TABLE 7-2
GENERAL DESCRIPTION AND EVALUATION
ALTERNATIVE A3

A. GENERAL DESIGN

Alternative A3 is designed to provide four flocculation and settling compartments in Basin No. 1. The layout is similar to Alternative A2, except the following:

1. Walls will be installed to divide Basin No. 1 into four compartments. Each compartment contains one train of flocculator and sedimentation units.

2. A split box with four outlets and connection piping will be provided to connect to the flocculator basins.

B. COMPLIANCE (With Respect to DNR Standard)

1. Flocculator Basin

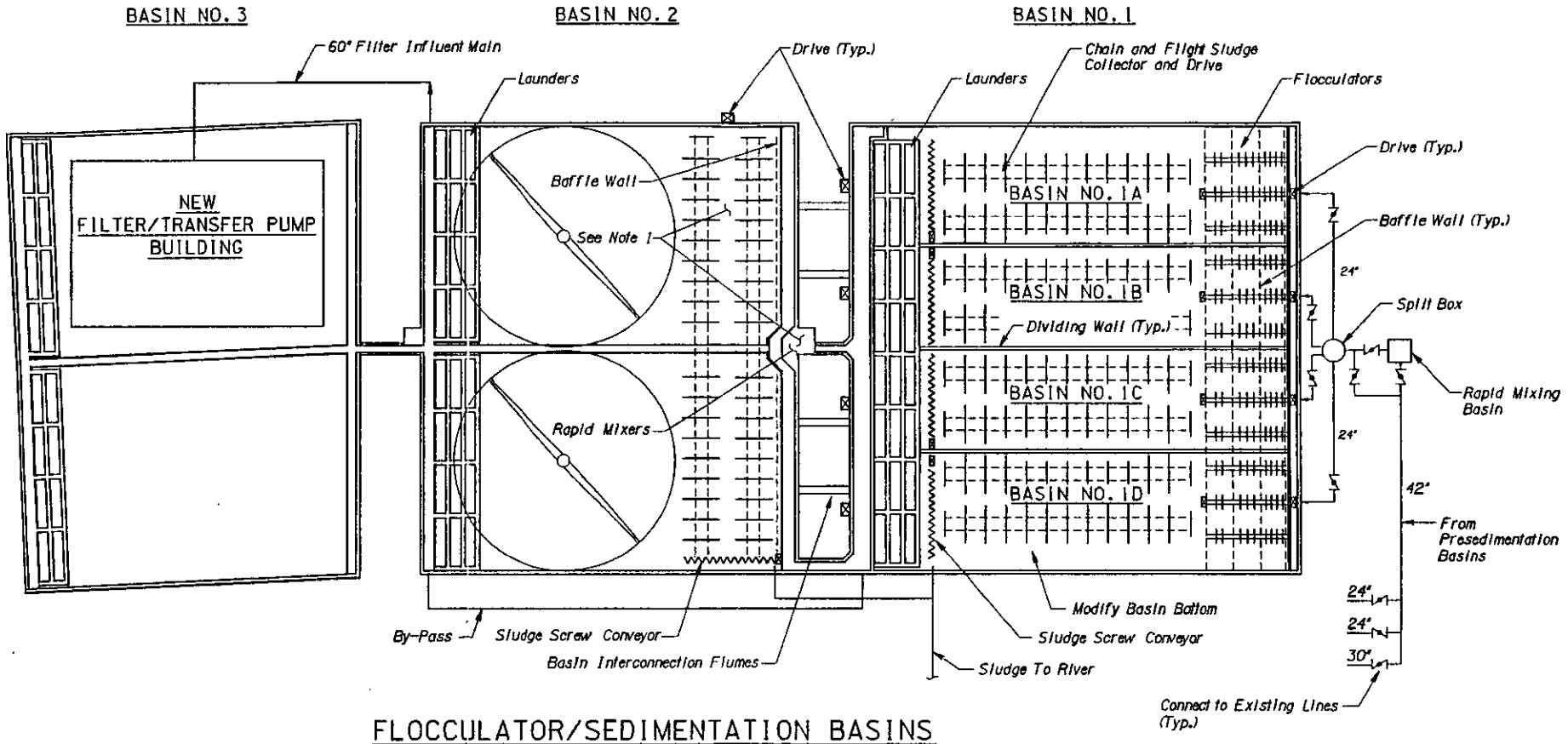
a. Detention time	
(1) All units in service	46 minutes (complies)
(2) One unit off-line	35 minutes (complies)
b. Flow-through velocity	
(1) All units in service	0.86 fpm (complies)
(2) One unit off-line	1.15 fpm (complies)

2. Sedimentation Basin

a. Detention time	
(1) Basin No. 1 (all units in use)	186 min. (requires variance)
(2) Basin No. 1 (one unit off-line)	140 min. (requires variance)
(3) Basin No. 1 (all units in use) and Basin No. 2	369 min. (complies)
(4) Basin No. 1 (one unit off-line) and Basin No. 2	323 min. (complies)
b. Flow-through velocity	
(1) All units in Service	
Basin No. 1	0.86 (requires variance)
Basin No. 2	0.96 (requires variance)
(2) One unit off-line in Basin No. 1	
(a) Basin No. 1	1.15 fps (requires variance)

TABLE 7-3
BASIN WORK AND ADDITIONAL ALUM STORAGE
ADDITIONAL COST ESTIMATE
ALTERNATIVE A3

No.	ITEM	COST
	Base Construction Cost*	$8,810,000
1.	Rapid Mixing Basin	215,000
2.	Split Box	50,000
3.	Flocculator Baffle Walls a. Basin No. 1	175,000
	b. Basin No. 2	43,000
4.	Three-Staged, Tapered Flocculators a. Basin No. 1	430,000
	b. Basin No. 2	- - -
5.	Sludge Collector System a. Basin No. 1	900,000
	b. Basin No. 2 (partial)	170,000
6.	Dividing Wall a. Basin No. 1	990,000
	b. Basin No. 2	- - -
7.	Effluent Collection Launders a. Basin No. 1	225,000
	b. Basin No. 2	40,000
8.	Rehabilitation of Basin No. 1 Bottom	300,000
9.	Flumes Connecting Basin No. 1 and No. 2	75,000
10.	Removal of the Existing Flocculator and Rapid Mixer	20,000
11.	Influent Piping & Connections	475,000
12.	Effluent Piping & Connections	170,000
13.	100,000 Gallon Alum Storage Tank	200,000
	SUBTOTAL	$13,288,000
14.	Roof a. Basin No. 1	1,520,000
	b. Basin No. 2	1,520,000
15.	Superpulsator/Clarifier Building	- - -
	TOTAL	$16,368,000



FLOCCULATOR/SEDIMENTATION BASINS

NOTE:
1. Remove existing flocculators, rapid mixer and wooden baffle wall.

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH, MISSOURI

ST. JOSEPH
WATER TREATMENT PLANT
IMPROVEMENT PROJECT
ALTERNATIVE A3

GANNETT FLEMING INC. SEPTEMBER 1992

GFWR\EXHIBITS\AMERICAN\28512EX1.DGN

EXHIBIT A3

TABLE 8-1
ALTERNATIVE B1
ONE RAPID MIXING BASIN/TWO PARALLEL FLOCCULATOR-SEDIMENTATION BASINS/SEDIMENTATION BASIN
DETENTION TIME AND FLOW-THROUGH VELOCITY
(Design Flow Rate - 30 MGD)

	Treatment Unit	Basin Dimension (LxWxD) (ft x ft x ft)	Basin Volume (gallons)	Detention Time (Minutes)	Flow-Through Velocity (fpm)
I.	**Basin No. 1**	203 x 209 x 15.75	4,998,325		
	A. Sedimentation Basin	203 x 209 x 15.75	4,998,325	240	0.85
II.	**Basin No. 2** (with one dividing wall)	175 x 209 x 13.91	3,805,511		
	A. Flocculator (FL) - all units in use	50 x 208 x 13.91	1,082,087	52	0.96
	1. FL No. 2A - one train off-line	50 x 104 x 13.91	270,522	26	1.92
	2. FL No. 2B - one train off-line	50 x 104 x 13.91	270,522	26	1.92
	B. Sedimentation Basin (SB) - all units in use	120 x 208 x 13.91	2,597,008	125	0.96
	1. SB No. 2A - one train off-line	120 x 104 x 13.91	1,298,504	62	1.92
	2. SB No. 2B - one train off-line	120 x 104 x 13.91	1,298,504	62	1.92
	TOTAL DETENTION TIME				
	A. Flocculator				
	1. All units in use			52	
	2. One train off-line			26	
	B. Sedimentation Basin				
	1. Basin No. 2 (all trains in use)			125	
	2. Basin No. 2 (one train off-line)			62	
	3. Basin No. 2 (all trains in use) → Basin No. 1			365	
	4. Basin No. 2 (one train off-line) → Basin No. 1			302	

TABLE 8-2
GENERAL DESCRIPTION AND EVALUATION
ALTERNATIVE B1

A. GENERAL DESIGN

1. Maintain the existing rapid mixing basin and add one unit for total of 2-stage rapid mixing and retrofit Basin No. 1.

2. Replace existing flocculators in Basin No. 2 with new three-stage, tapered flocculators.

3. Provide in Basin No. 2 baffle walls including flocculator influent baffle wall, baffle wall between different stages of flocculators, and diffuser wall between flocculators and settling basin.

4. Install dividing wall in Basin No. 2.

5. Connect Basin No. 2 effluent flume with Basin No. 1 influent flume, and Basin No. 1 effluent with filters.

6. Modify Basin No. 1 bottom for installation of sludge collecting system.

7. Provide effluent collection launders to Basin No. 1.

8. Add additional launder to Basin No. 2.

9. Basin No. 3 abandoned. Filters and possibly residual waste facilities to be constructed in this area.

B. COMPLIANCE (With Respect to DNR Standard)

1. Flocculation Basin

a.	Detention time	
(1)	All units in use	52 min. (complies)
(2)	One unit off-line	26 min. (requires variance)
b.	Flow-through velocity	
(1)	All units in use	0.96 fpm (complies)
(2)	One unit off-line	1.92 fpm (requires variance)

2. Sedimentation Basin

a.	Detention Time	
(1)	Basin No. 2 (all units in use)	125 min. (requires variance)
(2)	Basin No. 2 (one unit off-line)	62 min. (requires variance)
(3)	Basin No. 2 (all units in use) and Basin No. 1	365 min. (complies)

(4) Basin No. 2 (one unit off-line) and Basin No. 1 — 302 min. (complies)

b. Flow through velocity

(1) Basin No. 2 — 0.96 fpm (requires variance)
(2) Basin No. 1 — 0.85 fpm (requires variance)
(3) Basin No. 2 (one unit off-line) — 1.92 fpm (requires variance)

C. ADVANTAGES

1. Existing split box will allow for uniform distribution of flow to each flocculator basin.

2. The flocculators provide proper detention time and flow-through velocity

3. The dividing wall will provide the operator to take one series of process units off-line for repairs or maintenance while keeping the other in service.

4. With one flocculator-sedimentation basin off-line, this Alternative is capable of providing in excess of 240 min. (4 hours) sedimentation time.

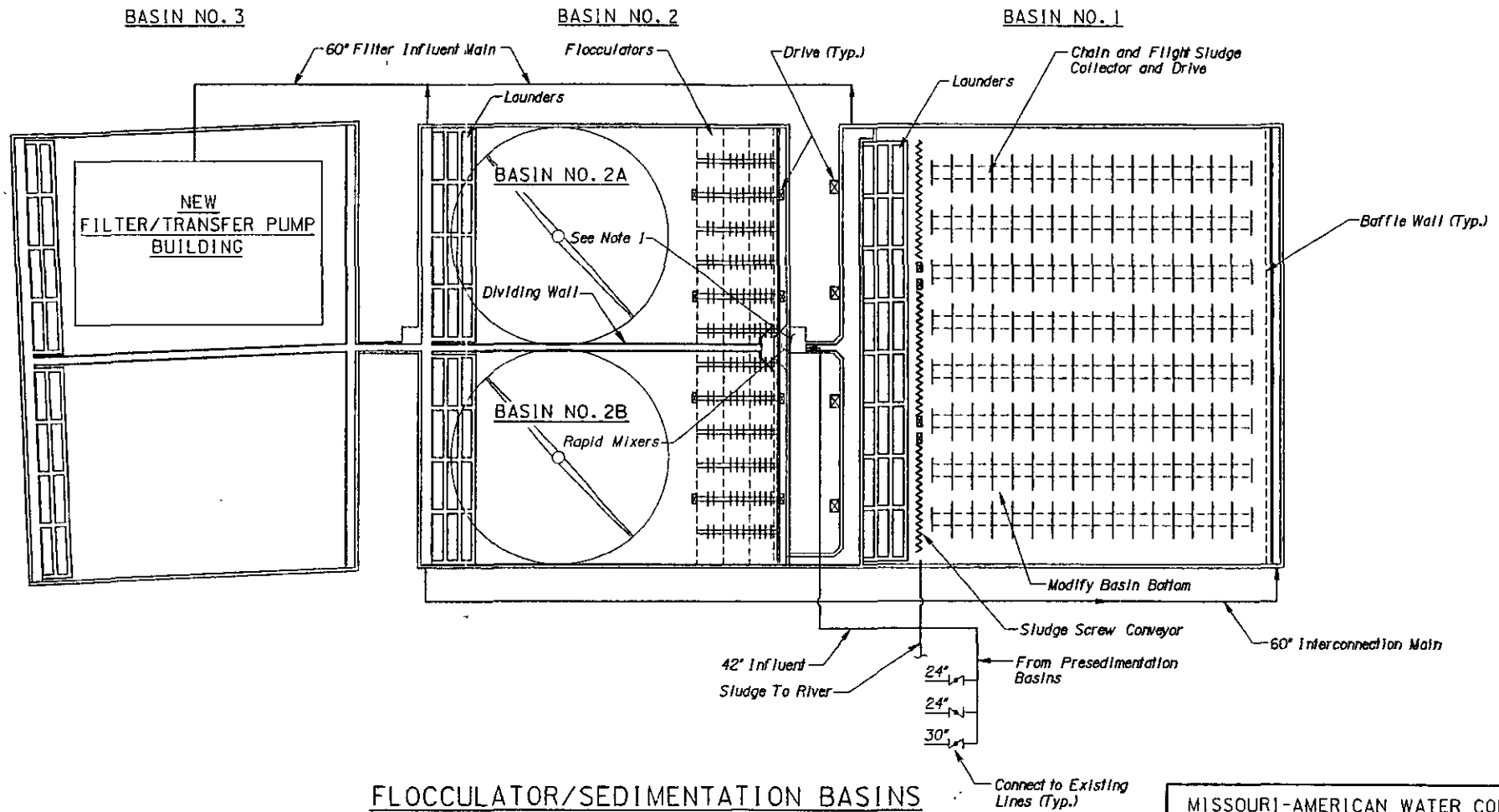
D. DISADVANTAGES

1. Disadvantages are same as for Alternate A2.

2. Logistics of constructing divider wall in Basin No. 2 and not using flocculators (Estimated at between 6 to 9 months) will preclude further consideration of this Alternative.

TABLE 8-3
BASIN WORK AND ADDITIONAL ALUM STORAGE ADDITIONAL COST ESTIMATE ALTERNATIVE B1

No.	ITEM	COST
	Base Construction Cost*	$8,810,000
1.	Rapid Mixing Basin	125,000
2.	Split Box	- - -
3.	Flocculator Baffle Walls a. Basin No. 1	43,000
	b. Basin No. 2	175,000
4.	Three-Staged, Tapered Flocculators a. Basin No. 1	- - -
	b. Basin No. 2	430,000
5.	Sludge Collector System a. Basin No. 1	900,000
	b. Basin No. 2 (partial)	- - -
6.	Dividing Wall a. Basin No. 1	- - -
	b. Basin No. 2	330,000
7.	Effluent Collection Launders a. Basin No. 1	225,000
	b. Basin No. 2	40,000
8.	Rehabilitation of Basin No. 1 Bottom	300,000
9.	Flumes Connecting Basin No. 1 and No. 2	- - -
10.	Removal of the Existing Flocculator and Rapid Mixer	10,000
11.	Influent Piping & Connections	150,000
12.	Effluent Piping & Connections	520,000
13.	100,000 Gallon Alum Storage Tank	200,000
	SUBTOTAL	$12,258,000
14.	Roof a. Basin No. 1	1,520,000
	b. Basin No. 2	1,520,000
15.	Superpulsator/Clarifier Building	- - -
	TOTAL	$15,298,000



FLOCCULATOR/SEDIMENTATION BASINS

NOTE:

1. Maintain the existing rapid mixing basin.

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH, MISSOURI

ST. JOSEPH
WATER TREATMENT PLANT
IMPROVEMENT PROJECT
ALTERNATIVE B1

GANNETT FLEMING INC. SEPTEMBER 1992

GFWR\EXHIBITS\AMERICAN\28512EX1.DGN

EXHIBIT B1

TABLE 9-1
ALTERNATIVE C1
TWO PARALLEL RAPID MIXING BASINS/SPLIT BOXES/ TWO PARALLEL FLOCCULATOR-SEDIMENTATION BASINS/ EACH WITH TWO COMPARTMENTS
DETENTION TIME AND FLOW-THROUGH VELOCITY
(Design Flow Rate - 30 MGD)

	Treatment Unit	Basin Dimension (LxWxD) (ft x ft x ft)	Basin Volume (gallons)	Detention Time (Minutes)	Flow-Through Velocity (fpm)
I.	**Basin No. 1** (with one dividing wall)	203 x 209 x 15.75	4,998,325		
	A. Flocculator (FL) - all trains in use (17 MGD)	40 x 208 x 15.75	980,179	83	0.48
	1. FL No. 1A - other train in Basin No. 1 off-line (12 MGD)	40 x 104 x 15.75	490,090	59	0.68
	2. FL No. 1A - one train in Basin No. 2 off-line (10.5 MGD)	40 x 104 x 15.75	490,090	67	0.60
	B. Sedimentation Basin (SB) - all trains in use	160 x 208 x 15.75	3,920,717	332	0.48
	1. SB No. 1A - other train in Basin No. 1 off-line (12 MGD)	160 x 104 x 15.75	1,960,358	235	0.68
	2. SB No. 1A - one train in Basin No. 2 off-line (10.5 MGD)	160 x 104 x 15.75	1,960,358	269	0.60
II.	**Basin No. 2** (with one dividing wall)	175 x 209 x 13.91	3,805,511		
	A. Flocculator (FL) - all trains in use (13 MGD)	50 x 208 x 13.91	1,082,087	120	0.42
	1. FL No. 2A - one train in Basin No. 1 off-line (9 MGD)	50 x 104 x 13.91	541,043	87	0.58
	2. FL No. 2A - other train in Basin No. 2 off-line (9 MGD)	50 x 104 x 13.91	541,043	87	0.58
	B. Sedimentation Basin (SB) - all trains in use	120 x 208 x 13.91	2,597,008	287	0.42
	1. SB No. 2A - one train in Basin No. 1 off-line (9 MGD)	120 x 104 x 13.91	1,298,504	208	0.58
	2. SB No. 2A - other train in Basin No. 2 off-line (9 MGD)	120 x 104 x 13.91	1,298,504	208	0.58
	TOTAL DETENTION TIME				
	A. Flocculator				
	1. All units in use			83-120	
	2. One unit off-line			59-87	
	B. Sedimentation Basin				
	1. Basin No. 1 and Basin No. 2 (all units in use)			287-332	
	2. Basin No. 1 and Basin No. 2 (one unit off-line)			208-269	

TABLE 9-2
GENERAL DESCRIPTION AND EVALUATION OF ALTERNATIVE C1

A. GENERAL DESIGN

1. Provide two parallel pretreatment processing systems. Each system contains a rapid mixing basin, split box, two trains of flocculator and settling basins.

2. Modify the existing influent piping system to split flow to rapid mix basins.

3. Provide Basin No. 1 with three-staged, tapered flocculators with variable energy input. Provide flocculator influent baffle wall, baffle walls between the staged flocculators and diffuser wall between the clarifier and flocculator.

4. Modify Basin No. 1 bottom for installation of sludge collecting system.

5. Rehabilitate Basin No. 2 with new three-staged, tapered flocculators, and provide baffle walls. Remove the existing flocculators and baffle wall.

6. Install dividing wall in Basin No. 1 and Basin No. 2.

7. Remove the existing rapid mixing basin.

8. Install effluent collecting launders in Basin No. 1 and add a new launder to Basin No. 2 existing effluent collecting launders.

9. Provide bypass to allow effluent from Basin No. 1 to bypass Basin No. 2 to filters.

10. Provide influent flow control facilities to split flow to each rapid mixing basin.

B. COMPLIANCE (With Respect to DNR Standard)

1. Flocculation Basin

a.	Detention time	
	(1) Basin No. 1	
	(a) All units in use	83 min. (complies)
	(b) One unit in Basin No. 1 off-line	59 min. (complies)
	(c) One unit in Basin No. 2 off-line	67 min. (complies)
	(2) Basin No. 2	
	(a) All units in use	120 min. (complies)
	(b) One unit in Basin No. 1 off-line	87 min. (complies)
	(c) One unit in Basin No. 2 off-line	87 min. (complies)
b.	Flow-through Velocity	
	(1) Basin No. 1	
	(a) All units in use	0.48 fpm (requires variance)
	(b) One unit in Basin No. 1 off-line	0.68 fpm (complies)
	(c) One unit in Basin No. 2 off-line	0.60 fpm (complies)

(2) Basin No. 2
- (a) All units in use — 0.42 fpm (requires variance)
- (b) One unit in Basin No. 1 off-line — 0.58 fpm (complies)
- (c) One unit in Basin No. 2 off-line — 0.58 fpm (complies)

2. Sedimentation Basin

a. Detention time

(1) All units in use
- (a) Basin No. 1 — 332 min. (complies)
- (b) Basin No. 2 — 287 min. (complies)

(2) One unit off-line
- (a) One unit in Basin No. 1 off-line
  - 1) Basin No. 1 — 235 min. (requires variance)
  - 2) Basin No. 2 — 208 min. (requires variance)
- (b) One unit in Basin No. 2 off-line
  - 1) Basin No. 1 — 269 min. (complies)
  - 2) Basin No. 2 — 208 min. (requires variance)

b. Flow-through Velocity

(1) Basin No. 1
- (a) All units in use — 0.48 fpm (complies)
- (b) One unit off-line
  - 1) Basin No. 1 — 0.68 fpm (requires variance)
  - 2) Basin No. 2 — 0.58 fpm (requires variance)

(2) Basin No. 2
- (a) All units in use — 0.42 fpm (complies)
- (b) One unit off-line
  - 1) Basin No. 1 — 0.60 fpm (requires variance)
  - 2) Basin No. 2 — 0.58 fpm (requires variance)

C. ADVANTAGES

1. Provides flexible modes of operation for pretreatment process.

2. Meets DNR flocculation and sedimentation design standards under normal mode of operation and sometimes with one train not in use.

3. Design will efficiently retrofit into the existing pretreatment process.

4. Advantage of other schemes are incorporated into this design alternate.

D. DISADVANTAGES

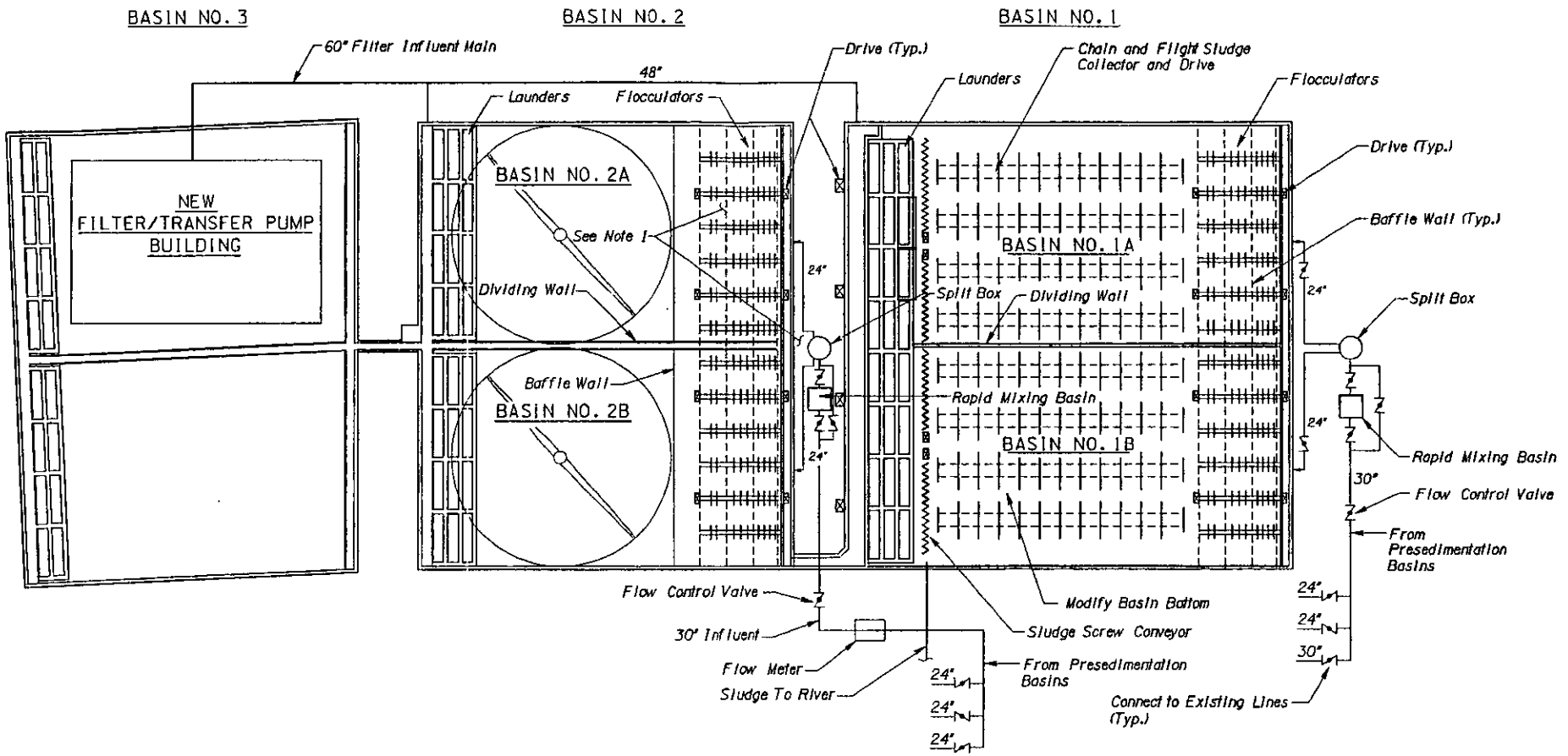
1. Relatively higher construction cost.

2. Requires duplicate pre-chemical feeding systems, or spitting of chemicals to mixing basins.

3. Winter ice problems will remain if costly roofed enclosure system is not constructed.

TABLE 9-3
BASIN WORK AND ADDITIONAL ALUM STORAGE
ADDITIONAL COST ESTIMATE
ALTERNATIVE C1

No.	ITEM	COST
	Base Construction Cost*	$8,810,000
1.	Rapid Mixing Basin	400,000
2.	Split Box	100,000
3.	Flocculator Baffle Walls a. Basin No. 1	175,000
	b. Basin No. 2	175,000
4.	Three-Staged, Tapered Flocculators a. Basin No. 1	430,000
	b. Basin No. 2	430,000
5.	Sludge Collector System a. Basin No. 1	900,000
	b. Basin No. 2 (partial)	- - -
6.	Dividing Wall a. Basin No. 1	330,000
	b. Basin No. 2	330,000
7.	Effluent Collection Launders a. Basin No. 1	225,000
	b. Basin No. 2	40,000
8.	Rehabilitation of Basin No. 1 Bottom	300,000
9.	Flumes Connecting Basin No. 1 and No. 2	- - -
10.	Removal of the Existing Flocculator and Rapid Mixer	20,000
11.	Influent Piping & Connections	575,000
12.	Effluent Piping & Connections	270,000
13.	100,000 Gallon Alum Storage Tank	200,000
	SUBTOTAL	$13,710,000
14.	Roof a. Basin No. 1	1,520,000
	b. Basin No. 2	1,520,000
15.	Superpulsator/Clarifier Building	- - -
	TOTAL	$16,750,000



FLOCCULATOR/SEDIMENTATION BASINS

NOTE:

1. Remove existing flocculators, rapid mixer and wooden baffle wall.

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH, MISSOURI

ST. JOSEPH
WATER TREATMENT PLANT
IMPROVEMENT PROJECT
ALTERNATIVE C1

GANNETT FLEMING INC. SEPTEMBER 1992

GFWR\EXHIBITS\AMERICAN\28512EX1.DGN

EXHIBIT C1

TABLE 10-1
ALTERNATIVE C2
ONE RAPID MIXING BASIN/SPLIT BOX/
TWO PARALLEL FLOCCULATOR-SEDIMENTATION BASINS
EACH WITH TWO COMPARTMENTS
DETENTION TIME AND FLOW-THROUGH VELOCITY
(Design Flow Rate - 30 MGD)

	Treatment Unit	Basin Dimension (LxWxD) (ft x ft x ft)	Basin Volume (gallons)	Detention Time (Minutes)	Flow-Through Velocity (fpm)
I.	**Basin No. 1** (with one dividing wall)	203 x 209 x 15.75	4,998,325		
	A. Flocculator (FL) - all trains in use (17 MGD)	40 x 208 x 15.75	980,179	83	0.48
	1. FL No. 1A - other train in Basin No. 1 off-line (12 MGD)	40 x 104 x 15.75	490,090	59	0.68
	2. FL No. 1A - one train in Basin No. 2 off-line (10.5 MGD)	40 x 104 x 15.75	490,090	67	0.60
	B. Sedimentation Basin (SB) - all trains in use	160 x 208 x 15.75	3,920,717	332	0.48
	1. SB No. 1A - other train in Basin No. 1 off-line (12 MGD)	160 x 104 x 15.75	1,960,358	235	0.68
	2. SB No. 1A - one train in Basin No. 2 off-line (10.5 MGD)	160 x 104 x 15.75	1,960,358	269	0.60
II.	**Basin No. 2** (with one dividing wall)	175 x 209 x 13.91	3,805,511		
	A. Flocculator (FL) - all trains in use (13 MGD)	50 x 208 x 13.91	1,082,087	120	0.42
	1. FL No. 2A - one train in Basin No. 1 off-line (9 MGD)	50 x 104 x 13.91	541,043	87	0.58
	2. FL No. 2A - other train in Basin No. 2 off-line (9 MGD)	50 x 104 x 13.91	541,043	87	0.58
	B. Sedimentation Basin (SB) - all trains in use	120 x 208 x 13.91	2,597,008	287	0.42
	1. SB No. 2A - one train in Basin No. 1 off-line (9 MGD)	120 x 104 x 13.91	1,298,504	208	0.58
	2. SB No. 2A - other train in Basin No. 2 off-line (9 MGD)	120 x 104 x 13.91	1,298,504	208	0.58
	TOTAL DETENTION TIME				
	A. Flocculator				
	1. All trains in use			83-120	
	2. One train off-line			59-87	
	B. Sedimentation Basin				
	1. Basin No. 1 and Basin No. 2 (all units in use)			287-332	
	2. Basin No. 1 and Basin No. 2 (one unit off-line)			208-269	

TABLE 10-2
GENERAL DESCRIPTION AND EVALUATION FOR ALTERNATIVE C2

A. GENERAL DESIGN

The general layout for Alternative C2 is similar to Alternative C1, as shown on Exhibit C2, except:

1. Alternative C1 provides only one rapid mixing basin and split box located between Basin No. 1 and Basin No. 2 instead of one for each basin.

2. Only one influent main required.

3. Flow through Basin No. 1 is reversed.

4. Additional sludge collection piping is required.

5. Additional settled water piping is required.

B. COMPLIANCE (With Respect to DNR Standard)

(Same as Alternative C1)

C. ADVANTAGES

1. Provides flexible operating modes for flocculation and settling processes.

2. Meets DNR flocculation and sedimentation basin design standards under normal mode of operation and sometimes with one unit not in use.

3. Lower Construction cost than alternative C1.

D. DISADVANTAGES

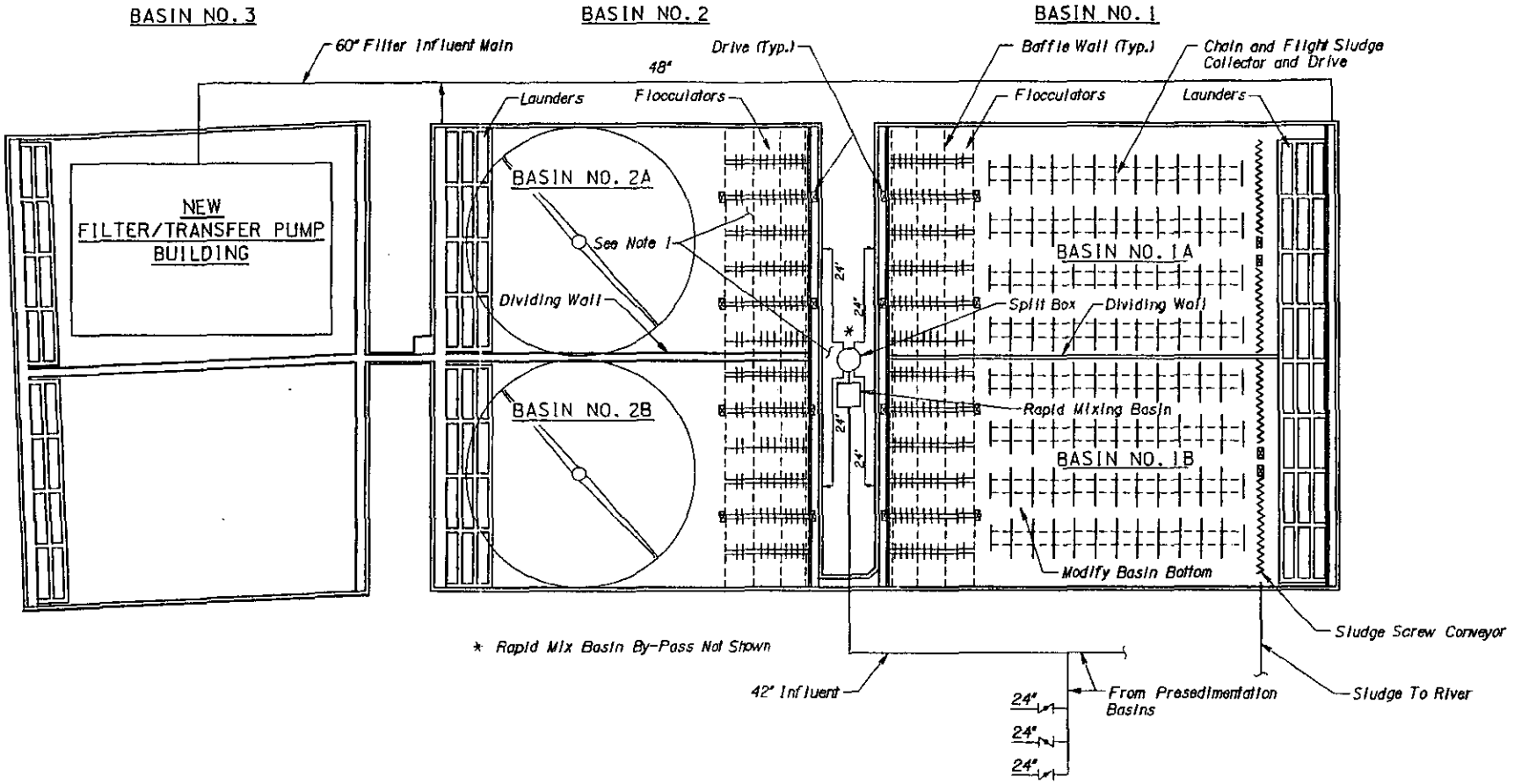
1. With rapid mixing basin off-line, the treatment process will lack chemical dispersion and result in subsequent poor flocculation and settling process.

2. Difficulty to construct influent piping and rapid mixer while keeping Basin No. 2 in service.

3. Winter ice problem will remain if costly roofed enclosure system is not constructed.

TABLE 10-3
BASIN WORK AND ADDITIONAL ALUM STORAGE
ADDITIONAL COST ESTIMATE
ALTERNATIVE C2

No.	ITEM	COST
	Base Construction Cost*	$8,810,000
1.	Rapid Mixing Basin	215,000
2.	Split Box	50,000
3.	Flocculator Baffle Walls a. Basin No. 1	175,000
	b. Basin No. 2	175,000
4.	Three-Staged, Tapered Flocculators a. Basin No. 1	430,000
	b. Basin No. 2	430,000
5.	Sludge Collector System a. Basin No. 1	900,000
	b. Basin No. 2 (partial)	- - -
6.	Dividing Wall a. Basin No. 1	330,000
	b. Basin No. 2	300,000
7.	Effluent Collection Launders a. Basin No. 1	225,000
	b. Basin No. 2	40,000
8.	Rehabilitation of Basin No. 1 Bottom	300,000
9.	Flumes Connecting Basin No. 1 and No. 2	- - -
10.	Removal of the Existing Flocculator and Rapid Mixer	20,000
11.	Influent Piping & Connections	525,000
12.	Effluent Piping & Connections	365,000
13.	100,000 Gallon Alum Storage Tank	200,000
	SUBTOTAL	$13,490,000
14.	Roof a. Basin No. 1	1,520,000
	b. Basin No. 2	1,520,000
15.	Superpulsator/Clarifier Building	- - -
	TOTAL	$16,530,000



FLOCCULATOR/SEDIMENTATION BASINS

NOTE:

1. Remove existing flocculators, rapid mixer and wooden baffle wall.

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH, MISSOURI

ST. JOSEPH
WATER TREATMENT PLANT
IMPROVEMENT PROJECT
ALTERNATIVE C2

GANNETT FLEMING INC. SEPTEMBER 1992

GFWR\EXHIBITS\AMERICAN\28512EX1.DGN

EXHIBIT C2

TABLE 11-1
FOUR SUPERPULSATOR/CLARIFIER UNITS
DESIGN CRITERIA
(Design Flow Rate 30 MGD)

A.	Rapid Mixing	
	1. Type	Two stage rapid mixing
	2. Number of mixing basins	2
B.	Clarification	
	1. Type	Superpulsator upflow solids contact clarifier
	2. Number of Superpulsator unit	4
	3. Surface landing rate (based on 30 MGD)	3 gpm/ft

TABLE 11-2
GENERAL DESCRIPTION AND EVALUATION FOR
ALTERNATIVE D1

A. GENERAL DESIGN

In Alternative D, Superpulsator clarifiers replace the three existing concrete sedimentation basins. The Superpulsator clarifiers are solids-contact type units operating in an upflow mode. The Superpulsator installation consists of the following facilities:

1. Two stage rapid mix/high intensity flocculation tanks.

2. Four concrete tanks outfitted as Superpulsator/Clarifiers.

3. Integral sludge collection piping, valves, and controls.

4. Inlet and outlet flumes/piping.

5. Masonry superstructure enclosure.

B. COMPLIANCE (With Respect to DNR Standards)

The DNR must specifically review the proposed design criteria for the Superpulsator as the current DNR design standards do not address upflow solids contact clarification.

C. ADVANTAGES

1. The Superpulsator clarifiers have the capability to hold powdered activated carbon in suspension, providing enhanced organic and THM precursor removal.

2. The compact size of the Superpulsators liberates space at the treatment plant for other improvements.

3. The enclosure over the Superpulsators prevents ice related problems.

4. The Superpulsator has no wetted mechanical equipment to fail or maintain.

5. The Superpulsator has integral continuous sludge removal.

6. Four units allows one to be removed from service without significant process impacts.

D. DISADVANTAGES

1. The Superpulsator alternative is more expensive than making improvements to existing sedimentation basins.

2. The Superpulsator requires a solids blanket control polymer which increases chemical costs by approximately $3 per million gallons.

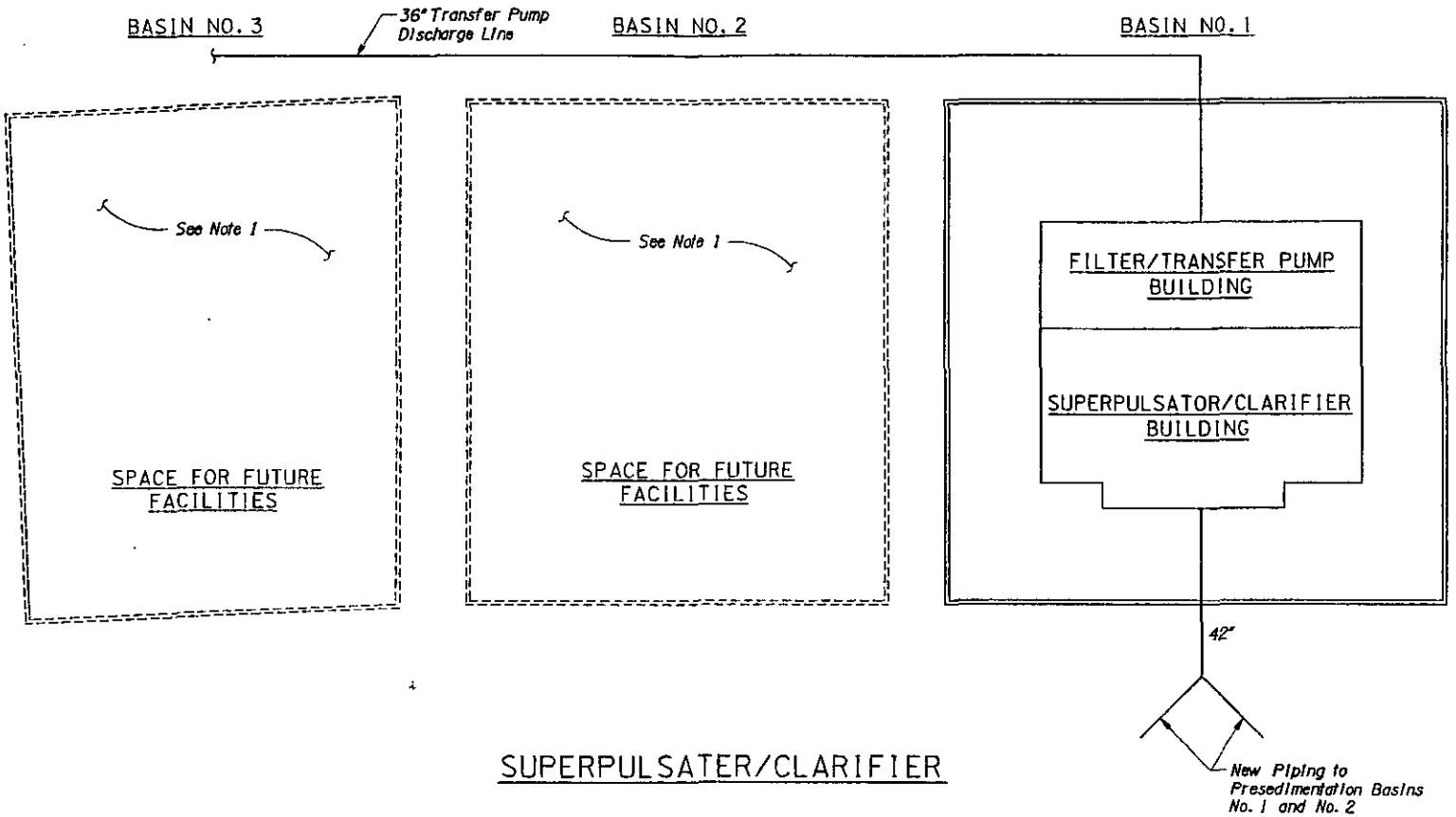
3. The solids contact process requires greater operator skill in determining chemical treatment.

Note: This Table was jointly prepared by Gannett Fleming, Inc. and American Water Works Service Company personnel.

TABLE 11-3
BASIN WORK AND ADDITIONAL ALUM STORAGE - ALTERNATIVE D1

No.	ITEM	COST
	Base Construction Cost*	$8,810,000
1.	Rapid Mixing Basin	- - -
2.	Split Box	- - -
3.	Flocculator Baffle Walls a. Basin No. 1	- - -
	b. Basin No. 2	- - -
4.	Three-Staged, Tapered Flocculators a. Basin No. 1	- - -
	b. Basin No. 2	- - -
5.	Sludge Collector System a. Basin No. 1	- - -
	b. Basin No. 2 (partial)	- - -
6.	Dividing Wall a. Basin No. 1	- - -
	b. Basin No. 2	- - -
7.	Effluent Collection Launders a. Basin No. 1	- - -
	b. Basin No. 2	- - -
8.	Rehabilitation of Basin No. 1 Bottom	- - -
9.	Flumes Connecting Basin No. 1 and No. 2	- - -
10.	Removal of the Existing Flocculator and Rapid Mixer*	35,000
11.	Influent Piping & Connections	150,000
12.	Effluent Piping & Connections	125,000
13.	100,000 Gallon Alum Storage Tank	200,000
14.	Roof a. Basin No. 1	- - -
	b. Basin No. 2	- - -
15.	Superpulsator/Clarifier Building	4,365,000
	TOTAL	$13,685,000

* Includes removal of launder, sludge collector, and flocculators from Basin No. 2 and No. 3.



SUPERPULSATER/CLARIFIER

NOTE:

1. Remove existing flocculators, rapid mixer, wooden baffle wall, sludge scrapper, and launders.

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH, MISSOURI

ST. JOSEPH
WATER TREATMENT PLANT
IMPROVEMENT PROJECT
ALTERNATIVE D1

GANNETT FLEMING INC. SEPTEMBER 1992

GFWR\EXHIBITS\AMERICAN\28512EX1.DGN

EXHIBIT D1

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT
ST. JOSEPH, MISSOURI

ST. JOSEPH
WATER TREATMENT PLANT

DESIGN MEMORANDUM

PRELIMINARY
AUGUST 1993

Prepared By:

GANNETT FLEMING, INC.
WATER RESOURCES AND GEOTECHNICAL DIVISION
HARRISBURG, PENNSYLVANIA

SCHEDULE
JSY-4

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT
ST. JOSEPH, MISSOURI

ST. JOSEPH
WATER TREATMENT PLANT

DESIGN MEMORANDUM

PRELIMINARY
AUGUST 1993

Prepared By:

GANNETT FLEMING, INC.
WATER RESOURCES AND GEOTECHNICAL DIVISION
HARRISBURG, PENNSYLVANIA

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH WATER TREATMENT PLANT
DESIGN MEMORANDUM

TABLE OF CONTENTS

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH WATER TREATMENT PLANT
DESIGN MEMORANDUM

TABLE OF CONTENTS (Cont'd)

EXHIBITS

APPENDICES

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH WATER TREATMENT PLANT
DESIGN MEMORANDUM

I. WATER TREATMENT REQUIREMENTS

A. Removal and disinfection of bacteria, viruses and other pathogenic organisms, including protozoan cysts.

B. Reduction of suspended and colloidal solids, including plankton, in compliance with provisions of the Surface Water Treatment Rule and to the lowest practical levels.

C. Reduction of iron and manganese levels to below the secondary MCL, and to the lowest practical levels.

D. Reduction of color levels to below the secondary MCL, and to the lowest practical level.

E. Reduction of formation of trihalomethanes and other disinfectant byproducts.

F. Removal of organics, herbicides and pesticides

G. Reduction of tastes and odors.

H. Production of stable, non-corrosive water.

I. Phased construction

1. Phase 1 - Filter media replacement in existing filters (completed)

2. Phase 2 - Superpulsators/Chemical Facilities

3. Phase 3 - Filters, clearwell, transfer pumping station & support facilities

4. Phase 4 - Additional filters and Contact Tank

II. PLANT CAPACITY

A. Plant Design Flows, mgd

1. Minimum 12.0

2.	Average	17.0
3.	Maximum	30.0
4.	Hydraulic Capacity	45.0

III. SOURCE OF SUPPLY

A. Existing Source - Missouri River

1.	Average flow, mgd	26,465
2.	Minimum flow, mgd (Jan. 1937)	1,486
3.	100-yr. flood elevation, ft. (FEMA)	821.0
4.	Maximum flood elevation, ft (July 1993)	826.4

IV. RAW WATER FACILITIES

A. Existing Primary Intake to Screen Wet Well

1.	Number of mains	3
2.	Size of mains, inch	1 @ 24, 2 @ 36

3. Existing sheet pile structure protects intake pipes

4. Mains act as siphon with jet educators to prime and maintain siphon

5. Suction well is equipped with travelling screen

B. Existing Auxiliary Intake

1. Located 1000 feet downstream of the primary intake

2. One 15 mgd vertical turbine pump

3. Suction line is a 24-inch line extending 30 feet into the river

4. Discharge is a 24-inch main to clarifiers or to existing basin No. 1

5. Not used under normal conditions

C. Existing Low Service Pumping Station

Pump No.	Year Installed	Hp	Head (ft)	Rated Capacity (MGD)
9	1953	125	45	13.0
10 (Auxiliary Intake)	1953	250	70	15.0
12	1956	150	35	15.0
15	1962	200	50	19.0

1. Total capacity with largest pump out-of-service, mgd — 43

D. Existing Raw Water Mains to Clarifiers

1. Number — 3
2. Size, in. — 2 @ 20/24, 1 @ 36
3. Replace segment of the two 20"/24" with 36" to provide desired 45 mgd hydraulic capacity

E. New Raw Water Metering and Flow Control

1. Two magnetic flow meters and control valves
2. Size, in. — 36
3. Evaluate economics of reducing to 24-inch size

V. FIRST STAGE (PRESEDIMENTATION) CLARIFIERS

A. Existing Units (plan for additional presedimentation capacity to accommodate plant expansion and reliability).

1. Number — 2
2. Unit dimensions
   a. Diameter, feet — 75
   b. Height, feet — 19.0
   c. Volume, gallons — 630,000

3.	Detention Time, hours		
	a.	Minimum flow	2.5
	b.	Average flow	1.78
	c.	Maximum flow	1
4.	Surface Loading - GPD per sq. foot		
	a.	Minimum flow	1,360
	b.	Average flow	1,925
	c.	Maximum flow	3,400
5.	Effluent Weir Elevations, feet		
	a.	Unit No. 1	835.90
	b.	Unit No. 2	836.19
6.	Settled Water Main to Plant (New)		
	a.	Size, in.	48
	b.	Velocities, fps	
		1) Minimum Flow	1.48
		2) Average Flow	2.09
		3) Maximum Flow	3.69
		4) Hydraulic Capacity	5.54

VI. PRETREATMENT CHEMICALS

A. Pretreatment Chemicals

1. Refer to Appendix A for location of chemical feed points, daily usage rates and storage requirements

Chemical	Form	Range Min/Avg/Max (mg/l)
Cationic Polymer	Liquid - Bulk	0.3/0.8/5
Potassium Permanganate	Crystal - Drum	0.1/0.5/2
Powdered Activated Carbon	Dry - Bulk	5/10/30
Lime	Hydrated - Bulk	5/15/65
Caustic Soda (Backup for Lime)	Liquid - Bulk	2/6/15
Chlorine	Liquid - Ton Container	2/6/12
Alum	Liquid - Bulk	2/15/50 Normal 30/200 High
Blanket Polymer	Liquid - Drum	0.05/0.2/0.5
Filter Aid Polymer	Liquid - Drum	0.01/0.05/0.2
Ozone (Future Provision)	Gas-Generated On Site	Not Defined

VII. MIXING

A. Rapid Mixer

1. Type - Dual stage with radial turbine mixer

2. Number — 1

3. Dimension
   - a. Length — 6'-0"
   - b. Width — 6'-0"
   - c. Side Water Depth (to top of water) — 19'-0"

4. Volume, gallon — 5,116

5. G Value (Sec^{-1}) — 910

6. Detention time, seconds
   a. Minimum flow 37
   b. Average flow 26
   c. Maximum flow 15
   d. Hydraulic capacity 10

7. Mixing Control - Constant speed with gear changes to vary energy input

8. Motor Horsepower 40

B. Slow Mixing Basin

1. Type - Single stage with radial turbine mixer

2. Number 1

3. Dimensions
   a. Length 17'-0"
   b. Width 17'-0"
   c. Side Water Depth (to top of weir) 19'-0"

4. Volume, gallons 41,073

5. G value, sec^{-1} 0-200

6. Detention time, minutes
   a. Minimum flow 4.93
   b. Average flow 3.94
   c. Maximum flow 1.97
   d. Hydraulic Capacity 1.31

7. Mixing control - Variable frequency drive (VFD)

8. Motor Horsepower 10

9. Split box to distribute flows to the superpulsator clarifiers
   a. 4 weirs, 1 for future basin

VIII. SUPERPULSATOR CLARIFIERS

A. Superpulsator upflow solids contact clarifiers are to be constructed to clarify the effluent of the presedimentation (first stage) clarifiers and prepare the water for filtration. The Superpulsators are to be enclosed in a heated building to protect the clarifiers from snow and ice.

1.	Number of superpulsators basins	3
2.	Flow per basin, mgd	
	a. Minimum	4.0
	b. Average	5.67
	c. Maximum	10
	d. Maximum, one basin off line	15
3.	Basin dimensions - each, ft (Process Portion)	
	a. Width	2 @ 15
	b. Length	87
	c. Water depth	17
4.	Volume, each basin	
	a. Ft^3	42,959
	b. Gallons	321,333
5.	Surface area, ft^2	
	a. Each basin	2,527
	b. Total	7,581
6.	Upflow rate, gpm/ft^2	
	a. Minimum flow	1.11
	b. Average flow	1.57
	c. Maximum flow	2.77
	d. Maximum flow, one basin off line	4.16
7.	Detention time - min	
	a. Minimum flow	116
	b. Average flow	82
	c. Maximum flow	46
	d. Maximum flow, one basin off line	31
8.	Mechanical equipment	
	a. Vacuum pump - centrifugal type	
	b. Vacuum release valve	
	c. Sludge blowdown valve	
	d. Distribution pipes - PVC	
	e. Collection pipes - PVC	
	f. Sludge pipes - PVC	

	g.	Inclined plates - fiberglass	
	h.	Plate support angles - aluminum	
	i.	Submerged hardware - 304 stainless steel or aluminum	
	j.	Electrical controls	
	k.	Turbidimeter for each superpulsator clarifier effluent	
9.	Vacuum Pump		
	a.	Number of pumps (1 per basin)	3
	b.	Horsepower	—
	c.	Capacity	—
	d.	Provide a common spare for basin 1 & 2	
	e.	Provide a spare for basin 3	
10.	Influent		
	a.	Size, in.	42
	b.	Velocities, fps.	
		1) Minimum flow	0.67
		2) Average flow	0.91
		3) Maximum flow	1.61
		4) Maximum flow, one basin off-line	2.41
11.	Effluent Slide Gate		
	a.	Size	4'-4"D x 8'-0"L (plus guide depth)
12.	Effluent Flume		
	a.	Velocities, fps	0.5-0.8
13.	Solids Removal/Transfer		
	a.		
	b.		

IX. FILTRATION

A. Existing filters to remain in service until Phase 4 filters are placed in service. Downflow gravity filter beds consisting of gravel, sand and granular activated carbon (GAC). Filter bed supported on a gravel base contained within rectangular reinforced concrete basins.

1. Existing Filters:

Filter Numbers	Year Constructed	Bed Size	Filter Area (SF)		Filter Capacity (MGD) at 2 GPM/SF	
			Each	Total	Each	Total
1-8	1913	12'x 17'-6"	210	1,680	0.60	4.84
9-18	1925	16'x 22'	352	3,520	1.01	10.14
19-24	1956	16'-7"x 22'	365	2,190	1.05	6.30
					TOTAL	21.28

2. Number of new filter basins
   a. Phase 3 — 3
   b. Phase 4 — 3
   Total — 6

3. Flow per filter - all units in service, mgd
   a. Minimum — 2.0
   b. Average — 2.83
   c. Maximum — 5.0
   d. Maximum, one filter out of service — 6.0

4. Filter area, ft^2
   a. Per filter — 1,042.67
   b. Totals
      1) Phase 3 (3 filters) — 3,128
      2) Phase 4 (6 filters) — 6,256

5. Filter box dimensions, ft
   a. Width — 15.33
   b. Length — 34.0
   c. Depth (incl. 2' freeboard) — 15.00
   d. Water depth over media (w.s. el. 830.75) — 6.5

6. Surface loading - all filters in service, gpm/ft^2
   a. Minimum 1.33
   b. Average 1.59
   c. Maximum 3.33

7. Surface loading - one filter out of service, gpm/ft^2
   a. Minimum 1.60
   b. Average 2.26
   c. Maximum 4.00

8. Filter underdrain
   a. Type - clay tile with dual lateral

9. Media design:

Component	Depth (in)	Effective Size (mm)	Uniformity Coefficient	Specific Gravity
GAC	39			
Silica Sand	9.0	0.35 - 0.45	<1.5	>2.6
Garnet Sand	4.5	0.18 - 0.28	<1.5	3.9 - 4.1
Total Sand	13.5			
Garnet Gravel	3	1.0 - 2.0		>3.9
Silica Gravel	9	3/16" - 1.0"		>2.6
Total Gravel	12			
Total Depth Above Gravel	52.5			
Total Depth Including Gravel	64.5			

10. Detention time:

	Chlorine Contact Time above media (6.5') (min)	Empty bed Contact Time thru GAC (min)
a. Minimum flow	36.5	18.3
b. Average flow	25.8	12.9
c. Maximum flow	14.6	7.3
d. Maximum flow, one basin out	12.2	6.1

11. Accessories per filter
    a. Filter flow controller - universal tube with electric motor operator
    b. Head loss transmitter with high alarm
    c. Flow transmitter
    d. Effluent low range turbidimeter with high alarm
    e. Backwash Turbidimeter
    f. Control console
    g. Semi-automatic backwash and filter to waste programs
    h. Washwater troughs - 2 per filter will this comply w/standards
    i. Filter underdrains, clay tile w/header - Lateral Airwash System
    j. Motorized butterfly control valves unless noted as sluice gate

		Size (in)	Max V (fps)
1)	Influent (6 mgd)	36	1.3
2)	Wash (18 gpm/ft^2)	30	4.7
3)	Waste (18 gpm/ft^2)	36	3.0
4)	Air (4.0 scfm/ft^2)	12	44
5)	Effluent (6 mgd)	20	4.3
6)	Filter to waste (6 mgd)	20	4.3

    k. Filter aid, nonionic polymer, feed point (influent)
    l. Air wash piping above filter gravel
    m. Two filters to have head loss probes @ various media depths

12. Backwash water
    a. Flow rates, gpm/filter

1)	Minimum - 5 gpm/ft^2	2,607
2)	Maximum - 18 gpm/ft^2	9,384
3)	Pipe hydraulic design - 20 gpm/ft^2	10,427
4)	Volume per wash, gals. (10 min @ 5 gpm/ft 10 min @ 18 gpm/ft)	240,000

    b. Source of water - clearwell/transfer pump
    c. Coagulant feed point (washwater main) to condition backwash water

13. Filter air blower

a.	Number	1
b.	Flow rate, scfm/ft^2	4.0
c.	Blower capacity, scfm	2,085

14. Other Features
    a. Filter influent flume along the ends of the filters.
    b. Filter to waste to be separate from backwash waste to allow direct recycling of filter-to-waste water.

c. Provide wall sleeves for carbon removal/placement.
d. Provide water supply for carbon educator supply and routine cleaning.
e. Provide walls with vision panels and doors along the end of the filters to make the filter operating floor a room separate from the filters.
f. Provide generous lighting and ventilation in the filter area and filter operating floor.
g. Filter gallery is to be dehumidified to minimize condensation, subsequent corrosion of piping and to prolong life of electric actuators and instrumentation.
h. Equip two of the filters with loss-of-head probes at various filter media depths to monitor loss-of-head throughout the filter to assist in optimizing treatment and extending filter runs.
i. Provide master filter rate setpoint to set individual filter rate setpoints.
j. Level in filter influent flume shall bias the filter setpoint to maintain filter influent level.

X. POST CHEMICAL TREATMENT

(Refer to Appendix A for chemical feed and storage requirements)

A. Post-Chemicals

Chemical	Form	Range Min/Avg/Max mg/l
Chlorine	Liquid-Ton Container	0/3.5/5
Hydrofluosilicic Acid as F	Liquid-Bulk	0.2/0.4/1.0
Ammonia (Future)	Gas-Bulk	0/2.4/4.5

XI. CLEARWELL (PHASE 3)

A. Constructed below the proposed filters to provide post-filtration disinfection contact time and source of backwash water.

1. Type & Design features
   a. Reinforced concrete construction

2. Two cell with serpentine baffling

3. Inlet and outlet baffling

4. Provide for one cell to be taken out of service at a time for cleaning and inspection.

5. Future ammonia feed capability @ beginning and end of clearwell.

B. Volume required, MG

1.	Filter washing, 2 units	0.48
2.	Pump Sta. wet well	0.05
	Total	0.53

		Clearwell Cell A	Clearwell Cell B	P.S. Wet Well	Totals
C.	Size, ft.				
1.	Width	34	34	20/15	
2.	Length	109.5	88.5	27/39	
3.	Depth	9.0	9.0	17	
D.	Volume, gallons				
1.	Actual (elev. 816.5)	251,000	203,000	143,000	597,000
2.	Useable* (elev. 816.0)	237,000	191,000	93,000	521,000
E.	Contact time, min.				
1.	Minimum flow	28	23	11	62
2.	Average flow	20	16	8	44
3.	Maximum flow	11	9	5	25

* 6' in bottom of pump station wet well (0.05 mg) deducted for pump bell and submergence requirements.

F. Ct Criteria

1.	pH	8
2.	Temperature, °C	0.5
3.	Free chlorine residual, mg/l	2
4.	Baffling factor	0.7

5. Clearwell operating level, % 50

6. Production Rate, mgd 30

G. CT (chlorine residual x contact time)

1. Required, mg/l - min --

2. Calculated --

XII. CONTACT TANKS (PHASE 4)

A. Constructed adjacent to existing 1.0 mg prestressed concrete storage tank and normally operate in series.

1. Type & Design features
   a. Prestressed concrete or steel tank

2. Serpentine baffling in new and existing unit.

3. Provide for either unit to be taken out of service at a time for cleaning and inspection with other unit remaining in service.

Item	Existing	New	Total
B. Size, ft.			
1. Inside Diameter	70.0	110.0	
2. Height	35.0	35.0	
C. Volume, gallons			
1. Actual	1,007,500	2,488,000	3,495,500
2. Useable	1,007,500	2,488,000	3,495,500
D. Contact time, hrs. (min.)			
1. Minimum flow	2.0 (120)	5.0 (300)	7.0 (419)
2. Average flow	1.4 (85)	3.5 (211)	4.9 (296)
3. Maximum flow	0.8 (48)	2.0 (119)	2.8 (167)

E. Ct Criteria

1.	pH	8
2.	Temperature, °C	0.5
3.	Free chlorine residual, mg/l	2
4.	Baffling factor	0.7
5.	Clearwell operating level, %	50
6.	Production Rate, mgd	30

F. CT (chlorine residual x contact time)

1.	Required, mg/l - min	--
2.	Calculated	--

XIII. PUMPS

A. Existing Transfer Units

Number of Pumps	Year Installed	Hp	Head (ft)	Rated Capacity Each	
				(mgd)	(gpm)
6	1984	75	40	7.0	4,900

B. New Transfer/Backwash Units

1.	Number	4
2.	Capacity with largest unit out of service, mgd	30
3.	Design Criteria:	

Design Point No.	Capacity (mgd)	Capacity (gpm)	Head (ft.)	Efficiency (%)	NPSHR (ft.)	NPSHA (ft.)	Hp (Required)
Peerless Transfer Unit - 14HH (Curve No. 2846901) 1 Stage, 1785 rpm							
A (shut off)	0	0	97				63
B	3	2,100	70	67	15	40	55
C (primary)	5	3,500	50	83	15	40	53
D	6	4,200	37	75	23	40	52
Peerless Transfer Unit - 20HH (Curve No. 2806181) 1 Stage, 1185 rpm							
A (shut off)	0	0	92				120
B	6	4,200	65	68	9	40	101
C (primary)	10	7,000	50	88	13	40	100
D	12	8,400	34	83	17	40	87
Peerless Transfer/Backwash Units - 24HH (Curve No. 4806310) 1 Stage, 1185 rpm							
A (shut off)	0	0	114				208
B	10	7,000	68	75	22		160
C (primary)	15	10,500	50	86	20	40	154
D	17	11,900	36	78	28	40	139

C. Existing High Service Units

1. Design Criteria:

Pump No.	Year Installed	Hp	Head (ft)	Rated Capacity (mgd)	Rated Capacity (gpm)
8	1953	600	330	9.36	6,500
11	1954	400	330	6.05	4,200
13	1962	800	345	11.50	8,000
14	1962	800	345	11.50	8,000

2. Total capacity with largest pump out of service, mgd 26.9

D. New high service pump

1. Number 1

2. Capacity, mgd 6

3. Drive variable speed

4. Design Criteria:

Design Point No.	Capacity (mgd)	Capacity (gpm)	Head (ft.)	Efficiency (%)	NPSHR (ft.)	NPSHA (ft.)	Hp (Required)
Peerless Unit 18HXB (Curve No. 2846852) 3 Stages, 1,760 rpm							
A (shut off)	0	0	477				293
B	5	3,500	366	81	23	40	400
C (primary)	6	4,200	345	85	25	40	430
D	7	5,600	246	78	40	40	446

XIV. MOTORS

A. New Units

Pump Designation	Hp	Voltage	Nominal Rotation Speed (rpm)	Efficiency		
				Full Load	3/4 Load	1/2 load
5 mgd Transfer	60	460	1,800	91.0	91.0	90.0
10 mgd Transfer	125	460	1,200	92.0	92.0	90.5
15 mgd Transfer/ Backwash	200	460	1,200	92.0	92.0	90.5
16 mgd High Service	500	4,000	1,800	93.6	94.3	94.1

XV. METERS

A. New Units

Meter Designation	Quantity	Type	Size (in)	Flow (mgd)			Differential (in.)			Head Loss (in.)		
				Min.	Avg.	Max.	Min	Ave	Max	Min	Ave	Max
Raw Water	2	Magnetic	30	6	17	30	--	--	--	--	--	--
Filter Effluent	6	Venturi	20 "A"	2	2.83	6	5.6	11.3	50.8	0.32	0.64	2.88
Filter Backwash	1	Venturi	24 "A"	3.75	11.25	15	11.7	105.7	187.9	0.85	7.7	13.7
Transfer	1	Venturi	42 "A"	12	17	30	17.2	34.6	107.7	1.51	3.04	9.47
Plant Effluent	1	Venturi	48 "A"	12	17	30	9.8	19.7	61.4	0.83	1.67	5.21

XVI. PLANT SUPPORT FACILITIES

A. ADMINISTRATIVE AREA

1. Entrance Way/Vestibule
2. Multi-Purpose Room (Storage, Drawing files, Office Machines, Copier, Fax)
3. Mudroom
4. Multi-Purpose Room (training, lunch, conference)
5. Workshop
6. Control Room
7. Computer Room
8. Laboratories
   a. Process
   b. Wet Chemistry
   c. Bac-T
   d. Atomic Absorption or Gas Chromatograph
   e. Laboratory Storage Room
   f. Future Gas Storage

9. Offices
   a. Production Superintendent
   b. Water Quality Superintendent
   c. Assistant Production Superintendent/Production Supervisor/Chemist

10. Public Restrooms
    a. Mens Restroom
    b. Womens Restroom

11. Plant Personnel Restrooms
    a. Mens Restroom
    b. Mens Locker/Shower Room
    c. Womens Restroom
    d. Womens Locker/Shower Room

12. Janitors Closet

13. Storage Closet for long tables, chairs used at conferences

B. PROCESS AREA

1. Chemical Storage Room

2. Chemical Feed Room

3. Chlorine Storage Room

4. Chlorine Feed Room

5. Chlorine Scrubber Room

6. Caustic Soda Storage/Feed Room

7. Alum Storage Area

8. Alum Feed Area

9. Mixer/Lime Feed Room

10. Process Room

11. Filter Room

12. Filter Operating Room

13. Filter Pipe Gallery

14. Electrical Rooms

15. Pump Station

16. Ammonia Feed Room (Future)

17. Lime Silo

18. Carbon Silo/Feed Room

XVII. PROCESS CONTROL AND INSTRUMENTATION

A. Piping and instrumentation control diagrams - See Drawing Nos. I-1 & I-2. For other instrumentation, see Appendix B.

XVIII. ELECTRICAL

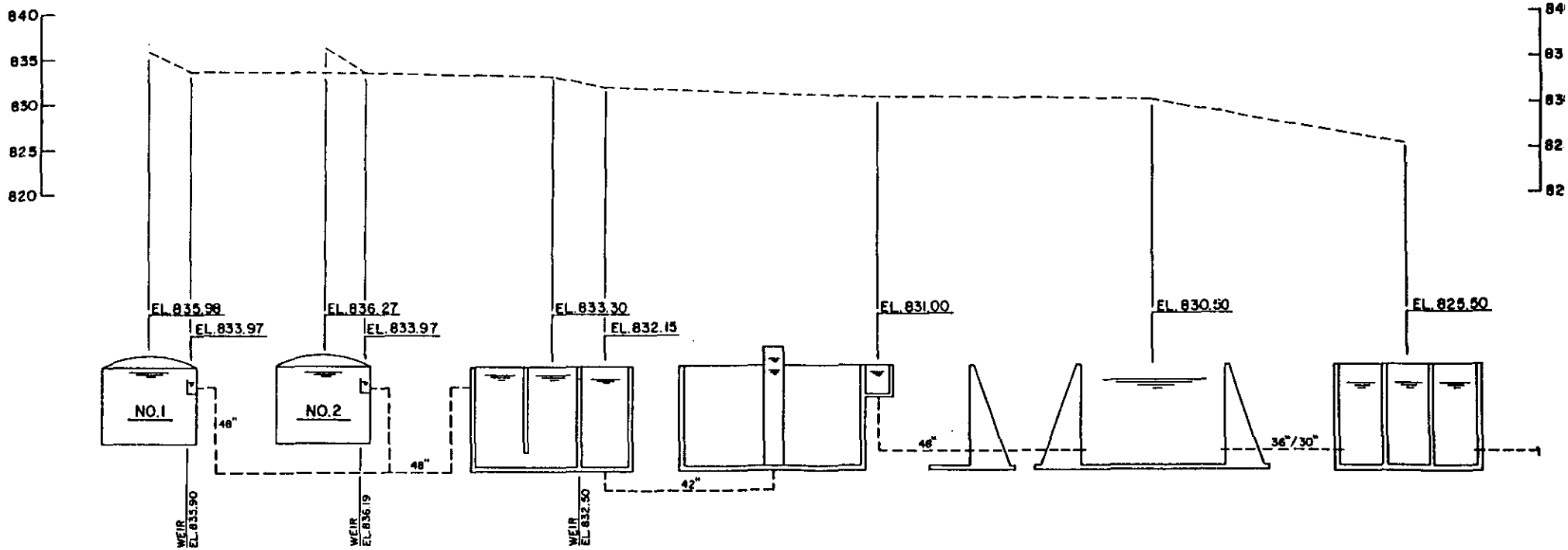
A. Power distribution one-line diagram - See Appendix C

XIX. GEOTECHNICAL

A. Interim foundation recommendations - See Appendix D

EXHIBITS

A - F



Q = 25.0 M.G.D.

MISSOURI AMERICAN WATER CO.
ST. JOSEPH DISTRICT

HYDRAULIC PROFILE
PHASE I

GANNETT FLEMING, INC. JULY, 1993

EXHIBIT