

Proposed Project for Application to the Kansas Department of Health and Environment for the Kansas Water Pollution Control Revolving Loan Fund and to the Department of Commerce for a Grant.

Applicant: City of Belvue
Wastewater Treatment System Improvements

Contact Person: Donna J. Crawford

Address: Governmental Assistance Services
905 Joseph Dr.
Lawrence, KS 66049

Sent to the Kansas Geological Survey for environmental review.

Agency Review Comments:

Any short-term adverse impacts during construction should be offset by the long-term benefits of the improvements to the wastewater treatment system, assuming that the facility and its operation (including use of treated wastewater for irrigation) conform to regulations and standards of the Kansas Department of Health and Environment.

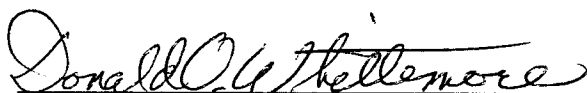
Recommended Action:

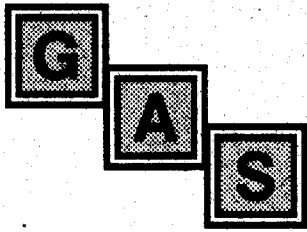
- ☒ Clearance of project should be granted
- ☐ Clearance of project should not be granted
- ☐ Clearance of project should be delayed until the issues or questions have been clarified
- ☐ Clearance of project should not be delayed, but the applicant (in the application) should address or clarify the questions or concerns indicated above

Donald O. Whittemore
Reviewer's Name

Geohydrology Section, Kansas Geological Survey
Division/Agency

6/20/03
Date


Reviewer's Signature



Governmental Assistance Services

905 Joseph Drive

Lawrence, Kansas 66049

785-832-2141 • Fax 785-832-1111

Toll Free 888-832-3335

e-mail: gasdonnaa@aol.com

June 3, 2003

Dr. Lee Allison
Kansas Geological Survey
University of Kansas
1930 Constant Ave. – Campus West
Lawrence, KS 66047

RE: Request for Environmental Comments – City of Belvue, KS
Sanitary Sewer System Improvements

Dear Dr. Allison:

The City of Belvue, Kansas is in the process of submitting a grant request to the Kansas Department of Commerce and for KDHE revolving loan funds, each to share costs 50-50. Option 3 has been recommended by the City Engineer to construct a totally new 2.0 acre cell to the west of existing cells 1 & 3. Existing cells 1, 2, & 3 will remain the same 0.60, 0.30 and 0.45 acres. Improvements are needed to meet the KDHE schedule of compliance.

The city is submitting options investigated. Please feel free to comment on all options. The existing facility is located in the SE ¼, SW ¼, SE ¼, Section 34, Township 9 South, Range 11 East, Pottawatomie County, Kansas.

Also, if your department is involved in flood information, please state if the location is in or out of the floodplain.

Please submit all your comments to Governmental Assistance Services, 905 Joseph Dr., Lawrence, KS 66049.

If you should have questions please call my office toll free at 888-832-3335.

Sincerely,

Donna J. Crawford
Project Coordinator

Enc/ Narrative of Options
Topo Map

DESIGN PARAMETERS**4.1 DISCUSSION**

Consideration of alternatives for updating, improving or expanding a wastewater treatment facility requires that certain design parameters be established as a basis for alternative comparison. These parameters consist of current and projected wastewater flows, BOD5 loading, wastewater composition, existing condition of the treatment facility, and other general design considerations. These parameters are based upon KDHE "Minimum Standards..." engineering principals and practices, field survey data, existing City information and knowledge, and practical engineering experience.

4.2 INFLOW AND INFILTRATION

The collection system was constructed in its entirety at the time of the lagoon construction in 1971. As the collection system gets older, inflow and infiltration will increase. The maximum allowable inflow and infiltration (I/I) into the sanitary sewer system according to KDHE Minimum Standards is 250 gallons per day per inch of nominal pipe diameter per mile of sanitary sewer line. Below are calculations for the max allowable I/I flow for the City of Belvue. (The length of collection system piping was taken off of the construction plans.)

$$250 \text{ gpd/inch/mile} \times 8 \text{ inch} \times 2.28 \text{ miles} = 4,560 \text{ gpd}$$

4.3 PROJECTED WASTEWATER FLOWS

As discussed in Section 3.1, the standard design flow for wastewater treatment facilities is 100 gpcd. In addition, a design population equivalent of 335 shall be used as discussed in Section 3.2. Projected wastewater flows for design year 2022 are shown below.

$$335 \text{ P.E.} \times 100 \text{ gpcd} = 33,500 \text{ gpd}$$

$$\text{Design Flow} + \text{Allowable Infiltration} = \text{Total Design Flow}$$

$$33,500 \text{ gpd} + 4,560 \text{ gpd} = 38,060 \text{ gpd}$$

4.4 PROJECTED WASTE LOAD

For domestic waste, the size and/or type of wastewater treatment utilized is in part dependent upon the amount of organic matter that must be decomposed by that facility. This organic matter is measured in terms of 5-day Biochemical Oxygen Demand (BOD5). The Kansas Department of Health and Environment recommends design values for BOD5 and Total Suspended Solids (TSS) as follows:

Design Year	2025
Design Population	335 P.E.
Design Waste Load	0.17 lbs. BOD5/P.E./day
	0.21 lbs. TSS/P.E./day

Total Daily Loading (Design)

335 P.E.	x	0.17	=	57 lbs./BOD5/day
335 P.E.	x	0.21	=	70 lbs./TSS/day

4.5 SUMMARY OF DESIGN PARAMETERS

2002 (current) Population	232 P.E.
2025 (projected) Population	335 P.E.
Actual Year average per capita Wastewater Flow	87 gpcd
Estimated Future per capita Wastewater Flow	100 gpcd
Actual Average Daily Wastewater Flow	20,200 gpd
Est. Future (2025) Daily Wastewater Flow (Based on 335 P.E. and 87 gpcd)	29,145 gpd
Est. Future (2025) Daily Wastewater Flow (Based on 335 P.E. and 100 gpcd)	33,500 gpd
Est. Future (2025) Total Daily Wastewater Flow (Includes max allowable infiltration)	38,060 gpd
BOD Loading (2025)	57 lb/day
TSS Loading (2025)	70 lb/day

ALTERNATIVE FOR UPDATING WASTEWATER TREATMENT FACILITIES**5.1 NO ACTION**

The existing wastewater treatment facilities for the City of Belvue, Kansas currently cannot continuously comply with state and federal permit regulations. During the last 11 BOD tests, only 4 passed. Also, according to KDHE Minimum Standards of Design, the treatment facility must have at least 120 days of detention with proper piping. If no action is taken, the treatment facility will continue to be out of compliance and the present problems will only get worse. This is not considered an option at this time. KDHE will not tolerate another year of non-compliance with permit limits.

5.2 MECHANICAL PLANT WITH EXISTING LAGOON

A Mechanical plant is more desirable for communities larger than the size of Belvue. The initial construction and monthly operational cost of a mechanical plant prohibits this option. In addition, the effluent permit limits for a mechanical plant are more stringent than those for a discharging lagoon.

5.3 CONTINUOUSLY DISCHARGING 3-CELL SYSTEM, 120 DAYS OF DETENTION

The continuously discharging waste stabilization lagoon is designed based on: 1.) organic loading, and 2.) hydraulic detention (or storage). The total volume and surface area needed to accommodate a 3-Cell system with 120 days of detention have been calculated for four (4) options. In all options, Geology will be required prior to actual design to verify groundwater and rock depth. It would be advantageous to increase the depth of Cell 3 from 5' down to 10 ft. so that discharge effluent may be drawn off at elevations 2, 5, and 10 ft. from water surface. Doing so gives flexibility for achieving the best quality effluent that will pass NPDES permit conditions for various conditions of Cell 3. Normally, effluent would be drawn off at the 2' depth. The 5' depth is used when excessive algae or duckweed is present on the surface and the 10' depth is used to drain the pond. However, this option has been discussed with the City who considers this benefit not cost-effective at this time. Increasing the depth of Cell 3 is not part of the options that retrofit the existing facility, but it is part of Option No. 4, which is to construct a totally new facility.

The format of the following 4 options will present a brief explanation of the option, design calculations, a preliminary cost estimate, and a preliminary site plan.

OPTION 1

Option 1 will extend the existing cell 1 to the west. Sludge will be removed from Cell 1. All new transfer structures and piping will be built. Cell 2 has 5' of freeboard so the depth of the pond can be increased from 4' to 5' without sludge removal by the design of new transfer structures and piping. The geometry of Cell 3 will stay the same.

- a. 120 days Detention Time - Volume Required for Total Facility:

$$38,060 \text{ gpd} \times 120 \text{ days} = 4,567,200 \text{ gallons}$$

- b. Volume Required for New Cell 1:

- 4,567,200 gal.
 - 688,769 gal. (Existing Cell 3 @ actual 5' depth)
 - 475,791 gal. (Existing Cell 2 @ new 5' depth)
-
- 3,402,640 gallons

Volume
Required for
New Cell 1.

$$3,402,640 \text{ gallons} \div 7.48 \text{ gal/cu. ft.} = \mathbf{454,867 \text{ cu. ft.}}$$

- c. BOD₅ Loading:

$$\text{Rate} = 34 \text{ lbs./BOD}_5/\text{acre/day}$$

$$57 \text{ lb./day} \div 34 \text{ lb./acre/day} = \mathbf{1.68 \text{ acres}}$$

Water Surface Area
Required for
Primary Treatment

Primary treatment cells are the initial cell(s) that receive the raw wastewater. If Cell 1 receives 100% of the raw wastewater, then Cell 1 must have at least 1.68 acres of water surface area. If the raw wastewater is split between 2 cells, then the water surface area of both cells must add up to be greater than the 1.68 acres. In this case, New Cell 1 receives 100% of the raw wastewater.

- d. Geometry of New Cell 1:

The geometry of New Cell 1 is shown on the Site Plan. A regular rectangle could not be used without violating the KDHE minimum design standard requiring that the length be less than or equal to 3 times the width. The size of Cell 1 is controlled by the 120-day detention requirement.

- Surface Area - (see site plan) - **2.50 ac.** (>1.68 ac.)
- Depth - 5 ft.
- Side Slopes - 3.5:1
- Design Volume - approx. **478,000 cu. ft.** (> 454,867 cu. ft.)

OPTION 1

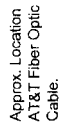
- Cell 1 expands to the west for 2.50 ac. of Water Surface Area
- Cell 2 increases in depth by 1' while Cell 3 remains unchanged
- Construct all new transfer structures and piping between cells

The proposed expansion of Cell 1 for 2.50 acres is greater than the 1.68 acres of primary treatment required and the total volume of the facility meets the requirement for 120 days detention. The accumulated sludge in Cell 1 would be removed. Design water depth and side slopes are 5' and 3.5:1, respectively, to match existing Cell 1. The sludge in Cell 2 will not be removed and the depth will increase 1 ft. by design of new transfer structures and piping. Various temporary pumping would occur as each cell is worked on.

Preliminary Opinion of Probable Cost			
ITEM	QUANTITY	UNIT PRICE	TOTAL PRICE
1 Mobilization	Lump Sum	\$10,000.00	\$10,000.00
2 Clearing and Grubbing	Lump Sum	5,000.00	5,000.00
3 Lagoon Construction	Lump Sum	100,000.00	100,000.00
4 Pond Sterilization	2.7 Acres	500.00	1,350.00
5 Finish Grading New Lagoons	3.3 Acres	1,200.00	3,960.00
6 Pond Sealing (Bentonite)	2.7 Acres	7,000.00	18,900.00
7 Remove sludge in Exist. Cell 1	Lump Sum	7,500.00	7,500.00
8 Distribution Box	1 Each	7,000.00	7,000.00
9 Outlet Structure	1 Each	7,000.00	7,000.00
10 Flow Control Structure	3 Each	6,000.00	18,000.00
11 4" Force Main	350 Lin. Ft.	20.00	7,000.00
12 4" Plug Valve w/Box	2 Each	1200.00	2,400.00
13 8" Pond Piping (PVC)	300 Lin. Ft.	25.00	7,500.00
14 8" Pond Piping (DIP)	450 Lin. Ft.	35.00	15,750.00
15 Concrete Backslope Lining	20 Sq. Yds.	500.00	10,000.00
16 Splash Block	5 Sq. Yds.	500.00	2,500.00
17 Level Indicator	3 Each	1,000.00	3,000.00
18 Concrete Headwall	1 Each	3,500.00	3,500.00
19 Fence (48" Woven Wire) (New)	1,000 Lin. Ft.	5.00	5,000.00
20 12' Gate	1 Each	300.00	300.00
21 8" Plug Valve w/Box	2 Each	1,900.00	3,800.00
22 18" Rock Embankment	5 Cu. Yds.	40.00	200.00
23 Rock Slope Protection (Lagoons)	3,400 Sq. Yds.	6.50	22,100.00
24 Seeding, Fertilizing and Mulching (Lagoons)	Lump Sum	6,500.00	6,500.00
25 Land Purchase	5 Acres	1,000.00	5,000.00
Subtotal			\$273,260.00
10% Construction Contingency			\$27,326.00
Total Construction Cost			\$300,586.00
40% Contingency, Design, Const. Adm., Legal Financing, etc.			\$120,234.40
Preliminary Opinion of Probable Cost			\$420,820.40

5-4

5-4



OPTION 2

Option 2 will combine existing Cells 1 and 2 for a New Cell 2. The dike between them will be removed. These cells both have 5' of freeboard so the depth of the pond can be increased from 4' to 5' without sludge removal by the design of new transfer structures and piping. A New Cell 1 will be constructed to the west of the facility. The length of the new cell shall match the existing facility. The geometry of existing Cell 3 shall remain the same.

- a. 120 days Detention Time/Volume Required for Total Facility:

$$38,060 \text{ gpd} \times 120 \text{ days} = 4,567,200 \text{ gallons}$$

- b. Volume Required for New Cell 1:

$$\begin{array}{r}
 4,567,200 \text{ gal.} \\
 - 688,769 \text{ gal. (Existing Cell 3 @ actual 5' depth)} \\
 - 475,791 \text{ gal. (Existing Cell 2 @ new 5' depth)} \\
 - 781,060 \text{ gal. (Existing Cell 1 @ new 5' depth)} \\
 - 210,562 \text{ gal. (Est. Volume of Common Dike btwn. Cell 1 and 2)} \\
 \hline
 2,411,018 \text{ gallons}
 \end{array}$$

$$2,411,018 \text{ gallons} \div 7.48 \text{ gal/cu. ft.} = \mathbf{322,306 \text{ cu. ft.}}$$

- c. BOD5 Loading:

$$\text{Rate} = 34 \text{ lbs./BOD5/acre/day}$$

$$57 \text{ lb./day} \div 34 \text{ lb./acre/day} = \mathbf{1.68 \text{ acres}}$$

Volume
Required for
New Cell 1.

Water Surface Area
Required for
New Cell 1

- d. Geometry of New Cell 1:

$$\begin{array}{rcl}
 \text{Surface Area} & - & 370 \text{ ft.} \times 235 \text{ ft.} \quad - \quad \mathbf{2.00 \text{ ac.}} \text{ (>1.68 ac.)} \\
 \text{Depth} & - & 5 \text{ ft.} \\
 \text{Side Slopes} & - & 3:1 \\
 \text{Design Volume} & - & \mathbf{390,500 \text{ cu. ft.}} \text{ (>322,306 cu. ft.)}
 \end{array}$$

OPTION 2

- Construct totally new 2.00 ac. Cell 1 to the west of existing Cells 1 and 3
- Proposed Cell 2 will combine existing Cells 1 and 2 for a total of 1.10 ac.
- Cell 3 remains the same at 0.45 ac.
- Construct all new transfer structures and piping between cells.

Accumulated sludge from existing Cells 1 and 2 will not be removed. The dike between these two cells will be removed to create one large cell, Proposed Cell 2. Elevations can be adjusted by new transfer structures and piping to provide a full 5' of water depth above the existing sludge. The proposed expansion of Cell 1 for 2.00 acres is greater than the 1.68 acres of primary treatment required. The total volume of the facility also meets the minimum required for 120-day detention. Various temporary pumping would occur as each cell is worked on.

Preliminary Opinion of Probable Cost

ITEM	QUANTITY	UNIT PRICE	TOTAL PRICE
1 Mobilization	Lump Sum	\$10,000.00	\$10,000.00
2 Clearing and Grubbing	Lump Sum	5,000.00	5,000.00
3 Lagoon Construction	Lump Sum	95,000.00	95,000.00
4 Pond Sterilization	2.2 Acres	500.00	1,100.00
5 Finish Grading New Lagoons	2.9 Acres	1,200.00	3,480.00
6 Pond Sealing (Bentonite)	2.2 Acres	7,000.00	15,400.00
7 Distribution Box	2 Each	7,000.00	14,000.00
8 Outlet Structure	1 Each	7,000.00	7,000.00
9 Manholes	1 Each	2,500.00	2,500.00
10 Flow Control Structure	3 Each	6,000.00	18,000.00
11 4" Force Main	400 Lin. Ft.	20.00	8,000.00
12 8" Pond Piping (PVC)	150 Lin. Ft.	25.00	3,750.00
13 8" Pond Piping (DIP)	400 Lin. Ft.	35.00	14,000.00
14 Concrete Backslope Lining	20 Sq. Yds.	500.00	10,000.00
15 Splash Block	5 Sq. Yds.	500.00	2,500.00
16 Level Indicator	3 Each	1,000.00	3,000.00
17 Concrete Headwall	1 Each	3,500.00	3,500.00
18 Fence (48" Woven Wire) (New)	1,200 Lin. Ft.	5.00	6,000.00
19 12' Gate	1 Each	300.00	300.00
20 8" Plug Valve w/Box (outlet structure)	3 Each	1,900.00	5,700.00
21 18" Rock Embankment	5 Cu. Yds.	40.00	200.00
22 Rock Slope Protection (Lagoons)	4,700 Sq. Yds.	6.50	30,550.00
23 Seeding, Fertilizing and Mulching (Lagoons)	Lump Sum	6,500.00	6,500.00
24 Land Purchase	5 Acres	1,000.00	5,000.00
Subtotal			\$270,480.00
10% Construction Contingency			\$27,048.00
Total Construction Cost			\$297,528.00
40% Contingency, Design, Const Adm., Legal Financing, etc.			\$119,011.20
Preliminary Opinion of Probable Cost			\$416,539.20

POND OVERFLOW
AND DRAINLINE

CONC. REMOVAL W/LI. FILL GATE
ELEV. 49.0

OPTION NO. 2

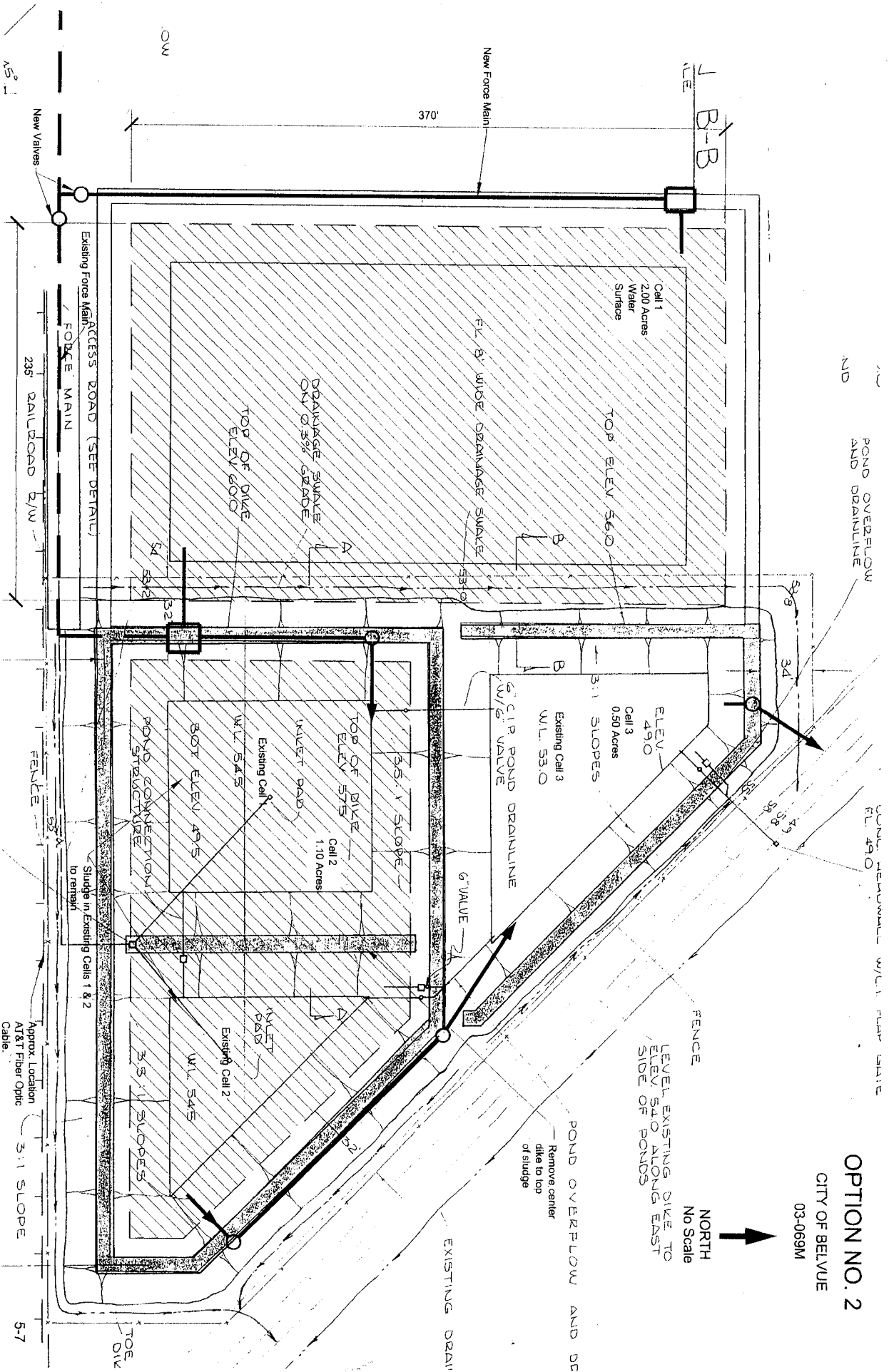
CITY OF BELVUE

03-069M



NORTH
No Scale

LEVEL EXISTING DIKE TO
ELEV. 54.0 ALONG EAST
SIDE OF PONDS



OPTION 3

Option 3 is similar to Option 2 except that the dike between existing Cells 1 and 2 will not be removed. These cells both have 5' of freeboard so the depth can be increased from 4' to 5' without sludge removal by the design of new transfer structures and piping. A New Cell 1 will be constructed to the west of the facility. The length of the new cell shall match the existing facility. The geometry of existing Cell 3 shall remain the same. The facility basically becomes a 4-cell treatment facility.

- a. 120 days Detention Time/Volume Required for Total Facility:

$$38,060 \text{ gpd} \times 120 \text{ days} = 4,567,200 \text{ gallons}$$

- b. Volume Required for New Cell 1:

- 4,567,200 gal.
 - 688,769 gal. (Existing Cell 3 @ actual 5' depth)
 - 475,791 gal. (Existing Cell 2 @ new 5' depth)
 - 781,060 gal. (Existing Cell 1 @ new 5' depth)
-
- 2,621,580 gallons

Volume
Required for
New Cell 1.

$$2,621,580 \text{ gallons} \div 7.48 \text{ gal/cu. ft.} = \mathbf{350,454 \text{ cu. ft.}}$$

- c. BOD5 Loading:

$$\text{Rate} = 34 \text{ lbs./BOD5/acre/day}$$

$$57 \text{ lb./day} \div 34 \text{ lb./acre/day} = \mathbf{1.68 \text{ acres}}$$

Water Surface Area
Required for
New Cell 1

New Cell 1 receives 100% of the raw wastewater.

- d. Geometry of New Cell 1:

- Surface Area - 370 ft. x 235 ft. - **2.00 ac.** (>1.68 ac.)
- Depth - 5 ft.
- Side Slopes - 3:1
- Design Volume - **390,500 cu. ft.** (350,454 cu. ft.)

OPTION 3

- Construct totally new 2.00 ac. Cell 1 to the west of existing Cells 1 and 3
- Existing Cells 1, 2, & 3 remain the same at 0.60, 0.30, and 0.45 ac., respectively
- Construct all new transfer structures and piping between cells

This option is similar to Option 2 without the earthwork required to breach the dike between existing cells 1 and 2. Elevations can be adjusted by new transfer structures and piping to provide a full 5' of water depth above the existing sludge in these two cells. This option creates a 4-cell discharging lagoon. The proposed new Cell 1 at 2.00 acres meets the minimum of 1.68 acres of primary treatment required. The total treatment facility volume also meets the minimum required for 120-day detention. Various temporary pumping would occur as each cell is worked on.

Preliminary Opinion of Probable Cost

ITEM	QUANTITY	UNIT PRICE	TOTAL PRICE
1 Mobilization	Lump Sum	\$10,000.00	\$10,000.00
2 Clearing and Grubbing	Lump Sum	5,000.00	5,000.00
3 Lagoon Construction	Lump Sum	80,000.00	80,000.00
4 Pond Sterilization	2.2 Acres	500.00	1,100.00
5 Finish Grading New Lagoons	2.9 Acres	1,500.00	4,350.00
6 Pond Sealing (Bentonite)	2.2 Acres	7,000.00	15,400.00
7 Distribution Box	2 Each	7,000.00	14,000.00
8 Outlet Structure	1 Each	7,000.00	7,000.00
9 Flow Control Structure	3 Each	6,000.00	18,000.00
10 4" Force Main	400 Lin. Ft.	20.00	8,000.00
11 4" Plug Valve w/Box	3 Each	1,200.00	3,600.00
12 8" Pond Piping (PVC)	150 Lin. Ft.	25.00	3,750.00
13 8" Pond Piping (DIP)	500 Lin. Ft.	35.00	17,500.00
14 Concrete Backslope Lining	20 Sq. Yds.	500.00	10,000.00
15 Splash Block	5 Sq. Yds.	500.00	2,500.00
16 Level Indicator	3 Each	1,000.00	3,000.00
17 Concrete Headwall	1 Each	3,500.00	3,500.00
18 Fence (48" Woven Wire) (New)	1,200 Lin. Ft.	5.00	6,000.00
19 12' Gate	1 Each	300.00	300.00
20 8" Plug Valve w/Box (outlet structure)	3 Each	1,900.00	5,700.00
21 18" Rock Embankment	5 Cu. Yds.	40.00	200.00
22 Rock Slope Protection (Lagoons)	3,100 Sq. Yds.	8.00	24,800.00
23 Seeding, Fertilizing and Mulching (Lagoons)	Lump Sum	6,500.00	6,500.00
24 Land Purchase	5 Acres	1,000.00	5,000.00
Subtotal			\$255,200.00
10% Construction Contingency			\$25,520.00
Total Construction Cost			\$280,720.00
40% Contingency, Design, Const. Adm., Legal			
Financing, etc.			\$112,288.00
Preliminary Opinion of Probable Cost			\$393,008.00

IMPERVIOUS BLANKET OF
NATURAL CLAY OR
PREPARED MATERIAL

POND OVERFLOW
AND DRAINLINE

FL 49.0

OPTION NO. 3

CITY OF BELVUE

03-069M

2'-0" B-1-B
ALE

Cell 1
2.00 Acres
Water
Surface

TOP ELEV 56.0

FL 8' WIDE DRAINAGE SWALE

DRAINAGE SWALE
ON 0.3% GRADE

TOP OF DIKE
ELEV 60.0

3W

370'

New Force Main

Existing Force Main

ACCESS ROAD (SEE DETAIL)
FORCE MAIN

235' RAILROAD b/w

45'-4"

New Valves

5'-8" 34' 5'-8" 49'

Cell 3
0.50 Acres
Existing Cell 3
3:1 SLOPES

ELEV 49.0

W.L. 53.0

6" CIP POND DRAINLINE
w/ 6" VALVE

3.5:1 SLOPE

TOP OF DIKE
ELEV 57.5

Existing Cell 1
0.50 Acres

INLET PAD

W.L. 54.5

BOT ELEV 49.5

POND CONNECTION
STRUCTURE

Sludge in Existing Cells 1 & 2
to remain

FENCE

Approx Location
AT&T Fiber Optic
Cable.

3:1 SLOPE

5-10

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

INLET
PAD

W.L. 54.5

3.5:1 SLOPES

Existing Cell 2
0.40 Acres

W.L. 54.5

OPTION 4

Option 4 is the design of a completely new 3-cell discharging lagoon system west of the existing treatment facility.

- a. 120 days Detention Time:

$$38,060 \text{ gpd} \times 120 \text{ days} = 4,567,200 \text{ gallons}$$

- b. Volume Required:

$$4,567,200 \text{ gallons} \div 7.48 \text{ gallons/ cu. ft.} = \mathbf{610,588 \text{ cu. ft.}}$$

Volume
Required for
Total Facility.

- c. BOD5 Loading:

$$\text{Rate} = 34 \text{ lbs./BOD5/acre/day}$$

$$57 \text{ lb./day} \div 34 \text{ lb./acre/day} = \mathbf{1.68 \text{ acres}}$$

Water Surface Area
Required for
Primary Treatment

$$\text{Existing Cell No. 1} - 0.60 \text{ ac.} < 1.68 \text{ acres required}$$

- d. Geometry of Total Facility:

Knowing that Cell 1 will receive 100% of the raw wastewater, a surface area greater than the minimum 1.68 ac. is chosen:

Cell 1	Surface Area	-	385 ft. x 200 ft.	-	1.77 ac. (>1.68 ac.)
	Depth	-	5 ft.		
	Side Slopes	-	3:1		
	Design Volume	-	342,250 cu. ft.		

Cell 3 should be larger than 0.70 ac. for ease of construction at the 10' depth.

Cell 3	Surface Area	-	0.73 ac. - 200 ft. x 159 ft.
	Depth	-	10 ft.
	Side Slopes	-	3:1
	Design Volume	-	219,300 cu. ft.

The remaining volume and geometry of Cells 1 and 3 dictate the size of Cell 2.

Cell 2	Surface Area	-	0.92 ac. - 200 ft. x 200 ft.
	Depth	-	5 ft.
	Side Slopes	-	3:1
	Design Volume	-	171,125 cu. ft.

- e. Volume Check: Total Volume = **732,675 cu. ft.** (> 610,588 cu. ft.)

OPTION 4

- Construct all new 3-Cell lagoon facility west of the existing.
 - o Cell 1 – 1.77 ac.
 - o Cell 2 – 0.92 ac.
 - o Cell 3 – 0.73 ac.
- Dewater the existing lagoon facility, fill all cells and remove all structures. Farm area after demolition is complete.

The proposed new Cell 1 at 1.77 acres meets the minimum of 1.68 acres of primary treatment required. The total treatment facility volume also meets the minimum required for 120-day detention. This Option provides the ultimate operation and maintenance capabilities, but is also the most expensive.

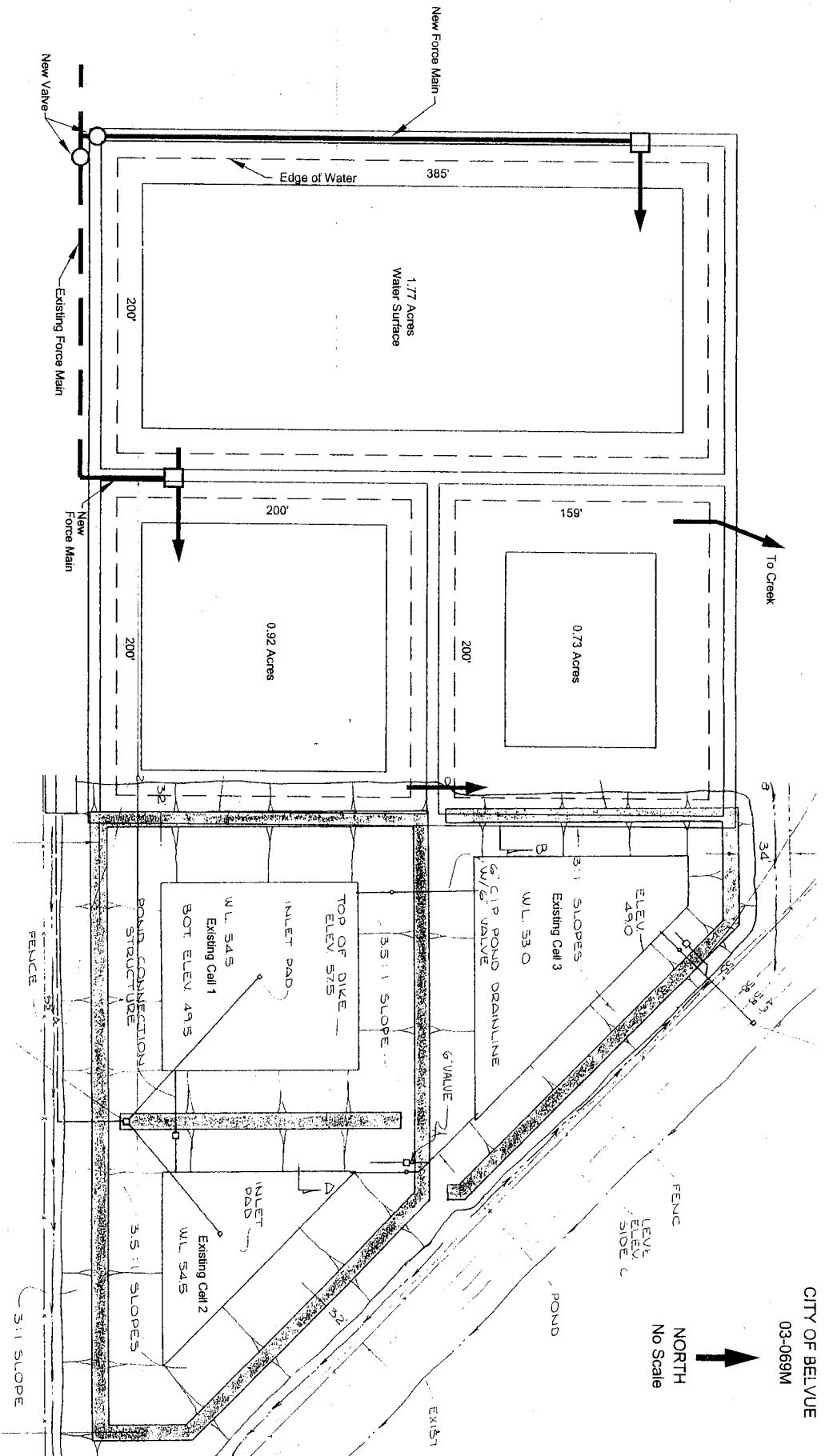
Preliminary Opinion of Probable Cost

ITEM	QUANTITY	UNIT PRICE	TOTAL PRICE
1 Mobilization	Lump Sum	\$10,000.00	\$10,000.00
2 Clearing and Grubbing	Lump Sum	5,000.00	5,000.00
3 Lagoon Construction	Lump Sum	140,000.00	140,000.00
4 Pond Sterilization	3.6 Acres	500.00	1,800.00
5 Finish Grading New Lagoons	4.0 Acres	1,200.00	4,800.00
6 Pond Sealing (Bentonite)	3.6 Acres	7,000.00	25,200.00
7 Demolition of old site	Lump Sum	20,000.00	20,000.00
8 Distribution Box	2 Each	7,000.00	14,000.00
9 Outlet Structure	1 Each	7,000.00	7,000.00
10 Flow Control Structure	2 Each	6,000.00	12,000.00
11 4" Force Main	455 Lin. Ft.	20.00	9,100.00
12 8" Pond Piping (PVC)	200 Lin. Ft.	25.00	5,000.00
13 8" Pond Piping (DIP)	450 Lin. Ft.	35.00	15,750.00
14 Concrete Backslope Lining	20 Sq. Yds.	500.00	10,000.00
15 Splash Block	5 Sq. Yds.	500.00	2,500.00
16 Level Indicator	3 Each	1,000.00	3,000.00
17 Concrete Headwall	1 Each	3,500.00	3,500.00
18 Fence (48" Woven Wire) (New)	2,500 Lin. Ft.	5.00	12,500.00
19 12' Gate	1 Each	300.00	300.00
20 8" Plug Valve w/Box	3 Each	1,900.00	5,700.00
21 18" Rock Embankment	5 Cu. Yds.	40.00	200.00
22 Rock Slope Protection (Lagoons)	6,400 Sq. Yds.	8.00	51,200.00
23 Seeding, Fertilizing and Mulching (Lagoons)	Lump Sum	6,500.00	6,500.00
24 Land Purchase	8 Acres	1,000.00	8,000.00
Subtotal			\$373,050.00
10% Construction Contingency			\$37,305.00
Total Construction Cost			\$410,355.00
40% Contingency, Design, Const. Adm., Legal Financing, etc.			\$164,142.00
Preliminary Opinion of Probable Cost			\$574,497.00

OPTION NO. 4

CITY OF BELVUE

03-069M



5.4 IRRIGATION

Wastewater irrigation is intended to irrigate crops that are not produced for direct human consumption. To provide total effluent discharge irrigation would require a very large area of property. It is unlikely that total effluent irrigation is feasible. The City should consider and discuss with the adjoining landowners the possibility of intermittent short-term irrigation around the facility, including the existing grassed dikes and waterways. During hot summer days the water level may be lowered by irrigation, resulting in less of a discharge in the fall and spring.

The following management and monitoring requirements apply for treated wastewater from the treatment facility utilized for irrigation purposes at the dikes and waterways.

- Irrigation shall be limited in such a manner as to avoid runoff of effluent to adjacent landowners.
- Control tailwater to prevent runoff to surface waters of the State
- Draw water only from the final cell in the treatment process.
- Irrigation using treated wastewater shall occur only at times when public access to the irrigated area is restricted.
- No ponding of wastewater on the ground surface.
- All monitoring of the treated wastewater shall be conducted using EPA approved methods and KDHE certified laboratories.
- The results of the analyses shall be reported quarterly to the address shown on the standard discharge monitoring report.

5.5 LAND REQUIREMENTS FOR NEW CELLS OR TOTAL FACILITY

The minimum separation requirements for a facility of 100 P.E. or larger are as follows:

This information is reproduced from the KDHE Minimum Design Standards, Section IV General Design Considerations for Sewage Treatment Works.

<u>Plant Type</u>	<u>Existing Habitations</u>	<u>Proposed Development</u>	<u>Property Lines</u>
*Aerobic Lagoon	500'	350'	100'

* This is the same type of treatment facility that the City of Bellevue currently uses.

**This distance may be reduced to a minimum of 350 feet with the written permission of the affected property owner.

- Where an existing treatment plant has been established on a site with fixed boundaries, modifications, and/or additions to the plant should only be concerned with the 100 foot separation from property lines.
- The separation distances may include roadway or railway right of way as long as a minimum of 100 feet from property lines is observed.

RECOMMENDATIONS

6.1 FINAL RECOMMENDATION FOR UPDATING THE WASTEWATER TREATMENT FACILITY

All things considered, cost, ease of construction, and future operation and maintenance capabilities, **Option No. 3** provides the greatest benefit for the cost estimated.

Unlike Option No. 1, there is no sludge removal involved, a procedure that is expensive because the amount of labor involved. Option No. 1 also involves geometry that is not standard.

Option 2 provides a good facility, but the removal of the dike increases cost more than if the dike is left alone and the volume is made up for in new Cell 1 as in Option 3. Removal of the dike creates difficulty in construction for timing and temporary pumping and requires more labor.

Option No. 4 is the ultimate improvement, as most new facilities are. Construction is easier than retrofitting an old facility, transfer of flow options are available, and Cell 3 can be constructed to the recommended lower depth, providing versatility in depth of effluent draw-off. However, this option is costly, requiring more land purchase and construction than what the City feels is needed. Option No. 3 can meet the needs of this project at a much lower cost.

