field duplicate, the spike sample was handled, in all respects, like a routine sample. The spike analyses were performed blind. That is to say that the amount of spike was not made known to the analyst until after the analysis was completed. Results of this spike were also reported in the periodic report.

4. Check Standards were analyzed with each series of analysis. These data are recorded in permanent, bound laboratory notebooks with the analysis data.

5. Optimum Concentration Range as attached. Samples were diluted or concentrated to fall within this range. Metal analyses were digested with Nitric Acid and concentrated 4:1. Dilutions were made in accordance with accepted laboratory procedures, using Volumetric Pipettes and Class A Volumetric Flasks.

6. Sensitivity

	Opt. Conc.	Sensitivity
TDS	0-10 %	100 ppm/1 mg for 10 ml sample
S.S.	0-20,000 mg/l	4 ppm/1 mg for 250 ml sample
Hard	0-50,000 mg/l	20 ppm/1 ml for 50 ml sample
D.O.	0-20 mg/l	1 ppm/1 ml for 50 ml sample
G & O	0-1,000 mg/l	1 ppm/1 mg for 1000 ml sample
P	0-1.2 mg/l	120 ug/1 ABS Unit
NH3	0-100 mg/l	59 rel mv/decade
TKN	0-500 mg/l	59 rel mv/decade
CN	0-0.15 mg/l	6.25 ug/ABS Unit
As	0-0.1 mg/l	2.5 NG/ABS Unit
Cd	0-2.0 mg/l	4.8 ppm/ABS Unit
Cr	0-5.0 mg/l	28 ppm/ABS Unit
Cu	0-50 mg/l	22 ppm/ABS Unit
Pb	0-20 mg/l	0.10 ppm/% Absorbence
Mn	0-3.0 mg/l	12 ppm/ABS Unit
Hg	0-0.005 mg/l	0.02 ug/% Absorbence
Ni	0-5.0 mg/l	25 ppm/ABS Unit
Zn	0-1.0 mg/l	3.6 ppm/ABS Unit
PCB	0-0.5 mg/l	0.008 NG/CM
Temp	-20-110 C	N/A
pH	1-13 S.U.	N/A
% So.	0-100%	1%/0.1 gs. for 10 ml sample
% V.S.	0-100%	1%/0.1 gs. for 10 ml sample
COD	0-900 mg/l	2000 ppm/ABS Unit
Ba	0-25 mg/l	0.10 ppm/% Absorbence
Fe	0-5.0 mg/l	28 ppm/ABS Unit

D. Limitations in Sampling and Testing

Nalgene carboys, 15 liter, were taken out in the boat to hold samples until arriving back at the dock. The reason for using a carboy was to be able to get a 5 liter volume adequately transferred to a sample container with a minimum of spillage. Carboys have a wider mouth and larger volume to accommodate a rapid transfer from sampler to container. Ideally, glass should be used for handling of samples for PCB analysis, but because of safety reasons, Nalgene was used. Contact time was kept to a minimum. Nalgene carboys were also used in autosamplers. The only limitation here would be possible PCB exposure and adsorption in the Nalgene container. The effect of using Nalgene in lieu of glass is minimal. The initial sampling by Daily and Associates on October 18, 1984 used the proper glass containers. The results for PCB analysis at all monitoring stations on this date showed PCB's, if present, were below detectable levels of the laboratory equipment. The subsequent monitoring utilizing Nalgene showed PCB results also to be below detectable levels. The minimum contact time of 30 minutes with the Nalgene is not applicable to the samples collected at the filter influent and effluent. In this instance, the samples are a one week

composite. However, since PCB's are not present in concentrations above detectable limits at all other monitoring points, the use of glass containers for the weekly composite would be of no benefit to improvement in the analytical results.

Past experience with turbidity measurement showed calibration and measurement were difficult (and probably inaccurate) to perform in a bouncing boat. Meter needles were observed to swing on account of roughness. Therefore, turbidity measurements were made after transporting the samples back to the dock or the derrick barge.

Maintaining a 50 foot distance from the dike while sampling station 5, 6, and 7 was difficult due to rough water. Corps of Engineer' personnel indicated an "eyeball" estimate of 50' was adequate for this purpose.

The sample collected at station 3 was a seven day composite. This sample was required to be iced on a daily basis by the dredging contractor. As a consequence of the sampling procedure, pH, required by the Work Order, will be inaccurate due to holding time. The effect of long sample holding times is shown by comparison of the pH at Station 1 to Station No. 2. The sample collection at Station 1 is a grab sample from within the CDF. The pH was field measured as per the Contract Requirements. A differential between the pH from Station 1 and Station 3 did not exceed 0.5 pH units. Therefore, it was concluded the inaccuracy in the pH measurement is not significant and would not limit the conclusions drawn from the data. The contractor's pump to the filter cell was observed to have occasional shutdowns and non-uniform flows to the filter cell. The sampler at Station 3 was in a location where a low flow coming in would provide enough volume so this station would not pump air.

Samples collected at Station 4 were subject to occasional stirred up water due to commercial river traffic.

E. Analysis of Data

The results of the monitoring data are shown in Appendix A for Station Nos. 1 through 11 and the turbidity measurements are presented in tabular format with the minimum, maximum and mean average values computed for each monitoring point. Stations are noted in Plates No. 2 and No. 3.

A discussion of the effluent compliance with water quality parameters is presented in Part G of this report.

The monitoring data was consistent for each monitoring station. The data did not indicate trends occurring which were adverse to the effects noted and discussed in the Environmental Impact Statement (Corps of Engineers 1982). An observation noted

was that the maximum reading for Suspended Solids occurred on April 23, 1986 at Stations 6, 7, and 8. Since dredging began May 8, 1986, and the far field data from Station No. 8 showed a similar trend as Stations 6 and 7, it is concluded this was an isolated deviation in ambient water quality.

The results of water quality monitoring within the CDF, Monitoring Station 1, indicate that the mean values of all parameters monitored, except ammonia nitrogen, were less than one order of magnitude greater than the ambient water quality of the Calumet Harbor, Monitoring Station 4. As would be expected, the concentrations for contaminants within the CDF did increase above background monitoring results obtained prior to the start of the dredging/disposal operations. The increases in parameter concentrations were not time dependent in that the increases did not unilaterally occur from the start to finish of the dredging operations. The maximum readings for all parameters within the CDF did not correlate to the days on which the maximum levels were monitored in the ambient water quality.

The physical features, temperature dissolved oxygen and specific conductance were monitored at Monitoring Station 1 at depths in increments of 1 foot. The data is shown at the end of Appendix A.

The turbidity levels observed near the disposal operations show an increase above ambient levels in the Calumet Harbor. The monitoring points (Station Nos. 9, 10, & 11) in the harbor show good correlation with each other for ambient turbidity levels. These monitoring stations are near the barge off loading station. No apparent trends are apparent which can be correlated to barge off loading. The turbidity levels adjacent to the dredging operations showed the turbidity near the dredge to be as high as 10 times the ambient levels, except for the May 23, 1986 sample. A similar trend was noticed during the 1984 and 1985 operating seasons. The turbidity decreased at 300 feet downstream to levels less than 2 times levels measured at 100 feet upstream of the operations. It appears the current direction was incorrectly identified for 4 of the 13 samples as the upstream turbidity exceeds downstream readings. The sluggish river currents are noted as a complication to correct identification of current direction.

The impact of turbidity was addressed in the Environmental Impact Statement. The expected turbidity levels were not reported. It is judged that the levels of turbidity are consistent with the operations and not excessive. It is also judged that the impact of the turbidity is consistent with the effects identified in the Environmental Impact Statement and is not considered significant to the point that mitigation is warranted.

F. Performance Evaluation of CDF Filters

A rigid analysis of the performance characteristics of the CDF Filters for the operating period from May 8, 1986 through June 28, 1986, is not necessary since the filter did produce an acceptable quality effluent based on the monitoring results.

A log of operations for the 1986 season is included in Appendix B. The south filter was the primary unit operated in 1986. The north filter was a standby (back up) in the event the south filter plugged during the 1986 operating season.

The log of operations for the filter units was provided by the Corps of Engineers. The filtration rate (pumping rate) was estimated to be 1.5 cubic feet per second, by the Corps of Engineers for the 1985 operating season. The pumping rate was not changed for the 1986 season. At this hydraulic loading rate, the 269.5 hours of filter operation represent a total filtered volume of 10.59 million gallons. By using the Suspended Solids loading (Station 2) versus the Suspended Solids discharged (Station 3), the total solids captured was calculated to be 468.2 pounds. This equates to a filter solids capture rate (area basis) of 0.516 pounds/square foot (1.22 grams/square centimeter). The filter solids capture rate (volume basis) was computed to be 0.045 pounds/cubic foot (3.5×10^{-3} grams/cubic centimeter). The filter design value for solids capture was 0.3 grams/cubic centimeter.

The filter hydraulic loading rate at 1.5 cubic feet/second represents a rate of 0.75 gallon/minute/square foot. The design flow rate for hydraulic loading was 2 gallon/minute per square foot.

The 1986 loadings to the filter were 37 percent of the design hydraulic loading rate and 1.1 percent of the design solids capture rate (volume basis).

The principal reason for the low solids loading to the filters is the continuation of the mechanical dredging methods versus the hydraulic methods anticipated for the basis of design.

It is recommended that the installation of piezometers be considered at the time that the south filter media is changed (see 1984 Operations Report, p. 8) provided hydraulic dredging practices are anticipated to occur.

G. Compliance Evaluation With Water Quality Standards

The facility effluent monitoring occurred at Station No. 3. Table One has been prepared which lists the maximum, minimum, and mean average values for the effluent quality for the 1986 facility operation. The intermittent discharge occurred

over the period from May 12, 1986 through June 28, 1986. The facility discharge appears to be in compliance with applicable water quality standards.

The effluent quality was compared to the ambient water quality of the receiving stream. The ambient water quality of the receiving stream is indicated by the analysis results from monitoring Station No. 4. The median value for 6 parameters of the 20 analyzed in the effluent showed concentrations exceeding the median value for ambient water quality. A mixing zone determination was not necessary since the effluent achieves compliance with water quality limits.

The water quality was monitored at 50 feet from the dike perimeter at monitoring stations Nos. 5, 6, and 7. The mean average concentrations for all parameters at these stations were consistent with ambient water quality monitored at Station No. 8, located in the lake. No discernible trends were noted in the dike perimeter monitoring indicative of significant seepage through the dike. A typical dike cross section is shown on Figure 2. The monitoring station and data summary are included as Appendix A.

H. Conclusions

The Chicago Confined Disposal Facility Operations were monitored for the period of April 23 through July 8, 1986. The dredging operations began May 8, 1986 and concluded on June 28, 1986.

1. Sampling Techniques: It was concluded that sampling techniques utilized were adequate to provide reliable analytical testing results except that the sampling methods for Station No. 3 effluent do not produce a daily 24 hour composite sample. This would appear inconsistent with the sampling requirements for analysis in conformance with he Water Quality Standards. Two modifications would provide improvements to the data available. It is recommended that a propeller or dopler type flowmeter be installed on the filter influent line with recording totalizer and sampler control capability. It is recommended that at least one 24 hour composite sample of the influent and effluent be collected. This change would provide data consistent with monitoring requirements for judging compliance with Water Quality Standards. As may be required under the Illinois EPA Water Pollution Control Permit for the Chicago Area CDF or if the Corps desires additional monitoring of operations, a second sampler could provide the 7 day composite at the influent and/or effluent station(s).

2. Water Quality Compliance: It was concluded that the filter performance resulted in a facility discharge which was in compliance with the water quality regulations of the State of Illinois governing the discharge.

TABLE ONE

SUMMARY EFFLUENT QUALITY

File: STATION 3: Minimum, Maximum and Mean Average
For Discharge Period May 21, 1986 to July 1, 1986

For: Chicago District, Corps of Engineers
Prepared By: Daily & Associates, Engineers, Inc. - Peoria, IL
Daily Analytical Laboratories - Peoria, IL

STATION #3 WATER QUALITY DATA Contract Number: DACW 23
Confined Disposal Facility Calumet Harbor

		MAXIMUM	MINIMUM	MEAN AVERAGE	IL STD*
SOLIDS, DISSOLVED	mg/l	250	200	230	1500.0
SOLIDS, TOTAL SUSPENDED	mg/l	4	<2	2.0	15.0
HARDNESS, AS CaCO3	mg/l	160	150	160	---
DISSOLVED OXYGEN	mg/l	---	---	---	6.0/5.
OIL and GREASE	mg/l	4	<1	2	15.0
PHOSPHORUS, TOTAL	mg/l	.024	<.015	.017	---
AMMONIA NITROGEN as N	mg/l	.04	<.01	.01	2.5 & 4
TOTAL KJELDAHL NITROGEN	mg/l	.98	.22	.46	---
CYANIDE	mg/l	<.01	<.01	<.01	.1
ARSENIC	mg/l	<.005	<.001	<.002	1.0
CADMIUM	mg/l	<.01	<.01	<.01	.15
CHROMIUM	mg/l	<.01	<.01	<.01	.3
COPPER	mg/l	<.01	<.01	<.01	1.0
LEAD	mg/l	.2	<.01	.05	.1
MANGANESE	mg/l	<.01	<.01	<.01	1.0
MERCURY	mg/l	<.0002	<.0002	<.0002	.0005
NICKEL	mg/l	.01	<.01	.01	1.0
ZINC	mg/l	.13	.01	.04	1.0
TOTAL PCB's	mg/l	<.0001	<.0001	<.0001	---
TEMPERATURE (field)	OC	12	12	12	
pH (field)	S.U.	8.2	7.9	8.1	

* = Illinois Standards for Water Quality for Secondary Contact Waters

For purposes of Statistical evaluation, "less than," , <, values were treated as being equal to the Detection Limit.

Table 2 has been prepared which lists the maximum, minimum, and mean average values for the sediment quality.

TABLE TWO

SUMMARY SEDIMENT QUALITY

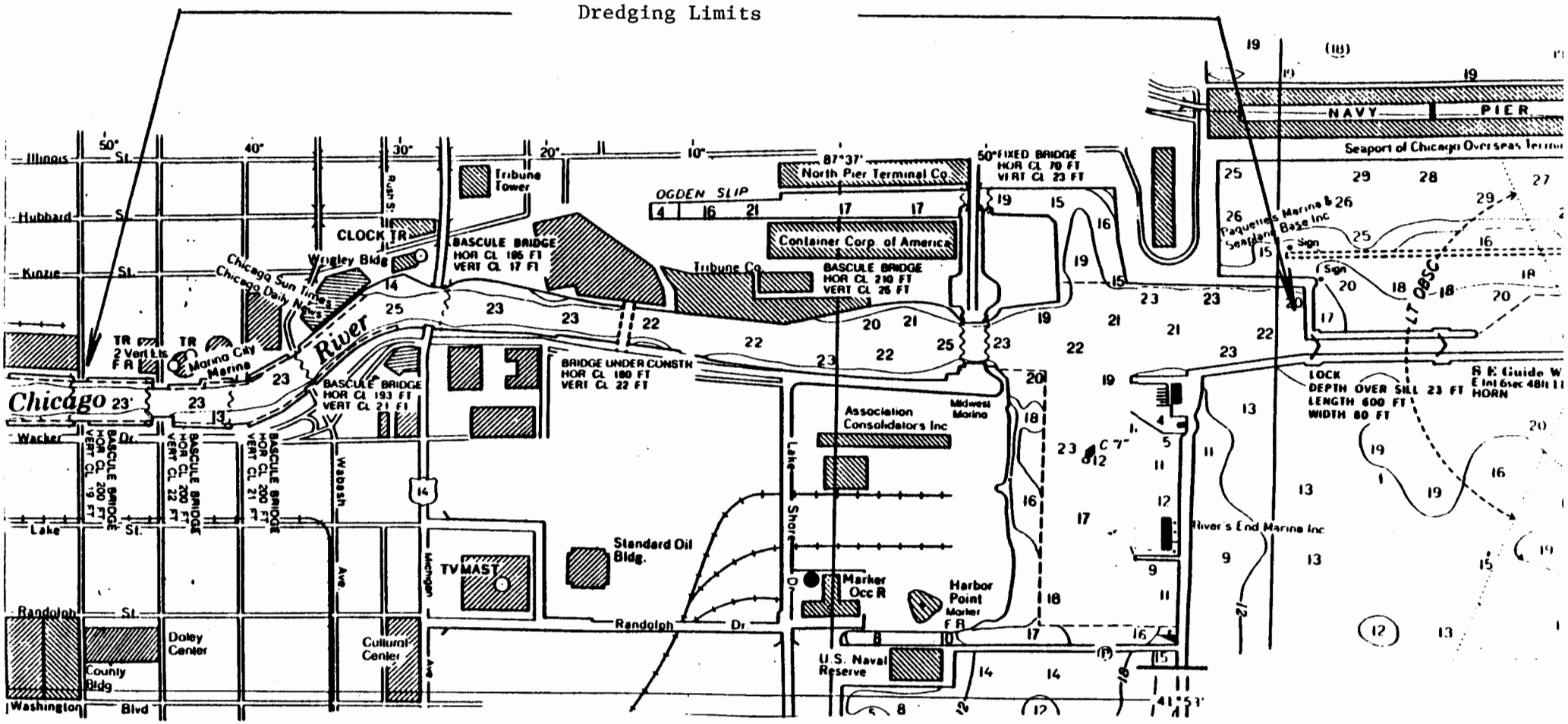
File: SEDIMENT: Minimum, Maximum and Mean Average
For Dredging Period May 13, 1986 to June 25, 1986

For: Chicago District, Corps of Engineers
Prepared By: Daily & Associates, Engineers, Inc. - Peoria, IL
Daily Analytical Laboratories - Peoria, IL

SEDIMENT QUALITY Contract Number: DACW 23
Confined Disposal Facility Calumet Harbor

		MAXIMUM	MINIMUM	MEAN AVERAGE
TOTAL SOLIDS	%	74	37	54
TOTAL VOLATILE SOLIDS	%	19	2.4	9.3
CHEMICAL OXYGEN DEMAND	mg/kg	52,000	21,000	39,000
TOTAL KJELDAHL NITROGEN	mg/kg	1500	360	910
OIL and GREASE	mg/kg	6500	650	3360
AMMONIA NITROGEN as N	mg/kg	240	15	80
TOTAL PHOSPHORUS	mg/kg	540	180	360
ARSENIC	mg/kg	4.3	.66	2.2
BARIUM	mg/kg	190	28	66
CADMIUM	mg/kg	5.1	.82	2.7
CHROMIUM	mg/kg	62	3	24
CYANIDE	mg/kg	.54	<.01	.23
IRON	mg/kg	12,000	5,400	8,100
LEAD	mg/kg	250	18	140
MANGANESE	mg/kg	160	130	140
MERCURY	mg/kg	.9	.11	.57
NICKEL	mg/kg	19	8.6	14
ZINC	mg/kg	280	61	170
COPPER	mg/kg	82	4.4	42
TOTAL PCB's	mg/kg	12	.41	5.4

For purposes of Statistical evaluation, "less than," ,<, values were treated as being equal to the Detection Limit.



CHICAGO RIVER AND HARBOR
MAINTENANCE DREDGING 1986
GENERAL PLAN
SOUNDINGS IN FEET

FEET
100 0 500 1000 1500 2000 2500 3000

STATUTE MILE
0 1 2 3 4 5 6

Plate 1.
Contract DACW23-84-D-0012
Work Order 0010

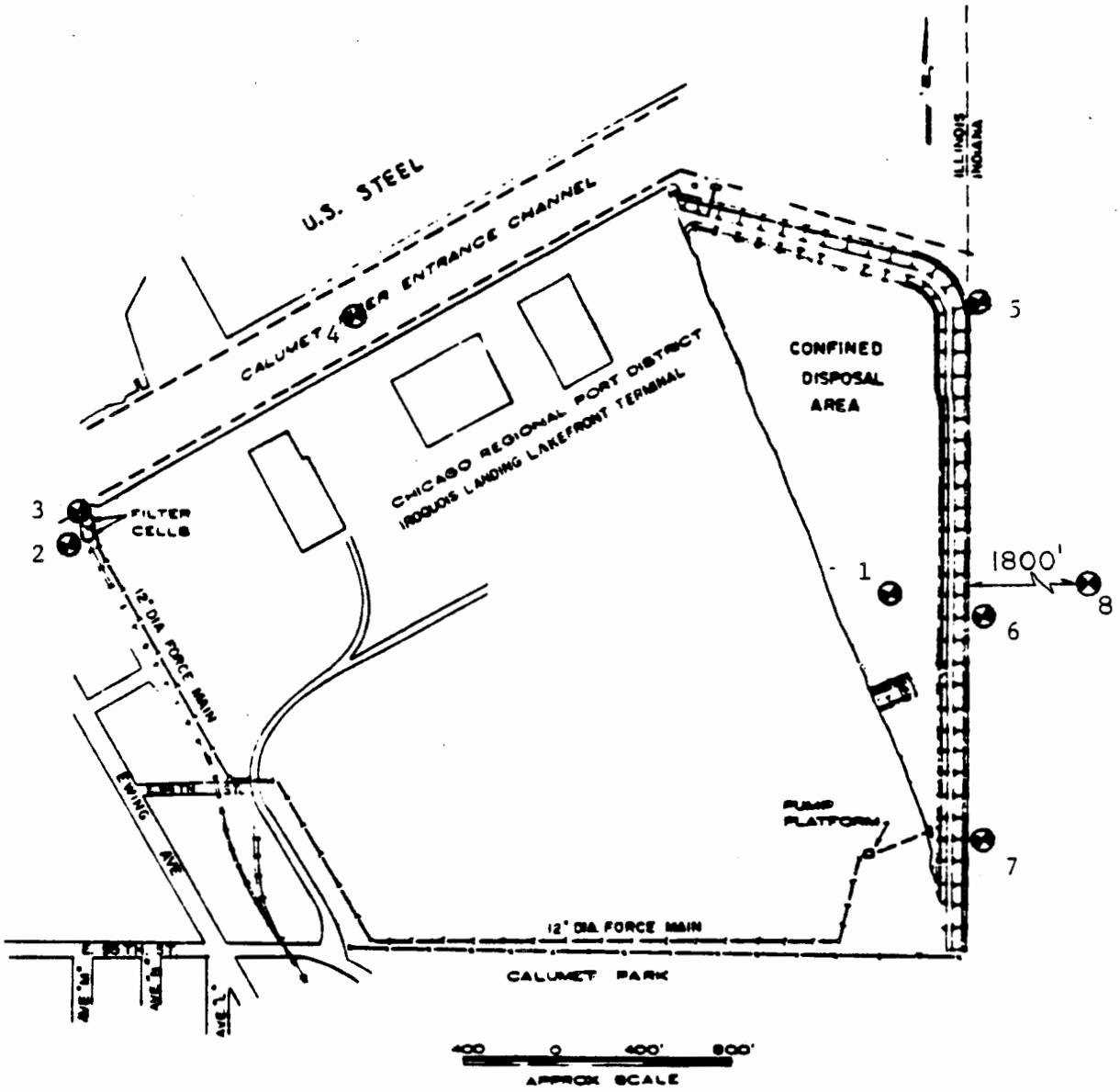


Plate 2.

WATER QUALITY MONITORING STATIONS AT
CHICAGO AREA CDF

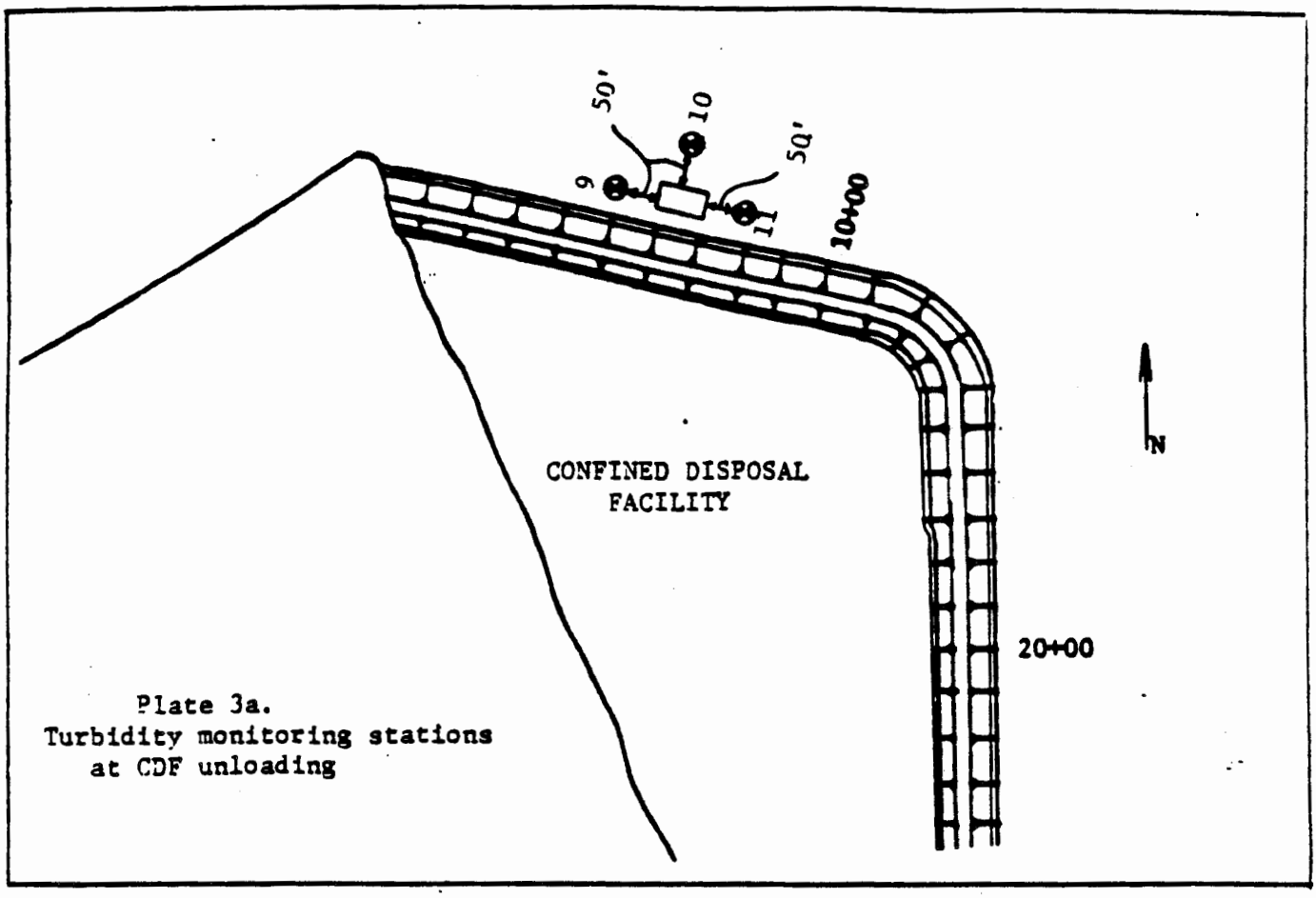


Plate 3a.
Turbidity monitoring stations
at CDF unloading

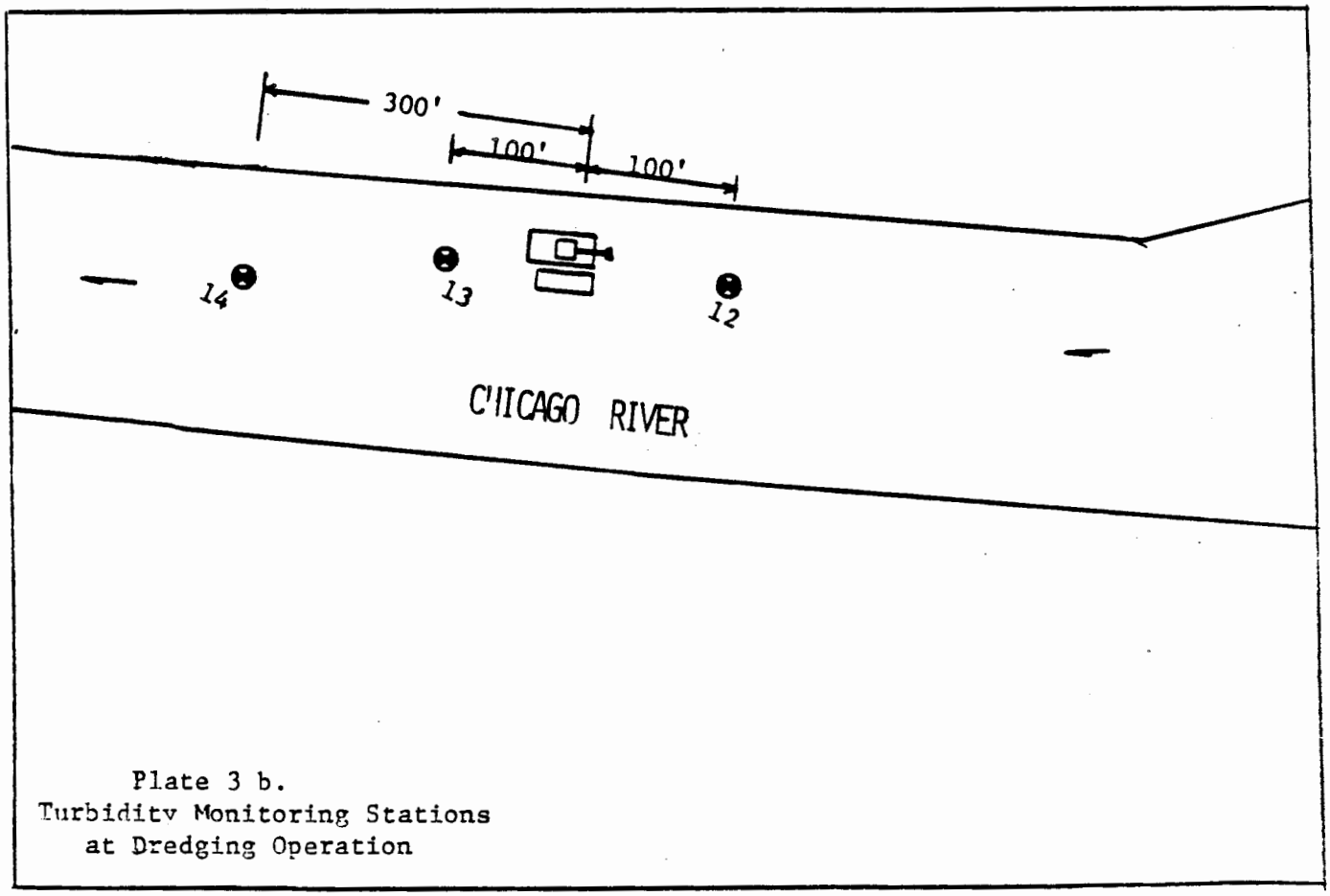
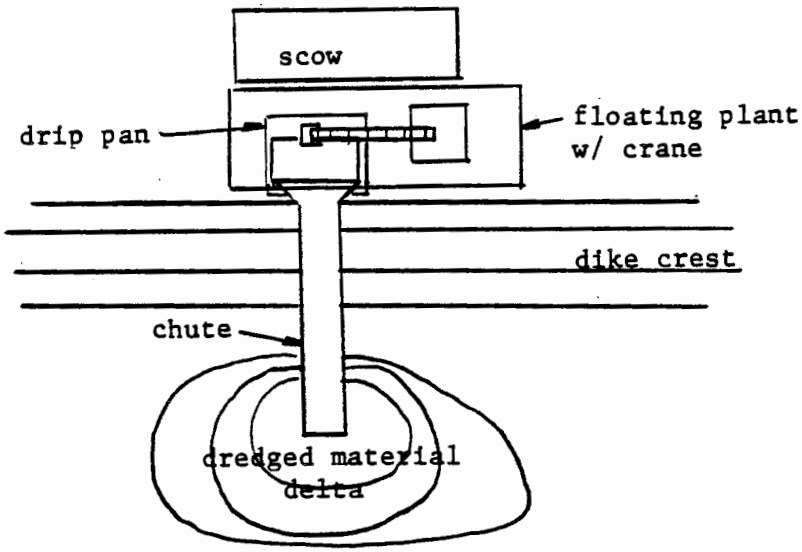
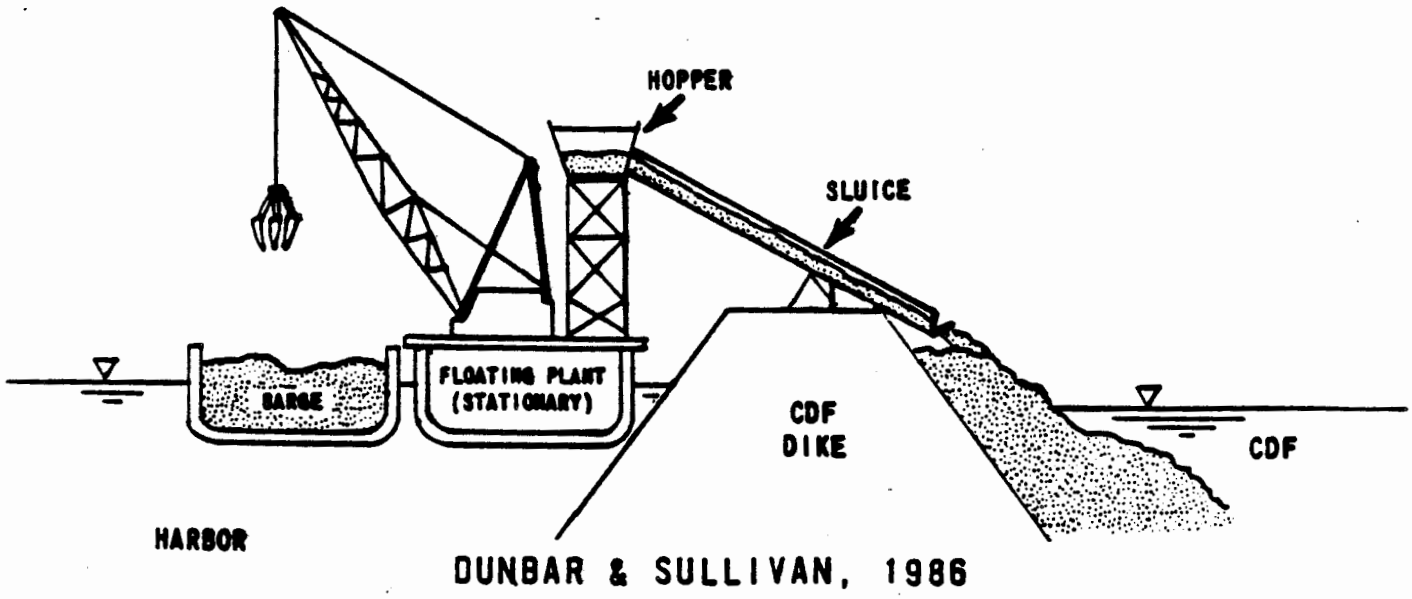


Plate 3 b.
Turbidity Monitoring Stations
at Dredging Operation

Calumet Harbor



CDF



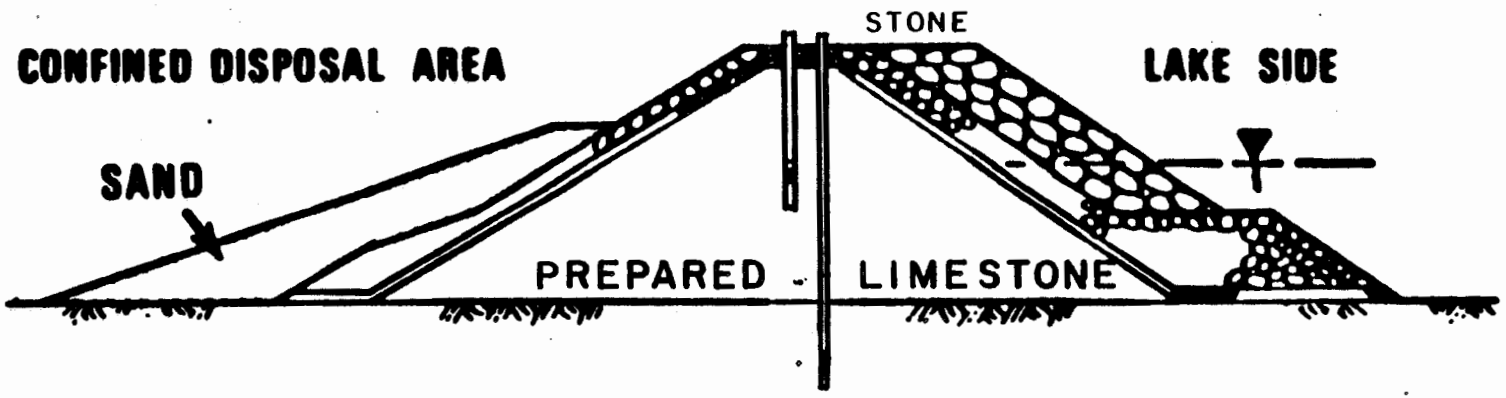
DUNBAR & SULLIVAN, 1986

Figure 1.

Contract DACW23-84-D-0012

Work Order 0010

DUAL WELL INSTALLATION



**Dike cross section of Chicago Area CDF,
Calumet Harbor, Illinois**

Contract DACW23-84-D-0012 Figure 2. Work Order 0010

APPENDIX A

MONITORING DATA

File: SEDIMENT

for: Chicago District Corps of Engineers
prepared by: Daily and Associates Engineers, Inc., Peoria, Illinois
: Daily Analytical Laboratories, Peoria, Illinois

SEDIMENT QUALITY — Contract Number:
Confined Disposal Facility — Calumet Harbor

D/A Sample #		6136-02	6143-61	6151-12	6155-62	6162-80	6169-58	6177-21
COLLECTED DURING WEEK OF:		5/13/86	5/21/86	5/29/86	6/3/86	6/10/86	6/17/86	6/25/86
TOTAL SOLIDS	%	64	37	51	41	60	54	74
TOTAL VOLATILE SOLIDS	%	10	19	8.8	8.9	6	10	2.4
CHEMICAL OXYGEN DEMAND	mg/kg	22000	40000	45000	51000	52000	45000	21000
TOTAL KJELDAHL NITROGEN	mg/kg	360	1200	1500	990	960	1000	370
OIL and GREASE	mg/kg	1300	4200	4900	6500	3700	2300	650
AMMONIA NITROGEN, as N	mg/kg	16	31	240	67	61	130	15
TOTAL PHOSPHORUS	mg/kg	180	330	540	350	490	420	240
ARSENIC	mg/kg	.66	1.5	1.8	1.9	1.6	4.3	3.7
BARIUM	mg/kg	40	34	63	49	190	60	28
CADMIUM	mg/kg	.82	2.2	5.1	4.1	2.8	2.4	1.2
CHROMIUM	mg/kg	10	3	62	35	26	25	9.6
CYANIDE	mg/kg	<.01	<.3	<.03	<.27	.54	.19	.3
IRON	mg/kg	5400	6300	9100	8800	12000	7300	7900
LEAD	mg/kg	100	120	240	18	250	140	120
MANGANESE	mg/kg	140	130	150	150	160	130	150
MERCURY	mg/kg	.11	.62	.9	.77	.63	.69	.29
NICKEL	mg/kg	8.6	11	19	14	17	15	11
ZINC	mg/kg	61	160	280	230	170	190	91
COPPER	mg/kg	9.7	4.4	82	53	66	52	28
TOTAL PCB's	mg/kg	.41	7.9	6.9	12	3.4	6.5	.49
Total Org. Carbon	mg/kg	9000	75400	64300	96500	51700	76500	29500

D/A Sample #		MINIMUM	MAXIMUM	MEAN	MEDIAN
COLLECTED DURING WEEK OF:					
TOTAL SOLIDS	%	37	74	54	54
TOTAL VOLATILE SOLIDS	%	2.4	19	9.3	8.9
CHEMICAL OXYGEN DEMAND	mg/kg	21000	52000	39000	45000
TOTAL KJELDAHL NITROGEN	mg/kg	360	1500	910	990
OIL and GREASE	mg/kg	650	6500	3360	3700
AMMONIA NITROGEN, as N	mg/kg	15	240	80	61
TOTAL PHOSPHORUS	mg/kg	180	540	360	350
ARSENIC	mg/kg	.66	4.3	2.2	1.8
BARIUM	mg/kg	28	190	66	49
CADMIUM	mg/kg	.82	5.1	2.7	2.4
CHROMIUM	mg/kg	3	62	24	25
CYANIDE	mg/kg	<.01	.54	.23	<.27
IRON	mg/kg	5400	12000	8100	7900
LEAD	mg/kg	18	250	140	120
MANGANESE	mg/kg	130	160	140	150
MERCURY	mg/kg	.11	.9	.57	.63
NICKEL	mg/kg	8.6	19	14	14
ZINC	mg/kg	61	280	170	170
COPPER	mg/kg	4.4	82	42	52
TOTAL PCB's	mg/kg	.41	12	5.4	6.5
Total Org. Carbon	mg/kg	9000	96500	57600	64300

for: Chicago District, Corps of Engineers
prepared by: Daily & Associates, Engineers, Inc., Peoria, Illinois
: Daily Analytical Laboratories, Peoria, Illinois

Sample Location: Sta. 1

PARAMETER		D/A Sample #: 6114-63	6119-102	6134-04	6143-50	6151-01	6155-48	6162-69	6169-40	6177-10
		Sample Collected on: 4/23/86	4/29/86	5/13/86	5/21/86	5-29/86	6/3/86	6/10/86	6/17/86	6/24/86 6/25/86
Solids Total Dissolved	mg/l	220	210	200	230	230	250	230	220	240
Solids, Total Suspended	mg/l	6	3	4	8	4	7	4	5	3
Hardness(as CaCO3)	mg/l	160	160	160	160	150	160	160	160	160
Dissolved Oxygen	mg/l									
Oil and Grease	mg/l	<1	1	<1	<1	<1	6	<1	1	1
Phosphorous Total	mg/l	<.03	<.03	.024	.037	.024	.024	<.015	.030	.022
Ammonia-Nitrogen	mg/l	.10	.04	<.01	.08	.39	.57	.64	.93	.7
Total Kjeldahl Nitrogen	mg/l	.10	<.1	.13	.34	.75	.72	<.01	.93	1.2
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	<.001	<.001	<.001	.002	<.001	.002	<.01	.006	.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	.01	<.01	<.01	<.01	<.01	<.01	.03	<.01	<.01
Lead Total	mg/l	<.01	<.01	<.01	.02	<.01	.03	<.01	.06	.02
Manganese Total	mg/l	<.01	<.01	.01	.01	<.01	.01	<.01	.01	.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	.0003	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	.02
Zinc Total	mg/l	.01	.01	.07	.03	.04	.02	.09	.02	.03
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	10	14	16	14	17	18	19	20	22
pH (field)	Units	8.1	8.4	8.4	8.4	8.2	8	8.2	8.4	8.3

PARAMETER		D/A Sample #: 6183-99	6191-04				
		Sample Collected on: 7/1/86	7/8/86	MINIMUM	MAXIMUM	MEAN	MEDIAN
Solids Total Dissolved	mg/l	220	260	200	260	230	230
Solids, Total Suspended	mg/l	6	7	3	8	5	5
Hardness(as CaCO3)	mg/l	160	160	150	160	160	160
Dissolved Oxygen	mg/l						
Oil and Grease	mg/l	<1	4	<1	6	2	<1
Phosphorous Total	mg/l	.021	.024	<.015	.037	.026	.024
Ammonia-Nitrogen	mg/l	.25	.4	<.01	.93	.37	.39
Total Kjeldahl Nitrogen	mg/l	.34	.53	<.01	1.2	.47	.34
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	.007	<.001	<.001	<.01	.003	.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	<.01	<.01	<.01	.03	.01	<.01
Lead Total	mg/l	.01	<.01	<.01	.06	.02	<.01
Manganese Total	mg/l	.01	<.01	<.01	.01	.01	.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	.0003	.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	.02	.01	<.01
Zinc Total	mg/l	.01	.01	.01	.09	.03	.02
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	20	25	10	25	18	18
pH (field)	Units	8.4	8.3	8	8.4	8.3	8.3

File: FILTER INFLUENT

for: Chicago District, Corps of Engineers
prepared by: Daily & Associates, Engineers, Inc., Peoria, Illinois
: Daily Analytical Laboratories, Peoria, Illinois

Sample Location: Sta. 2

PARAMETER		D/A Sample #: 6136-01	6143-60	6151-02	6155-58	6162-79	6169-50	6177-20
		Sample Collected on: 5/13/86	5/21/86	5/29/86	6/3/86	6/10/86	6/17/86	6/25/86
Solids Total Dissolved	mg/l							
Solids, Total Suspended	mg/l	14	19	5	6	3	3	4
Hardness(as CaCO3)	mg/l							
Dissolved Oxygen	mg/l							
Oil and Grease	mg/l							
Phosphorous Total	mg/l							
Ammonia-Nitrogen	mg/l							
Total Kjeldahl Nitrogen	mg/l							
Cyanide Total	mg/l							
Arsenic Total	mg/l							
Cadmium Total	mg/l							
Chromium Total	mg/l							
Copper Total	mg/l							
Lead Total	mg/l							
Manganese Total	mg/l							
Mercury Total	mg/l							
Nickel Total	mg/l							
Zinc Total	mg/l							
PCB'S Total	mg/l							
Temperature(OC) Field	oC							
pH (field)	Units							

PARAMETER		MINIMUM	MAXIMUM	MEAN	MEDIAN
Solids Total Dissolved	mg/l				
Solids, Total Suspended	mg/l	3	19	8	5
Hardness(as CaCO3)	mg/l				
Dissolved Oxygen	mg/l				
Oil and Grease	mg/l				
Phosphorous Total	mg/l				
Ammonia-Nitrogen	mg/l				
Total Kjeldahl Nitrogen	mg/l				
Cyanide Total	mg/l				
Arsenic Total	mg/l				
Cadmium Total	mg/l				
Chromium Total	mg/l				
Copper Total	mg/l				
Lead Total	mg/l				
Manganese Total	mg/l				
Mercury Total	mg/l				
Nickel Total	mg/l				
Zinc Total	mg/l				
PCB'S Total	mg/l				
Temperature(OC) Field	oC				
pH (field)	Units				

File: FILTER EFFLUENT

for: Chicago District, Corps of Engineers
prepared by: Daily & Associates Engineers, Inc. Peoria, Illinois
: Daily Analytical Laboratories Peoria, Illinois

Sample Location: Sta. 3

PARAMETER		D/A Sample #: 6143-51	6151-03	6155-49	6162-70	6169-41	6177-10	6183-100
		Sample Collected on: 5/21/86	5/29/86	6/3/86	6/10/86	6/17/86	6/24/86 6/25/86	7/1/86
Solids Total Dissolved	mg/l	250	230	230	200	230	240	210
Solids, Total Suspended	mg/l	2	2	4	<2	<2	<2	2
Hardness(as CaCO3)	mg/l	160	150	160	150	160	160	150
Dissolved Oxygen	mg/l							
Oil and Grease	mg/l	<1	<1	2	4	1	2	2
Phosphorous Total	mg/l	<.015	.022	.024	<.015	.015	<.015	<.015
Ammonia-Nitrogen	mg/l	<.01	<.01	<.01	<.01	<.01	.04	<.01
Total Kjeldahl Nitrogen	mg/l	.33	.22	.38	.27	.25	.81	.98
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	<.001	<.001	<.001	.003	.005	<.001	.004
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Lead Total	mg/l	<.01	.02	.02	.03	.2	.04	.01
Manganese Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	<.01	<.01	.01	<.01
Zinc Total	mg/l	.03	.13	.02	.02	.01	.02	.03
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	12						
pH (field)	Units	8	8.1	8.2	8	7.9	8.2	8.2

PARAMETER		D/A Sample #: Sample Collected on: MINIMUM	MAXIMUN	MEAN	MEDIAN
Solids Total Dissolved	mg/l	200	250	230	230
Solids, Total Suspended	mg/l	<2	4	2	2
Hardness(as CaCO3)	mg/l	150	160	160	160
Dissolved Oxygen	mg/l				
Oil and Grease	mg/l	<1	4	2	2
Phosphorous Total	mg/l	<.015	.024	.017	<.015
Ammonia-Nitrogen	mg/l	<.01	.04	.01	<.01
Total Kjeldahl Nitrogen	mg/l	.22	.98	.46	.33
Cyanide Total	mg/l	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	<.001	.005	.002	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01
Copper Total	mg/l	<.01	<.01	<.01	<.01
Lead Total	mg/l	<.01	.2	.05	.02
Manganese Total	mg/l	<.01	<.01	<.01	<.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	.01	.01	<.01
Zinc Total	mg/l	.01	.13	.04	.02
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	12	12	12	12
pH (field)	Units	7.9	8.2	8.1	8.1

for: Chicago District Corps of Engineers
prepared by: Daily and Associates Engineers, Inc., Peoria, Illinois
: Daily Analytical Laboratories, Peoria, Illinois

Sample Location: Sta. 4

PARAMETER		D/A Sample #: 6114-64	6119-103	6134-05	6143-52	6151-04	6155-50	6162-71	6169-42	6177-12
		Sample Collected on: 4/23/86	4/29/86	5/13/86	5/21/86	5/29/86	6/3/86	6/10/86	6/17/86	6/25/86
Solids Total Dissolved	mg/l	180	170	200	170	220	220	230	180	200
Solids, Total Suspended	mg/l	9	<2	6	10	6	8	11	3	8
Hardness(as CaCO3)	mg/l	140	140	140	140	140	140	140	140	140
Dissolved Oxygen	mg/l	9.2	10.1	9.6	10.2	9.5	9.9	9.5	9	9.3
Oil and Grease	mg/l	2	4	1	<1	<1	2	1	1	<1
Phosphorous Total	mg/l	<.03	<.03	<.015	<.015	<.015	.017	<.015	<.015	.015
Ammonia-Nitrogen	mg/l	.14	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Total Kjeldahl Nitrogen	mg/l	.14	<.1	.11	.40	.27	.25	.19	.16	.58
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	.005	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	.02	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Lead Total	mg/l	<.01	<.01	<.01	.02	.01	.02	<.01	.03	.04
Manganese Total	mg/l	<.01	<.01	.02	.02	.01	.02	.02	.01	.02
Mercury Total	mg/l	<.0002	<.0002	.0005	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	.02
Zinc Total	mg/l	.02	<.01	.03	.02	.03	.02	.02	<.01	.03
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	9	11	14	12	15	15	16	17	18
pH (field)	Units	8.2	8.3	8.3	8.2	8.2	8.3	8.3	8.3	8.3

PARAMETER		D/A Sample #: 6183-101	6191-05				
		Sample Collected on: 7/1/86	7/8/86	MINIMUM	MAXIMUM	MEAN	MEDIAN
Solids Total Dissolved	mg/l	170	210	170	230	200	200
Solids, Total Suspended	mg/l	6	<2	<2	11	6	6
Hardness(as CaCO3)	mg/l	140	140	140	140	140	140
Dissolved Oxygen	mg/l	8	9.5	8	10.2	9.4	9.5
Oil and Grease	mg/l	2	3	<1	4	1.7	1
Phosphorous Total	mg/l	.017	<.015	<.015	<.03	.018	<.015
Ammonia-Nitrogen	mg/l	<.01	<.01	<.01	.14	.02	<.01
Total Kjeldahl Nitrogen	mg/l	.23	.27	<.1	.58	.25	.23
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	.004	<.001	<.001	.005	.002	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	<.01	<.01	<.01	.02	.01	<.01
Lead Total	mg/l	.02	.01	<.01	.04	.02	.01
Manganese Total	mg/l	.01	<.01	<.01	.02	.01	.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	.02	.01	<.01
Zinc Total	mg/l	.01	.04	<.01	.04	.02	.02
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	20	16	9	20	15	15
pH (field)	Units	8.3	8.1	8.1	8.3	8.3	8.3

for: Chicago District, Corps of Engineers
prepared by: Daily & Associates Engineers, Inc. Peoria, Illinois
: Daily Analytical Laboratories Peoria, Illinois

Sample Location: Sta. 5

D/A Sample #:		6114-65	6119-104	6134-06	6143-53	6151-05	6155-51	6162-72	6169-43	6177-13
Sample Collected on:		4/23/86	4/29/86	5/13/86	5/21/86	5/29/86	6/3/86	6/10/86	6/17/86	6/25/86
PARAMETER										
Solids Total Dissolved	mg/l	180	160	160	200	210	200	180	220	230
Solids, Total Suspended	mg/l	10	6	3	3	3	6	2	5	5
Hardness(as CaCO3)	mg/l	140	140	140	140	140	140	140	140	140
Dissolved Oxygen	mg/l	9.5	10.8	9.8	10	9.6	9.9	9.9	9	9.1
Oil and Grease	mg/l	4	<1	<1	<1	<1	2	<1	<1	<1
Phosphorous Total	mg/l	<.03	<.03	<.015	<.015	<.015	.017	.031	<.015	.015
Ammonia-Nitrogen	mg/l	.07	<.01	<.01	<.01	.03	<.01	<.01	<.01	<.01
Total Kjeldahl Nitrogen	mg/l	.08	<.1	<.05	.3	.27	.29	.06	.27	.17
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	<.001	<.001	<.001	.002	<.001	<.001	.001	.005	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Lead Total	mg/l	<.01	<.01	<.01	.02	<.01	<.01	<.01	.06	.05
Manganese Total	mg/l	<.01	.01	<.01	.01	<.01	<.01	<.01	<.01	.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Zinc Total	mg/l	.05	.03	.05	.05	.05	.02	.02	.02	.04
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	9	11	14	12	15	15	16	17	18
pH (field)	Units	8.2	8.3	8.3	8.3	8.2	8.2	8.3	8.4	8.3

D/A Sample #:		6183-102	6191-06				
Sample Collected on:		7/1/86	7/8/86				
PARAMETER				MINIMUM	MAXIMUM	MEAN	MEDIAN
Solids Total Dissolved	mg/l	170	230	160	230	190	200
Solids, Total Suspended	mg/l	4	<2	<2	10	4	4
Hardness(as CaCO3)	mg/l	140	140	140	140	140	140
Dissolved Oxygen	mg/l	8.3	9.6	8.3	10.8	9.6	9.6
Oil and Grease	mg/l	<1	<1	<1	4	1	<1
Phosphorous Total	mg/l	<.015	.018	<.015	.031	.02	.015
Ammonia-Nitrogen	mg/l	<.01	<.01	<.01	.07	.02	<.01
Total Kjeldahl Nitrogen	mg/l	.19	.32	<.05	.32	.19	.19
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	.005	<.001	<.001	.005	.002	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	<.01	<.01	<.01	.01	.01	<.01
Lead Total	mg/l	.02	<.01	<.01	.06	.02	<.01
Manganese Total	mg/l	.01	<.01	<.01	.01	.01	<.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Zinc Total	mg/l	.02	.01	.01	.05	.03	.03
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	20	17	9	20	15	15
pH (field)	Units	8.3	8.2	8.2	8.4	8.3	8.3

for: Chicago District Corps of Engineers
prepared by: Daily and Associates Engineers, Inc., Peoria, Illinois
: Daily Analytical Laboratories, Peoria, Illinois

Sample Location: Sta. 6

D/A Sample #:		6114-66	6119-105	6134-07	6143-54	6151-06	6155-52	6162-73	6169-44	6177-14
Sample Collected on:		4/23/86	4/29/86	5/13/86	5/21/86	5/29/86	6/3/86	6/10/86	6/17/86	6/25/86
PARAMETER										
Solids Total Dissolved	mg/l	180	170	170	200	200	190	170	180	210
Solids, Total Suspended	mg/l	9	<2	<2	6	3	2	<2	<2	3
Hardness(as CaCO3)	mg/l	140	140	140	140	140	140	140	140	140
Dissolved Oxygen	mg/l	9.5	11.1	9.8	10	9.8	10	9.9	8.9	9.5
Oil and Grease	mg/l	<1	2	<1	<1	<1	3	2	<1	<1
Phosphorous Total	mg/l	<.03	<.03	<.015	<.015	<.015	.02	<.015	.039	.022
Ammonia-Nitrogen	mg/l	.05	<.01	<.01	.02	.02	<.01	<.01	<.01	<.01
Total Kjeldahl Nitrogen	mg/l	.19	<.1	.08	.33	.2	.14	.22	.22	.22
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	<.001	<.001	<.001	<.001	<.001	<.001	.001	.002	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	.01	<.01	<.01	<.01	.02	<.01	<.01	<.01	<.01
Lead Total	mg/l	<.01	<.01	<.01	<.01	.02	.02	<.01	.05	.02
Manganese Total	mg/l	<.01	<.01	<.01	.01	<.01	<.01	<.01	<.01	<.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Zinc Total	mg/l	.01	.02	.04	.01	.02	.02	.02	<.01	.02
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	9	10	15	13	15	16	16	17	19
pH (field)	Units	8.2	8.3	8.3	8.3	8.3	8.3	8.3	8.4	8.3

D/A Sample #:		6183-103	6191-07				
Sample Collected on:		7/1/86	7/8/86				
PARAMETER				MINIMUM	MAXIMUM	MEAN	MEDIAN
Solids Total Dissolved	mg/l	190	210	170	210	190	190
Solids, Total Suspended	mg/l	4	2	<2	9	3	2
Hardness(as CaCO3)	mg/l	140	140	140	140	140	140
Dissolved Oxygen	mg/l	8.2	9.6	8.2	11.1	9.7	9.8
Oil and Grease	mg/l	1	3	<1	3	2	<1
Phosphorous Total	mg/l	<.015	.016	<.015	.039	.02	.016
Ammonia-Nitrogen	mg/l	<.01	<.01	<.01	.05	.02	<.01
Total Kjeldahl Nitrogen	mg/l	.41	.21	.08	.41	.21	.21
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	.002	<.001	<.001	.002	.001	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	<.01	.07	<.01	.07	.02	<.01
Lead Total	mg/l	.01	.03	<.01	.05	.02	.01
Manganese Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Zinc Total	mg/l	.02	.04	<.01	.04	.02	.02
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	20	17	9	20	15	16
pH (field)	Units	8.3	8.2	8.2	8.4	8.3	8.3

for: Chicago District Corps of Engineers
prepared by: Daily and Associates Engineers, Inc., Peoria, Illinois
: Daily Analytical Laboratories, Peoria, Illinois

Sample Location: Sta. 7

PARAMETER		D/A Sample #: 6114-67	6119-106	6134-08	6143-55	6151-07	6155-53	6162-74	6169-45	6177-15
		Sample Collected on: 4/23/86	4/29/86	5/13/86	5/21/86	5/29/86	6/3/86	6/10/86	6/17/86	6/25/86
Solids Total Dissolved	mg/l	200	170	160	190	210	200	200	190	200
Solids, Total Suspended	mg/l	8	<2	<2	6	2	<2	<2	<2	3
Hardness(as CaCO3)	mg/l	140	140	140	140	140	140	140	140	140
Dissolved Oxygen	mg/l	9.5	10.8	9.7	10	10	10	9.9	8.8	9.1
Oil and Grease	mg/l	2	<1	<1	<1	<1	1	2	2	<1
Phosphorous Total	mg/l	<.03	<.03	<.015	.037	<.015	<.015	<.015	<.015	.015
Ammonia-Nitrogen	mg/l	.04	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Total Kjeldahl Nitrogen	mg/l	.43	<.1	.14	.23	<.05	.04	.2	<.05	.13
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	.003	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	.01	<.01	<.01	<.01	.02	<.01	<.01	<.01	<.01
Lead Total	mg/l	<.01	<.01	<.01	<.01	<.01	.01	.03	.04	.02
Manganese Total	mg/l	<.01	.01	<.01	.01	<.01	.01	<.01	<.01	<.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	.0013	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Zinc Total	mg/l	.02	.04	.04	.03	.02	.04	.02	.02	.02
PCB'S Total	mg/l	<.0001	<.0001	<.0001	.0009	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	9	10	15	13	15	16	16	17	19
pH (field)	Units	8.2	8.4	8.3	8.3	8.2	8.3	8.4	8.4	8.3

PARAMETER		D/A Sample #: 6183-106	6191-08				
		Sample Collected on: 7/1/86	7/8/86	MINIMUM	MAXIMUM	MEAN	MEDIAN
Solids Total Dissolved	mg/l	190	200	160	210	170	200
Solids, Total Suspended	mg/l	5	2	<2	8	3	2
Hardness(as CaCO3)	mg/l	140	140	140	140	140	140
Dissolved Oxygen	mg/l	8.2	9.6	8.2	10.8	9.6	9.7
Oil and Grease	mg/l	1	2	<1	2	1	1
Phosphorous Total	mg/l	.017	.017	<.015	.037	.02	.015
Ammonia-Nitrogen	mg/l	<.01	<.01	<.01	.04	.01	<.01
Total Kjeldahl Nitrogen	mg/l	<.05	.18	.04	.43	.15	.13
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	.004	<.001	<.001	.004	.001	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	<.01	<.01	<.01	.02	.01	<.01
Lead Total	mg/l	.01	<.01	<.01	.04	.02	<.01
Manganese Total	mg/l	<.01	<.01	<.01	.01	.01	<.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Zinc Total	mg/l	.01	<.01	<.01	.04	.02	.02
PCB'S Total	mg/l	<.0001	<.0001	<.0001	.0009	.0002	<.0001
Temperature(OC) Field	oC	20	17	9	20	15	16
pH (field)	Units	8.4	8.3	8.2	8.4	8.3	8.3

for: Chicago District Corps of Engineers
prepared by: Daily and Associates Engineers, Inc., Peoria, Illinois
: Daily Analytical Laboratories, Peoria, Illinois

Sample Location: Sta. 8

D/A Sample #:		6114-68	6119-107	6134-09	6143-56	6151-08	6155-54	6162-75	6169-46	6177-16
Sample Collected on:		4/23/86	4/29/86	5/13/86	5/21/86	5/29/86	6/3/86	6/10/86	6/17/86	6/25/86
PARAMETER										
Solids Total Dissolved	mg/l	230	170	160	170	190	190	180	200	190
Solids, Total Suspended	mg/l	8	3	2	6	3	3	<2	2	4
Hardness(as CaCO3)	mg/l	140	140	140	140	140	140	140	140	140
Dissolved Oxygen	mg/l	9.9	10.7	10	10.2	10.4	10	9.9	9.1	9.2
Oil and Grease	mg/l	<1	<1	<1	1	<1	1	1	<1	1
Phosphorous Total	mg/l	<.03	<.03	<.015	<.015	.015	.016	<.015	<.015	<.015
Ammonia-Nitrogen	mg/l	.09	.02	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Total Kjeldahl Nitrogen	mg/l	1.1	<.1	.30	<.05	<.05	.35	.27	.07	.25
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	.002	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	.02	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Lead Total	mg/l	<.01	<.01	<.01	.02	<.01	.01	<.01	.04	.02
Manganese Total	mg/l	<.01	<.01	<.01	.01	<.02	<.01	<.01	<.01	<.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	.02	<.01
Zinc Total	mg/l	.01	.02	.04	.02	.07	.02	.02	.02	.03
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	9	10	15	12	15	15	16	17	18
pH (field)	Units	8.2	8.3	8.3	8.2	8.2	8.2	8.4	84	8.3

D/A Sample #:		6183-107	6191-09				
Sample Collected on:		7/1/86	7/8/86				
PARAMETER				MINIMUM	MAXIMUM	MEAN	MEDIAN
Solids Total Dissolved	mg/l	190	240	160	240	190	190
Solids, Total Suspended	mg/l	3	2	<2	8	3	3
Hardness(as CaCO3)	mg/l	10	140	140	140	140	140
Dissolved Oxygen	mg/l	8.4	8.9	8.4	10.7	9.8	10
Oil and Grease	mg/l	<1	<1	<1	1	1	<1
Phosphorous Total	mg/l	<.015	.019	<.015	<.03	.018	<.015
Ammonia-Nitrogen	mg/l	<.01	<.01	<.01	.09	.02	<.01
Total Kjeldahl Nitrogen	mg/l	<.05	.27	<.05	1.1	.26	.25
Cyanide Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Arsenic Total	mg/l	<.001	<.001	<.001	.002	.001	<.001
Cadmium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Chromium Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Copper Total	mg/l	<.01	<.01	<.01	.02	.01	<.01
Lead Total	mg/l	.02	.02	<.01	.04	.02	.01
Manganese Total	mg/l	<.01	<.01	<.01	<.01	<.01	<.01
Mercury Total	mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Nickel Total	mg/l	<.01	<.01	<.01	.02	.01	<.01
Zinc Total	mg/l	.01	.01	.01	.07	.02	.02
PCB'S Total	mg/l	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Temperature(OC) Field	oC	19	18	9	19	15	15
pH (field)	Units	8.4	8.1	8.1	8.4	8.3	8.3

File: TURBIDITIES

TITLE
CORPS of ENGINEERS
FOR: CHICAGO DISTRICT, CORPS OF ENGINEERS
PREPARED BY: DAILY & ASSOCIATES, ENGINEER, INC., PEORIA, ILLINOIS
: DAILY ANLYTICAL LABORATORIES, PEORIA, ILLINOIS

WORK ORDER 0010 TURBIDITY RESULTS

STATION / SAMPLE DATE	#9	#10	#11	#12	#13	#14
5/13/86	6.2	6	8.6	4.4	140	9.5
5/21/86*	6.6	6.6	9	12	8.3	8.6
5/21/86**	6.6	6.8	7.8	14	9.2	17
5/29/86*	2.9	2.8	3.6	4.2	48	14
5/29/86**	4	4	4.2	4.2	60	15
6/3/86*	5.2	5.2	5.8	5.2	30	8.1
6/3/86**	6.8	6.2	6.8	6.2	36	12
6/10/86*	4	3.6	8.4	60	14	8.4
6/10/86**	4	3.8	4.4	57	15	13
6/17/86*	3	3.2	3.6	3.8	18	5.3
6/17/86**	3	3.5	6	4.2	20	28
6/25/86*	8	6.4	4.6	9	16	7.4
6/25/86**	7.8	8.8	32	10	16	11
MINIMUM	2.9	2.8	3.6	3.8	8.3	5.3
MAXIMUM	8	8.8	32	60	140	28
MEAN	4.9	5.1	8.1	15	33	12
MEDIAN	5.2	5.2	6	6.2	18	11

* SURFACE
** MID DEPTH

Daily Analytical Laboratories
1621 W. Candletree Drive Peoria, Illinois 61614
Tel. (309) 692-5252

Corps of Engineers 5671.10

CDF Station 1

Date: April 23, 1986 Time: 1:00PM
Air Temp(C): 14.3 Depth: 20.5ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	9.5	9.2	310
2	9.0	9.0	
3	9.0	9.1	
4	9.0	9.0	
5	9.0	9.0	
6	9.0	9.0	
7	9.0	9.0	
8	9.0	9.0	
9	9.0	9.0	
10	9.0	9.0	310
11	9.0	9.0	
12	9.0	8.9	
13	9.0	8.9	
14	9.0	8.9	
15	9.0	8.9	
16	9.0	8.9	
17	9.0	8.8	
18	8.8	8.9	
19	8.8	8.9	
20	8.8	8.9	300

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CDF Station 1

Date: April 29, 1986 Time: 1:10PM
Air Temp(C): 23.3 Depth: 22.0ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	14	8.8	260
2	14	8.6	
3	14	10.0	
4	14	10.0	
5	14	10.0	
6	14	10.0	
7	14	10.0	
8	14	10.0	
9	14	10.0	
10	14	10.0	
11	14	10.0	280
12	14	10.0	
13	14	10.0	
14	14	10.0	
15	14	10.0	
16	14	10.0	
17	14	10.0	
18	13	10.2	
19	13	10.2	
20	13	10.2	
21	13	10.2	280
22	13	10.2	

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CDF Station 1

Date: MAY 13, 1986 Time: 8:00AM
Air Temp(C): 16.1 Depth: 22.5ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	16	8.6	330
2	16	9.0	
3	16	9.0	
4	16	9.1	
5	16	9.2	
6	16	9.2	
7	16	9.2	
8	16	9.2	
9	16	9.2	
10	16	9.1	
11	16	9.0	330
12	16	9.0	
13	16	9.0	
14	16	9.0	
15	16	9.0	
16	16	9.0	
17	16	9.0	
18	16	8.7	
19	16	8.6	
20	16	8.6	
21	16	8.4	340
22	16	8.4	

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CDF Station 1

Date: MAY 21, 1986 Time: 2:20PM
Air Temp(C): 18.7 Depth: 20.0ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	14	9.2	310
2	14	9.2	
3	14	9.2	
4	13	9.4	
5	13	9.4	
6	13	9.4	
7	13	9.4	
8	13	9.4	
9	13	9.4	
10	13	9.4	
11	13	9.4	
12	13	9.4	
13	13	9.4	330
14	13	9.4	
15	13	9.4	
16	13	9.3	
17	13	9.3	
18	13	9.3	
19	13	9.3	340

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CDF Station 1

Date: MAY 29, 1986 Time: 2:20PM
Air Temp(C): 17.7 Depth: 19.0ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	17	8.7	340
2	17	9.1	340
3	17	9.2	
4	16	9.3	
5	16	9.4	338
6	16	9.4	
7	16	9.4	
8	16	9.4	
9	16	9.4	340
10	16	9.4	
11	16	9.3	
12	16	9.2	
13	15	9.0	
14	15	8.0	330
15	14	7.6	
16	14	7.2	
17	14	7.0	
18	14	6.4	330

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CDF Station 1

Date: June 3, 1986 Time: 4:00PM
Air Temp(C): 17.5 Depth: 20.0ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	18	8.7	360
2	18	9.0	
3	18	9.0	
4	18	9.1	
5	18	9.2	
6	18	9.2	
7	17	9.1	
8	17	9.1	
9	17	9.1	
10	17	9.1	350
11	17	9.1	
12	17	9.0	
13	17	9.0	
14	17	9.0	
15	16	9.0	
16	16	8.9	
17	16	8.8	
18	16	8.8	350
19	16	8.8	

Daily Analytical Laboratories
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Tel. (309) 692-5252

Eugene J. Daily, Chairman
John P. Higgins, President
Otis E. Michels, Vice President
James F. Dallmeyer
Laboratory Director

Corps of Engineers 5671.10

CDF Station 1

Date: JUNE 10, 1986 Time: 2:30PM
Air Temp(C): 28.7 Depth: 19.0ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	20	8.0	350
2	20	8.2	
3	20	8.4	
4	20	8.4	
5	20	8.5	
6	20	8.5	
7	19	8.5	
8	19	8.5	
9	19	8.5	
10	19	8.4	350
11	19	8.3	
12	19	8.3	
13	18	8.4	
14	17	8.5	
15	17	8.4	
16	17	7.8	
17	17	7.7	
18	17	7.0	350

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CDF Station 1

Date: JUNE 17, 1986 Time: 5:25PM
Air Temp(C): 16.5 Depth: 20.0ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	21	7.8	380
2	21	7.6	
3	21	7.6	
4	22	7.6	
5	21	7.6	
6	21	7.2	
7	21	7.6	
8	21	7.6	
9	21	7.6	
10	21	7.5	370
11	20	7.5	
12	20	7.4	
13	20	7.3	
14	20	7.0	
15	20	6.8	
16	19	6.0	
17	18	5.0	
18	17	4.6	
19	17	4.6	370
20	17	4.4	

Daily Analytical Laboratories
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CDF Station 1

Date: JUNE 24, 1986 Time: 3:00PM
Air Temp(C): 16.3 Depth: 17.0ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	22	7.8	370
2	22	8.0	
3	22	8.0	
4	22	8.2	
5	22	8.3	
6	22	8.1	
7	22	8.2	
8	22	8.0	
9	22	8.0	
10	22	8.0	380
11	22	8.0	
12	22	8.0	
13	22	8.0	
14	22	8.0	
15	22	8.0	
16	20	5.0	380
17	19	4.2	

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Tel. (309) 692-5252

Corps of Engineers 5671.10

CDF Station 1

Date: JULY 1, 1986 Time: 5:45PM
Air Temp(C): 17.7 Depth: 17.0ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	21	8.0	380
2	21	8.0	
3	21	8.0	
4	21	8.0	
5	21	8.0	
6	21	7.9	
7	21	7.9	
8	21	7.9	380
9	21	7.9	
10	21	7.9	
11	21	7.9	
12	21	7.9	
13	21	7.8	
14	21	7.8	
15	21	7.8	
16	21	7.8	380

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CDF Station 1

Date: JULY 8, 1986 Time: 12:55PM
Air Temp(C): 30.2 Depth: 18.0ft

Depth(ft)	Temp(C)	D.O.(mg/L)	Specific Conductance (uS) @25C
1	25	8.8	350
2	25	8.8	
3	25	8.8	
4	25	8.8	
5	25	8.8	
6	25	8.7	
7	25	8.6	
8	24	8.3	360
9	24	8.2	
10	24	8.0	
11	24	8.0	
12	24	7.8	
13	23	7.6	
14	23	7.5	
15	22	7.2	
16	21	6.0	
17	21	5.9	360

APPENDIX B

LOG OF OPERATIONS

Date	Hours Operational Dredging	Hours Disposal	Hours Filtering	Weather Delays/Comments
4-10-86				Mobilization begins in Kentucky
4-22-86				On site assembly of chute sections begins at rental location.
5-7-86				Dredging begins with cable markings by bouys.
5-8-86	9			
5-9	7.5			
5-10	0	8	0	Dredge wait for tug or scow
Sunday				
5-12	8	8	7.5	
5-13	9.5*	8	8	*Contractor incurred 2.5 hr delay due to no extra barge when concurrence with spec section 2B, 4.4 was requested
5-15	8	8	8	
5-15	8	8	9	30 min waiting for dewatering
5-16	8	8	8	
5-17	8	8	8	
Sunday				
5-18				Calumet Harbor 3 to 5' swell
5-19	9	8	8	
5-20	0	0	0	Weather Delay
5-21	8	8	8	
5-22	8	8	8	
5-23	8	8	8	
5-24	9	8	8	

Date	Hours Operational Dredging	Hours Disposal	Hours Filtering	Weather Delays/Comments
6-19	11.5	8	8	
6-20	8	8	8	Pump H_2O from barge
6-21	8	8	8	Silt Clay
Sunday				
6-23	8	8	8	2 hrs pump H_2O from scow
6-24	4	0	0	weather delay white caps
6-25	12	8	0	2-3% debris, filter cell pump under repair - 2 days down
6-26	14.5	8	0	15 min pump H_2O from scows
6-27	10	8	8	
6-28	0	8	8	Dredge demobolized from Chicago River
Sunday				
6-30	0	0	0	Dredging complete
7-9	0	0	0	Removal of H_2O from force main 6200 gallons disposed in CDF