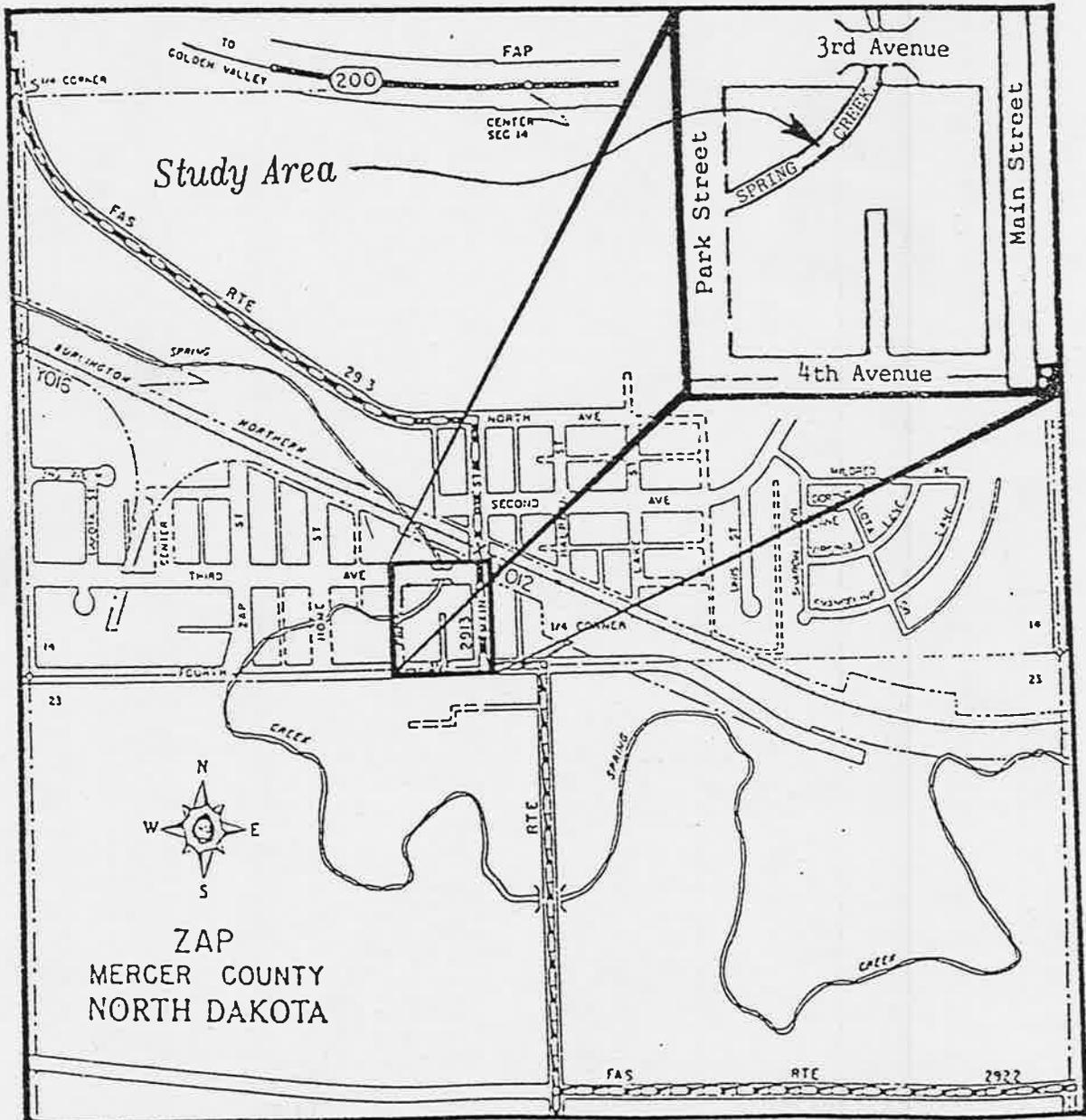


PRELIMINARY ENGINEERING REPORT  
SPRING CREEK BANK STABILIZATION

S.W.C. PROJECT NO. 1291

MERCER COUNTY



NORTH DAKOTA  
STATE WATER COMMISSION

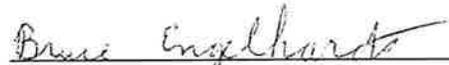
PRELIMINARY ENGINEERING REPORT  
SPRING CREEK BANK STABILIZATION

City of Zap  
Mercer County, North Dakota  
SWC Project #1291

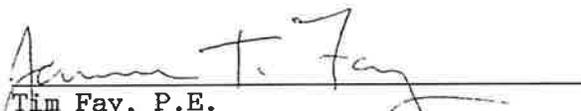
North Dakota State Water Commission  
900 East Boulevard  
Bismarck, ND 58505-0187

April, 1988

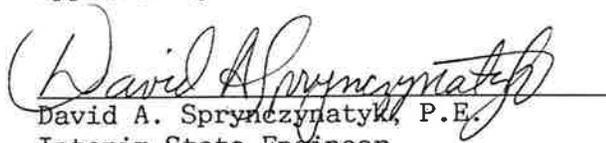
Prepared by:

  
\_\_\_\_\_  
Bruce Engelhardt  
Water Resource Engineer

Submitted by:

  
\_\_\_\_\_  
Tim Fay, P.E.  
Chief, Investigations Section

Approved by:

  
\_\_\_\_\_  
David A. Sprynczynatyk, P.E.  
Interim State Engineer

Prepared for the Mercer  
County Water Resource Board

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## INTRODUCTION

### Background

The bank line of Spring Creek within the City of Zap has recently experienced severe erosion. High flow during spring runoff is the primary cause of the erosion in this reach of Spring Creek. The loss of bank material is endangering a sewer line and several homes in the city. One house has already been lost.

In June, 1987, the Mercer County Water Resource District requested the North Dakota State Water Commission to investigate the problem with the intent to enter into a cost-sharing agreement on the project. In July, an investigation agreement was signed. After the original agreement was signed, a second erosion site was brought to the attention of the Water Commission. This second site includes a sewer line located at Section 4+39 (see project drawing). An amendment dated July 28, 1987, was signed to incorporate this second site into the project. The entire site was surveyed in August.

In October, a request for assistance under the authority of Section 14 of the Flood Control Act of 1946, concerning the area of the sewer line, was made to the Corps of Engineers. The Corps is currently waiting for funds to be made available for this study. If the study determines that the project is feasible, the Corps may participate in construction of the protection.

### Study Objectives:

The overall objective is to determine a feasible and effective erosion control method for the bank line in the City of Zap. This report presents several alternatives to control the bank erosion, and a cost estimate for each alternative.

### Study Area:

The project is located in the City of Zap, Section 14, Township 144 North, Range 89 West, in Mercer County. The project is along the left bank of Spring Creek, extending approximately 400 feet downstream from the Third Avenue Bridge. Spring Creek makes a sharp bend to the west approximately 150 feet south of the Third Avenue Bridge. A map of the project area is shown in Figure 1.

Flows in Spring Creek are very low during most of the year. For a short time during the spring runoff, the creek experiences high flows which cause the erosion. The water's force is causing severe erosion along the left (south) bank, and the formation of a sandbar along the right bank. The majority of the erosion is occurring between Sections 2+02 and 2+61 (see project drawings). The bank is approximately 20 feet high in this reach and, due to the erosion, nearly vertical.

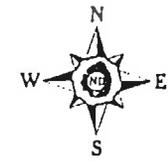
A sewer line crosses Spring Creek at approximately Section 4+39. The sewer line was built in 1949, since that time the creek bed has eroded so that the sewer line is now in danger of being washed away. Based on the information available, it is impossible to determine the exact amount of earth covering the pipe, but it is estimated to be less than 1 foot.

**SPRING CREEK BANK STABILIZATION**

SWC Project #1291  
Location Map

**LEGEND**

- EXISTING STREET OR ROADWAYS
- NON-EXISTANT DEDICATED STREET
- (Highway System Road Types)
- BITUMINOUS-HIGH TYPE (7' or over)
- BITUMINOUS-LOW TYPE (under 7')
- GRAVEL, GRADED AND DRAINED ROAD
- GRADED AND DRAINAGE MUD
- FEDERAL AID INTERSTATE SYSTEM
- FEDERAL AID PRIMARY SYSTEM
- FEDERAL AID SECONDARY SYSTEM
- INTERSTATE NUMBERED ROUTE
- U.S. NUMBERED ROUTE
- STATE NUMBERED ROUTE
- CORPORATE BOUNDARY
- SECTION LINE
- RAILWAY RIGHT OF WAY BOUNDARY
- RAILWAY
- RAILWAY STATION
- RAILWAY CROSSING
- CROSSING TYPE
- WIG WAG
- FLOOD LIGHTS
- AUTOMATIC FLASHING
- CROSS BUCKS
- AUTOMATIC FLASHING WITH ROTATING STOP SIGN
- AUTOMATIC FLASHING WITH GATES



**ZAP  
MERCER COUNTY  
NORTH DAKOTA**

PREPARED BY THE  
NORTH DAKOTA STATE HIGHWAY DEPARTMENT  
TRANSPORTATION SERVICES DIVISION  
IN COOPERATION WITH THE  
U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION

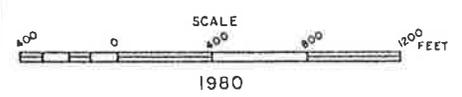
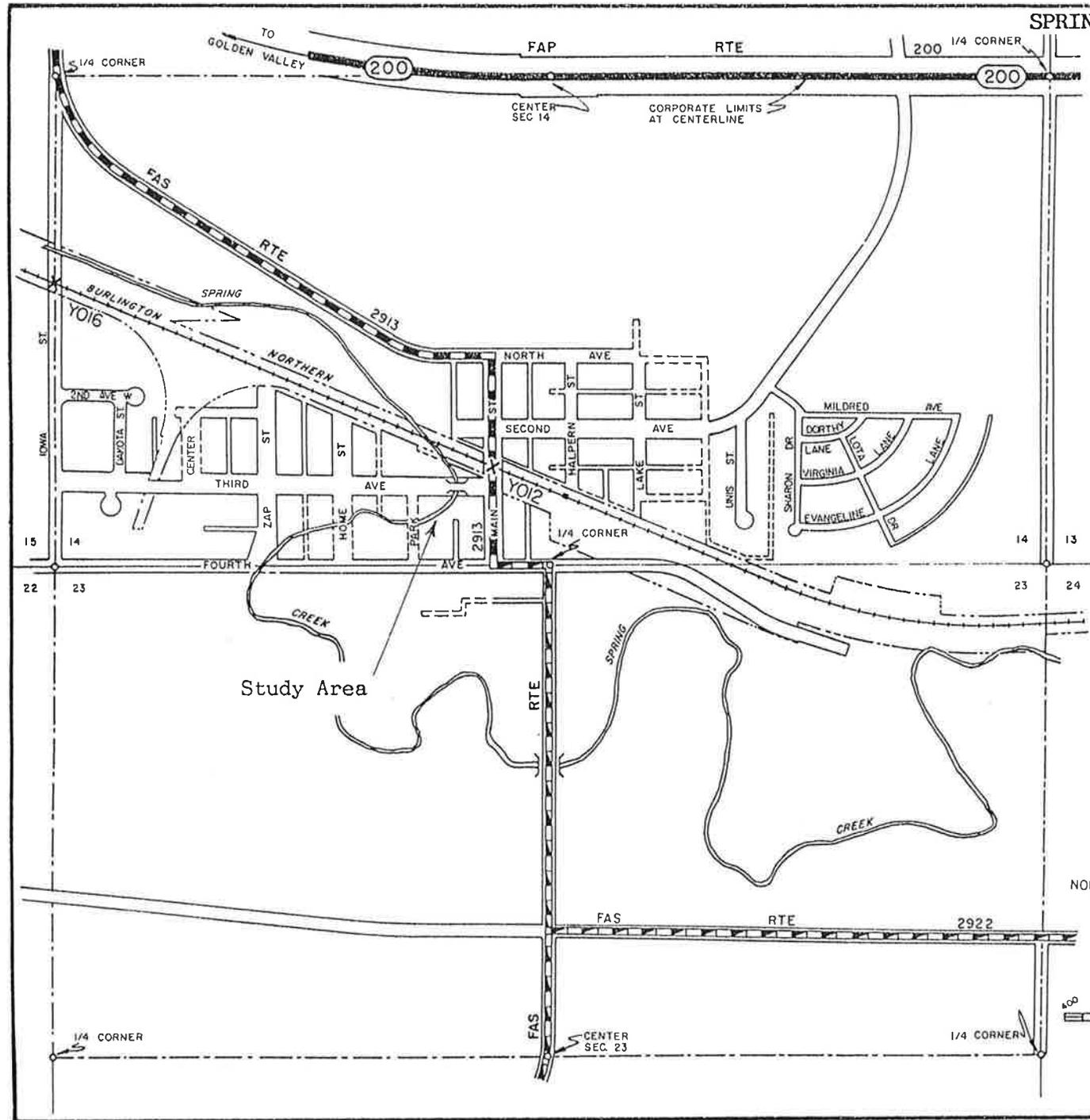


Figure 1



## BANK PROTECTION METHODS

### Alternatives:

The alternatives considered in this study consist of sloping the lower bank and protecting it with rock riprap. The riprap would consist of broken field stone. The upper bank would be cut back to a stable slope and grass seeded to hold the soil. The division between the upper and lower bank is approximately 18 feet above the bottom of the channel, at 1838 feet msl, approximately the elevation of a 20-year flood. The sloping of the bank will result in the loss of land along the bank in some areas and would also result in the loss of some trees along the bank line.

The three alternatives each protect different lengths of stream bank. Alternative #1 protects the area from the Third Avenue Bridge to Section 3+77. This includes the most severe erosion but does not protect the sewer line. Alternative #2 protects the bank between Sections 1+65 and 2+61. This area is where the most severe erosion is occurring. Alternative #3 protects the entire reach from the bridge to Section 4+59, including the sewer line. Any one of the alternatives described should substantially reduce or eliminate bank erosion.

The sandbar that extends approximately 25 feet on each side of Section 2+29 will be removed in all the alternatives discussed. The sandbar contains approximately 28 cubic yards of material.

Alternative #1 - Protection Starting at Third Avenue Bridge:

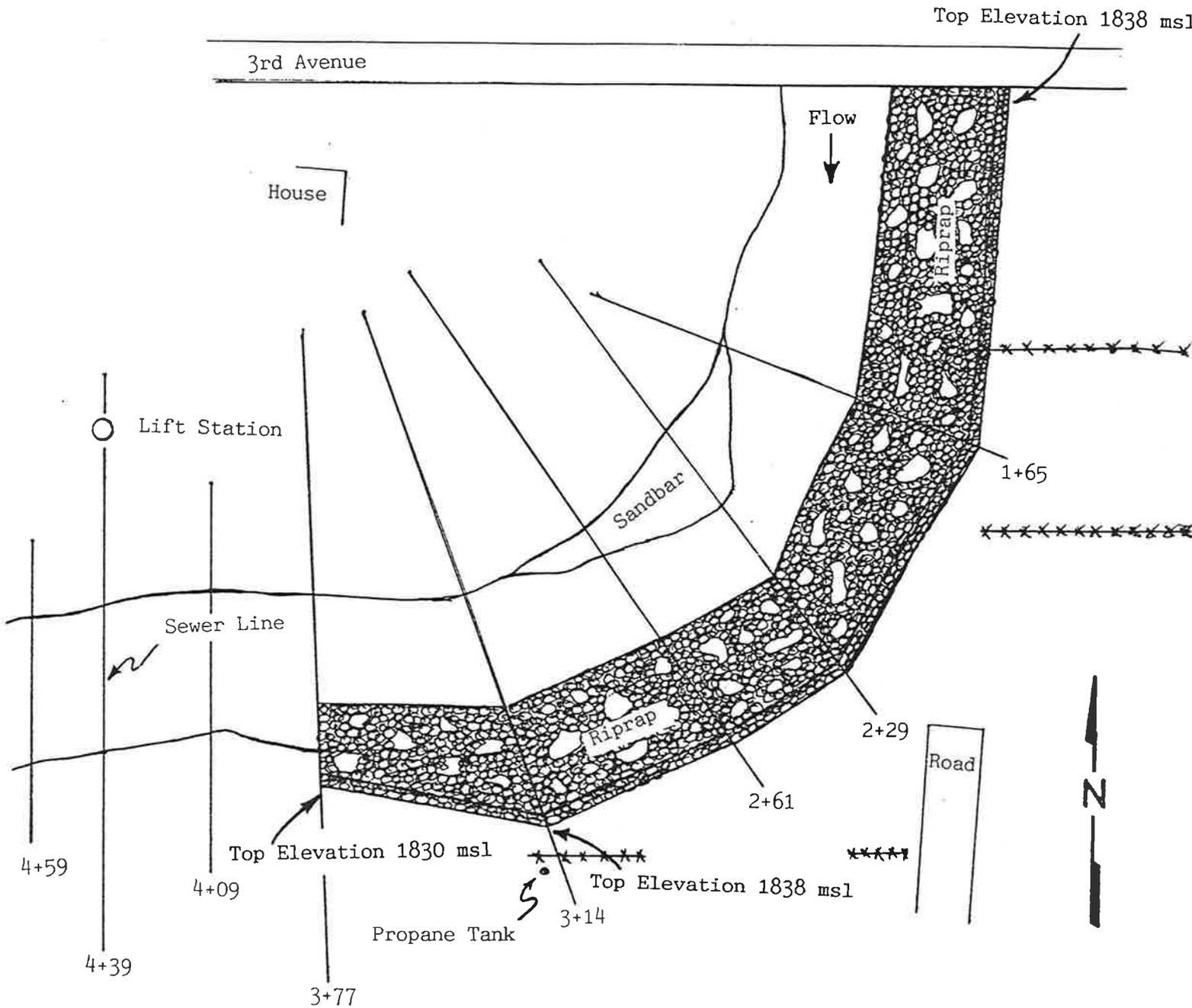
This alternative consists of placing a continuous revetment or layer of rock riprap, along the bank line. The revetment would begin at the Third Avenue Bridge and extend downstream a distance of 277 feet to cross-section 3+77, Figure 2. The stone would be placed at an approximate rate of 4 tons per linear foot with a top width of 3 feet. The bank area above the rock would be back-sloped at 3:1 (3 Horizontal to 1 Vertical), and the riprap would be placed on a 1.5:1 sloped surface. A typical section of the protected bank is shown in Figure 3. The riprap would extend down at least 19 feet to elevation 1819 msl, or below. A cost estimate is given below for Alternative #1:

Cost Estimate - Alternative #1

<u>Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Cost</u>
Mobilization		L.S.		\$ 3,000
Rock Riprap	691.00	C.Y.	\$ 28	19,348
Fill	57.00	C.Y.	3	171
Excavate	1472.00	C.Y.	4	5,888
Clearing & Grubbing	0.50	Ac.	500	250
Seeding	0.25	Ac.	700	<u>175</u>
	Subtotal			\$28,832
	30% Contingencies & Engineering			<u>\$ 8,650</u>
	Total			<u>\$37,482</u>

# Alternative #1

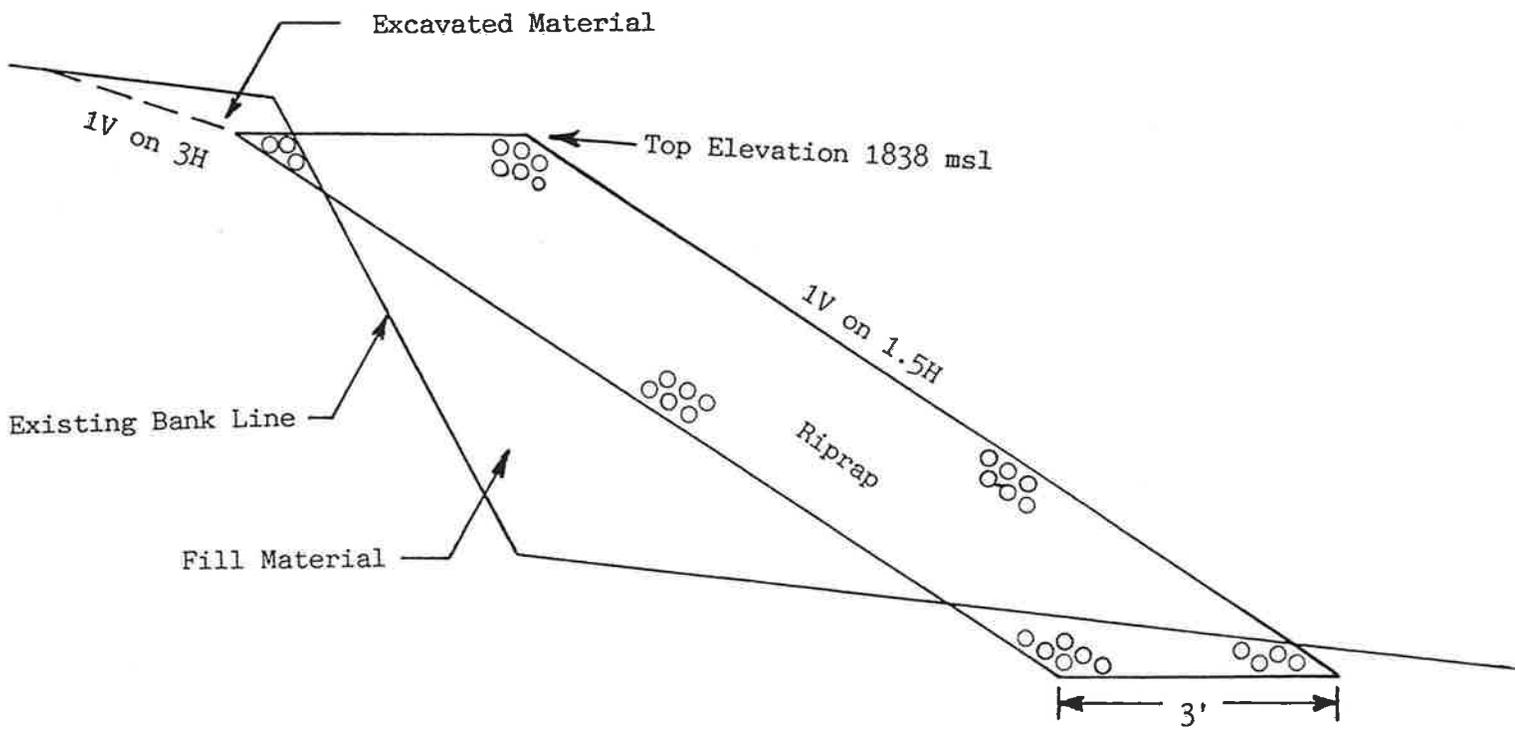
## Riprapped Bank Alignment



**SPRING CREEK BANK STABILIZATION**

City of Zap  
 SWC Project #1291  
 No Scale  
 Figure 2

# Alternative #1 Typical Section



## SPRING CREEK BANK STABILIZATION

City of Zap  
SWC Project #1291  
No Scale  
Figure 3

Alternative #2 - Section 1+65 to Section 2+61:

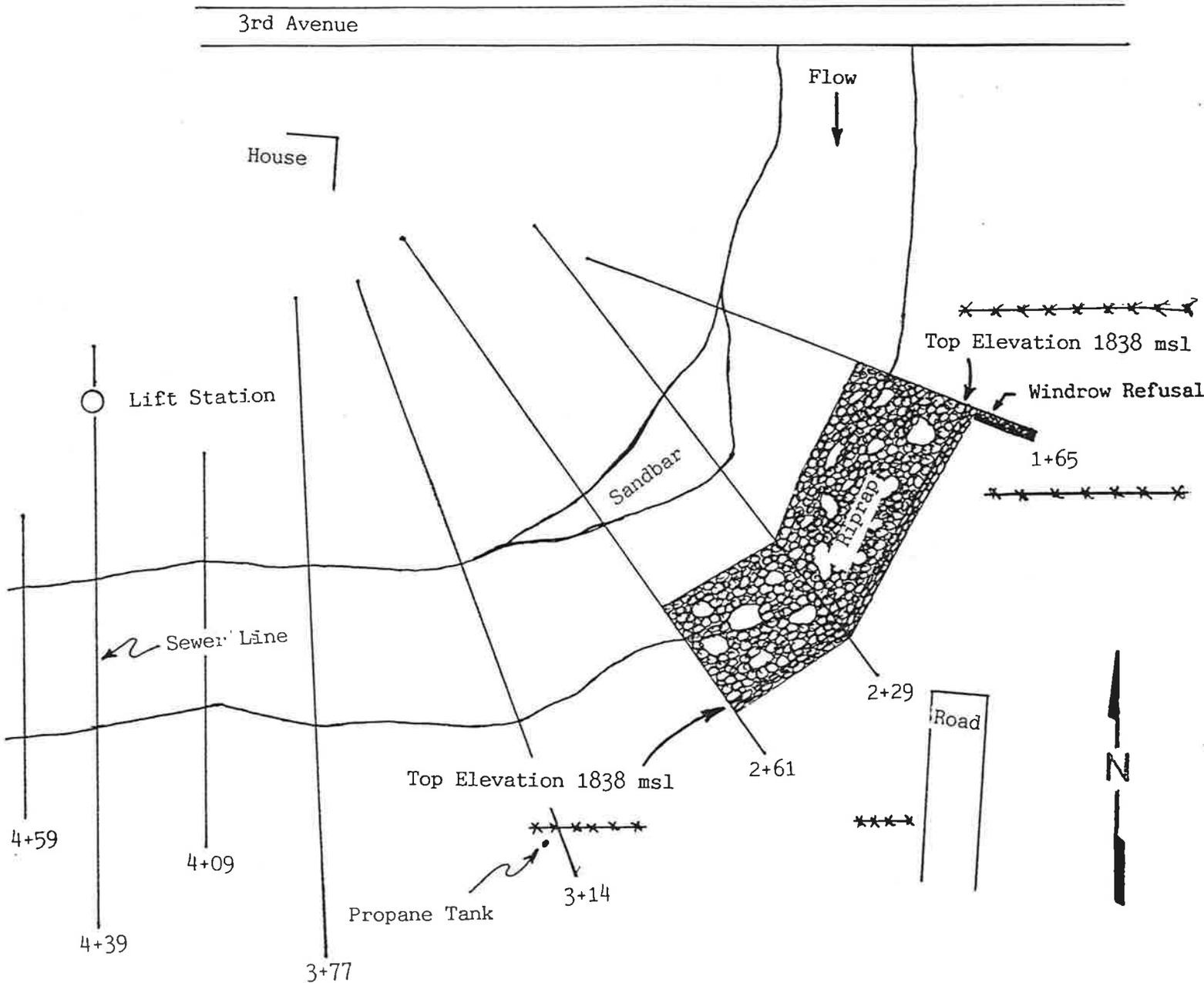
Alternative #2 is a segment of Alternative #1 that protects a shorter reach. The typical section of Alternative #2 is the same as the section shown for Alternative #1, Figure 3. Alternative #2 would provide protection for the area between Section 1+65 and Section 2+61, a distance of 96 feet (Figure 4). This area is now experiencing the majority of the erosion in the project area. By protecting this reach, the current severe erosion problem would be solved. However, Alternative #2 may increase erosion upstream or downstream of the protection.

A windrow refusal, a row of buried rock running perpendicular to the bank line to prevent the water from eroding behind the bank protection, will be placed at Section 1+65. The refusal will extend back from the bank line approximately 30 feet (Figure 5). The windrow refusal prevents erosion from occurring behind the revetment but will not prevent erosion upstream of the protection. A cost estimate for Alternative #2 is as follows:

Cost Estimate - Alternative #2

Item	Quantity	Unit	Unit Cost	Cost
Mobilization		L.S.		\$ 3,000
Rock Riprap	343	C.Y.	\$ 28.00	9,604
Fill	222	C.Y.	3.00	666
Excavate	882	C.Y.	4.00	3,528
Seeding	.3	Ac.	700.00	150
Clearing & Grubbing	.2	Ac.	500.00	140
	Subtotal			\$17,088
	30% Contingencies & Engineering			<u>\$ 5,126</u>
	Total			<u>\$22,214</u>

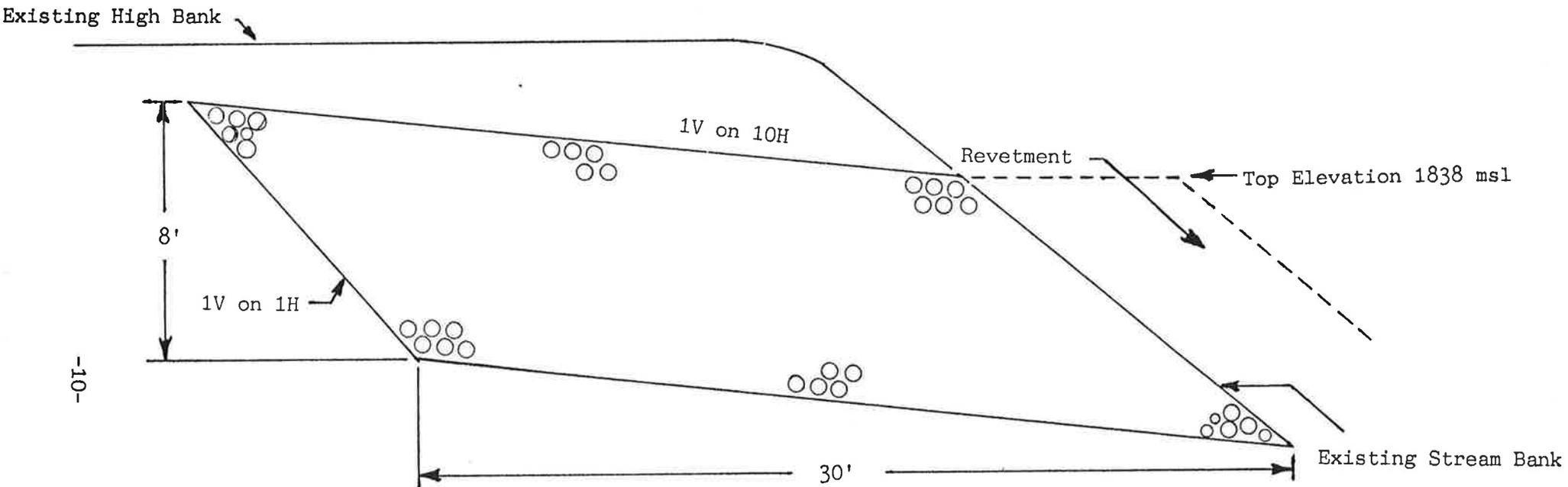
# Alternative #2 Riprapped Bank Alignment



**SPRING CREEK BANK STABILIZATION**

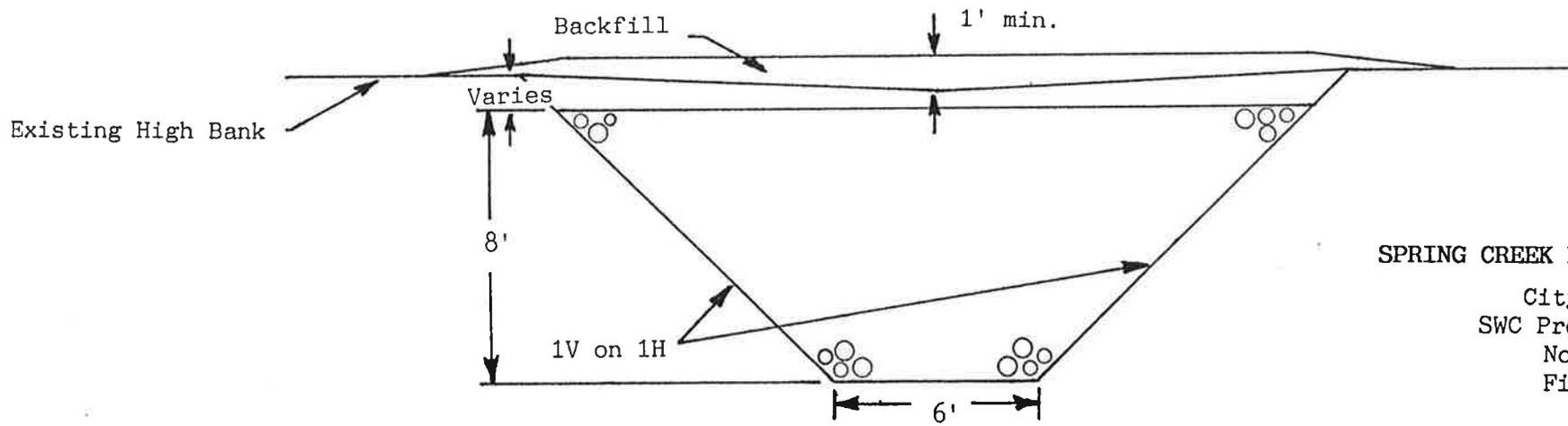
City of Zap  
 SWC Project #1291  
 No Scale  
 Figure 4

# Alternative #2 Windrow Refusal Profile



-10-

## Typical Section



SPRING CREEK BANK STABILIZATION

City of Zap  
SWC Project #1291  
No Scale  
Figure 5

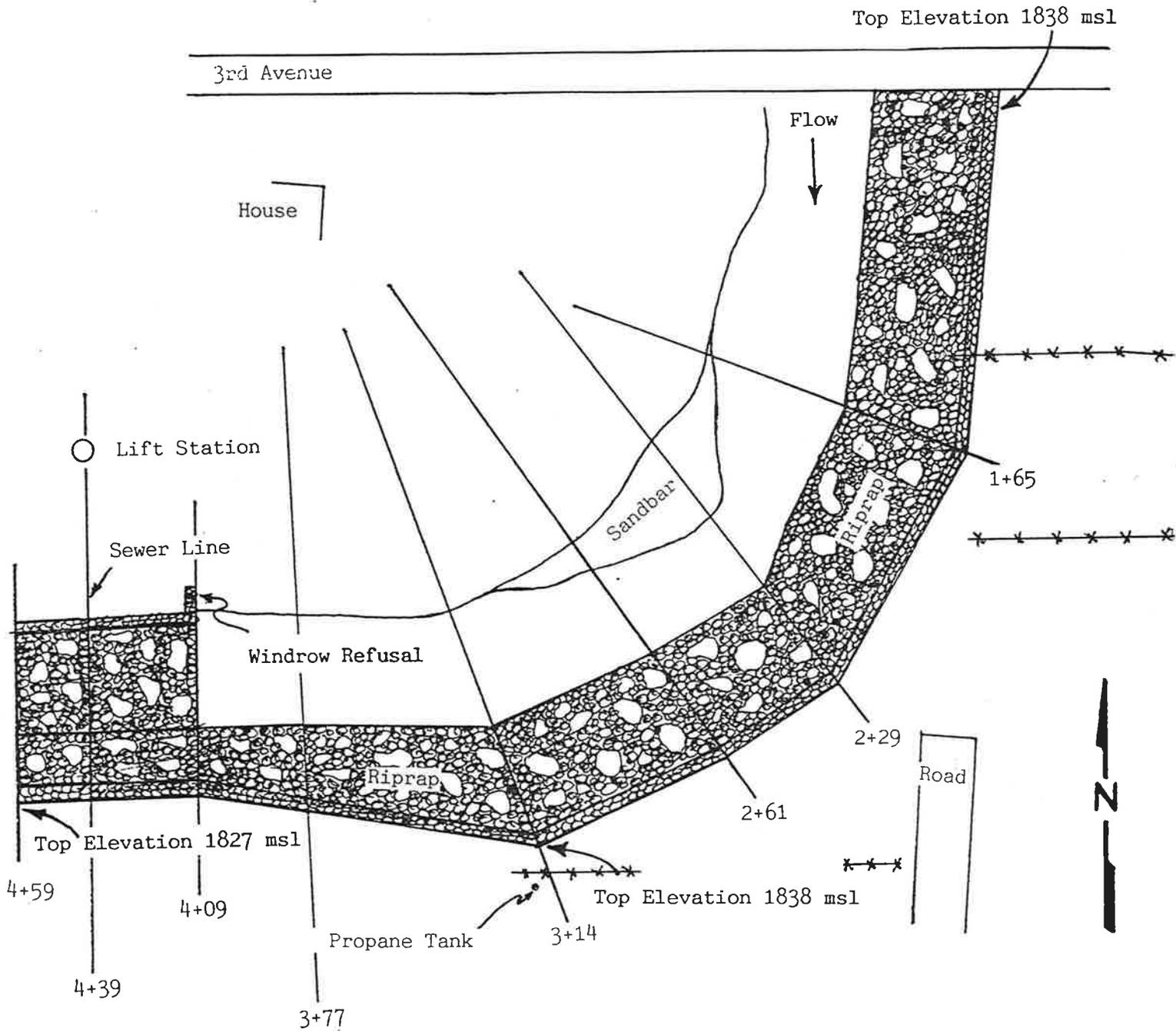
### Alternative #3 - Protect Sewer Line:

This alternative extends the protection provided by Alternative #1 to include the sewer line where it crosses the creek. Alternative #3 continues Alternative #1 from Section 3+77 to Section 4+09. The riprap top elevation slopes down from an elevation of 1838 msl, at Section 3+14 to 1827 msl, at Section 4+09, Figure 6.

From Section 4+09 to Section 4+59, the riprap will extend across the bottom of the creek and up the right bank to an elevation of 1827 msl (Figure 7). The riprap across the creek bottom will be 2 feet thick with the top of the rock at 1818 msl. The riprap on the right bank will have a crown width of 3 feet and be placed on a 1.5:1 sloped surface. The bank area above the riprap will be left undisturbed. A windrow refusal (Figure 8) will be placed in the right bank at Section 4+09, the refusal will extend approximately 10 feet back from the revetment. There will also be a block extending approximately 2 feet down into the creek bed at Section 4+09. Both the refusal and the block will prevent erosion behind the protection.

# Alternative #3

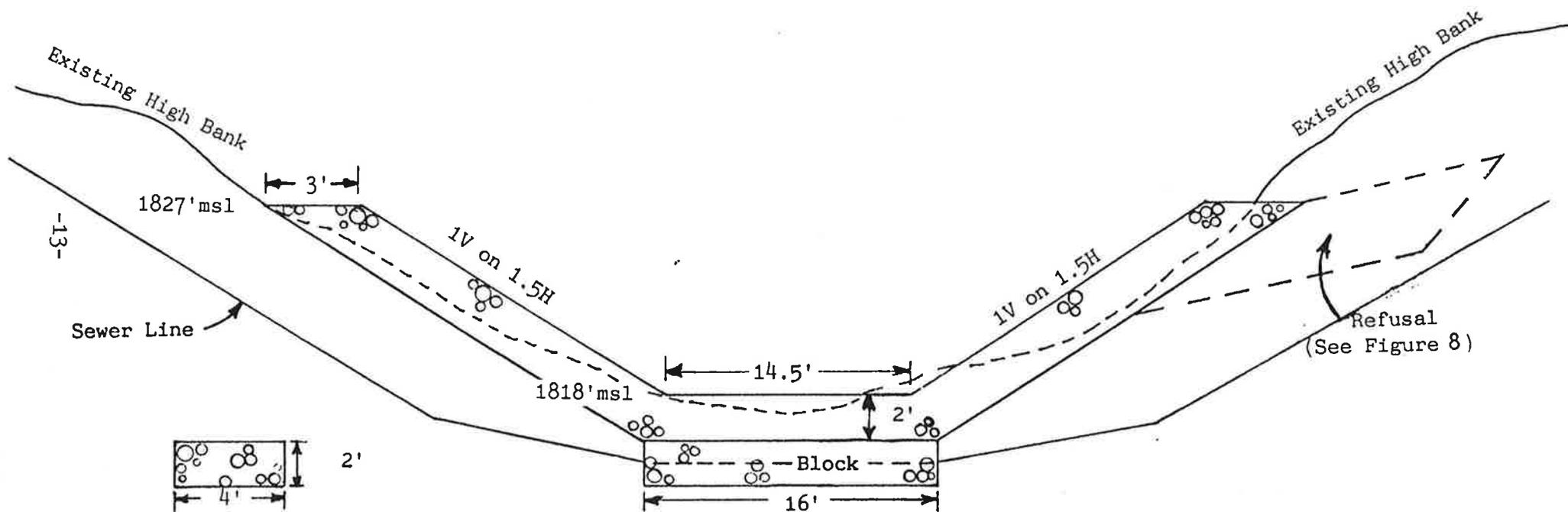
## Riprapped Bank Alignment



SPRING CREEK BANK STABILIZATION

City of Zap  
 SWC Project #1291  
 No Scale  
 Figure 6

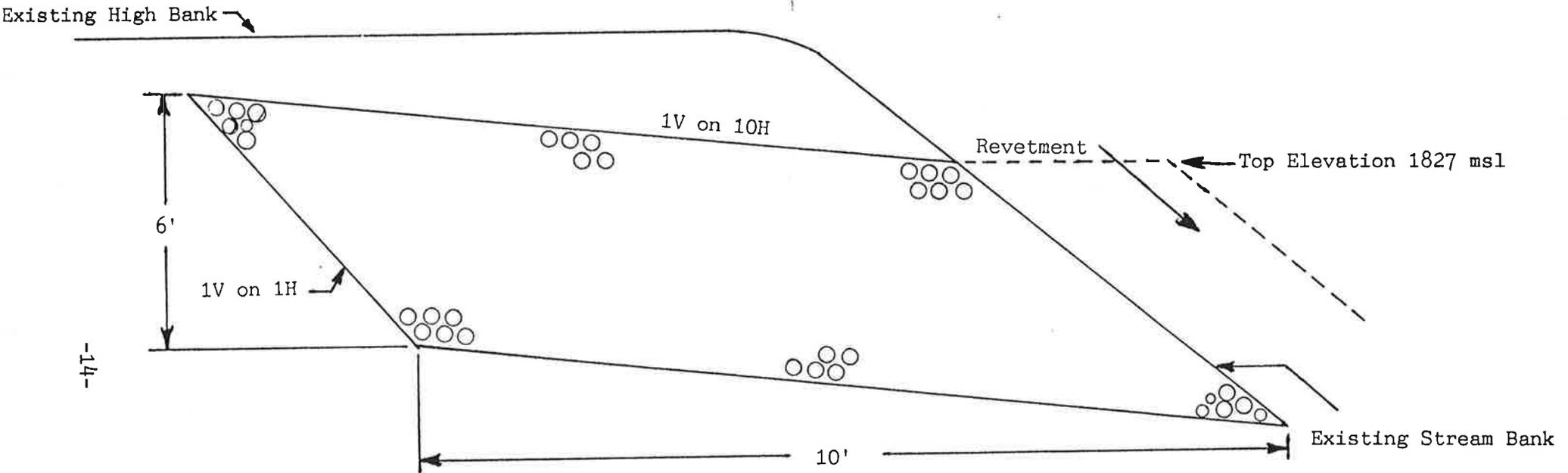
Alternative #3  
 Typical Section  
 X-Section 4+09 to 4+59



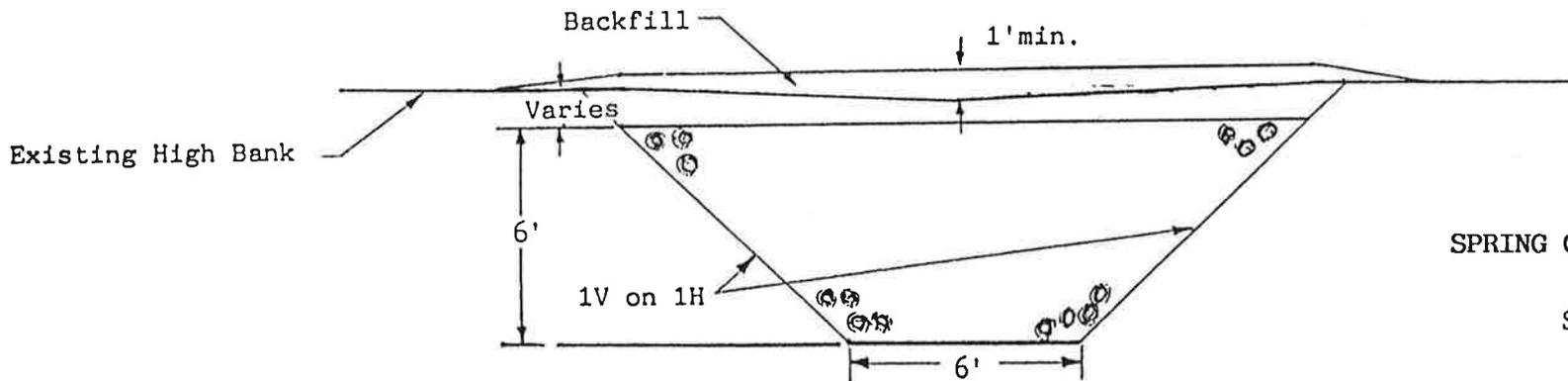
SPRING CREEK BANK STABILIZATION

City of Zap  
 SWC Project #1291  
 No Scale  
 Figure 7

# Alternative #3 Windrow Refusal Profile



# Typical Section



SPRING CREEK BANK STABILIZATION

City of Zap  
SWC Project #1291

No Scale  
Figure 8

If Alternative #3 is the preferred alternative, the exact location of the sewer line must be determined. If the sewer line does not have sufficient cover to protect it from the rock it will have to be lowered. Before excavation to lower the sewer line begins a de-sedimentation structure, a small dam made of rock to slow the water and allow the disturbed soil to settle out, must be built downstream of the site. The structure can be made of rock which, after removing the structure, could be used for the revetment.

The sewer trench can be excavated while the water is flowing, however, it is recommended that the work be done in August or September when the flow is at it lowest. The pipe under the creek should have ball joints to allow the pipeline to conform to the shape of the trench and allow for settling. The area of the pipe trench below the water level should be backfilled with a course sand.

Alternative #3 was designed as a single unit, but Alternative #1 could be built, and the portion of Alternative #3 downstream from Section 3+77 added later. A cost estimate for Alternative #3, constructed from the Third Avenue bridge through Section 4+59 (360 feet), is as follows:

Cost Estimate - Alternative #3  
Bank Protection

Item	Quantity	Unit	Unit Cost	Cost
Mobilization		L.S.		\$ 3,000
Rock Riprap	937.00	C.Y.	\$ 28.00	26,236
Fill	176.00	C.Y.	3.00	528
Excavate	1772.00	C.Y.	4.00	7,088
Seeding	0.40	Ac.	700.00	280
Clearing & Grubbing	0.70	Ac.	500.00	350
				<u>37,482</u>
				Subtotal
				\$37,482
				30% Contingencies & Engineering
				<u>\$11,245</u>
				Total
				<u>\$48,727</u>

Sewer Line Relocation

Item	Quantity	Unit	Unit Cost	Cost
Excavate	160	C.Y.	\$ 4.00	\$ 640
Pipe				
Ball Joint	80	Feet	55.00	4,400
Straight Joint	60	Feet	13.50	810
Connectors	2	Ea.	100.00	200
Fill	160	C.Y.	7.00	1,120
De-sedimentation Structure				
Riprap	45	C.Y.	5.00	225
Removal	45	C.Y.	4.00	180
				<u>7,575</u>
				Subtotal
				\$ 7,575
				30% Contingencies & Engineering
				<u>\$ 2,273</u>
				Total - Sewer Line Relocation
				<u>\$ 9,848</u>

Total - Alternative 3                      \$58,575

Possible Participation by Other Agencies:

The Corps of Engineers will be conducting a study under Section 14 of the Flood Control Act of 1946 of the sewer line area. If the study determines that the protection would have benefits greater than the costs the Corps may assist in the construction.

The local sponsor has made a request to the National Guard to participate in the construction of the project. If the National Guard does the construction the sponsors would be responsible only for the fuel and materials used. The cost of the fuel may be eligible for State cost sharing. No cost estimates were calculated considering National Guard assistance due to the difficulty of estimating the amount of fuel that would be used.

Regulatory Requirements:

Approval must be obtained from the Corps of Engineers before any fill can be placed in the waterway. Also, to meet flood plain management requirements it must be shown that the proposed construction will not have any effect on the 100 year water surface elevation.

## SUMMARY

### Conclusions:

The banks of Spring Creek in the City of Zap are eroding and are in need of immediate protection. A sewer line crossing approximately 450 feet downstream of Third Avenue is also in danger of being damaged.

Alternative #1 provides protection for the entire reach that is not being studied by the Corps of Engineers. Alternative #2 protects only the area which is currently experiencing severe erosion. Although Alternative #2 will provide adequate protection for the endangered area, it may increase erosion in other locations. Alternative #3 provides protection for the greatest area, and protects both the bank and the sewer line. However, construction of Alternative #3 should not begin until the Corps of Engineers has completed its study. Since Alternative #3 includes all of Alternative #1, Alternative #1 could be constructed soon and the remaining portion of Alternative #3 installed after the Corps has completed its study. A table summarizing the alternatives is given below:

Alternative	Protected Length	Cost
1	277 feet	\$34,020
2	100 feet	\$22,214
3	360 feet (includes sewer line)	\$58,575

The costs given in the above table should be substantially reduced if the National Guard does the construction. The Guard may not have the ability to lower the sewer line or fracture the rock. If they are not able to do these two

parts of the project these items will have to be contracted making it even more difficult to determine a cost estimate for Guard participation at this time.

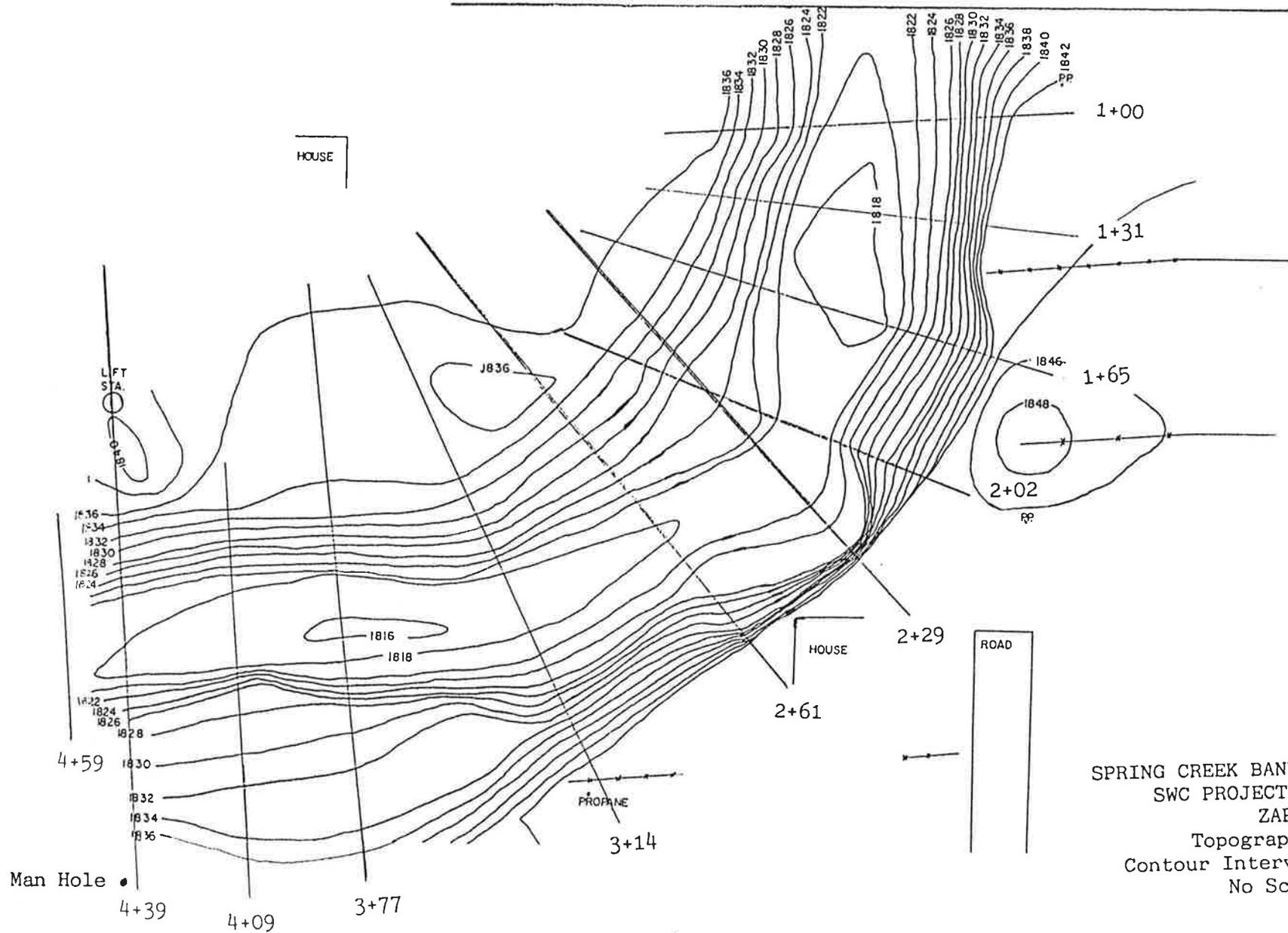
The alternative described in this report should reduce or eliminate bank erosion in the project area. However, no form of bank protection can provide guaranteed protection from the erosive forces possible during high flows.

Recommendations:

Due to the limited amount of bank protected by Alternative #1 and #2 and the fact that neither alternative protects the sewer line, it is recommended that Alternative #3 be implemented. It is also recommended that due to the possibility of funding under Section 14 and the Corps expertise in bank protection the Corps of Engineers report on Section 14 assistance be reviewed before any final decision is made. In the interim, it is suggested that the National Guard be contacted to determine what work if any, they could do. The decision to proceed with the project must be made by the Mercer County Water Resource Board.

**APPENDIX**

3rd Avenue



SPRING CREEK BANK STABILIZATION  
SWC PROJECT NO. 1291  
ZAP  
Topography Map  
Contour Interval - 2 feet  
No Scale

