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STATE OF ILLINOIS
Pollution Control Board

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

CITY OF CHARLESTON, ILLINOIS,	)	
	)	
Petitioner,	)	
	)	
v.	)	**PCB 04 - 111**
	)	
	)	
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY,	)	
	)	
	)	
Respondent,	)	

NOTICE OF FILING

To:

Illinois Pollution Control Board
100 West Randolph Street
James R. Thompson Center
Suite 11-500
Chicago, Illinois 60601-3218

Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Pollution Control Board, Substitute Exhibits to the Variance Petition previously filed herein said exhibits being attached hereto this Notice.

DATED this 2nd day of February 2004

Brian L. Bower, City Attorney

Brian L. Bower
City Attorney
600 Jackson Avenue
Charleston, Illinois 61920
(217) 345-4012

ORIGINAL

CERTIFICATE OF SERVICE

The undersigned, being first duly sworn upon oath deposes and states that on the ______ day of February 2004 , by way of depositing a photocopy of **NOTICE OF FILING** along with ten (10) copies of **ORIGINAL SUBSTITUTE EXHIBITS** going to the Illinois Pollution Control Board and one (1) copy going to the Illinois Environmental Protection Agency via Overnight mail with the proper postage prepaid and addressed to the following in the manner set forth:

Illinois Pollution Control Board
100 W. Randolph
James R. Thompson Center
Suite 11500
Chicago, Illinois 60601-3218

Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

BY: ______________________________

SUBSCRIBED and **SWORN** to before
me this 2nd day of February 2004.

____
NOTARY PUBLIC

Brian L. Bower
City Attorney
600 Jackson Avenue
Charleston, IL 61920
(217) 345-4012
(217) 345-7554 (fax)

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JAN 13 2004

STATE OF ILLINOIS
Pollution Control Board

ILLINOIS POLLUTION CONTROL BOARD
January 13, 2004

RECEIVED
CLERK'S OFFICE

FEB - 3 2004

STATE OF ILLINOIS
Pollution Control Board

CITY OF CHARLESTON, ILLINOIS,	)	
	)	
Petitioner,	)	
	)	
v.	)	PCB 04-111
	)	(Variance - Public Water Supply)
ILLINOIS ENVIRONMENTAL	)	
PROTECTION AGENCY,	)	
	)	
Respondent.	)	

HEARING OFFICER ORDER

The parties are advised that this matter has been assigned to the hearing officer identified below. From this date forward, any pleading filed with the Clerk of the Board in this matter must also be served individually on the hearing officer.

The parties are directed to participate in a telephone status conference with the hearing officer at 10:00 a.m. on January 23, 2004. The telephone status conference will be initiated by the complainant. The parties shall be prepared to discuss the status of this matter.

The statutory decision deadline is May 7, 2004, which would require the Board to decide this matter at its meeting on May 6, 2004. If petitioner does not waive the statutory decision deadline, the parties shall be prepared to set this matter for hearing.

IT IS SO ORDERED.

Carol Sudman

Carol Sudman
Hearing Officer
Illinois Pollution Control Board
1021 North Grand Avenue East
P.O. Box 19274
Springfield, Illinois 62794-9274
217/524-8509
sudmanc@ipcb.state.il.us

CERTIFICATE OF SERVICE

It is hereby certified that true copies of the foregoing order were mailed, first class, to each of the following on January 13, 2004:

Brian L. Bower
Brainard, Bower and Kramer Law Office
600 Jackson Avenue
Charleston, IL 619203

IEPA, Division of Legal Counsel
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

It is hereby certified that a true copy of the foregoing order was hand delivered to the following on January 13, 2004:

Dorothy M. Gunn
Illinois Pollution Control Board
James R. Thompson Center
100 W. Randolph St., Ste. 11-500
Chicago, Illinois 60601

Carol Sudman

Carol Sudman
Hearing Officer
Illinois Pollution Control Board
1021 North Grand Avenue East
P.O. Box 19274
Springfield, Illinois 62794-9274
217/524-8509
sudmanc@ipcb.state.il.us

ILLINOIS POLLUTION CONTROL BOARD
December 6, 2001

CITY OF CHARLESTON, Petitioner, v. ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, Respondent.	)	COPY PCB 02-20 (Variance – Public Water Supply)

OPINION AND ORDER OF THE BOARD (by N.J. Melas):

This matter is before the Board pursuant to a petition for variance filed by the City of Charleston (Charleston), on August 16, 2001. Pursuant to Section 35(a) of the Environmental Protection Act (Act), the Board may grant variances from Board regulations whenever immediate compliance with Board regulations would impose an arbitrary or unreasonable hardship on the petitioner. 415 ILCS 5/35(a) (2000). The Illinois Environmental Protection Agency (Agency) is required to appear in hearings on variance petitions. 415 ILCS 5/4(f) (2000). The Agency is charged with the responsibility of investigating each variance petition and making a recommendation to the Board as to the disposition of the petition. 415 ILCS 5/37(a) (2000).

Charleston is seeking a variance for its drinking water treatment plant (plant). The requested variance is from Subsection 611.743(a)(1) of the Board's primary drinking water standards. 35 Ill. Adm. Code 611.743.[1] This provision mandates lower turbidity levels in filtered drinking water samples. Charleston has requested the variance for a period of two years. Pet. at 2; resp. at 1.[2]

In a variance proceeding, the burden is on the petitioner to present proof that immediate compliance with Board regulations would cause an arbitrary or unreasonable hardship, which outweighs public interest in compliance with the regulations. Marathon Oil v. Environmental Protection Agency, 242 Ill. App. 3d 200, 206, 610 N.E.2d 789, 793 (5th Dist. 1993). Pursuant to Section 35(a) of the Act, the Board finds that Charleston has presented

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[1] These standards were adopted by the Board in SDWA Update, USEPA Regulations (July 1, 1998 through December 31, 1998), R99-12 (July 22, 1999).

[2] Charleston's petition will be cited as "Pet. at __"; the Agency's recommendations will be cited as "Rec. at __"; Charleston's response to the hearing officer order will be cited as "Resp. at __".

requirements of subsection (a) or (b) of this Section or Section 611.250 (b) or (c) by December 31, 2001.

a) Conventional filtration treatment or direct filtration.

1) For systems using conventional filtration or direct filtration, the turbidity level must be less than or equal to 0.3 NTU in at least 95% of the measurements taken each month, measured as specified in Sections 611.531 and 611.533.

Thus, without the relief provided in a variance, Charleston will have to produce water with an NTU of 0.3 or less 95% of the time by December 31, 2001. Based on Charleston's data from 1998-2001, its existing plant can only produce finished water with a turbidity of 0.3 NTU or less 70% of the time. During that period, the lowest monthly compliance rate with the 0.3 NTU standard was just under 34%. Pet at 5, 9, 10 exh. A.

COMPLIANCE PLAN

In order for Charleston to produce 0.3 NTU combined finished water turbidities 95% of the time, it must build a new plant. Charleston estimated that construction of the plant will take 36 months but will not be complete by the end of December 2001. Charleston began preliminary engineering work in December 2000 and finished it in May 2001. It is in the process of design and permitting the new plant that it began in June 2001 and expects to complete by April 2002. Charleston predicted that construction, startup, and additional permitting activities will take from May 2002 until December 2003. It estimated that the new plant will cost $8.192 million, including $96,000 for preliminary design, $796,000 for design, and $7.3 million for construction. Future annualized costs are expected to be $1.6 million including debt service and operating expenses. Pet. at 5-6, 8. Charleston predicted that the turbidity in the water from the new plant will be 0.1 NTU or less 95% of the time, thereby exceeding the new standard. Pet. at 8-9.

During the term of the variance, Charleston proposes to comply with the current turbidity requirement of 0.5 NTU or less 95% of the time at Section 611.250(a)(1) of the Board's regulations. Pet. at 11.

Charleston's new plant will include a new rapid mixer; a pre-sedimentation basin to reduce turbidity; new lime softening contact units for hardness and reduced turbidity; new recarbonation basins for pH adjustment; a new ozone contact basin to control taste, odor, and microbial contaminants; and new granular activated carbon filters to control taste, odor, and turbidity. Pet. at 7-8.

ever been detected in the finished water. Charleston claimed that the health risk to its consumers during the requested two-year term of the variance will be minimal. Pet. at 9-10; resp. at 2, exh. B.

The Agency generally agreed, mentioning that Charleston has not had an outbreak of a waterborne disease since its current plant was constructed in 1964 and that the variance should not impose a significant risk to the public or the environment. Rec. at 8.

CONSISTENCY WITH FEDERAL LAWS

The basis for Subsection 611.743(a)(1) of the Board's regulations is the "Interim Enhanced Surface Water Treatment Rule" (IESWTR). *See* 63 Fed. Reg. 69,478 (Dec. 16, 1998); codified at 40 C.F.R. § 141.173 (2000).

Charleston and the Agency agreed that the requested variance may be granted consistent with Section 1412(b)(10) of the Safe Drinking Water Act. 42 U.S.C. Sec. 300g-1(b)(10); pet. at 12; rec. at 8-9. That section provides, in pertinent part:

> [A] State . . . may allow up to 2 additional years [beyond the effective date of the regulation] to comply with a . . . treatment technique if the . . . State . . . determines that additional time is necessary for capital improvements.

Both Charleston and the Agency agreed that constructing the new plant is a capital improvement necessary to comply with Subsection 611.743(a)(1) of the Board's regulations. Pet. at 12; rec. at 9.

Illinois has not yet received federal primacy authorization for the IESWTR. The variance thus only provides relief from state turbidity standards.

CONCLUSION

The Board finds that, if the instant variance petition is not granted, Charleston will incur an arbitrary or unreasonable hardship. For this reason, the Board will grant the requested variance, subject to the conditions recommended by the Agency.

This opinion constitutes the Board's findings of fact and conclusions of law.

ORDER

The Board hereby grants petitioner, the City of Charleston, a variance from 35 Ill. Adm. Code 611.743(a)(1) for its existing drinking water treatment plant (plant) in Charleston, Coles County, Illinois, subject to the following conditions:

City of Charleston
Petitioner

[signature]
Authorized Agent

Mayor
Title

12/19/01
Date

Section 41(a) of the Environmental Protection Act provides that final Board orders may be appealed directly to the Illinois Appellate Court within 35 days after the Board serves the order. 415 ILCS 5/41(a) (2000); *see also* 35 Ill. Adm. Code 101.300(d)(2), 101.906, 102.706. Illinois Supreme Court Rule 335 establishes filing requirements that apply when the Illinois Appellate Court, by statute, directly reviews administrative orders. 172 Ill. 2d R. 335. The Board's procedural rules provide that motions for the Board to reconsider or modify its final orders may be filed with the Board within 35 days after the order is received. 35 Ill. Adm. Code 101.520; *see also* 35 Ill. Adm. Code 101.902, 102.700, 102.702.

I, Dorothy M. Gunn, Clerk of the Illinois Pollution Control Board, certify that the Board adopted the above opinion and order on December 6, by a vote of 5-0.

Dorothy M. Gunn, Clerk
Illinois Pollution Control Board

Exhibit 'B'

CITY OF CHARLESTON
TURBIDITY RESULTS
CALENDAR YEARS 2002 AND 2003

MONTH/YEAR	# OF SAMPLES COLLECTED	# OF SAMPLES UNDER 0.344 NTU'S	% UNDER 0.344 NTU'S (95% Req'd)
JAN 2002	327	320	**97.9%**
FEB 2002	304	243	79.9%
MAR 2002	322	318	**98.8%**
APR 2002	329	271	82.4%
MAY 2002	326	277	85.0%
JUNE 2002	316	304	**96.2%**
JULY 2002	339	242	71.4%
AUG 2002	313	152	48.6%
SEPT 2002	333	243	73.0%
OCT 2002	323	294	91.0%
NOV 2002	292	292	**100.0%**
DEC 2002	289	204	70.6%
JAN 2003	285	254	89.1%
FEB 2003	265	255	**96.2%**
MAR 2003	286	286	**100.0%**
APR 2003	282	282	**100.0%**
MAY 2003	280	277	**98.9%**
JUNE 2003	265	263	**99.2%**
JULY 2003	283	274	**96.8%**
AUG 2003	301	301	**100.0%**
SEPT 2003	287	286	**99.7%**
OCT 2003	287	287	**100.0%**
NOV 2003	248	247	**99.6%**
DEC 2003	257	246	**95.7%**

Comments:

1. Added a new cationic polymer feed system at the rapid mix chamber in November of 2002.
2. Achieved 95% of readings under 0.544 NTU's in all 22 months.

CITY OF CHARLESTON, ILLINOIS
WATER TREATMENT PLANT IMPROVEMENTS

ENGINEER'S DESIGN SUMMARY

PREPARED BY:

CRAWFORD, MURPHY & TILLY, INC.
2750 West Washington Street
Springfield, Illinois 62702

JUNE, 2003

INTRODUCTION

Executive Summary

The City of Charleston, Illinois retained Crawford, Murphy & Tilly, Inc. (CMT) to evaluate improvements to the Charleston Water Treatment Facilities that are necessary in order to reliably meet current and future water production demand and address the taste and odor issues confronting the City of Charleston. In addition, future regulatory restrictions associated with the pending turbidity limit of 0.3 NTU promulgated under the Interim Enhanced Surface Water Treatment Rule (IESWTR) could present compliance related problems for the existing facilities. The improvements will also address deficiencies associated with certain treatment processes that could impact the facility's ability to consistently, safely and reliably meet applicable drinking water standards.

Included in this Engineer's Design Summary is a summary of the proposed improvements for providing increased capacity to meet future needs, reliably meet required drinking water standards and address problems associated with taste and odor.

Background – Existing Facility

The City of Charleston has been providing potable water for over 100 years. The existing water treatment plant was constructed in 1964, and since the original construction has received two major upgrades. Several deficiencies have been identified associated with certain treatment processes that could impact the facility's ability to consistently, safely and reliably meet applicable drinking water standards. The most significant deficiencies associated with the existing treatment facilities are:

- The existing raw water pumping station structure is in poor condition.
- The existing raw water pumps are old, are near the end of their useful service life, and should be replaced. The two pumps are both constant speed type, resulting in intermittent operation of the treatment facilities when water demand is less than the capacity of the smaller pump. Such operation has been shown to reduce the performance of the plant. In addition, based upon future growth projections the firm pumping capacity will need to be increased to meet future demand.
- The existing raw water intake structure is located in an area of the lake that has experienced siltation. The conditions at the existing intake structure result in reduced performance with only the highest intake screens capable of providing service. This condition affects both the quality and quantity of raw water available to the treatment plant.
- The plant's existing piping configuration does not allow for positive flow split to the three existing lime softening basins, resulting in unequal distribution of the hydraulic loading among the basins. The piping configuration also is likely to result in inaccurate flow measurement.
- The existing plant has only one lime feed system. No back-up system is available, and in the event of a system failure lime must be fed manually.

- The existing lime softening basins are not covered and are exposed to the elements. Debris that enters the tanks (leaves, etc.) causes intermittent plugging of the sludge lines. The equipment has needed a high degree of maintenance.
- The existing recarbonation basin is inadequately sized, and the current piping configuration is likely resulting in short-circuiting.
- The existing filters have shallow wash water troughs, resulting in either insufficient cleansing of the filter media or loss of media over the weirs during backwashing.
- The existing high service pumps require a high level of maintenance. The smallest pump will not meet the system demands and is rarely used. Under certain conditions the pumps experience priming problems. In addition, based upon future growth projections the firm pumping capacity will need to be increased to meet future demand.
- The existing chemical feed building does not currently have adequate ventilation. Also inadequate are visual and audible alarms for emergency situations.
- A high percentage of electrical and control equipment at the plant is in poor condition. Certain areas could be considered potentially hazardous.
- Taste and odor problems have not been resolved.

The high cost to maintain the existing facility, coupled with the numerous concerns mentioned above, have prompted the City to construct a new water treatment plant that will ensure adequate treatment as growth continues over the next 20 years. Construction of a new plant will allow the existing facilities to remain in service while new facilities are built, with no lapse in water quality or availability. In addition, the end result will be a totally new facility with state-of-the-art technology.

Design Basis

The following is a summary of the basis of design associated with the proposed WTP improvements. The following values are based upon design year 2025.

Current minimum daily demand ....1.00 MGD
Current average daily demand ....1.60 MGD
Design maximum daily demand ....4.50 MGD
Design minimum daily demand ....1.00-1.50 MGD
Design average daily demand.................................3.25 MGD

Raw water data collected from January 2000 to September 2002 was analyzed to verify the percentage of time raw water is pumped to the existing treatment plant for various flow ranges. This data is presented in Table 1 – Raw Water Data January 2000 – August 2002.

The design maximum daily demand of 4.50 MGD is at the request of the City to maximize the economy of scale when constructing a new water treatment plant.

CMT discussed the maximum daily demand of 4.50 MGD with IEPA personnel during the early planning and design phases of the project. IEPA stated that 4.50 MGD appears to be conservative and more than adequate and that if this was an SRF Loan project they would not be inclined to approve a design flow as high as 4.50 MGD. As such, the design maximum daily demand shall be 4.50 MGD. Plant hydraulics were designed at 4.50 MGD. A copy of the hydraulic profile is shown in Figure 1.

The design minimum daily demand simply extends the range of the current minimum daily demand.

The design average daily demand uses the average of the current peak to average ratio from the last three years, which is 1.3812, and applies it to the design peak of 4.50 MGD to obtain the design average daily demand of 3.25 MGD.

Table 1 - Raw Water Data January 2000 – August 2002

Flow	Total for Time Period	% Occurrence	% Occurrence Accumulated	% of Time
< 1.0	9	0.92	0.92	100.00
1.00 - 1.05	7	0.72	1.64	99.08
1.05 - 1.10	12	1.23	2.87	98.36
1.10 - 1.15	16	1.64	4.52	97.13
1.15 -1.20	22	2.26	6.78	95.48
1.20 -1.25	30	3.08	9.86	93.22
1.25 -1.30	37	3.80	13.66	90.14
1.30 -1.35	52	5.34	18.99	86.34
1.35 -1.40	64	6.57	25.56	81.01
1.40 -1.45	52	5.34	30.90	74.44
1.45 -1.50	58	5.95	36.86	69.10
1.50 -1.55	56	5.75	42.61	63.14
1.55 -1.60	56	5.75	48.36	57.39
1.60 -1.65	58	5.95	54.31	51.64
1.65 -1.70	56	5.75	60.06	45.69
1.70 -1.75	66	6.78	66.84	39.94
1.75 -1.80	59	6.06	72.90	33.16
1.80 -1.85	62	6.37	79.26	27.10
1.85 -1.90	54	5.54	84.80	20.74
1.90 -1.95	40	4.11	88.91	15.20
1.95 -2.0	36	3.70	92.61	11.09
2.0 - 2.05	18	1.85	94.46	7.39
2.05 - 2.10	18	1.85	96.30	5.54
2.10 - 2.15	12	1.23	97.54	3.70
2.15 - 2.20	11	1.13	98.67	2.46
2.20 - 2.25	6	0.62	99.28	1.33
2.25 - 2.30	4	0.41	99.69	0.72
> 2.3	3	0.31	100.00	0.31
	974	100.0		

SUMMARY OF PROPOSED IMPROVEMENTS

A summary of the proposed improvements is discussed below. Process Chemistry is indicated in Figure 2 – Process Diagram. Figure 3 is a Process Flow diagram indicating process flow through the proposed treatment plant.

RAW WATER PUMP STATION AND INTAKE

Raw Water Pumps Description: Raw Water Pumps are required to pump untreated water from the reservoir to the Head Tank at the proposed treatment plant. The difference in elevation of the normal pool at the reservoir and water level in the Head Tank results in a high (static) head pumping application.

The Raw Water Pumps proposed are vertical turbine pumps piped in parallel. Three pumps are proposed with one pump serving, as a backup should any single pump need to be taken out of service. The pumps will be mounted on a concrete slab and in a wet well. The controls, VFD's and electrical appurtences shall be housed in a new adjacent electrical building.

The location of the proposed Raw Water Pump Station is adjacent to the existing raw water pump station.

Raw Water Line Description: A new 14 inch raw water line from the proposed raw water pump station to the proposed water treatment plant location will be constructed by the City of Charleston prior to the raw water pump station construction.

Raw Water Intake Description: A new raw water intake is also proposed. The new raw water intake will be constructed adjacent to the existing intake in the same general vicinity of the water supply. The intake will include one intake screen at a single elevation.

Prior to construction, the City of Charleston will have silt removed from the intake basin.

Raw Water Pumps Design Criteria:

Number of Pumps	Three (3)
Horsepower (each)	150
Type of Pump	Vertical Turbine
Maximum Flow rate per pump	2.75 MGD
Turndown per pump	1.10 MGD
Raw Water Pump Station Rating	5.0 MGD

HEAD TANK

Description: A Head Tank will be installed at the beginning of the treatment process to serve as a chemical application point for Sodium Hypochlorite and Alum. The Head Tank also serves to prevent air entrainment in the clarifier, backflow of water and is used to visually observe raw water.

Design Criteria:

Number of Head Tanks	One (1)
Height	34 Feet
Diameter	6.0 Feet
Retention @ 4.5 MGD	1.59 Minutes

CLARIFIER-SOFTENER

Description: The softening process consists primarily of the clarifier and recarbonation vessels.

A ClariCone reactor softening clarifier is one of the primary processes for the proposed treatment plant improvements. This reactor is designed to treat hardness, turbidity, iron, manganese, color, and odor. Water enters the lower chamber of the clarifier through dual inlet pipes, which allows for optimum control of water velocity. Operators increase the velocity of incoming water by throttling down a motor operated valve on the larger of the two influent pipes, which increases the velocity through the smaller influent pipe.

Lime and anionic polymers are added in the clarifier where high stoichiometric efficiency results from thorough mixing as water swirls around fixed mix blades that protrude from the perimeter of the clarifier. As water rises and the cone-shaped section of the clarifier increases, a circular pattern develops with water velocity decreasing. Particles then coagulate to form a sludge blanket. Excess sludge overflows into an adjustable central concentrator and is drawn off as required. Water jets are provided to assist in increasing the velocity and swirling if required.

By increasing the pH of the water to optimum levels, calcium and magnesium precipitate out of the water. Typically, a reduction of radium of approximately 80-90% is achieved through this process.

Design Criteria:

Number of Clarifiers	Two (2)
Diameter	36.5 Feet
Height	29 Feet
Volume (Each)	99,976 Gallons
Rise rate at max. diameter	1.49 gpm/SF
Rise rate at sludge surface	1.71 gpm/SF
Retention @ 4.5 MGD	63.98 Minutes

CARBONATION VESSELS

Description: Carbonating the water reduces scaling and corrosion in downstream unit processes and the distribution system by lowering the pH to approximately 9.0. Water flows into the center of the top of the vessel and flows downward in a spiral.

Carbon dioxide is stored outside of the building in a horizontal storage tank and added near the base of the recarbonation vessels through fine bubble diffusers forcing the falling water to mix with the rising carbon dioxide gas producing a recarbonation efficiency of almost 100%.

Design Criteria:

Number of CO_2 Storage Tanks	One (1)
Capacity of CO_2 Storage Tank	14 Ton Liquid
CO_2 Feed Rate	150 lb./hr/recarb tank
Number of Recarbonation Vessels	Two (2)
Height	29 Feet
Diameter	9.0 Feet
Volume (Each)	8,320 Gallons
Retention @4.5 MGD	5.32 Minutes
Inlet Velocity	5.04 Ft/S
Throat Velocity	1.10 Ft/S
Ave. Deceleration Velocity	0.15 Ft/S
Can Velocity	0.05 Ft/S

Note that carbon dioxide may also be added during the backwash process to clean the porous plates on the underdrains of the filters.

OZONE TREATMENT

Description: Ozone is proposed to oxidize the water for taste and odor control. Ozone shall be generated on site by vaporizing stored Liquid Oxygen (LOX) to a gaseous stage (GOX) and then converting the oxygen to ozone.

LOX shall be stored outside in a 1,500 gallon storage tank. The LOX shall flow through ambient vaporizers, also located outside of the building, and LOX shall be converted to GOX.

The GOX shall flow inside of the building to pressure reducing stations on the ozone generators. The ozone generators shall convert GOX into ozone at the production rates discussed herein. The ozone shall then flow outside of the ozone generator room to the two pump/injector skids.

The ozone, with makeup water at approximately 10% of treated water, will be pumped and injected directly into a pipe upstream of an ozone contact tank. The makeup water will be supplied just upstream of the injection point, using carbonated effluent. The ozone contact tank will be sized for 10 minutes retention at 4.5 MGD. Approximately five minutes of contact will allow oxidation to occur for taste and odor control and the remaining five minutes will allow for decay of ozone such that treated water into the filters will have very little, if any, ozone residual.

Although ozone will not be used for CT credit for the proposed treatment plant, 10 minutes of retention time will also position the City to use ozone for CT credit in the future should regulations allow and the City elect to do so.

Off-gases are vented from the ozone contact tanks to a demister that removes any water in the off-gas. The off gas is heated to prevent condensation before it is sent to a catalyst chamber to destruct the ozone, decomposing the ozone back into oxygen. A blower then safely discharges the oxygen into the atmosphere. All of the off gas components shall be pre-assembled on a single skid, and installed in the ozone generator room.

A supplemental air system is also proposed to increase the nitrogen content in the GOX prior to conversion to ozone. The supplemental air system shall consist of two air compressors with filters, controls and other supplementary equipment.

Design Criteria:
For taste and odor control, a range of 3.5-ppm average to 5-ppm maximum ozone is typical.

Use 4.25 ppm, which is the average of 3.5 and 5.0 ppm.

4.5 MGD x 8.34 x 4.25 ppm = 159 lb/day ozone, say 160 lb/day ozone

The concept is to use multiple pieces of equipment (two) combined to generate and deliver 160 lb/day, with each individual piece of equipment capable of accommodating the approximate minimum flow of 1.0 MGD up to 2.25 MGD.

<u>Liquid Oxygen Storage</u>	
Number of Storage Tanks	One (1)
Type	Vertical Steel Pressure Vessel
Capacity	1,500 Gallon
<u>Ambient Vaporizers</u>	
Number of Vaporizers	Two (2)
<u>Ozone Generators</u>	
Number of Generators	Two(2)
Ozone Production (per generator)	
	140 ppd @ 7%
	100 ppd @ 10%
	80 ppd @ 12%
<u>Nitrogen Boost System</u>	
Number of Compressors	Two (2)
<u>Pump/Injector Skids</u>	
Number of Skids	Two(2)
Pumps per skid	Two (2)
Treated water per pump/injector	781 gpm
Injectors per skid	One (1)
<u>Ozone Contact Tank</u>	
Number Contact Tanks	Two (2)
Diameter	11'-0"
Height	29 Feet
Retention @ 4.5 MGD	10.12 Minutes
<u>Ozone Destruct Unit</u>	
Number of Destruct Units	Two (2)
Number of Blowers	Two (2)
Horsepower per Blower	1 HP

DUAL MEDIA DECELERATING FLOW FILTERS

Description: The proposed filters are center feed decelerating flow filters, which utilize an underdrain system equipped with porous plates to support the filter media. Two feet of 0.50 mm sand and 5 feet of granular activated carbon (GAC) are proposed for final polishing of the water.

Backwashing of the filters shall be conducted by using a combination of air and water. A positive displacement blower shall be used to deliver the air. The quantity of air delivered shall be measured by using a meter on the discharge of the blower and controlled by modulating a butterfly valve on the vent of the blower discharge piping system.

A separate reservoir shall be constructed directly below the filters to store backwash water. Because the backwash water will not be supplied from the clearwells, the amount of chorine in the backwash water can be controlled and may vary from approximately 0 –5.0-ppm chlorine, depending upon the operators requirement.

15 gpm/sf x 254.47 sf = 3817 gpm
3817 gpm x 15 minutes = 57,255 gallon backwash reservoir required

<u>Backwash Water Reservoir</u>	
Depth (with 1'-0" freeboard)	9.30 ft
Width	12-6"
Length	106-7"
Capacity	92,675 gallons

92,675 gallons available > 57,255 gallons required

Design Criteria:	
Number of Filters	Four (4)
Height	21 Feet
Diameter	18 Feet
Surface Area @ Underdrain	254.47 SF
Filter Loading, 4.5 MGD with 4 Filters	3.07 gpm/SF
Filter Loading, 4.5 MGD with 3 Filters	4.09 gpm/SF
Sand	2 Feet
Granular Activated Carbon	5 Feet

The CO_2 system for recarbonation shall also be piped to the filter effluent/backwash influent to clean and remove biological growth (if any) from the porous plates.

BACKWASH PUMPS

Description: Backwash pumps are required to provide a maximum of 15 gpm/sf backwashing of the filters with the flow varied by variable frequency drives Note that 8 gpm/sf shall be normal when used in conjunction with air scour.

15 gpm/sf x 254.47 sf = 3817 gpm
8 gpm/sf x 254.47 sf = 2036 gpm

Design Criteria:

Number of Backwash Pumps	Two (2)
Capacity (Each)	1270 – 3817 gpm
Type	Split Case Centrifgual

AIR SCOUR BLOWER

A positive displacement blower shall be used for air scour in conjunction with backwashing with water from the backwash pumps. Rate of air will be controlled by a PLC by reading flow rate from an air flow meter and throttling a vent valve on the discharge side of the pump.

3 – 5 SCFM per SF of filter area is required.

5 SCFM/SF x 254.47 SF = 1272.35
Say 1275 SCFM

Design Criteria:

Number of Blowers	One (1)
Type	Positive Displacement
Horsepower	150 HP
Air Flow	0 – 1275 SCFM

CLEARWELLS

Description: Clearwells are used for the storage of finished water at the treatment plant and allow for sufficient contact time for chemicals fed prior to the distribution system.

To meet the requirement for a minimum of two clearwell "compartments", two separate clearwells shall be provided. The primary clearwell shall be used on a daily basis and only taken out of service for an emergency or planned maintenance and shall be a 500,000-gallon aboveground steel clearwell.

The second clearwell to be used only during an emergency basis or planned maintenance of the steel clearwell shall be a concrete clearwell located directly below the filters.

Design Criteria:

Number of proposed clearwells	Two (2)
<u>Primary Clearwell:</u>	
Construction	Steel, aboveground
Diameter	85 Feet
Height	14 Feet
Sidewater Depth	12 Feet
Capacity	500,000 gallons
T_{10}/T	0.7
Method used to obtain T_{10}/T	"Ribbon Flow"

Backup/Emergency Clearwell

Construction	Concrete, below filters
Height	10.30 Feet
Sidewater Depth	9.30 Feet
Capacity	153,560 gallons
T_{10}/T	0.7
Method used to obtain T_{10}/T	"Serpentine Flow with Baffles"

CT calculations for both clearwells are included Attachment A.

HIGH SERVICE PUMPS

Description: High service pumps are used to pump treated water from the clearwells to the distribution system.

Design Criteria:

Number of Pumps	Three (3)
Capacity – One Pump	1.75 MGD
Capacity – Two Pumps	2.75 MGD each
Type	Horizontal Split Case Centrifugal

CHEMICAL FEED SYSTEMS

The following chemical feed systems shall be provided for the proposed water treatment plant improvements. Chemical feed systems were sized using water production criteria of 1.0 MGD minimum, 3.0 MGD future average and 4.5 MGD maximum. The dosage range varies per chemical. Unless stated otherwise, Day tanks were sized to hold 30 hours of chemical while bulk storage tanks were sized for 30 days storage, both at average dosage and maximum day water production. Chemical Feed Pumps were sized to pump maximum dosage at maximum water production with turndown to accommodate minimum dosage at minimum water production.

Sodium Hypochlorite

Description: Sodium Hypochlorite is required for disinfection. Multiple points of application shall be provided as follows:

- Head Tank
- Clarifier No. 1
- Clarifier No. 2
- Filtered Effluent to Concrete Clearwell
- Filtered Effluent to Steel Clearwell
- Filter Effluent to Backwash Reservoir
- Downstream of High Service Pumps, prior to distribution System

Note that both chem feed pumps to the clearwells will not be required at the same time. As such, the pump discharge lines are manifolded together so that a backup pump is provided.

Design Criteria:
12.5% Solution
Pumped Neat – No makeup Water
Flushing water provided

Dosage Range	0.45 – 5.4 PPM
Day Tank	1 – 200 Gallon
Bulk Storage Tank	2 – 3000 Gallon
Number of Chem Feed Pumps	Seven (7)
Chem Feed Pump Capacity (Each)	0.70 –8.4 gal/hr

Alum

Description: Alum is used as a primary coagulant in surface water treatment and the lime softening process. The application point is at the Head Tank.

Design Criteria:
Pumped Neat – No Makeup Water
Flushing Water Provided

Day Tank	2 – 200 Gallon
Bulk Storage Tank	2 – 3000 Gallon
Number of Chem Feed Pumps	Three (2 + 1 backup)
Chem Feed Pump Capacity (Each)	0.35 – 15.64 gal/hr

Lime

Description: Lime is used for softening of the water. A hydrated lime system is proposed along with a silo capable of storing a bulk truck delivery. The application point for lime is at the bottom of the clarifier. Three years of historical data for lime usage was reviewed and it was determined that approximately 1400 pounds of lime per million gallons of finished water is required.

Design Criteria:

Type of System	Packaged Hydrated Lime
Type of Application	Slurry
Application Point	Clarifier No. 1 & No. 2
Silo Storage	160,000 lbs
Number of Silos	One (1)
Storage @ 4.5 MGD	25 days
Number of Slurry Feed Pumps	Three (2 + 1 backup)
Pump Feed Rate (Each)	10 - 100 gallons/hr

Anionic Polymer

Description: Anionic polymer is used as an aid in flocculation and typically fed at the bottom of the clarifier. Dry polymer will be measured and manually fed into mix tanks.

Design Criteria:

Carrier/Flushing Water	
Application Point	Clarifier No. 1 & No. 2
Mix Tanks Mixer	2 – 330 gallon
Chem Feed Pump Capacity (Each)	0.21 – 9.6 gal/hr

Fluoride

Description: Fluoride is one 1½ HP mixer per tank and required by regulation.

Design Criteria:

Application Point	Combined Filter Effluent
Carrier/Flushing Water	
Day Tank	One (1) – 30 Gallon
Bulk Storage	300 Gallon Totes
Number of Chem Feed Pumps	Two (1 + 1 backup)
Chem Feed Pump Capacity (Each)	0.15 – 0.99 gal/hr

Carbon Dioxide

Description: Carbon dioxide is used for pH control and stabilization of the water. It is fed at recarbonation vessel through diffusers. Carbon dioxide can also be fed at the backwash supply line to clean the porous plates on the filter underdrains. Three years of historical data for CO_2 usage was reviewed and it was determined that approximately 400 pounds of CO_2 per million gallons of finished water is required.

Design Criteria:

Type	Stored Liquid
Application	Compressed Gas
Application point	Recarbonation Vessels
Number of Storage Tanks	One (1)
Tank Type	Insulated, Refrigerated, Steel
Storage Capacity	28,000 lbs
Storage @ 4.5 MGD	15 days
Storage @ 2.0 MGD	35 days
Number of Feeders	Two (2)
Feeder Type	Electric Throttling Valve With Mass Flowmeter
Feeder Capacity Range	200 – 1800 lb/day (each)

Cationic Polymer

Description: Cationic Polymer is used primarily as a filter aid and fed at the influent of the filter.

Design Criteria:

Application Point	Raw Water Influent Filter No. 1 & 2 Influent Filter No. 3 & 4 Influent
Day Tank	1 – 30 Gallon
Bulk Storage	300 Gallon Totes
Number of Chem Feed Pumps	Four (3 + 1 backup)
Cham Feed Pump Capacity	0.04 – 1.95 gal/hr

<u>**Ammonia**</u>

Description: Ammonia is used as a disinfection aid to prevent disinfection by-products (DBPs).

Design Criteria:

Application Point	High Service Pump Discharge
Day Tank	1 – 22 Gallon
Bulk Storage	300 Gallon Totes
Number of Chem Feed Pumps	Two (1 + 1 backup)
Chem Feed Pump Capacity (Each)	0.05 – 1.23 gal/hr

<u>**Polyphosphates**</u>

Description: Polyphosphates are used for corrosion control in the distribution system.

Design Criteria:

Application Point	High Service Pump Discharge
Day Tank	1 – 22 Gallon
Bulk Storage	300 Gallon Totes
Number of Chem Feed Pumps	Two (1 + 1 backup)
Chem Feed Pump Capacity (Each)	0.06 – 1.04 gal/hr

<u>**Calcium Thiosulfate**</u>

Description: Liquid Calcium Thiosulfate is used for ozone quenching should accidental overfeed of ozone occur.

Design Criteria:

Application Point	Ozone Contact Tank No. 1 & No. 2 Effluent
Day Tank	1 – 5½ Gallon
Bulk Storage	300 Gallon Totes
Number of Chem Feed Pumps	Two
Chem Feed Pump Capacity (Each)	1.0 – 5.0 gal/hr

Instrumentation and Control

Instrumentation and Controls (I & C) will be provided at the new treatment plant. A Supervisory Controls and Data Acquisition (SCADA) system will be provided. The system will receive data from proposed treatment plant and the two existing water tanks in the distribution system. All data will be sent to a single computer console.

ATTACHMENT A

CT CALCULATIONS FOR

500,000 GALLON ABOVEGROUND STEEL CLEARWELL

AND

153,560 GALLON CONCRETE (EMERGENCY) CLEARWELL

City of Charleston
Water Treatment Plant
SWTR CT Calculations

Flow Rate (mgd)	4.500	
Temperature (F)	32.9	(0.5 C)
Ammonia added after clearwell		

Unit Process:	Head tank	Clarifier	Recarb	Filters	Clearwell	Total Plant
Min. Operating Volume (gal.)					[redacted]	
Baffling Condition (T10/T)	1.0	0.3	0.5	0.5		
Flow Rate (gpm)	3,125	3,125	3,125	3,125	3,125	
TDT (min.)	0.00	0.00	0.00	0.00	80.00	
T10 (min.)	0.00	0.00	0.00	0.00	56.00	
<u>Chlorine:</u>						
Residual (mg/L)		0.25	0.25	0.25	[redacted]	
Plant CT (mg-min/L)	0.00	0.00	0.00	0.00	168.00	
pH	8.0	10.0	10.0	9.0	9.0	
Temp. C	0.5	0.5	0.5	0.5	0.5	
Req'd. Giardia CT	277			390	552	
Req'd. Virus CT	12			12	12	
Giardia Log Inact.				0.0000	0.9130	0.9130
Virus Log Inact.				0.0000	56.0000	56.0000
<u>Chloramine:</u>						
Residual (mg/L)					0.00	
Plant CT (mg-min/L)	0.00	0.00	0.00	0.00	0.00	
pH	8.0	10.0	9.0	9.0	9.0	
Temp. C	0.5	0.5	0.5	0.5	0.5	
Req'd. Giardia CT					3800	
Req'd. Virus CT					2883	
Giardia Log Inact.					0.0000	0.0000
Virus Log Inact.					0.0000	0.0000
<u>Chlorine dioxide:</u>						
Residual (mg/L)						
Plant CT (mg-min/L)	0.00	0.00	0.00	0.00	0.00	
pH	8.0	10.0	9.0	9.0	9.0	
Temp. C	0.5	0.5	0.5	0.5	0.5	
Req'd. Giardia CT						
Req'd. Virus CT						
Giardia Log Inact.						0.0000
Virus Log Inact.						0.0000
<u>Total Disinfectants:</u>						
Giardia Log Inact.	0.000	0.000	0.000	0.000	0.913	0.913
Virus Log Inact.	0.000	0.000	0.000	0.000	56.000	56.000

Complete Treatment Credit:	
Giardia Log Removal	2.500
Virus Log Removal	2.000

<u>Total Log Inactivation:</u>

[redacted]

City of Charleston
Water Treatment Plant
SWTR CT Calculations

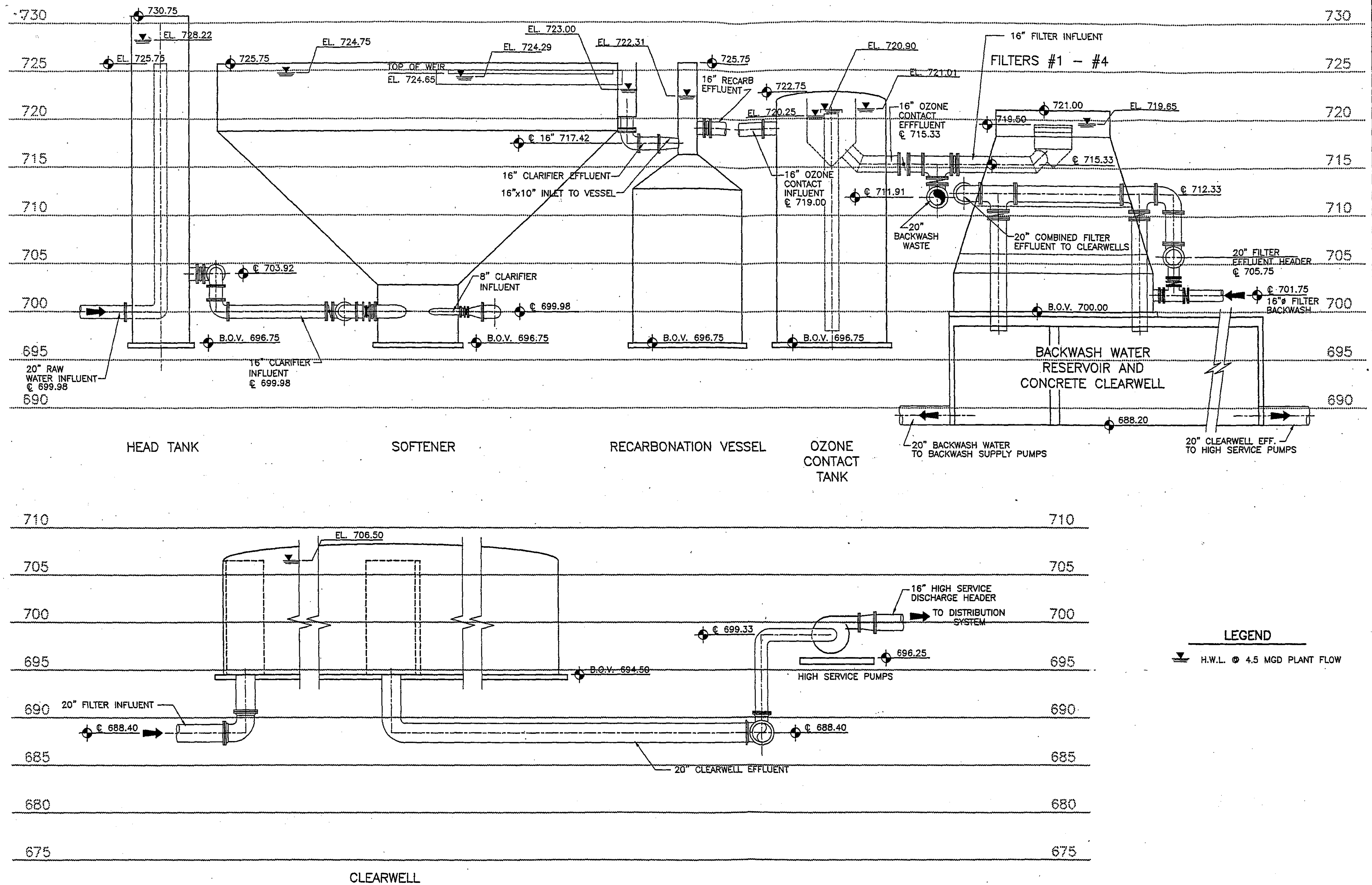
Flow Rate (mgd)	4.500	
Temperature (F)	32.9	(0.5 C)
Ammonia added after clearwell		

Unit Process:	Head tank	Clarifier	Recarb	Filters	Clearwell	Total Plant
Min. Operating Volume (gal.)					[redacted]	
Baffling Condition (T10/T)	1.0	0.3	0.5	0.5		
Flow Rate (gpm)	3,125	3,125	3,125	3,125	3,125	
TDT (min.)	0.00	0.00	0.00	0.00	49.14	
T10 (min.)	0.00	0.00	0.00	0.00	34.40	
<u>Chlorine:</u>						
Residual (mg/L)		0.25	0.25	0.25	[redacted]	
Plant CT (mg-min/L)	0.00	0.00	0.00	0.00	103.19	
pH	8.0	10.0	10.0	9.0	9.0	
Temp. C	0.5	0.5	0.5	0.5	0.5	
Req'd. Giardia CT	277			390	552	
Req'd. Virus CT	12			12	12	
Giardia Log Inact.				0.0000	0.5608	0.5608
Virus Log Inact.				0.0000	34.3975	34.3975
<u>Chloramine:</u>						
Residual (mg/L)					0.00	
Plant CT (mg-min/L)	0.00	0.00	0.00	0.00	0.00	
pH	8.0	10.0	9.0	9.0	9.0	
Temp. C	0.5	0.5	0.5	0.5	0.5	
Req'd. Giardia CT					3800	
Req'd. Virus CT					2883	
Giardia Log Inact.					0.0000	0.0000
Virus Log Inact.					0.0000	0.0000
<u>Chlorine dioxide:</u>						
Residual (mg/L)						
Plant CT (mg-min/L)	0.00	0.00	0.00	0.00	0.00	
pH	8.0	10.0	9.0	9.0	9.0	
Temp. C	0.5	0.5	0.5	0.5	0.5	
Req'd. Giardia CT						
Req'd. Virus CT						
Giardia Log Inact.						0.0000
Virus Log Inact.						0.0000
<u>Total Disinfectants:</u>						
Giardia Log Inact.	0.000	0.000	0.000	0.000	0.561	0.561
Virus Log Inact.	0.000	0.000	0.000	0.000	34.397	34.397

Complete Treatment Credit:	
Giardia Log Removal	2.500
Virus Log Removal	2.000

<u>Total Log Inactivation:</u>

[redacted]



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SURVEY BOOK #
DATE: Fri 6/6/03 5:00pm
XREF DWG: Clntinfo.dwg tb.dwg

REVISIONS		
NUMBER	BY	DATE

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THIS BAR IS EQUAL TO 2" AT FULL SCALE (34X22).

CITY of CHARLESTON
CHARLESTON, ILLINOIS

CHARLESTON WATER TREATMENT PLANT

HYDRAULIC PROFILE

CMT
CRAWFORD, MURPHY & TILLY, INC.
CONSULTING ENGINEERS
License No. 184-000613

DESIGN BY:	RTB
DRAWN BY:	RDM
CHECKED BY:	
APPROVED BY:	
DATE:	JUNE, 2003
JOB No:	02079–01

FIGURE 1

SHEET OF SHEETS

J:\Charleston\
FILE: FIGURE2.dwg
UPDATE BY: rmurphy
SURVEY BOOK #
DATE: Fri 6/6/03 5:01pm
XREF DWG: Clntinfo.dwg
tb.dwg

IMAGE FILES:

CITY of CHARLESTON
WATER PURIFICATION PROCESS DESIGN

TYPICAL RAW WATER

pH	8.3
TURBIDITY	20
HARDNESS	200
CALCIUM	130
MAGNESIUM	70
ALKALINITY	150
COLOR	100
IRON	0.3
MANGANESE	0.1
FLUORIDE	0.2
TOC	7

CLARICONE EFFLUENT

pH	10.3
TURBIDITY	0.5
HARDNESS	100
CALCIUM	50
MAGNESIUM	50
ALKALINITY	25–50
COLOR	5
IRON	0.01
MANGANESE	0.01
FLUORIDE	0.1
TOC	6

CARBONATION VESSEL EFFLUENT

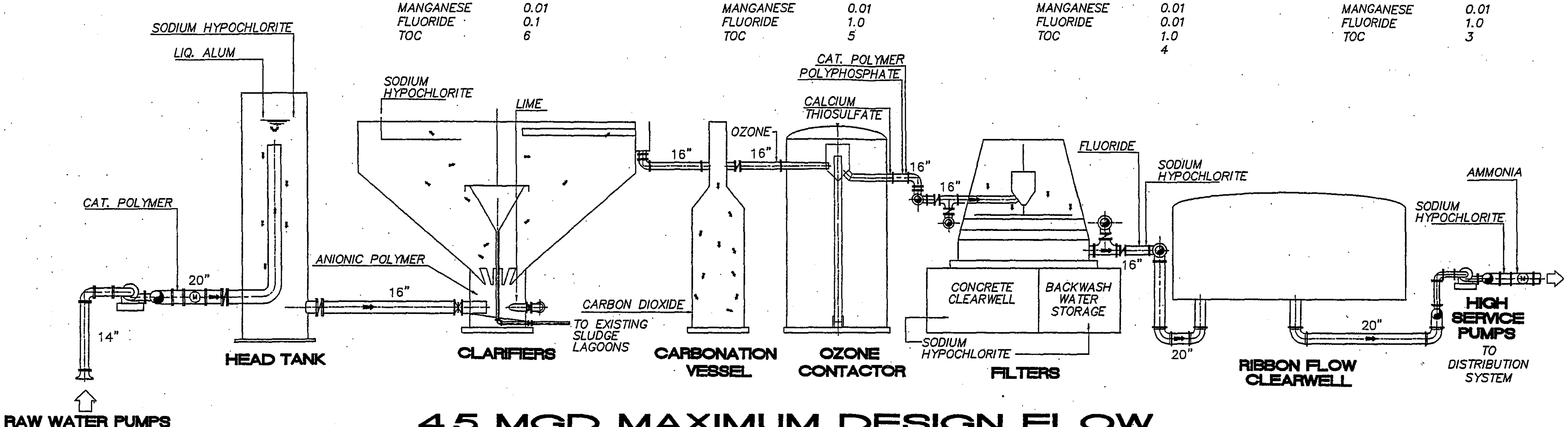
pH	9.0
TURBIDITY	0.5
HARDNESS	100
CALCIUM	50
MAGNESIUM	50
ALKALINITY	10–50
COLOR	1
IRON	0.01
MANGANESE	0.01
FLUORIDE	1.0
TOC	5

OZONE CONTACTOR

pH	9.0
TURBIDITY	0.5
HARDNESS	
CALCIUM	100
MAGNESIUM	50
ALKALINITY	50
COLOR	10–50
IRON	1
MANGANESE	0.01
FLUORIDE	0.01
TOC	1.0
	4

FINISHED WATER

pH	9.0
TURBIDITY	0.05
HARDNESS	100
CALCIUM	50
MAGNESIUM	50
ALKALINITY	10–50
COLOR	1
IRON	0.01
MANGANESE	0.01
FLUORIDE	1.0
TOC	3



4.5 MGD MAXIMUM DESIGN FLOW

HEAD TANK (1 UNIT)

HEIGHT	34 FT.
DIAMETER	6 FT.
INFLUENT PIPE	20 INCH DIA.
NET DOWNFLOW VOLUME	4,973 GAL.
RETENTION	1.59 MIN.
NET DOWNFLOW AREA	26.09 FT^2
DOWNFLOW VELOCITY	0.27 FT/SEC

36'-6" DIAMETER CLARICONE W/ RADIAL FLOW WEIRS AND STATIC MIX BLADES (2 UNITS)

HEIGHT	29 FT
SURFACE AREA (EA.)	1046 FT^2
VOLUME (EA.)	99,976 GAL.
TOTAL RETENTION	63.98 MIN.
RAPID MIX	0.84 MIN.
SLUDGE CONTACT	26.86 MIN.
CLARIFICATION	36.28 MIN.
RISE RATE AT MAX.	1.49 GPM/FT^2
RISE RATE AT SLUDGE SURFACE	1.71 GPM/FT^2
RISE RATE IN RAPID MIX	37.85 GPM/FT^2
SLUDGE DEPTH	14.67 FT.
CLARIFICATION DEPTH	7.33 FT.
DUAL INLETS	
LARGE	16" – 2.49 FT/SEC @ 1563 GPM
SMALL	8" – 9.97 FT/SEC @ 1563 GPM

SPIRAL DOWNFLOW CARBONATION VESSEL (2 UNITS)

HEIGHT	29 FT.
DIAMETER	9 FT.
INLET (SQUARE)	16"x10"
INLET VELOCITY	5.04 FT/SEC.
THROAT VELOCITY	1.10 FT/SEC.
AVG. DECELERATION VELOCITY	0.15 FT/SEC.
CAN VELOCITY	0.05 FT/SEC.
CONE VOLUME	7,614 GAL.
CAN VOLUME	706 GAL.
TOTAL VOLUME	8,320 GAL.
RETENTION	5.32 MIN.

SPIRAL DOWNFLOW OZONE CONTACTOR (2 UNITS)

HEIGHT	29 FT.
DIAMETER	11.0 FT.
INLET (SQUARE)	16"x12"
INLET VELOCITY	3.48 FT/SEC.
DECELERATION VELOCITY	0.04 FT/SEC.
VOLUME	15,815 GAL.
RETENTION	10.12 MIN.

18 FT. CENTER FEED DECELERATING FLOW FILTERS (4 UNITS)

HEIGHT	21 FT.
DIAMETER	18.0 FT.
SURFACE AREA @ UNDERDRAIN	254.47 FT^2
BOTTOM LOAD–NORMAL	3.07 GPM/FT^2
BOTTOM LOAD–1 Filter out of Service	4.09 GPM/FT^2
FILTER MEDIA:	
0.50 MM SAND	2.0 FT.
GRANULAR ACTIVATED CARBON	5.0 FT.
MAXIMUM HEADLOSS	3.21 FT.
MAXIMUM WASH RATE	3817 GPM
@ BOTTOM PLATE	15 GPM/FT^2
@ MEDIA SURFACE	20.23 GPM/FT^2
@ WEIR	27.68 GPM/FT^2

CONCRETE CLEARWELL (1 UNIT)

VOLUME	153,560 GAL.
SIZE	22'x106'
WATER DEPTH	9.3 FT.
DESIGN T 10/T	0.7

RIBBON FLOW CLEARWELL (1 UNIT)

VOLUME	500,000 GAL.
DIAMETER	85 FT.
WATER DEPTH	12 FT.
DESIGN T 10/T	0.7

REVISIONS

NUMBER	BY	DATE

0 1 2
THIS BAR IS EQUAL TO 2" AT FULL SCALE (34X22).

CITY of CHARLESTON
CHARLESTON, ILLINOIS

CHARLESTON WATER TREATMENT PLANT

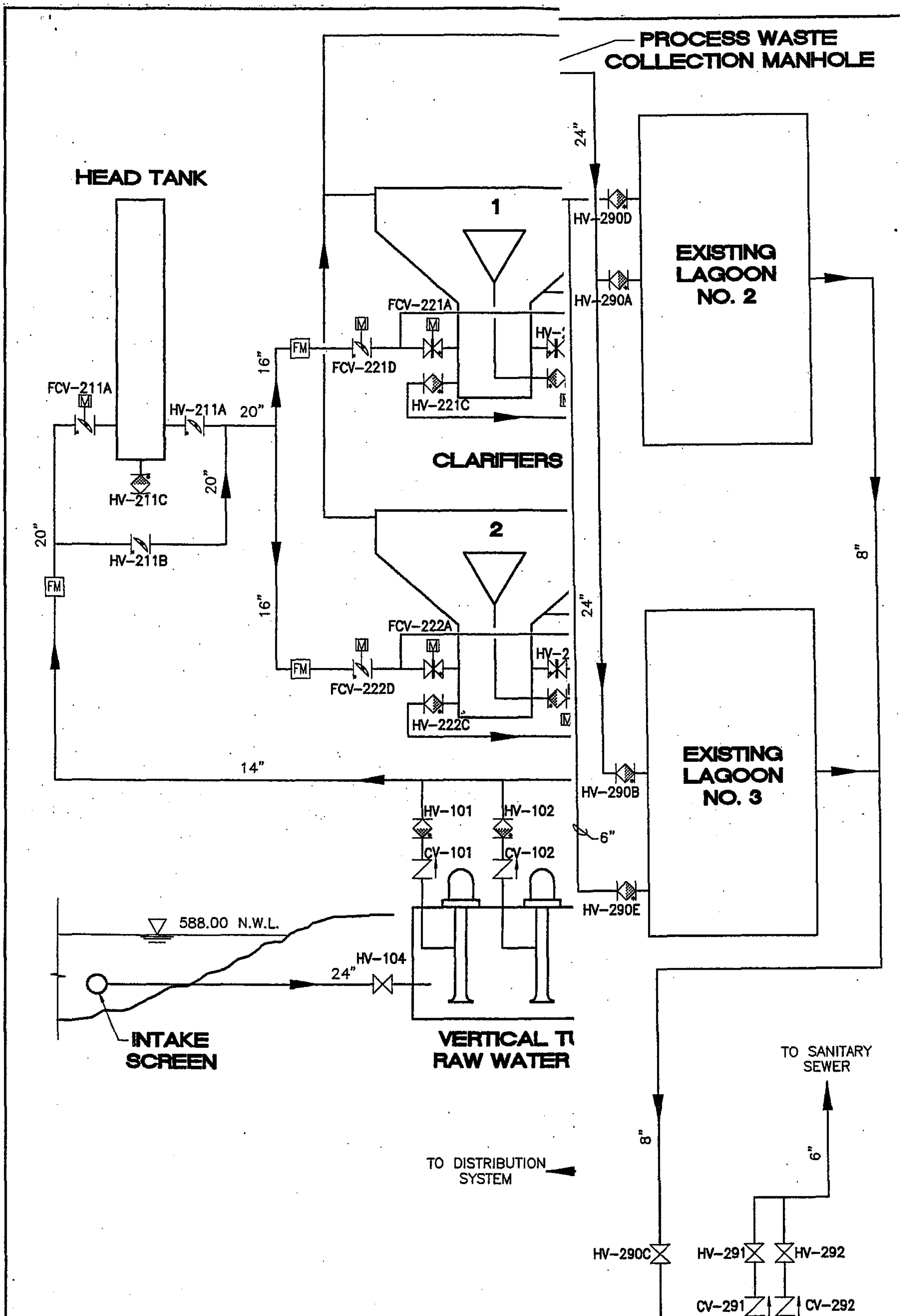
PROCESS DIAGRAM

CMT
CRAWFORD, MURPHY & TILLY, INC.
CONSULTING ENGINEERS
License No. 184-000613

DESIGN BY:	RTB
DRAWN BY:	KSK
CHECKED BY:	
APPROVED BY:	
DATE:	JUNE, 2003
JOB No:	02079-01

FIGURE 2

SHEET OF SHEETS



Q_{MAX} = 4.5 MGD = 3125 gpm

$Q_{/2}$ = 2.25 MGD = 1563 gpm

$Q_{/3}$ = ONE FILTER OUT OF SERVICE

$Q_{/3}$ = 1.5 MGD = 1042 gpm

J:\Charleston\
FILE: FIGURE3.dwg
UPDATE BY: rmurphy
SURVEY BOOK #
DATE: Mon 6/9/03 8:33am
XREF DWG: Cintinfo.dwg
tb.dwg

IMAGE FILES:

REVISIONS

NUMBER	BY	DATE

0 1 2
THIS BAR IS EQUAL TO 2" AT FULL SCALE (34X22).

CITY of CHARLESTON
CHARLESTON, ILLINOIS

CHARLESTON WATER TREATMENT PLANT

PROCESS FLOW DIAGRAM

CMT
CRAWFORD, MURPHY & TILLY, INC.
CONSULTING ENGINEERS
License No. 184-000613

DESIGN BY:	RTB
DRAWN BY:	RB
CHECKED BY:	
APPROVED BY:	
DATE:	JUNE, 2003
JOB No:	02079-01

FIGURE 3

SHEET OF SHEETS