City of Valdez

212 Chenega Ave.
Valdez, AK 99686

Meeting Agenda - Final-revised

Flood Mitigation Task Force

Monday, September 30, 2019 | **12:00 PM** | **Council Chambers**

Regular Meeting

I. CALL TO ORDER

II. ROLL CALL

III. DISCUSSION ITEMS

1. Meeting to Update the Flood Mitigation Task Force on Mitigation Projects being Completed on Mineral Creek and Valdez Glacier Stream. Discussion on Lowe River Flood Mitigation Options.

IV. ADJOURNMENT

File #: 19-0400, **Version:** 1

ITEM TITLE:
Updates on Flood Mitigation Projects in Mineral Creek and Valdez Glacier Stream. Discussion on Lowe River Flood Mitigation Options.
SUBMITTED BY: Rochelle Rollenhagen, Planning Director

FISCAL NOTES:

Expenditure Required: N/A
Unencumbered Balance: N/A
Funding Source: N/A

RECOMMENDATION:

Receive and File

SUMMARY STATEMENT:

Since the last task force meeting on June 11, 2019 dike and revetment repairs on Valdez Glacier Stream and Mineral Creek continue. Capital Facilities Director Nate Duval will speak on the current status of construction. Please see the attached photos.

Planning for future flood mitigation on the Lowe River needs to continue. Attached are past studies and recommendations from consultants for historical reference. These documents are for reference and discussion only, and are not recommendations from staff. After today's meeting we hope to get a sense of how the task force would like to proceed with flood control on the Lowe, and will provide further research if needed.

DOWL FILE No: 1136.62528.01

SCRIPT FILE:

N

300 0 300 600
SCALE IN FEET

Work status as of 9/27/19

Riprap complete

Active construction

Starting next week

LEFT BANK US
SHEETS 4–7

FEMA FLOODWAY
ZONE AE
100 YEAR FLOOD

RIGHT BANK US
BRIDGE
SHEETS 14–18

LEFT BANK US
BRIDGE
SHEETS 8–10

RIGHT BANK DS
BRIDGE
SHEETS 19–21

RIGHT BANK DS TRAIL
SHEETS 22–24

LEFT BANK DS
SHEETS 11–13

STATE OF ALASKA
49TH
Bradley M. Melodik
(CE 11098)
REGISTERED PROFESSIONAL ENGINEER
4/2/19

REV	DATE	DESCRIPTION	BY
		REVISIONS	
		Vertical Datum:	

DATA
Sm. Sewer
Storm Sewer
Water
Gas
Telephone
Electric
Cable TV
Easements
Footing Elev.
Approved

DOWL
AECL848
WWW.DOWL.COM
4041 B Street
Anchorage, Alaska 99503
907-562-2000

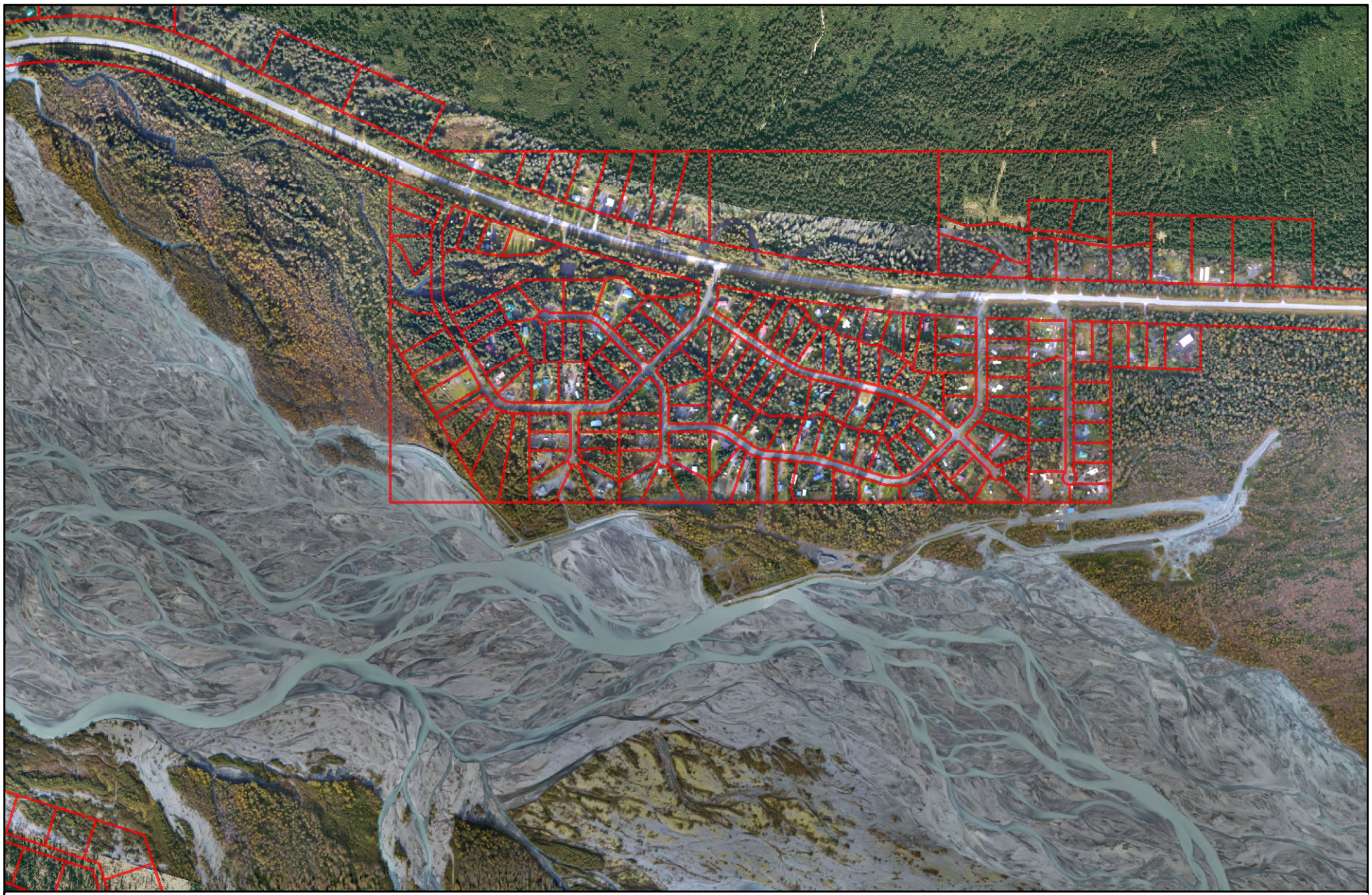
CITY OF VALDEZ –MINERAL
CREEK – BANK IMPROVEMENT
MINERAL CREEK AERIAL – KEY MAP

CHECKED BY	BMM
DESIGNED BY	
DRAWN BY	EAM/HCR
DATE	FEBRUARY 2019
W.O. NO.	62528
F.B. NO.	
REF. DWG	
LOCATION	VALDEZ ALASKA
SCALE	
HORZ.	
VERT.	
SHEET	3 OF 24
FILE NO.	

C:\36\62528-01\65CAD\Hydrology\SC14-CH-DR-62528-MINERAL-CREEK.dwg 2019-2-21 13:25:28

Photo taken during the outburst flood and how it prevented a repeat of the previous year's flooding.

Here's a photo of the start of the 700' long ditch we excavated and filled with riprap across from the landfill. The river is currently right next to it and may even expose the buried rock this fall.



N
W E
S

0 500 1,000 2,000 Feet

Date: 9/27/2019

Lowe River at 10 Mile

Imagery Dated: 9-23/24-2019
Credits: S. Benda

CITY OF VALDEZ, ALASKA
OPPORTUNITIES IN EVERY SEASON

Here's the section of groin 2 we repaired this summer. Photo Before repair.

Here's the section of groin 2 we repaired this summer. Photo after repair.

(1985 project)

CITY OF VALDEZ

BID FORM
AND
CONTRACT DOCUMENTS

FOR

ALPINE WOODS SUBDIVISION
LOWE RIVER FLOOD CONTROL

PROJECT NO. 85805
CONTRACT NO. 146

RIP-RAP AND DIKE CONSTRUCTION

AUGUST 1985

With DID WR constmt
Tht First Dlhr In
Alpine Woods.
To Dave D w/Assmn

CONTRACT DOCUMENTS
INDEX

85805cov

xc CCE 4-1-86

SPECIAL PROVISIONS

ALPINE WOODS SUBDIVISION
LOWE RIVER FLOOD CONTROL

PROJECT NO. 85805 CONTRACT NO. 146

RIP-RAP AND DIKE CONSTRUCTION

GENERAL:

I. Standard Specifications

This contract is subject to and hereby incorporates by reference the 1981 edition of the Department of Transportation and Public Facilities "Standard Specifications for Highway Construction" as modified herein.

II. Insurance

Before signing the Contract or commencing the work or allowing any subcontractor to commence work, the Contractor shall obatin all insurance required under this Article. The Contractor shall maintain this insurance until the final acceptance date. The Contractor shall file with the City as verification of insurance a certificate of insurance showing the type and amounts of insurance, the policy number, expiration date and signed by an authorized representative of the insurance company. Each certificate of insurance will state that the policy or policies have been endorsed whereby the insurance company will provide not less than thirty (30) days written notice to the Engineer of any material change, cancellation or non-renewal of the insurance policies. All insurance policies required under this Article shall name the City of Valdez as an additional insured for the purposes of the project and shallcontain a waiver of subrogation against the City.

The Contractor shall provide the following types of insurance:

Workers' Compensation	Minimum Limits
$100,000 Employers Liability and Workers' Statutory Compensation as required by Alaska State Workers' Compensation Statutes.	Statutory
When specified in the Special Provisions, the Contractor shall provide coverage under the Federal Longshoremen and Harbor Works Compensation Act and the Federal Maritime Liability Law (Jones Act).	

Comprehensive General Liability	Minimum Limits*
Bodily Injury and Property Damage Liability; Premises Operations including explosion, collapse and underground; Products and Complete Operations; Broad Form Property Damage; Blanket Contractual; Personal Injury	$1,000,000 Combined Limit Each Occurence and Aggregate
Comprehensive Automobile Liability	**Minimum Limits***
Bodily Injury and Property Damage, including all owned, hired and non-owned automobiles	$500,000 Combined Limit Accident
Excess Liability Insurance	**Minimum Limits**
Umbrella Form	$1,000,000 Combined Bodily Injury and Property Damage

*These limits may be reduced only if the excess insurance is increased to provide the same total coverage.

TECHNICAL

M.-S. 71-1-050-5, Rip-Rap Source

Mining Plan Requirements:

1. Prior to commencing work at the site, the Contractor shall furnish their detailed plan of quarry operation including use of existing and produced shot rock for review by the engineer.

2. All work shall be confined within the existing right-of-way.

3. All standing or down brush and timber, which must be removed to expose rock materials but which cannot be utilized by the Contractor or decked for utilization by local residents, shall be piled and burned. This work shall be incidental to other items of work appearing in this Contract. The Contractor shall obtain any required burning permits from local agencies.

4. The existing access route and any extension of this access to the top of the face or faces shall remain at the completion of the project. A safe working face or faces shall be established, maintained and remain at the completion of the project.

5. The quarry site shall be left at the completion of the project in such a condition as to allow further use of the site without extensive development work.

6. The Contractor shall doze all existing shot rock out of the area for current quarry development to an adjacent site, as directed, and shall not use or remove any of such existing material.

7. The Contractor shall use all reasonable means to protect the existing paved highway surface from damage from rocks blasted out or falling off trucks and from operation of equipment. The Contractor shall, at their sole expense, repair and restore the existing pavement to its original condition at the conclusion of the work.

104-106 Final Clean-up and Restoration

1.06.1 General

This item consists of furnishing all supervision, labor, equipment and materials necessary for final clean-up and restoration of all areas disturbed by construction activities to a condition equal to, or better than, before construction started. This does not include clean-up or restoration incidental or directly provided for by other construction items that are necessary for the orderly progress of construction.

1.06.2 Materials

Materials required for satisfactory completion of this work will not be paid for directly but are considered incidental to the Contract unless specifically provided for.

1.06.03 Construction

The Contractor shall clean up all sites disturbed during construction of this project. This includes removal of all construction equipment, disposal of all excess materials, disposal of all rubbish and debris, removal of all temporary construction structures, and grading of the sites so that no standing water is evident.

1.06.4 Method of Measurement

Measurement will be one unit for all work necessary under this item. Final acceptance of the work will constitute measurement.

1.06.5 Basis of Payment

Payment for all work done under this item will be made in one lump sum upon the satisfactory completion and acceptance of all work to be done under this Contract.

Payment will be made under

Item	Day Unit
Final Clean-up and Site Restoration	Lump Sum

107-1.11 Protection and Restoration of Property and Landscape

Add the following:

Blasting shall be restricted within 1000 feet of any utility, structure, or anadromous waters.

Restrictive blasting shall be defined by the formula:

Where: $W = (D/Ds)2$

W = Weight of explosives in pounds per delay.

D = Distance in feet between the nearest blast site and the point where it is desired to know the particle velocity.

Ds = 50

The formula is based upon using delay EB caps with at least eight (8) milliseconds between periods to initiate blast.

At no time within 500 feet of the point of interest shall the particle velocity exceed two (2) inches per second.

In addition, explosives shall not be discharged directly beneath or adjacent to anadromous water bodies if the charge weight and substrate type result in creating an excess of two (2) pounds per square (psi) pressure differential int he amvient hydrostatic pressure of the anadromous waters, without the written approval of the Engineer.

203.1 Description

Amend to read as follows:

Construct a gravel core from local gravel bar materials similar to those at the site for a wing dike as shown on Sheet 2 fo 3 titled, "SITE PLAN" and 3 of 3 titled, "SECTION." The construction site will be as staked on the ground by the City.

Contractor shall determine his source subject to approval of materials.

203-3.05 Compaction of Embankments Not Constructed with Moisture and Density Controls.

Amend to read as follows:

Compaction shall be achieved by leveling and rolling with wheeled and tracked equipment which shall be routed to cover the width of the dike. Maximum loose lift thickness shall be thirty (30) inches.

203-4.01 Method of Measurement

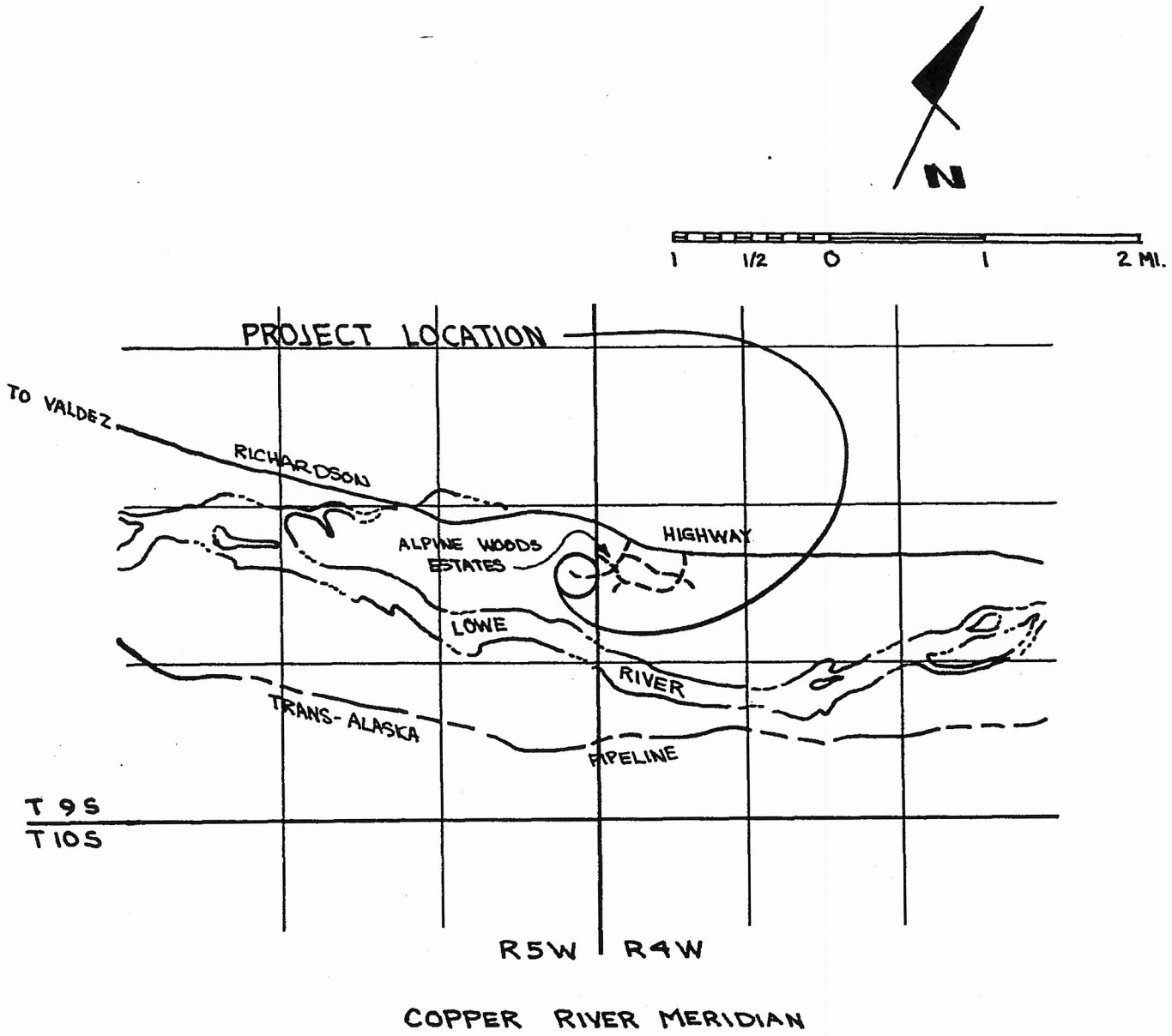
Amend to read as follows:

Measurement shall be by cubic yard of dike built to the grade slopes and width described under 203-1.01.

203-5.01 Basis of Payment

Amend to read as follows:

Payment will be made under Bid Item 5 for the lineal feet of gravel core dike built to the line and grade set by the City including toe trench.



PURPOSE: DIVERT NEW LOWE RIVER CHANNEL TO PROTECT PRIVATE PROPERTY

DATUM: MEAN SEA LEVEL

ADJACENT PROPERTY OWNERS: SEE APPLICATION-ATTACHMENT #1

VICINITY MAP

CITY OF VALDEZ
ALPINE WOODS FLOOD CONTROL
PROJECT NO. 85805

SHEET 1 of 3 AUGUST 1, 1985

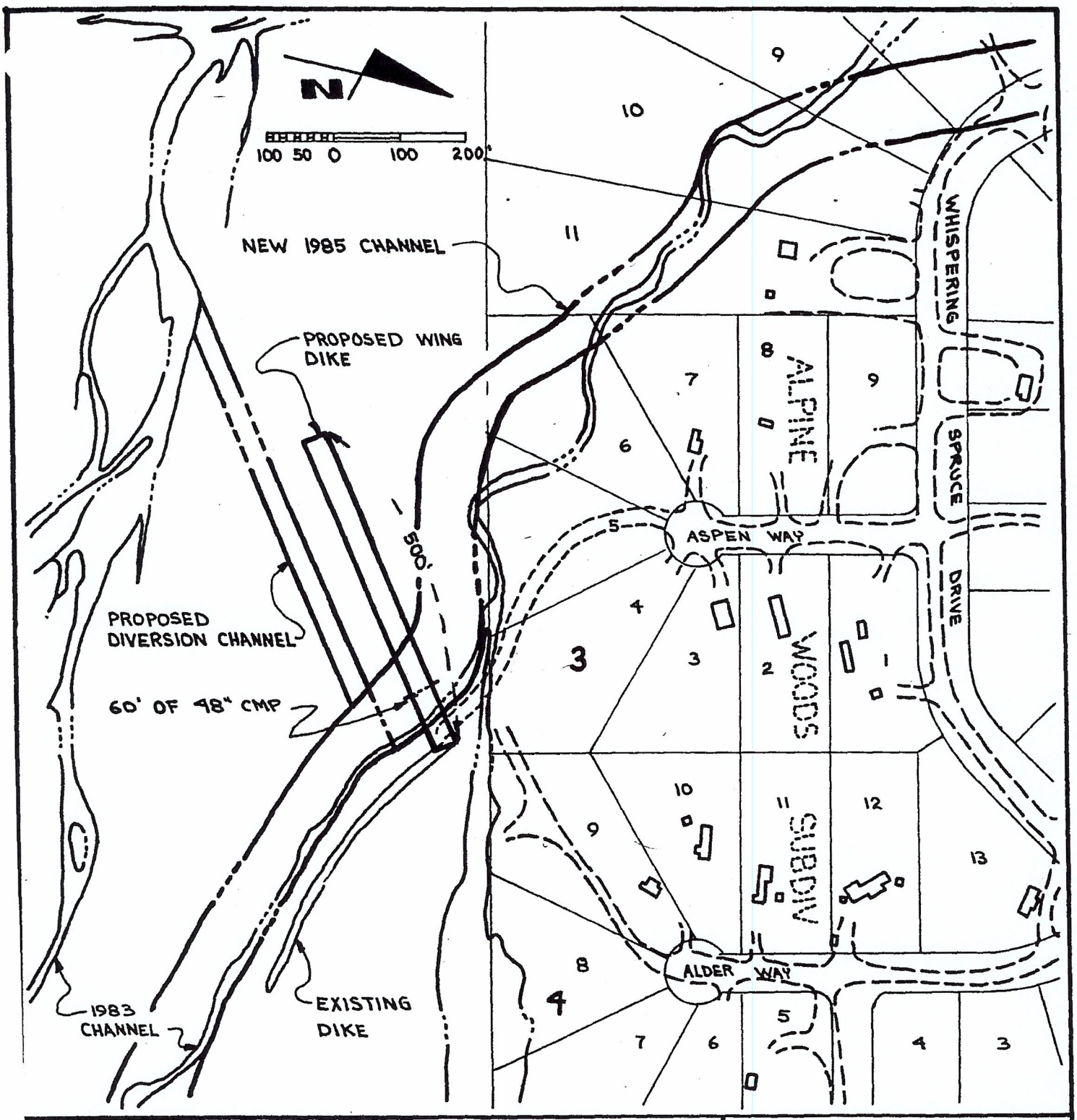
PROPOSED DIVERSION CHANNEL AND WING DIKE

IN: LOWE RIVER DRAINAGE SYSTEM

AT: VALDEZ, ALASKA

APPLICATION BY: CITY OF VALDEZ

REVISED 8-12-85



PURPOSE: DIVERT NEW LOWE RIVER CHANNEL TO PROTECT PRIVATE PROPERTY

DATUM: MEAN SEA LEVEL

ADJACENT PROPERTY OWNERS: SEE APPLICATION-ATTACHMENT #1

SITE PLAN

CITY OF VALDEZ
ALPINE WOODS FLOOD CONTROL
PROJECT NO. 85805

SHEET 2 of 3 AUGUST 1, 1985

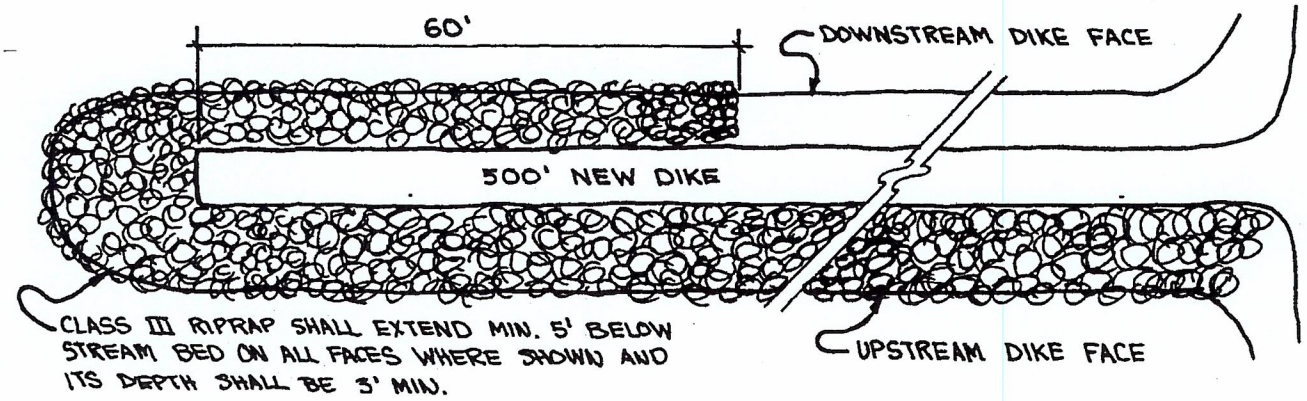
PROPOSED DIVERSION CHANNEL AND WING DIKE

IN: LOWE RIVER DRAINAGE SYSTEM

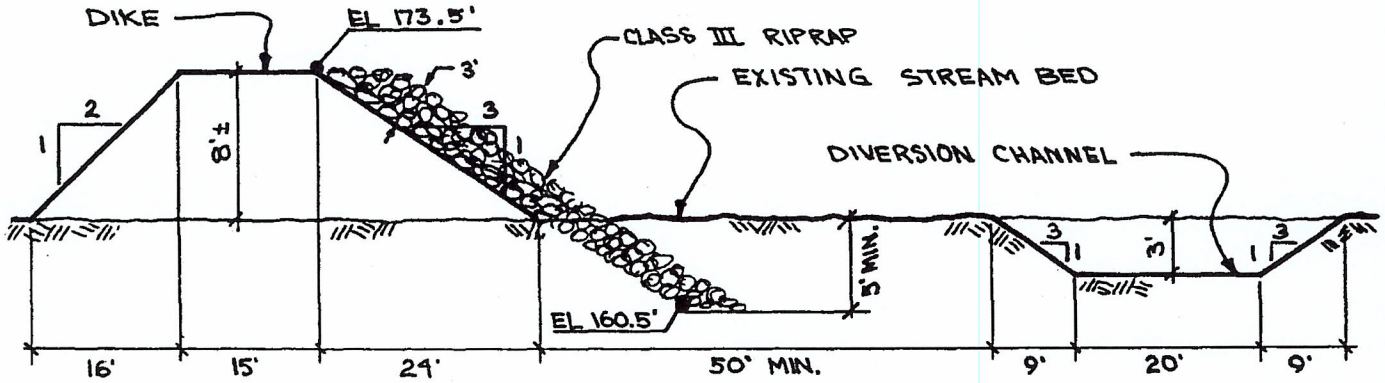
AT: VALDEZ, ALASKA

APPLICATION BY: CITY OF VALDEZ

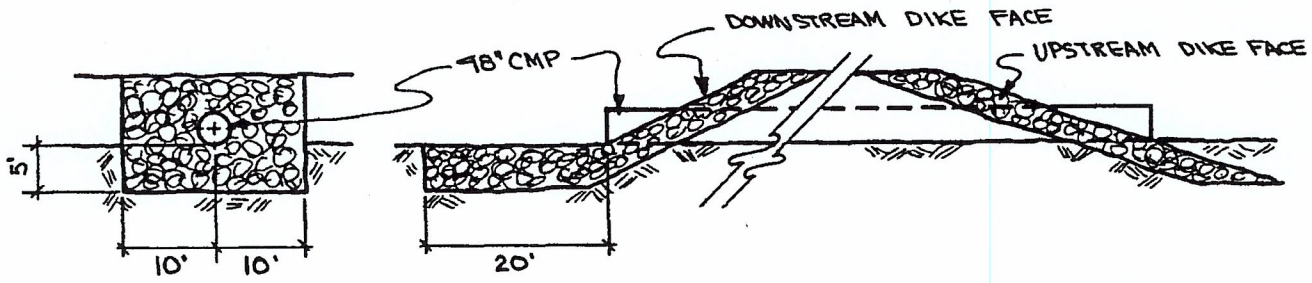
REVISED 8-12-85



RIPRAP DETAIL - PLAN VIEW



DIKE AND CHANNEL - TYPICAL SECTION



PIPE PROTECTION - TYPICAL SECTION

PURPOSE: DIVERT NEW LOWE RIVER CHANNEL TO PROTECT PRIVATE PROPERTY DATUM: MEAN SEA LEVEL ADJACENT PROPERTY OWNERS: SEE APPLICATION-ATTACHMENT #1	SECTION CITY OF VALDEZ ALPINE WOODS FLOOD CONTROL PROJECT NO. 85805 SHEET 3 of 3 AUGUST 1, 1985	PROPOSED DIVERSION CHANNEL AND WING DIKE IN: LOWE RIVER DRAINAGE SYSTEM AT: VALDEZ, ALASKA APPLICATION BY: CITY OF VALDEZ

CITY OF VALDEZ

ALPINE WOODS SUBDIVISION
LOWE RIVER FLOOD CONTROL

PROJECT NO. 85805

CONTRACT NO. 146

AUGUST, 1985

August 13, 1985

TO: All Planholders of Record

SUBJECT: Addendum #1

This addendum forms a part of the contract documents and modifies the original contract documents for the above referenced project. Acknowledge receipt of this addendum by signing, dating and submitting the addendum with the bid proposal form.

This addendum makes the following changes:

1. The contractor, its employees and its subcontractors shall keep fully informed of all Federal and State laws, all local laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. The contractor, its employees and its subcontractors shall at all times observe and comply with all such laws, ordinances, regulations, orders and decrees, and/or liability arising from or based on the violation of any such law, ordinance, regulation, order or decree whether by the contractor, its employees or its subcontractors.

2. That the contractor take all necessary measures to protect and maintain traffic during the use of this materials site, including the furnishing of such personnel, equipment and devices as may be required to ensure the safety and the convenience of the traveling public.

3. That any damage done to the new roadway, structures or culverts shall be restored to new condition acceptable to the State.

xc CCE 4-1-86

4. Upon completion of use of the material site all surplus materials shall be stockpiled or dressed away from the roadway; any clearing and grubbing shall be disposed of at locations approved by the State and the materials site shall be left in a safe and neat condition acceptable to the State.

5. In the Special Provisions, Section 203.1, Description, page 4 of 5, insert the following as the third paragraph:

   "The material to be used for the gravel core construction must be imported."

END OF ADDENDUM

Issued: John Thorp
John Thorp, P.E., City Engineer

Bidder:_____

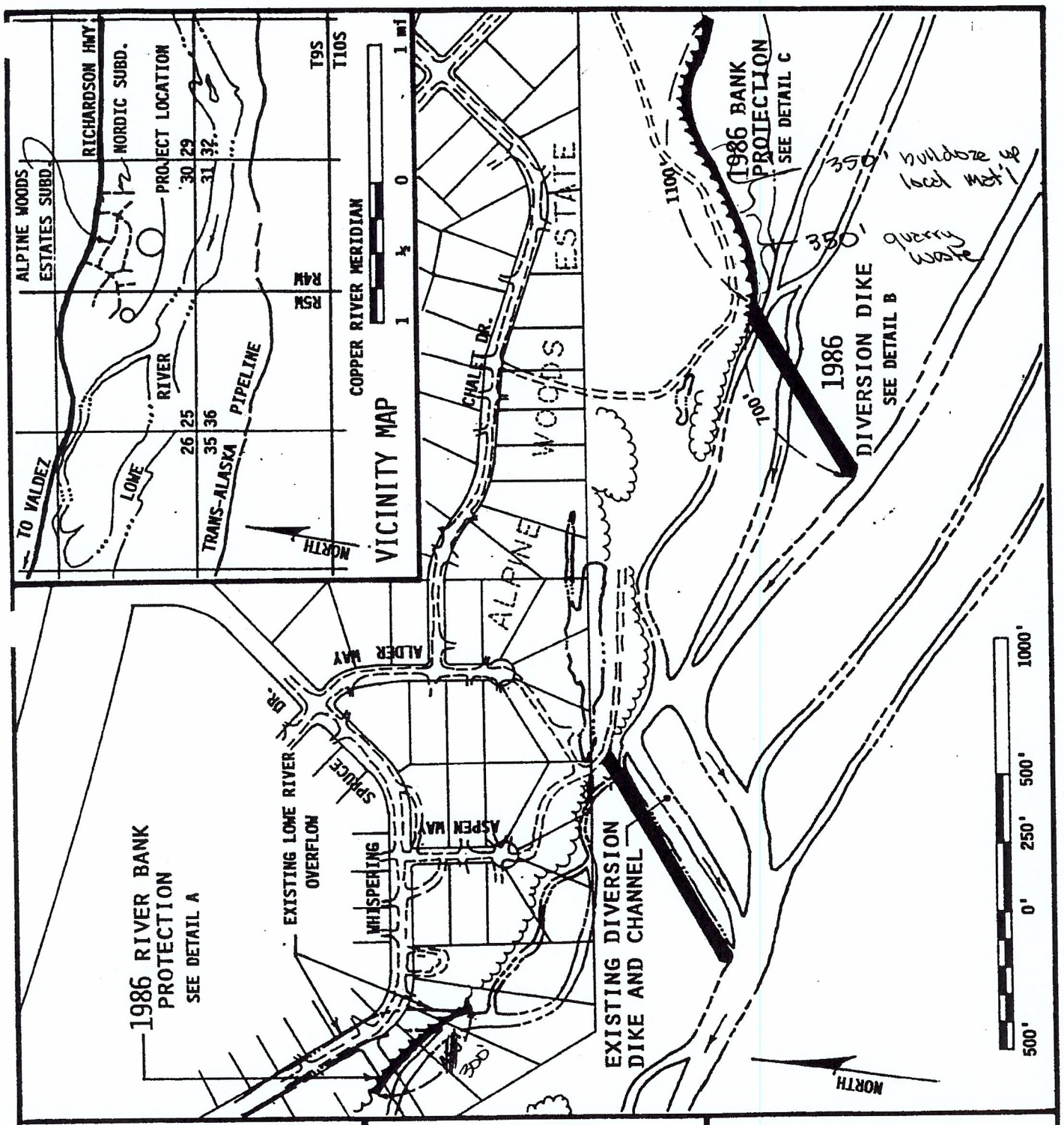
By:_____

Title:_____

Date:_____

122-85805add.1

1986 Project
Contract # 175



PURPOSE: DIVERT LOWE RIVER CHANNEL TO PROTECT PRIVATE PROPERTY

DATUM: MEAN SEA LEVEL

ADJACENT PROPERTY OWNERS: SEE APPLICATION - ATTACHMENT #1

PLAN VIEW

CITY OF VALDEZ
ALPINE WOODS FLOOD CONTROL
PROJECT NO. 86805

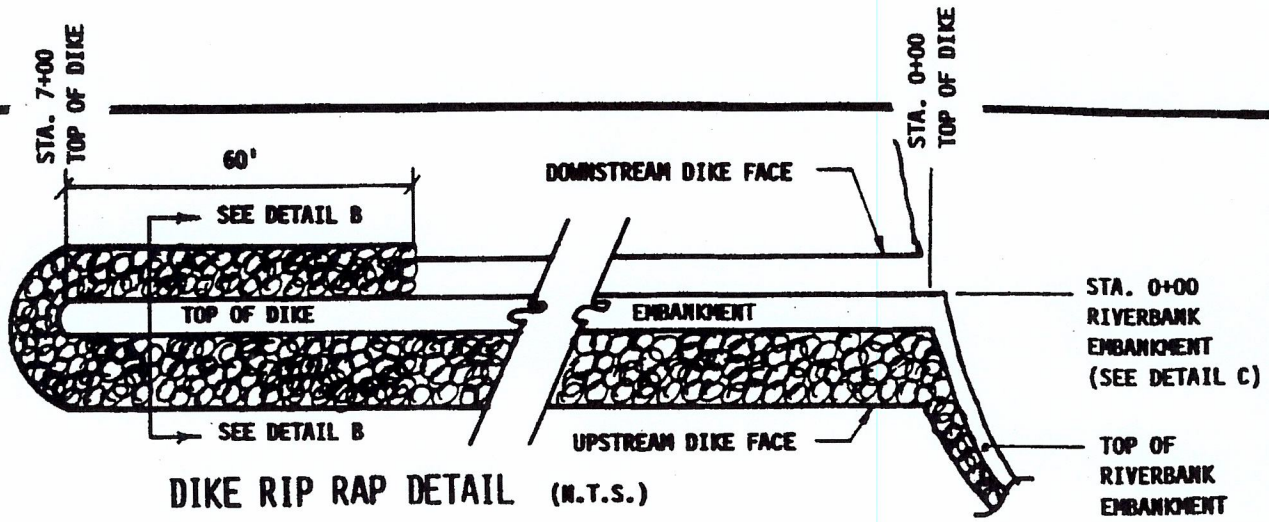
SHEET 1 of 2 DECEMBER 1985

PROPOSED DIVERSION DIKE AND BANK PROTECTION

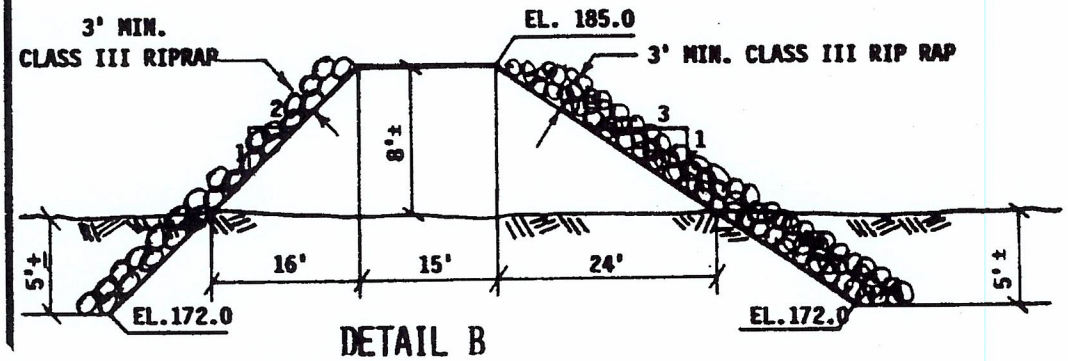
IN: LOWE RIVER DRAINAGE SYSTEM

AT: VALDEZ, ALASKA

APPLICATION BY: CITY OF VALDEZ

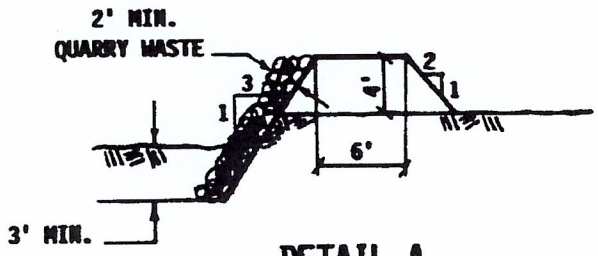


DIKE RIP RAP DETAIL (N.T.S.)



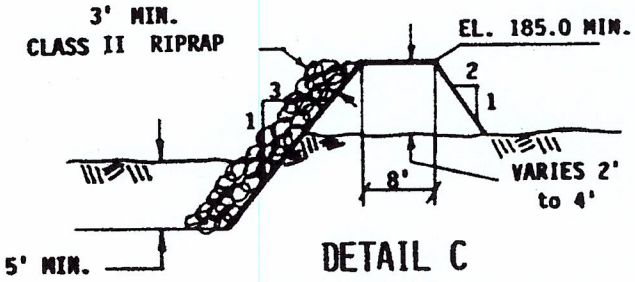
DETAIL B

TYPICAL SECTION (N.T.S.)



DETAIL A

TYPICAL SECTION (N.T.S.)

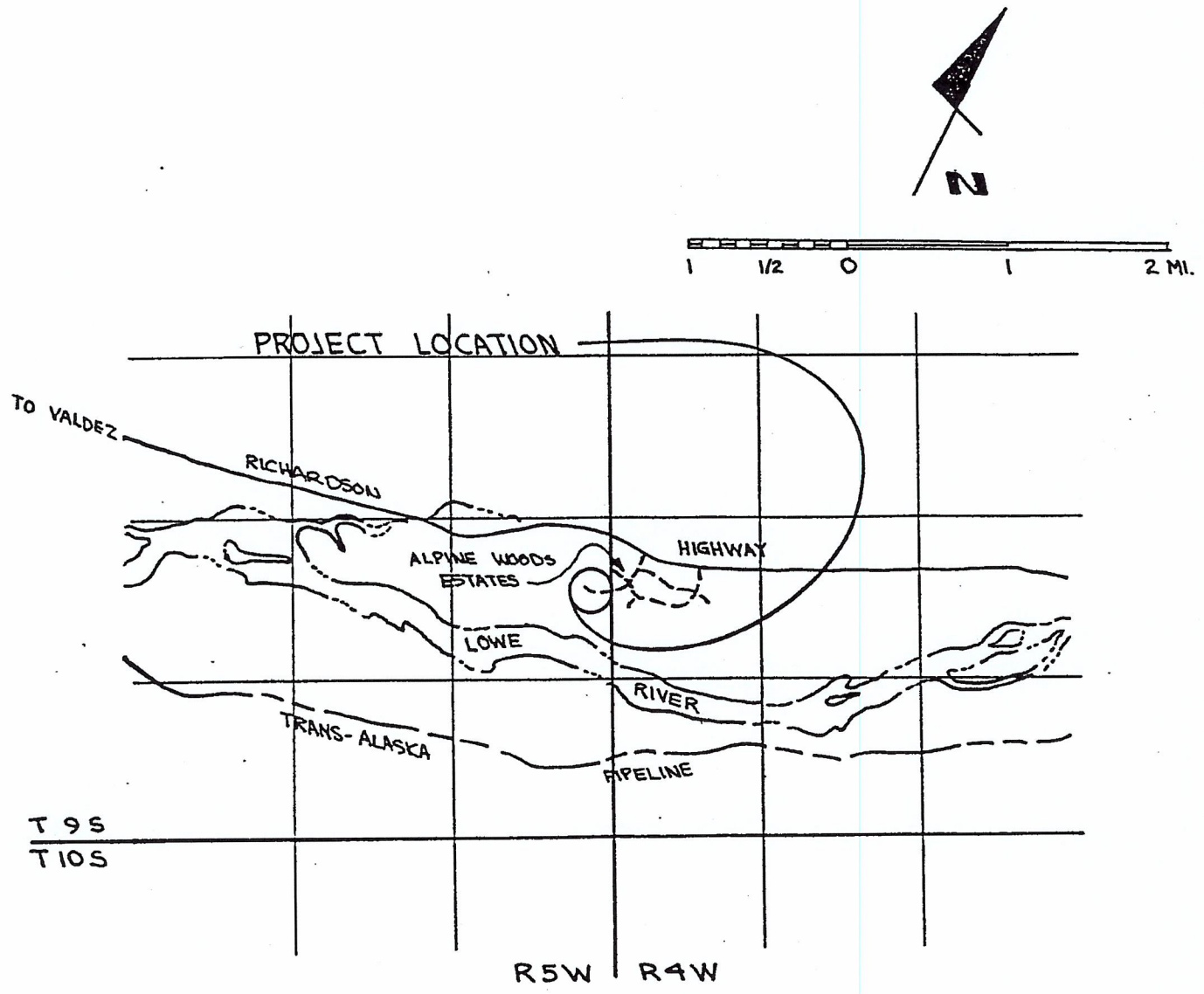


DETAIL C

TYPICAL SECTION (N.T.S.)

PURPOSE: DIVERT LOWE RIVER CHANNEL TO PROTECT PRIVATE PROPERTY DATUM: MEAN SEA LEVEL ADJACENT PROPERTY OWNERS: SEE APPLICATION - ATTACHMENT #1	SECTION VIEWS REVISED 4-86 CITY OF VALDEZ ALPINE WOODS FLOOD CONTROL PROJECT NO. 86805 SHEET 2 of 2 DECEMBER 1985	PROPOSED DIVERSION DIKE AND BANK PROTECTION IN: LOWE RIVER DRAINAGE AT: VALDEZ, ALASKA APPLICATION BY: CITY OF VALDEZ

1988 Work
Contract No. 234



PURPOSE: DIVERT NEW LOWE RIVER CHANNEL TO PROTECT PRIVATE PROPERTY

DATUM: MEAN SEA LEVEL

VICINITY MAP

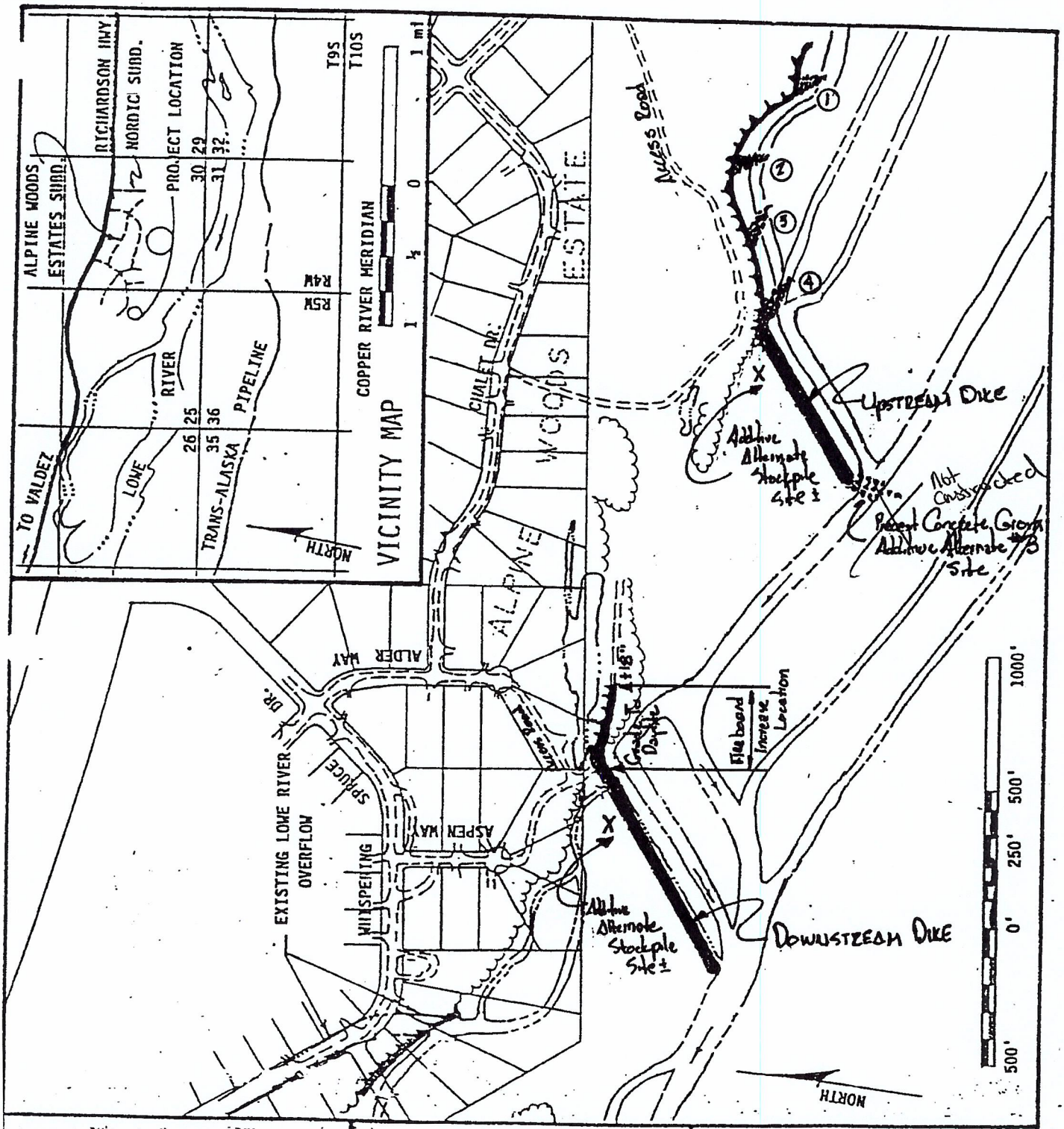
CITY OF VALDEZ
ALPINE WOODS FLOOD CONTROL
PROJECT NO. 8880E

SHEET 1 of 5 AUGUST 1, 1988

PROPOSED DIVERSION DIKE GROINS AND DOWNSTREAM DIKE IMPROVEMENTS

IN: LOWE RIVER DRAINAGE SYSTEM

AT: VALDEZ, ALASKA



PURPOSE: DIVERT LOWE RIVER CHANNEL TO PROTECT PRIVATE PROPERTY

TUM: MEAN SEA LEVEL

PLAN VIEW

CITY OF VALDEZ
ALPINE WOODS FLOOD CONTROL
PROJECT NO. 88805

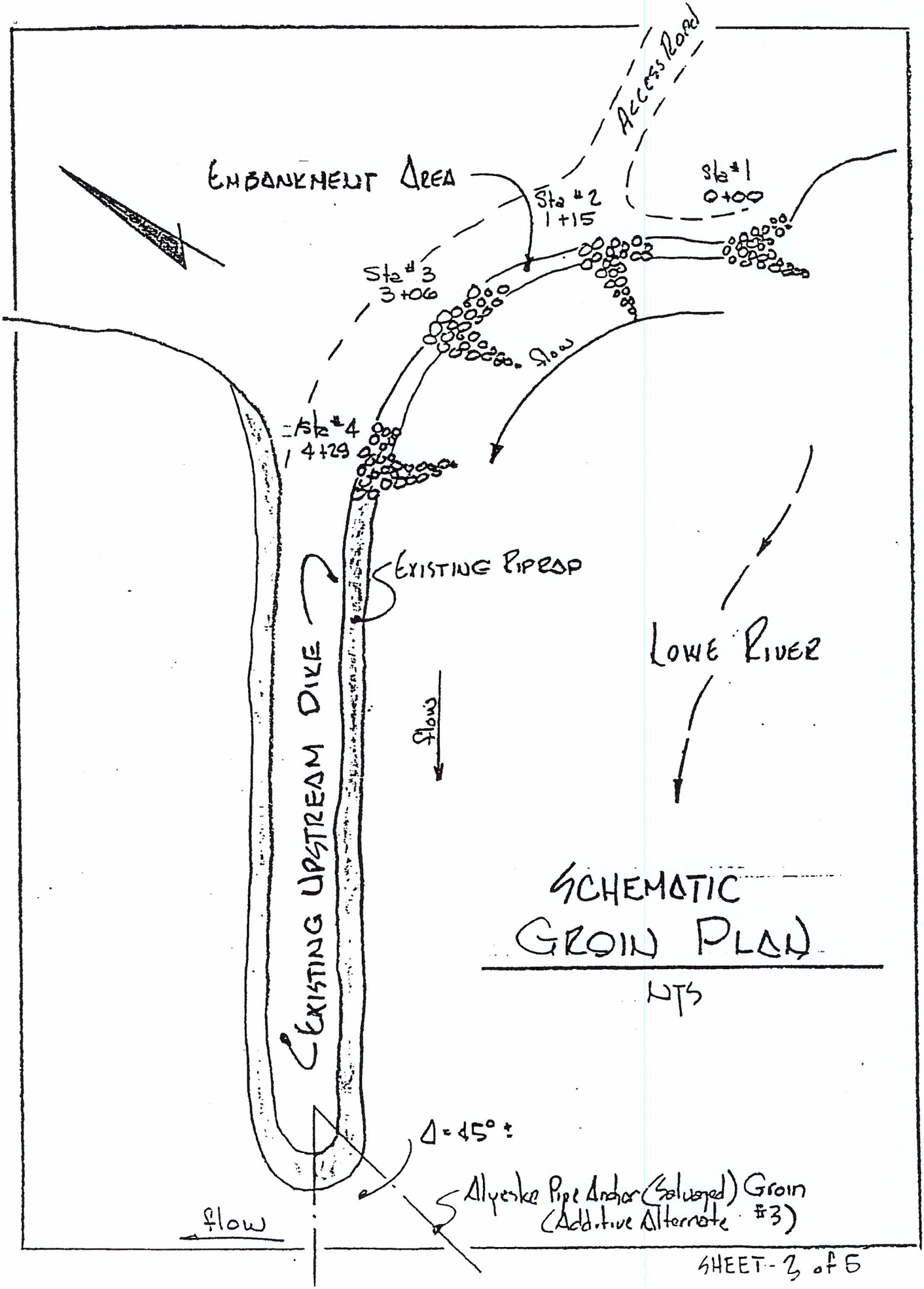
SHEET 2 of 5 DECEMBER 1988

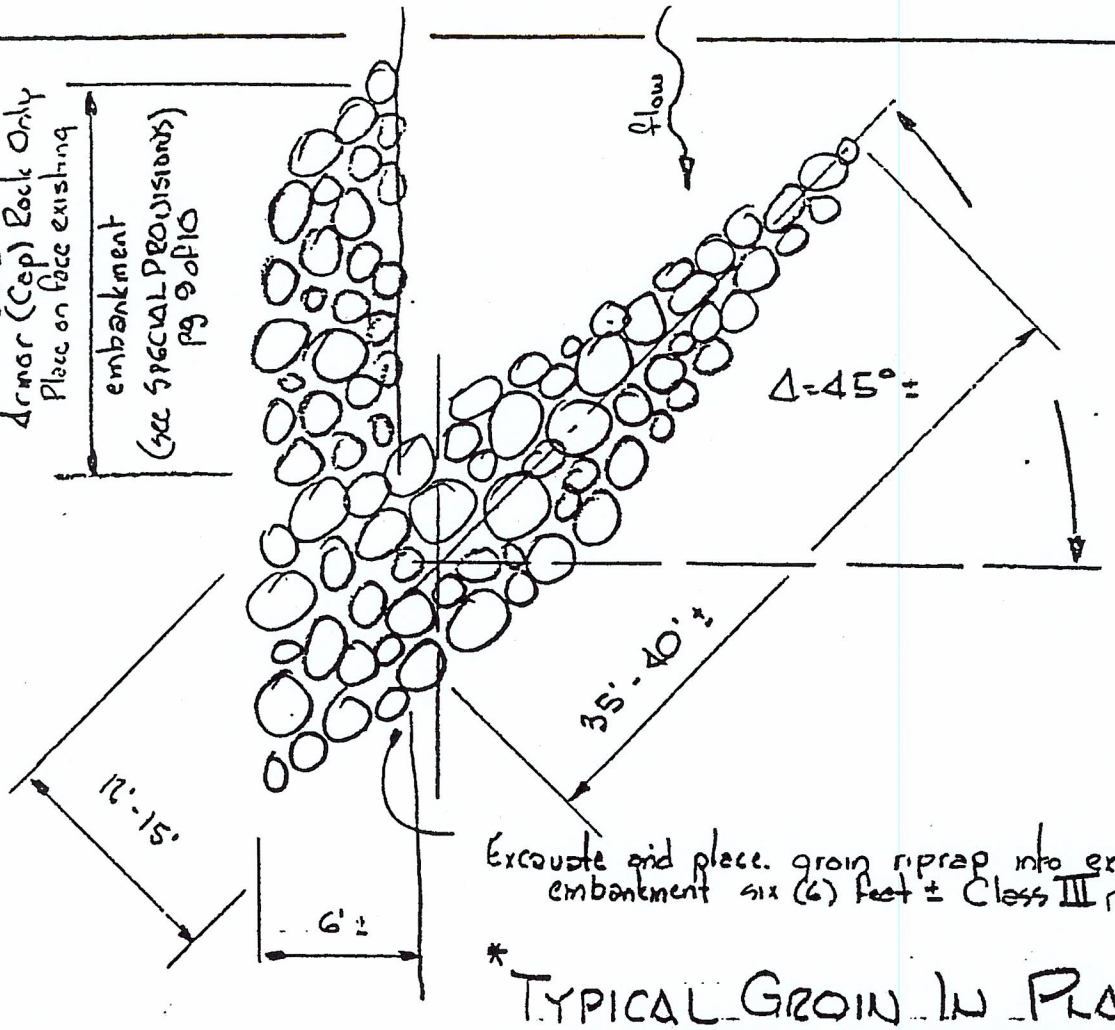
PROPOSED DIVERSION DIKE GROINS AND DOWNSTREAM IMPROVEMENTS

IN: LOWE RIVER DRAINAGE SYSTEM

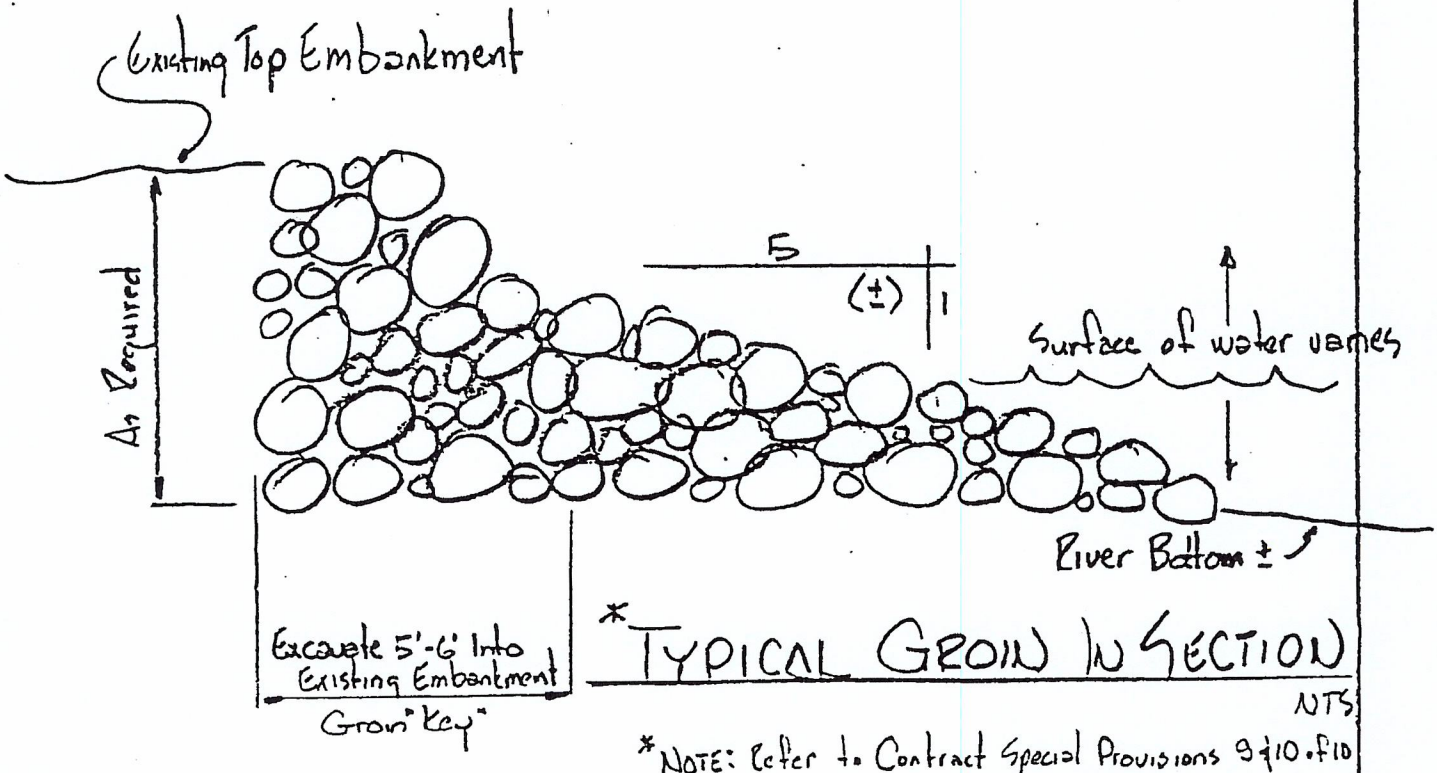
AT: VALDEZ, ALASKA

SHEET 2 of 5


Access Road
EMBANKMENT AREA
Sta #1
0+00
Sta #2
1+15
Sta #3
3+06
Flow
Sta #4
4+29
EXISTING RIPRAP
EXISTING UPSTREAM DIKE
LOWE RIVER
flow
SCHEMATIC
GROIN PLAN
NTS
Δ = 45° ±
Allyerke Pipe Anchor (Salvaged) Groin
(Additive Alternate #3)
flow
SHEET - 3 of 5

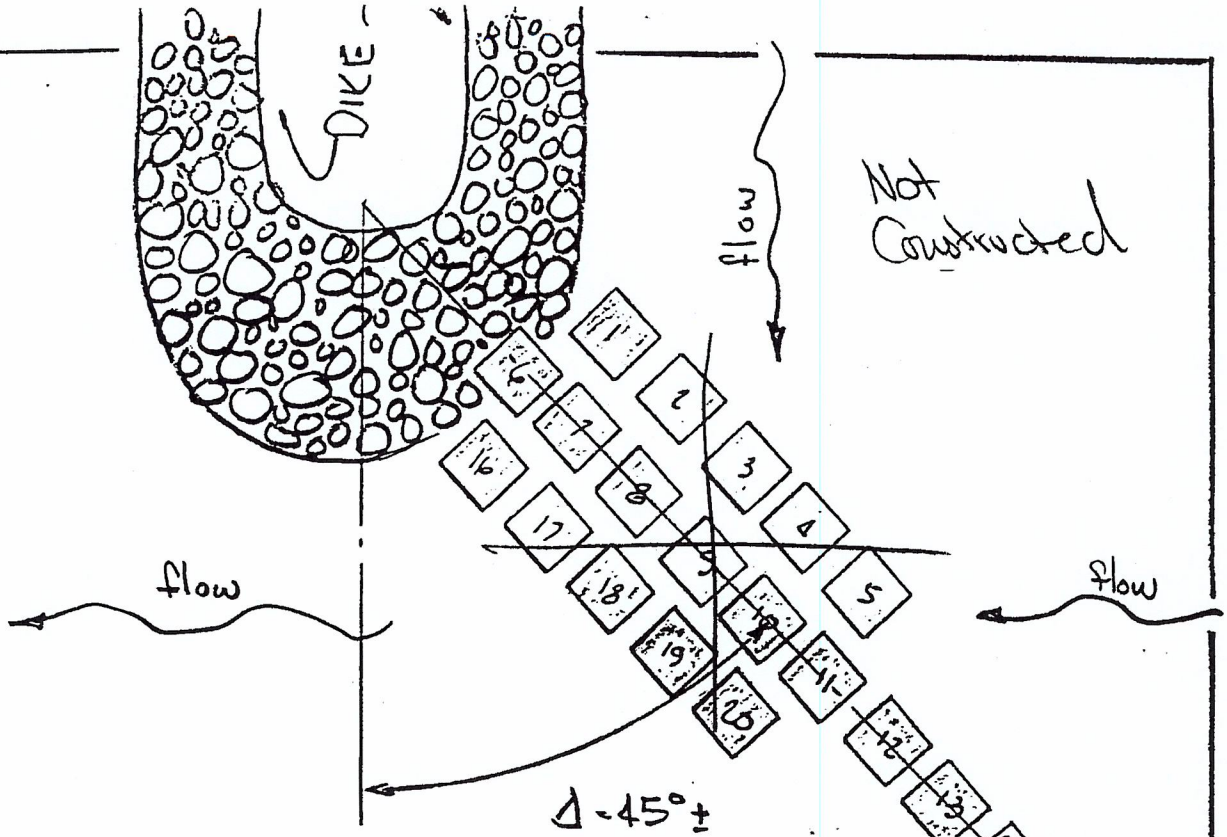


*TYPICAL GROIN IN PLAN NTS

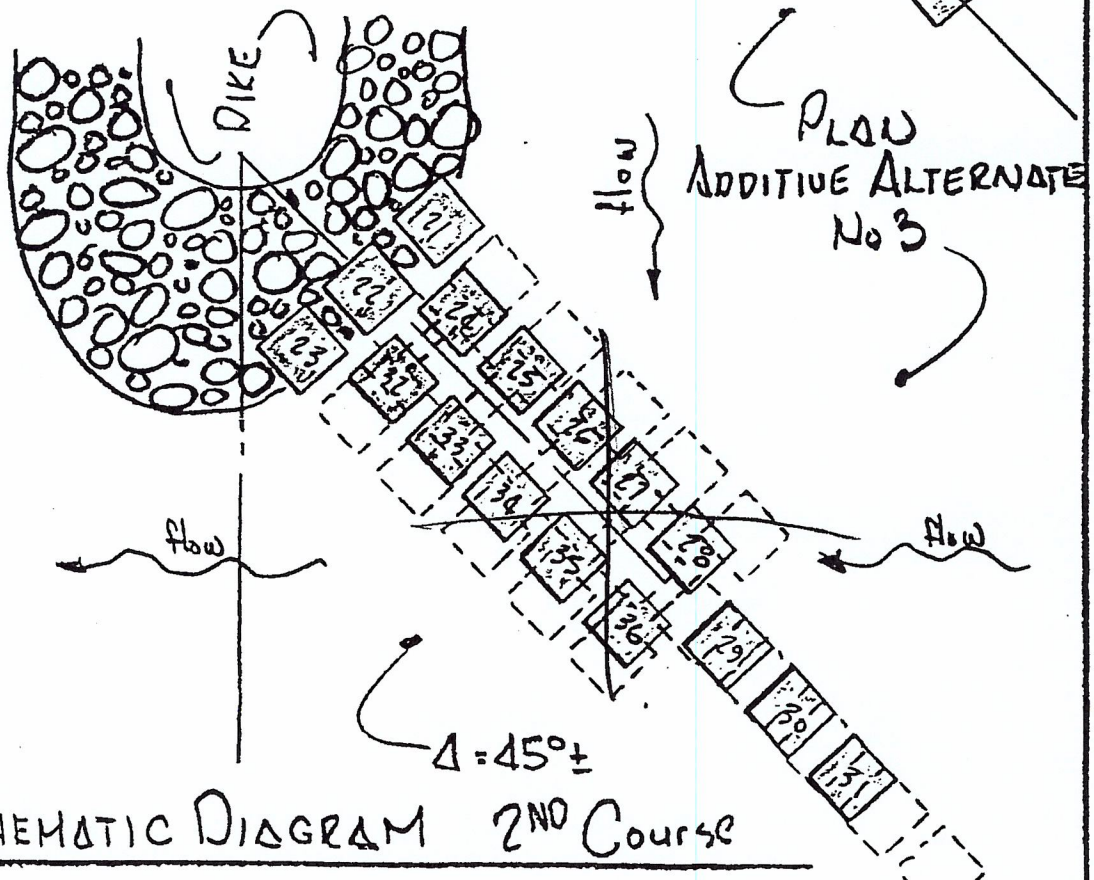


*TYPICAL GROIN IN SECTION NTS

*NOTE: Refer to Contract Special Provisions 9 & 10 of 10



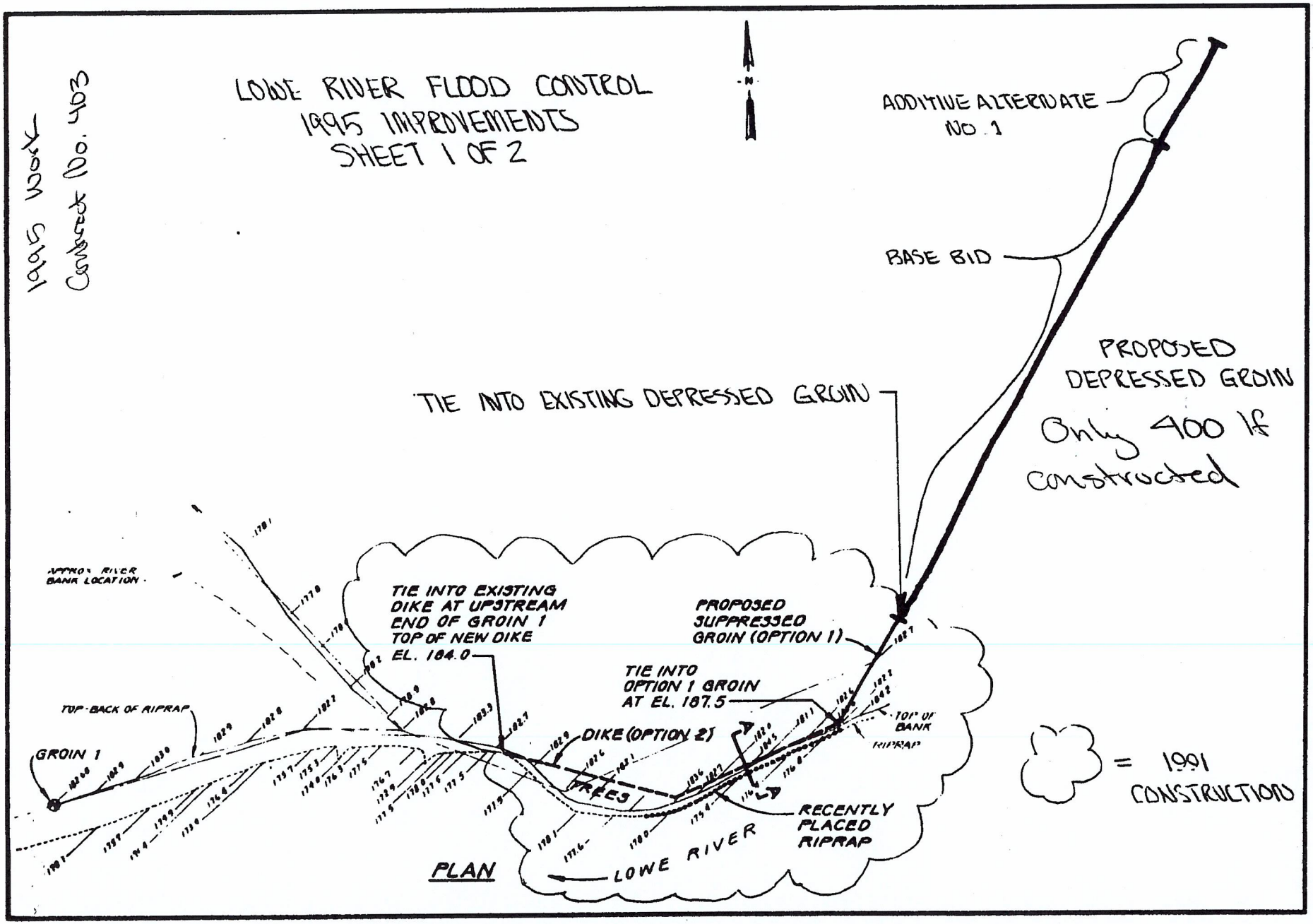
SCHEMATIC DIAGRAM 1ST Course



SCHEMATIC DIAGRAM 2ND Course

Note:
Precision placement of concretes blocks not required, however, above should be attempted.

SHEET 5 of 5 NTS


1995 Work
Contract No. 403
LOWE RIVER FLOOD CONTROL
1995 IMPROVEMENTS
SHEET 1 OF 2
N
ADDITIVE ALTERNATE
NO. 1
BASE BID
PROPOSED
DEPRESSED GROIN
Only 400 lf
constructed
TIE INTO EXISTING DEPRESSED GROIN
APPROX. RIVER
BANK LOCATION
TIE INTO EXISTING
DIKE AT UPSTREAM
END OF GROIN 1
TOP OF NEW DIKE
EL. 184.0
PROPOSED
SUPPRESSED
GROIN (OPTION 1)
TIE INTO
OPTION 1 GROIN
AT EL. 187.5
TOP BACK OF RIPRAP
GROIN 1
DIKE (OPTION 2)
TREES
TOP OF
BANK
RIPRAP
RECENTLY
PLACED
RIPRAP
= 1991
CONSTRUCTION
PLAN
LOWE RIVER

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
P.O. BOX 898
ANCHORAGE, ALASKA 99506-0898

REPLY TO ATTENTION OF:

JULY 28 1995

RECEIVED
AUG 02 1995
CITY OF VALDEZ

Regulatory Branch
Project Evaluation Section - South
P-850414

Ms. Charlotte Burrill
City of Valdez
Post Office Box 307
Valdez, Alaska 99686

Dear Ms. Burrill:

Enclosed is the signed Department of the Army permit, file number P-850414, Lowe River 18, authorizing the extension of a groin and dike structure near Valdez, Alaska. Also enclosed is a Notice of Authorization which should be posted in a prominent location near the authorized work.

If changes in the location or plans of the work are necessary for any reason, plans should be submitted to this office promptly. If the changes are unobjectionable, the approval required by law before construction is begun will be issued without delay.

Nothing in this letter shall be construed as excusing you from compliance with other Federal, State, or local statutes, ordinances, or regulations which may affect the proposed work.

In an effort to determine the level of customer satisfaction with the processing of Department of the Army permit applications, the Corps of Engineers, Regulatory Branch asks that you take a few moments to provide us with any constructive comments you feel are appropriate by filling out the enclosed questionnaire. Our interest is to see if we need to improve our service to you, our customer, and how best to achieve these improvements. Additional comments may be provided through the use of an oral exit interview, which is available to you upon request. Your efforts and interest in evaluating the regulatory program are much appreciated.

Please contact me at 1-907-753-2724, toll free in Alaska at 1-800-478-2712, or by mail at the address above, if you have questions.

Sincerely,

Johnny J. Duplantis
Project Manager, East Unit
Project Evaluation Section - South

Enclosures

DEPARTMENT OF THE ARMY PERMIT

Permittee City of Valdez

Permit No. P-850414 (MODIFICATION)

Issuing Office U.S. Army Engineer District, Alaska

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description:

Dishcharge approximately 2,800 cubic yards (cy) of riprap to construct a 625' depressed groin and dike structure. Approximately 1,800 cy of spoiled material will be excavated and used to construct an embankment.

All work will be performed in accordance with the attached plans, sheets 1-2, dated March 15, 1995.

Project Location:

Lowe River floodplain south of Alpine Woods Estates Subdivision located at mile post, Richardson Highway, T. 9 S., R. 4 W., section 30, Copper River Meridian, Valdez, Alaska.

Permit Conditions:

General Conditions:

1. The time limit for completing the work authorized ends on May 31, 1998. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

Tom Wilson, Acting Manager — 7/24/95

(PERMITTEE) *(DATE)*

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

28 Jul 95

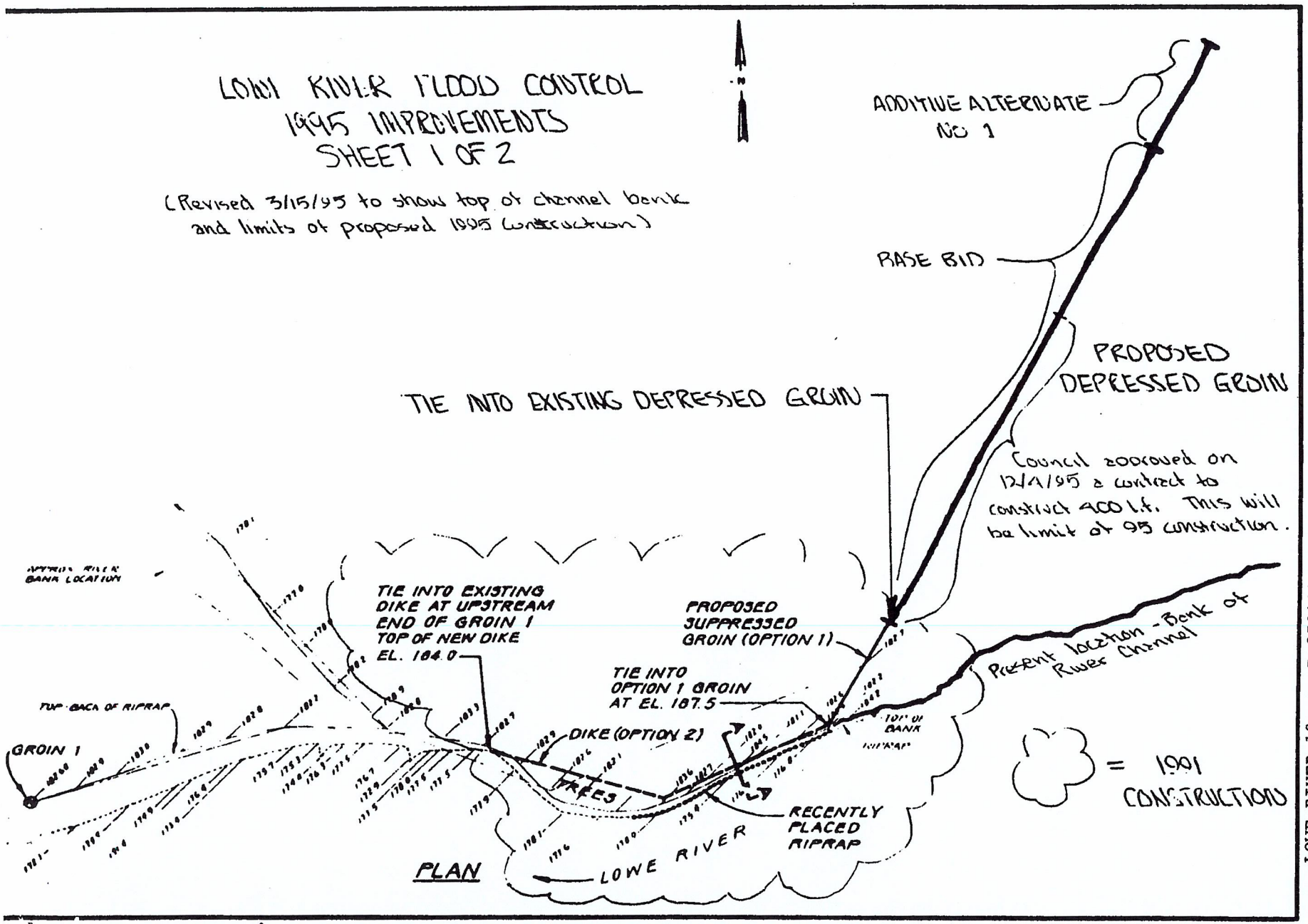
(DISTRICT ENGINEER) Colonel Peter A. Topp
Johnny Duplantis, Project Manager
Project Evaluation Section - South
Regulatory Branch

(DATE)

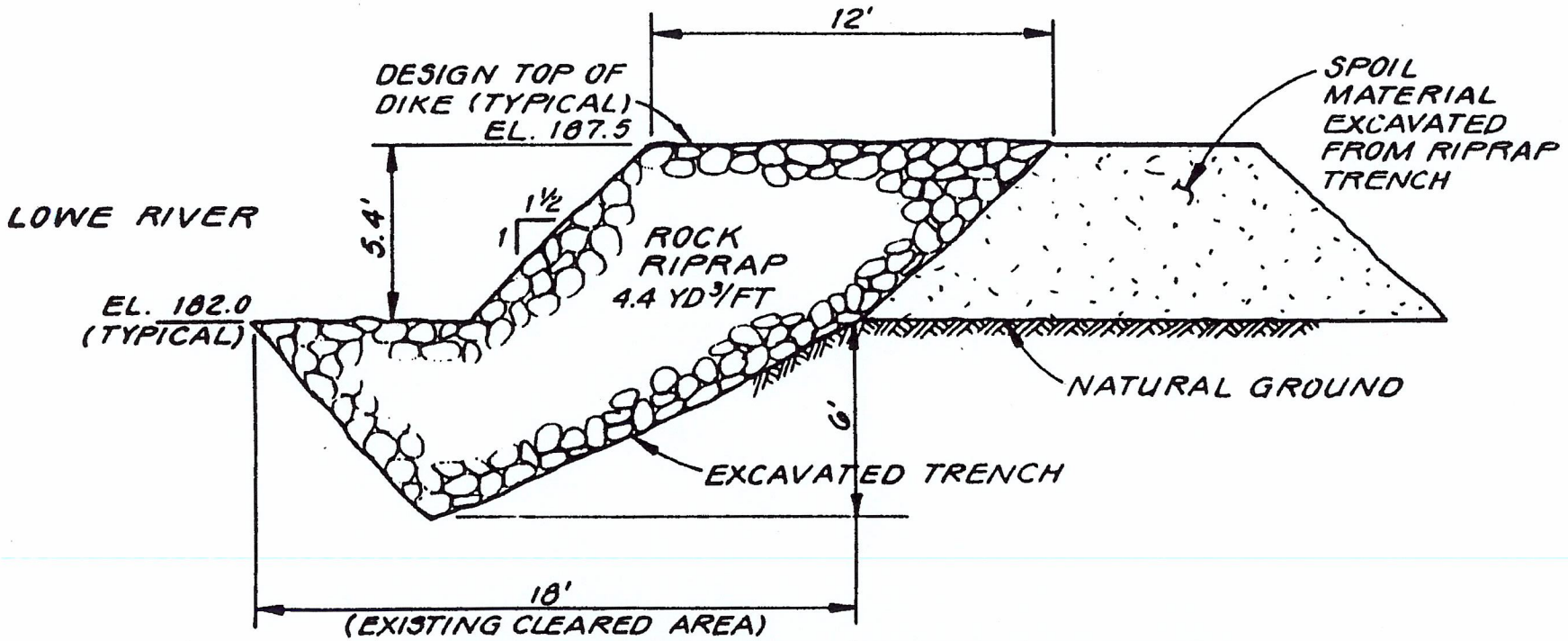
When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE) *(DATE)*

☆U.S. GOVERNMENT PRINTING OFFICE: 1986 — 717-425


LOWE RIVER FLOOD CONTROL
1995 IMPROVEMENTS
SHEET 1 OF 2
(Revised 3/15/95 to show top of channel bank and limits of proposed 1995 construction)
ADDITIVE ALTERNATE NO 1
BASE BID
PROPOSED DEPRESSED GROIN
TIE INTO EXISTING DEPRESSED GROIN
Council approved on 12/1/95 a contract to construct 900 L.f. This will be limit of 95 construction.
TIE INTO EXISTING DIKE AT UPSTREAM END OF GROIN 1 TOP OF NEW DIKE EL. 184.0
PROPOSED SUPPRESSED GROIN (OPTION 1)
TIE INTO OPTION 1 GROIN AT EL. 187.5
Present location - Bank of River Channel
TOP OF BANK RIPRAP
TOP BACK OF RIPRAP
GROIN 1
DIKE (OPTION 2)
TREES
RECENTLY PLACED RIPRAP
LOWE RIVER
PLAN
= 1991 CONSTRUCTION
LOWE RIVER 18 P-850414

LOWE RIVER FLOOD CONTROL
1995 IMPROVEMENTS
SHEET 2 OF 2



DEPRESSED GROIN TYPICAL SECTION
SCALE: 1"=5'

LOWE RIVER 18 P-850414

Figure A1
OPTION 1
DEPRESSED GROIN TYPICAL SECTION
CITY OF VALDEZ
LOWE RIVER STABILIZATION / RELOCATION STUDY

CH2MHILL

40.2.1e

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
P.O. BOX 898
ANCHORAGE, ALASKA 99506-0898

FEB 26 1996

RECEIVED
FEB 29 1996
CITY OF VALDEZ

Original to Clerks office 2/29/96 CB

REPLY TO ATTENTION OF:
Regulatory Branch
East Section
Q-850414

Ms. Charlotte Burrill
City of Valdez
Post Office Box 307
Valdez, Alaska 99686

Dear: Ms. Burrill:

Enclosed is a signed Department of the Army (DA) after the fact permit Q-850414, Lowe River 18, authorizing the extension of a groin and dike structure near Valdez, Alaska. Also is a Notice of Authorization which should be posted in a prominent location near the authorized work.

This permit modification resolves the violation. Our records indicate the City of Valdez did not contact this office during the emergency construction of the dike in September 1995. You must promptly contact us by telephone in the future should a similar flooding situation occur requiring work in waters of the U.S., including wetlands. We have expedited procedures for agency coordination and permitting under appropriate emergency conditions.

At this time we would also like to address the piecemeal way flood protection work at this location has been reviewed for DA permitting over the years, including numerous modifications and a previous after-the-fact permit. In your letter dated April 12, 1995, to this office in response to agency concerns for your proposed project to extend a groin and dike last year, you indicated additional flood control structures are planned as funding becomes available. We request you consolidate your plans in this regard and either request a jurisdictional determination or submit an application showing all proposed work along the Lowe River at this location so that a comprehensive review can be made for the project in its entirety. Hopefully, that would allow a review of your proposal that minimizes unnecessary adverse effects on the aquatic resource.

Nothing in this letter shall be construed as excusing you from compliance with other Federal, State, or local statutes, ordinances, or regulations which may affect this work.

In an effort to determine the level of customer satisfaction with the processing of Department of the Army permit applications, the Corps of Engineers, Regulatory Branch asks that you take a few moments to provide us with any constructive comments you may feel are appropriate by filling out the enclosed questionnaire. Our interest is to see if we need to improve our service to you, our customer, and how best to achieve these improvements. Additional comments may be provided though the used of an oral exit interview, which is available to you upon request. Your efforts and interest in evaluating the regulatory program are much appreciated.

Please contact Mr. Clyde Madrey at (907) 753-2724, toll free in Alaska at (800) 478-2712 or at the letterhead address, if you have questions.

Sincerely,

Clyde Madrey
Regulatory Specialist

Enclosure

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
P.O. BOX 898
ANCHORAGE, ALASKA 99506-0898

REPLY TO
ATTENTION OF:

Regulatory Branch
East Section

PERMITTEE: City of Valdez

EFFECTIVE DATE: FEB 28 1996

EXPIRATION DATE: MAY 31 1998

REFERENCE NO.: Q-850414 (Modification)

DEPARTMENT OF THE ARMY
AFTER THE FACT PERMIT MODIFICATION

Department of the Army permit number 4-950414, Lowe River 18, was issued to the City Of Valdez on August 9, 1985, to:

> "place approximately 5,000 cubic yards (cy) of gravel and 2,400 cy of riprap to construct a 500' long diversion dike, remove approximately 1,600 cy of gravel bar material to construct a 450-foot-long diversion channel in the Lowe River, and stockpile 50 to 75 cy of riprap at the site to replace rock eroded away from the toe of the diversion dike, approximately 1,000' south of Whispering Spruce Drive and Aspen Way intersection, Alpine Woods Estates Subdivision, in Valdez, Alaska."

The permit was modified (M-850414) on May 13, 1986, to:

> "retain a 300' extension to the existing diversion dike, place approximately 4,200 cubic yards (cy) of rock riprap and 7,300' cy of adjacent gravel bar material and construct a 700' long diversion dike east of the existing dike; place approximately 1,600 cy of gravel and 3,000 cy of rock riprap along a 1,100' area for bank protection upstream of the new diversion dike; and place 1,100 cy of gravel bar material and 750 cy of quarry waste along a 450' area to provide bank protection downstream of the existing diversion dike, to provide flood protection."

The permit was modified (N-850414) on August 8, 1988, to:

> "discharge approximately 1,500 cubic yards (cy) of shot rock and armor rock below the ordinary high water mark of Lowe River 18 to construct your channel control groins. The footprint dimensions of each groin would measure approximately 60-70' in length and 10-12' in width."

The permit was modified (O-850414) on May 6, 1991, to:

> "place additional riprap along a 200' section of shoreline, construct a 425' long dike, and a 150' long depressed groin/dike. Approximately 400' cubic yards (cy) of riprap will be placed along a 200' section of shoreline to reinforce existing riprap. Approximately 780 cy of quarry reject material and 30 cy of riprap will be used to construct a 425' long dike located between the existing dike and the proposed depressed groin/dike. To construct the 150' long depressed groin/dike, approximately 360 cy of riprap will be placed in the trench to construct the depressed groin. The purpose of the project is to improve flood control protection for the Alpine Woods Subdivision."

A subsequent modification (P-850414) issued July 28, 1995, authorized:

> "the discharge of approximately 2,800 cubic yards (cy) of riprap to construct a 625' depressed groin and dike structure. Approximately 1,800 cy of spoiled material will be excavated and used to construct an embankment."

Pursuant to your request dated November 27, 1995, the permit is hereby modified as follows:

> "to place approximately 7,600 cubic yards (cy) of fill material, and 3,200 cy of class III riprap to construct 700' long diversion dike (groin) to protect homes in the Alpine Woods Estates Subdivision, in Valdez, Alaska."

The following special condition has been added to the permit and applies to the work authorized by this modification:

"That all inwater work shall occur during the period of May 15, through July 15."

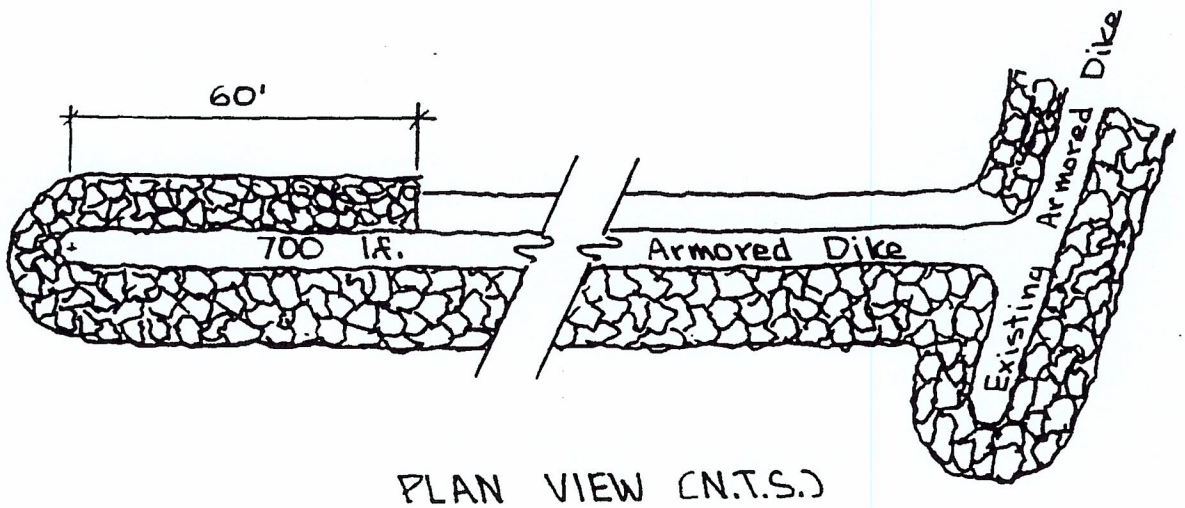
The time limit for completing the work authorized ends on 31 May 1998. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

This authorization and the enclosed plans in sheets 1 and 2 will now become part of the permit. All other terms and conditions of the original permit and subsequent modifications, except for the time limit, remain in full force and effect. This authorization and the enclosed modified plans should be attached to the original permit. Also enclosed is a Notice of Authorization which should be posted in a prominent location near the authorized work.

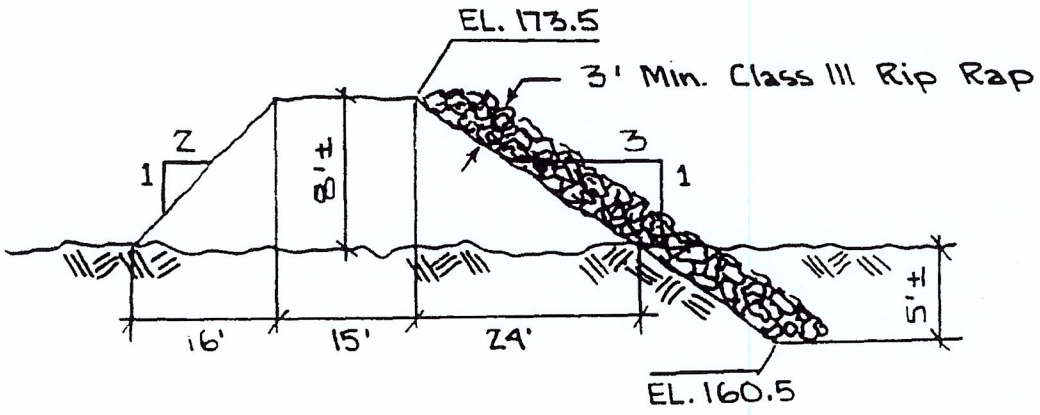
BY AUTHORITY OF THE SECRETARY OF THE ARMY:

Randy Steen
Unit Coordinator

Enclosures

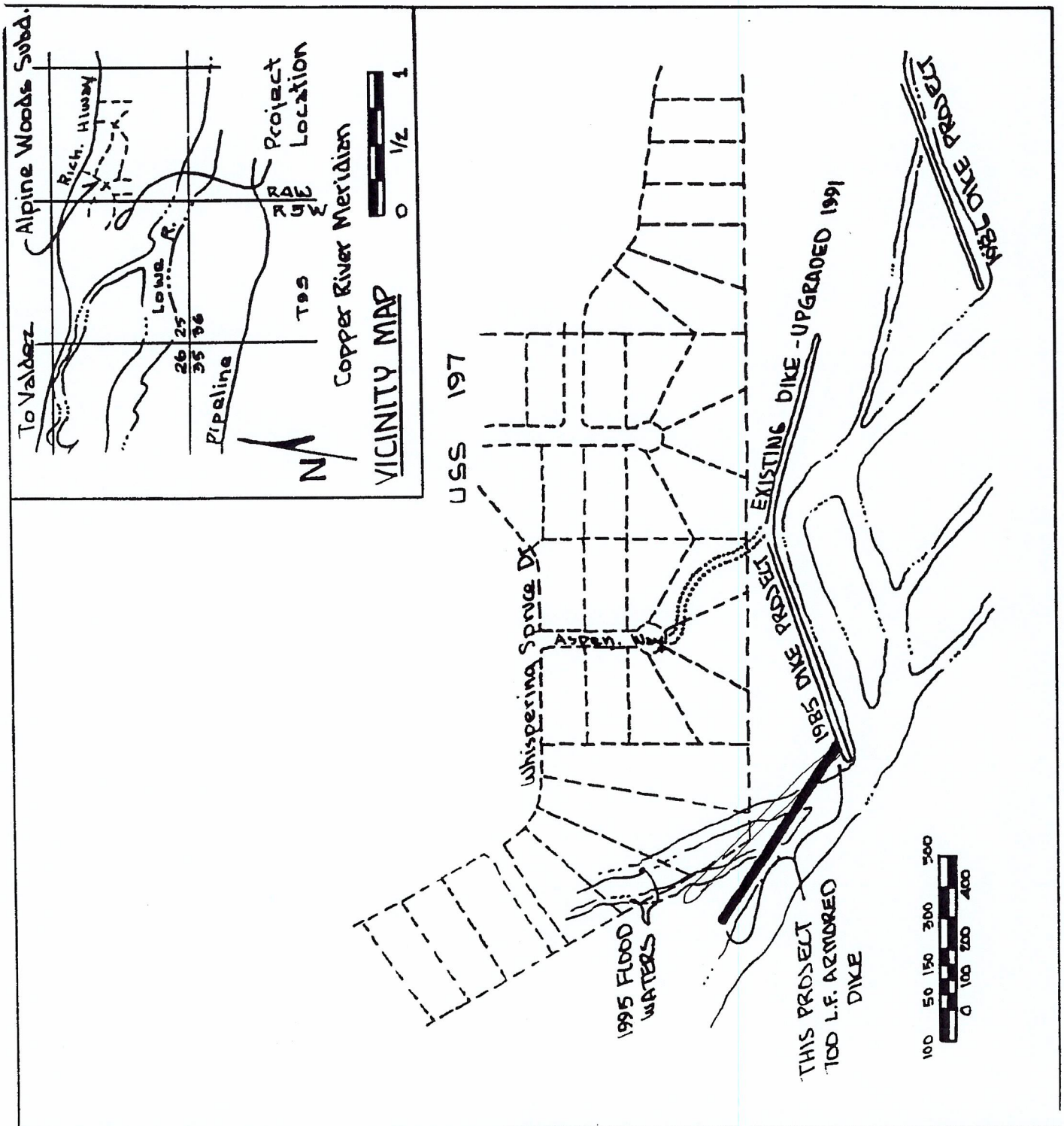


PLAN VIEW (N.T.S.)



TYPICAL SECTION (N.T.S.)

Armored Diversion Dike (Groin)	Details	In: Lowe River Drainage System
	City of Valdez Alpine Woods / Lowe River Flood Control	At: Valdez, Alaska
Purpose: Protect existing structures and private property	Sheet 2 of 2 November 25, 1995	Application by: City of Valdez



Armored Diversion Dike (Groin)	Site Plan	In: Lowe River Drainage System
Purpose: Protect existing structures and private property	City of Valdez Alpine Woods / Lowe River Flood Control	At: Valdez, Alaska
	Sheet 1 of 2 November 25, 1995	Application by: City of Valdez

V

Expires December 31, 1993

FEDERAL EMERGENCY MANAGEMENT AGENCY DAMAGE SURVEY REPORT - DATA SHEET	1. DECLARATION NO. FEMA 1072 -DR-	2. DSR NO. 36443	SUFF TO DSR NO.

PART I - PROJECT DESCRIPTION

APPLICANT NAME/COUNTY City of Valdez		3. PA IDENTIFICATION NO. 261-82200
10. PROJECT TITLE Repair Dikes	4. INSPECTION DATE 10-17-95	5. PROJECT NO. 399
11. DAMAGED FACILITY Dikes along Lowe River	6. % COMPLETE 0	7. WORK ACCOM BY F C (EC)
12. FACILITY LOCATION North Bank of Lowe River off of Nordic Ave	8. FINAL DSR YES ☐	9. CATEGORY C

13. DAMAGE DIMENSIONS/DESCRIPTION/SCOPE OF ELIGIBLE WORK

DIMENSIONS:

DESC/SCOPE: Flooding in the Lowe River damaged Two sections of Riprap on the right bank. Replace a 120' portion of eroded dike prior to replacing riprap and excavating 4'x 250' of gravel debris deposited by the flood so that the riprap can be replaced.

14. INSP NO. 0169	15. NAME OF FEDERAL INSPECTOR (Print) Richard Lantz	16. AGENCY CODE Fema	RECOMMENDATION (Y) N	ATTACHMENTS
18. INSP NO.	NAME OF STATE INSPECTOR (Print)	AGENCY CODE	RECOMMENDATION Y N	ATTACHMENTS
19. NAME OF LOCAL REPRESENTATIVE (Print)			CONCUR Y N	ATTACHMENTS

PART II - ESTIMATED COST OF PROPOSED WORK

ITEM	CODE	MATERIAL AND/OR DESCRIPTION (a)	UNIT OF MEAS (b)	QUANTITY (c)	UNIT PRICE (d)	COST (e)
1	3250	Slope Protection, Riprap	C.Y.	330	110.00	36,300
2	4020	Fill, unclassified	C.Y.	240	8.50	6,190
3	6110	Debris, Channel Exc	C.Y	300	4.50	1,350
4						
5						
6						
7						
8						

20. EXISTING INSURANCE TYPE – F: $ G: $

21. TOTAL $ 43,940

PART III - FLOODPLAIN MANAGEMENT/HAZARD MITIGATION REVIEW

22. IN OR AFFECTS FLOODPLAIN OR WETLAND	23. FLOODPLAIN LOC	24. % DAMAGE	25. DISASTER HISTORY	26. LAND USE	27. FPM REC
(F) W N	1 2 (3) 4 5	(1) 2 3 4	Y N (U)	(U) 2 3 4 - (U) 2 3 4	1 (2) 3 4 (5) 6 7

PART IV - FOR FEMA USE ONLY

28. AMOUNT ELIG $	29. ELIGIBLE (Y) N S V	30. SPECIAL CONSIDERATIONS	31. FLOODPLAIN REVIEW NO.	32. WORKSITE NO.

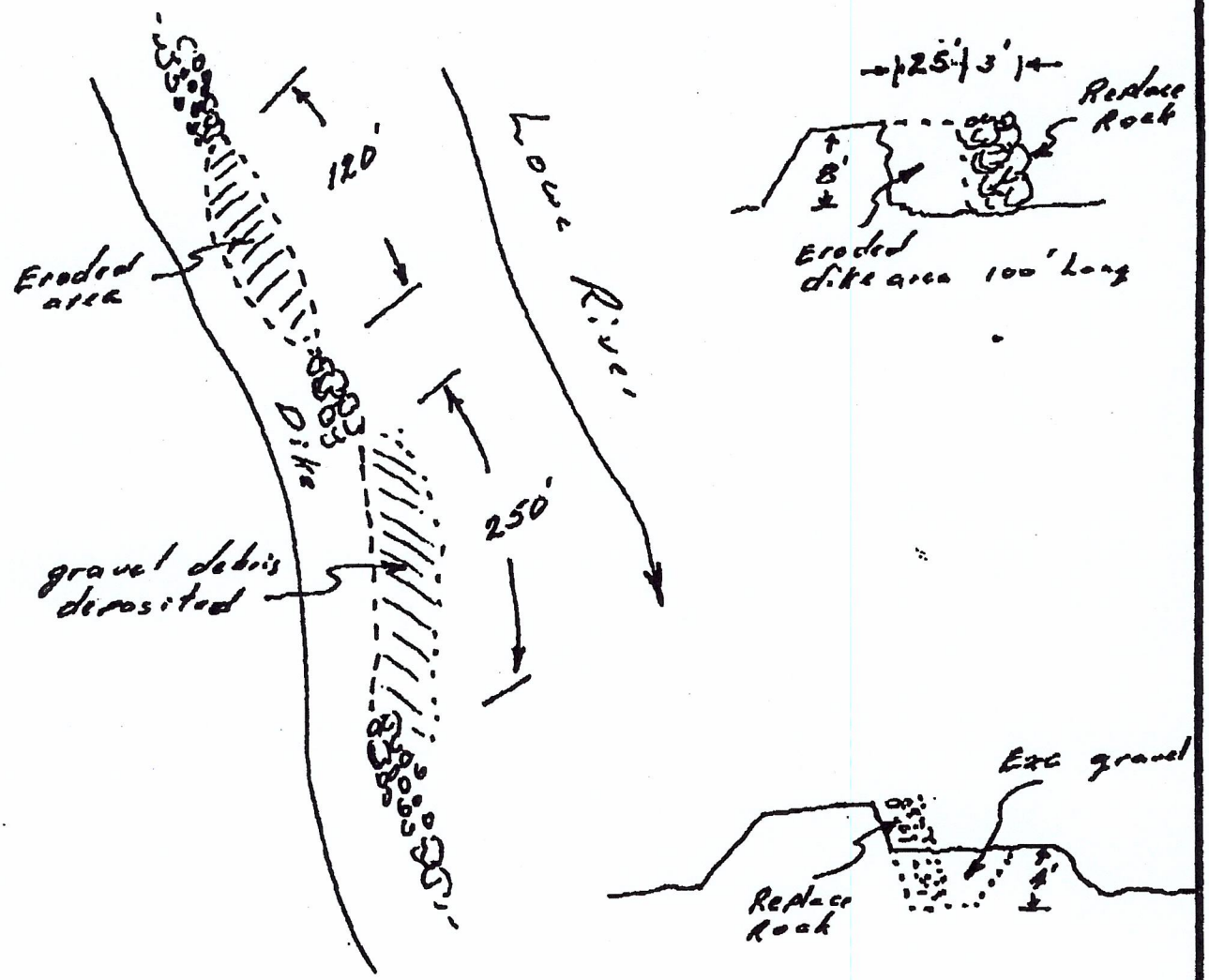
33. INSURANCE COMMITMENT REQUIRED		34. DURATION (Years)	
F - Building: $ Contents: $	G - Property: $ Contents: $	F - B: C:	G - P: C:

35. COMMENTS/CHANGES

FIRST REVIEW (Signature)	DATE	SECOND REVIEW (Signature)	DATE
		DRF	

FEMA Form 90-91, FEB 91 REPLACES ALL PREVIOUS EDITIONS *U.S.GPO:1992—625-882

DAMAGE SURVEY CONTINUATION SHEET			
Applicant: City of Valdez	DSR No. 36443	Category C	Sheet 3 of __
Photos, Sketches and/or Narrative			



Riprap 120' Long x 8' high x 3' deep ÷ 27 = 107 cy

250' x 8' x 3' ÷ 27 = 222 cy

330 cy.

Gravel Backfill 100' x 25' x 8' ÷ 27 = 740 cy

channel Exc 250 x 8' x 4 ÷ 27 = 300 cy

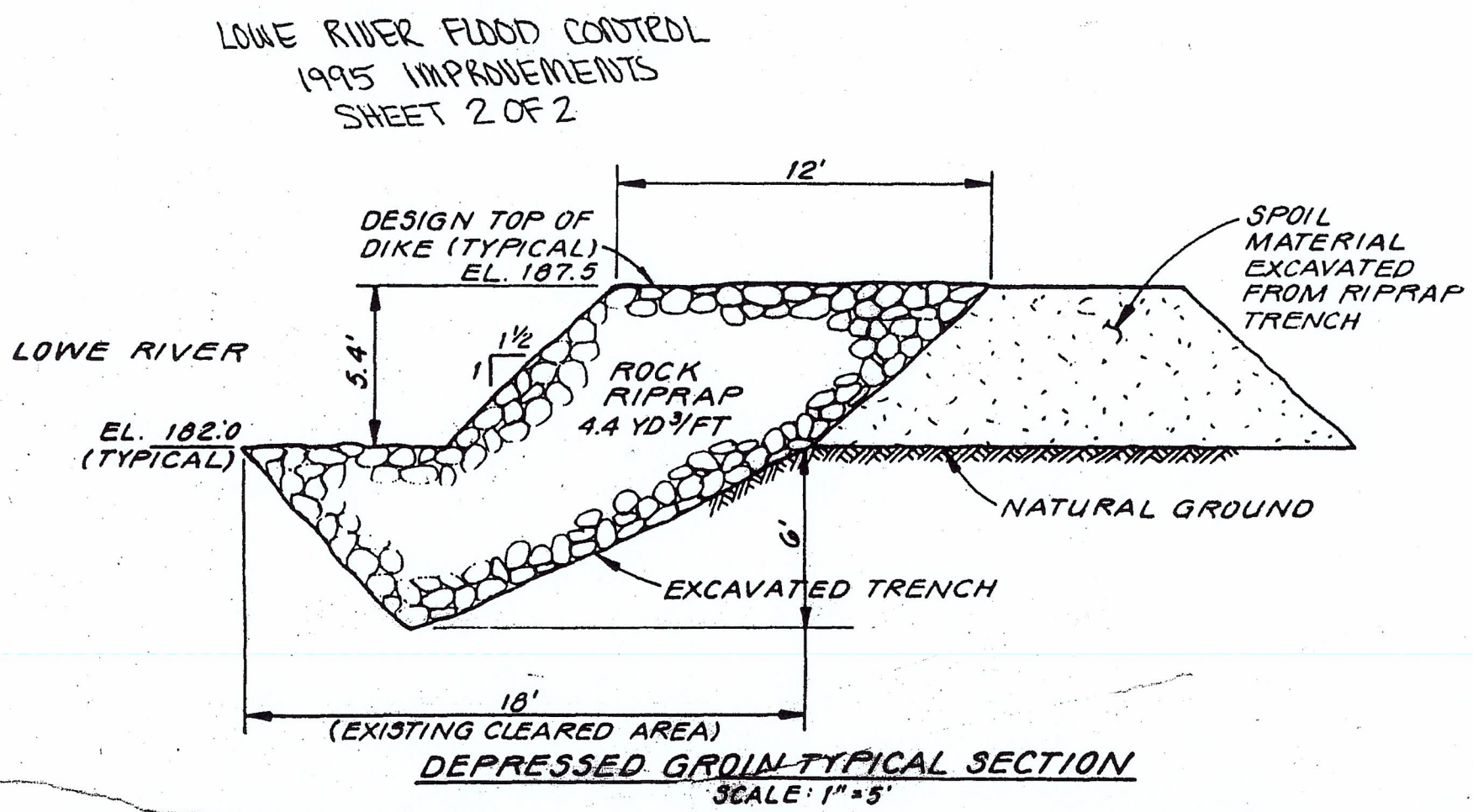


Figure A1

OPTION 1

DEPRESSED GROIN TYPICAL SECTION

CITY OF VALDEZ

LOWE RIVER STABILIZATION / RELOCATION STUDY

CH2MHILL

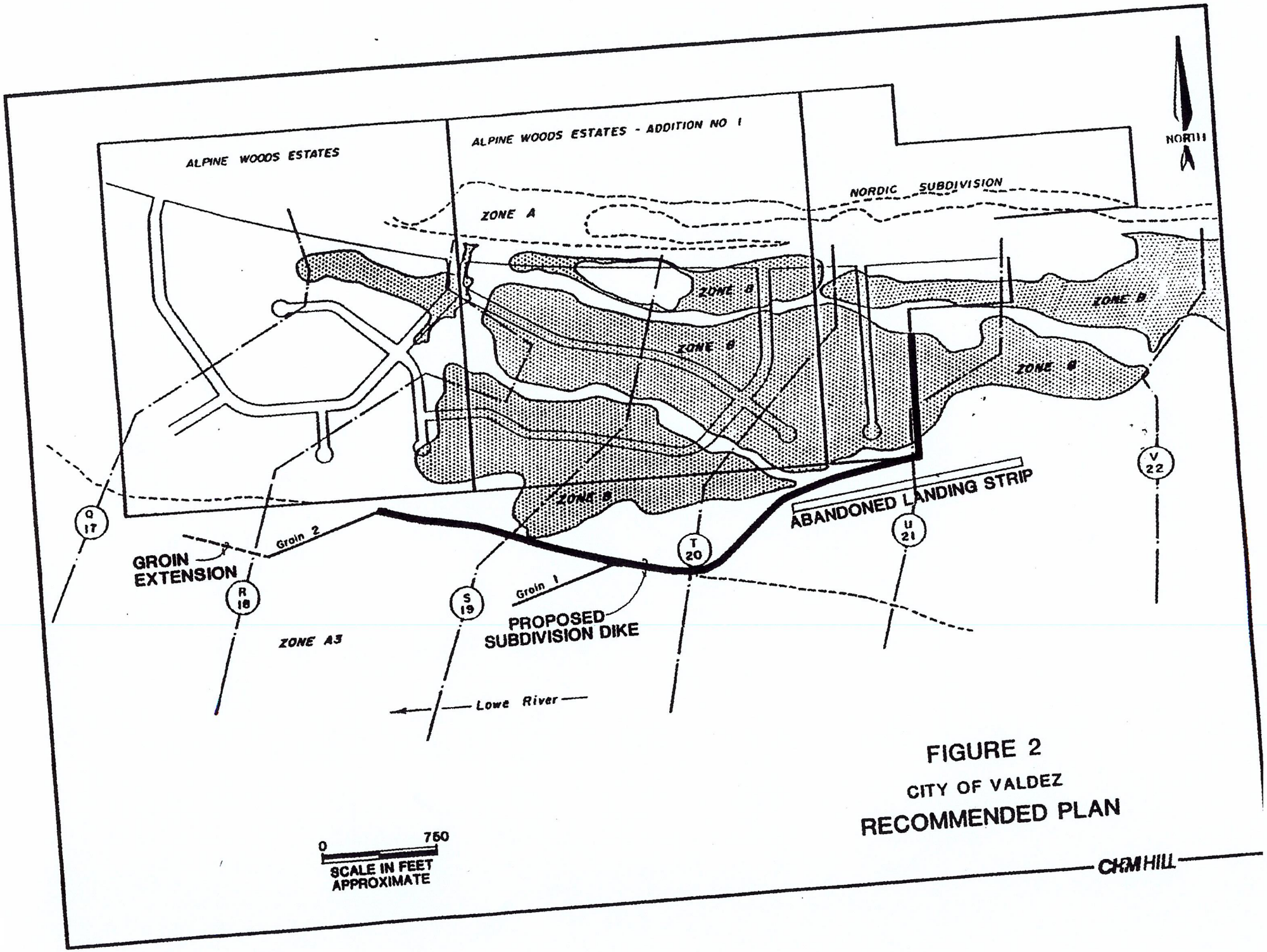
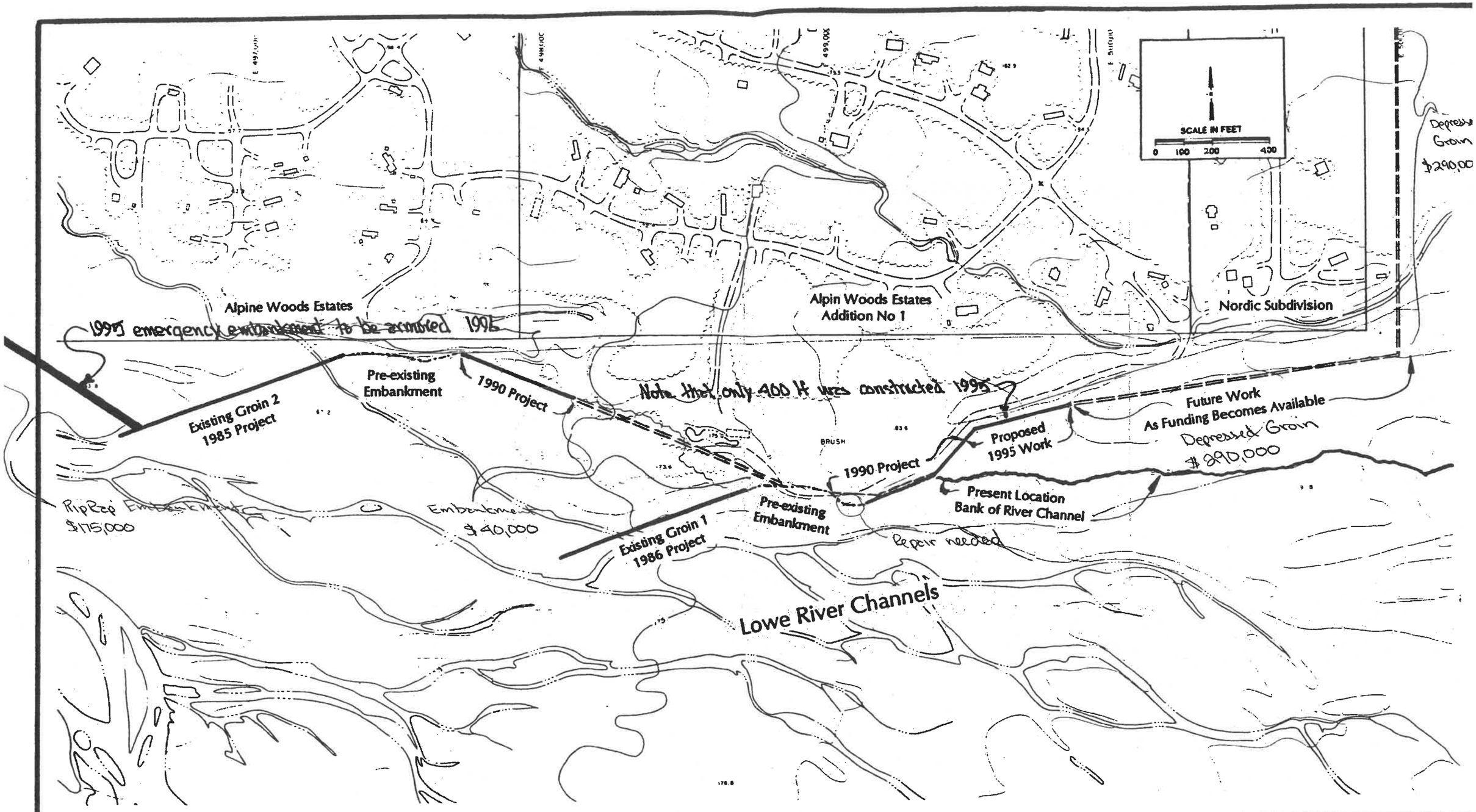


FIGURE 2

CITY OF VALDEZ

RECOMMENDED PLAN



Total: 175,000
40,000
290,000
505,000
290,000

Lowe River Flood Control Improvements

Plan View of Project Vicinity
Prepared for Submission to Regulatory Agencies for Permitting Purposes

Hydrology and Hydraulic Analysis of the Lowe River near the Alpine and Nordic Subdivisions, Valdez, Alaska

Final Report

A Report Prepared For:

Tryck Nyman Hayes, Inc.
911 W. 8th Avenue, Suite 300
Anchorage, AK 99501

and

The City of Valdez
Valdez, AK 99686

March 2008

Prepared By:
Kenneth F. Karle, P.E.
Hydraulic Mapping and Modeling
PO Box 181
Denali Park, AK 99755

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Introduction

Within the past 30 years, the City of Valdez has obtained several flood evaluations of the Lowe River, including the Alpine and Nordic subdivisions (Figure 1). These subdivisions are in a 'flood hazard high velocity zone (FIRM Zone A), and are protected from the river by a series of groins along the right bank. In October 2006, an ADOT&PF dike near Mile 12 of the Richardson Highway failed during a high water event. This breech allowed flood water to flow downstream outside of the Lowe River banks, eventually entering and flooding sections of the Alpine and Nordic subdivisions.

The City groins along the river were reported to have functioned well during the flood event, and there were no reports of flooding from the main channel of the river at that location. However, this event has resulted in renewed interest by the City of Valdez and local residents in obtaining designs and recommendations for flood management at several areas in and near Valdez. This report describes the hydrologic and hydraulic analysis of the Lowe River in the vicinity of the Alpine and Nordic subdivisions.

A number of reports that describe previous studies and surveys of the Lowe River and the flooding issues at the Alpine and Nordic subdivision have been prepared over the past 30 years. Many of these documents were reviewed as part of this project. A partial list of pertinent documents is found in the Bibliography.

Assumptions For Hydrologic Analysis

It is important to note that hydrologic studies are based to a large extent on methods in statistics and probability. Though methods are improving, the long-term forecast of streamflows and river behavior cannot be predicted with much certainty. Additionally, the use of mathematical equations to simulate and predict real events and processes is a difficult process. Unforeseen events, natural or human-caused, can alter the outcome of a modeled prediction.

The Lowe River is a dynamic river; watershed characteristics such as glaciers, large precipitation events, and high sediment loads all combine to make the task of flood analysis very difficult. Of special note is the fact that many areas of Alpine and Nordic subdivisions are at elevations lower than the thalweg of the adjacent main channel. The proper use of the hydrologic analysis in this report will involve developing solutions for a range of flood elevations and magnitudes, rather than focusing on a single result.

Planning for additional flood protection should consider risks that fall outside of the traditional 100-year flood study but may lead to flooding within the subdivisions. Risks could include sediment deposition in the adjacent channel, unexpected upstream dike failure, culvert blockage, severe channel migration, and others. Recurrence intervals for such events could be difficult to assign, leading to a qualitative assessment rather than a quantitative or probabilistic solution.

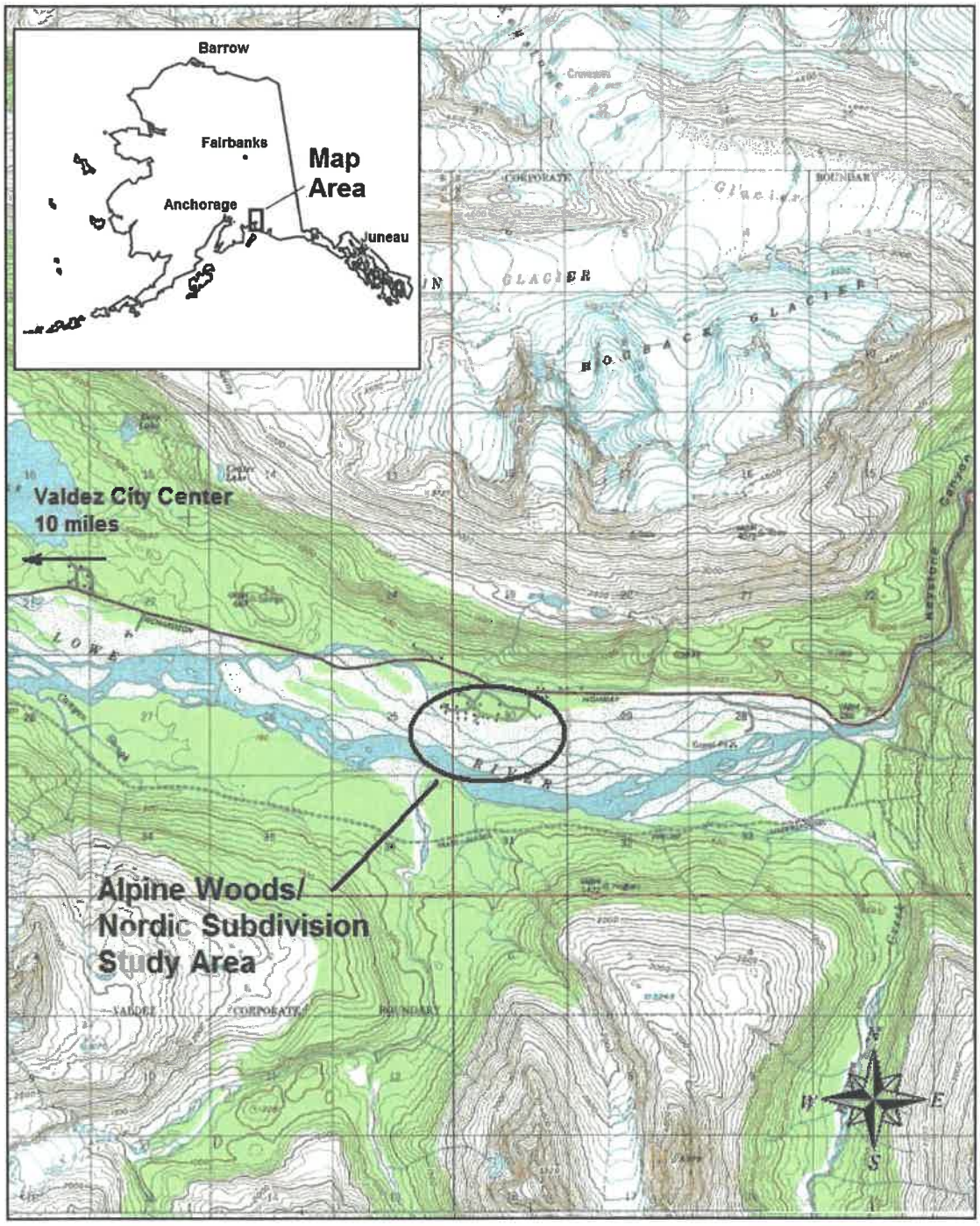

Figure 1. Project location map for Lowe River near Valdez, Alaska.

Hydraulic History

Typical of most of Alaska, little information is available concerning historical floods on the Lowe River. An inactive USGS gaging station (15226600) with a drainage area of 222 square miles is located on the Lowe River in Keystone Canyon, approximately 6 miles upstream from the project site at the Alpine Subdivision (drainage area 328.5 square miles). Six years of peak flow data are available for that site, including two historical floods (isolated high-magnitude peaks that occurred outside the period of systematic data collection).

In addition to a 1995 peak flood of 18,700 cfs, the USGS estimated a maximum peak flow of 42,000 cfs during the October 2006 flooding event. The magnitude of the flood peak was determined by surveying cross-sections through the channel and floodplain immediately following the flood event, noting the high water elevations, and using the slope-area method to determine discharge (David Meyer, USGS, personal communication). The USGS has labeled that event as having a recurrence interval of greater than 100 years.

Hydrology

Since the available peak flow record is so short as to be below the minimum necessary to develop flood estimations based on probability analysis alone, the following methods were used. First, flood magnitude estimations were developed using USGS regression equations for estimating the magnitude of peak streamflows in Alaska, using methods described in Curran et al. (2003). Then a statistical flood-frequency analysis of the annual-maximum peak flows was developed using a log-Pearson Type III probability distribution and the USGS Bulletin 17B methods (USGS, 2006). Using results from the first two methods, a third estimate of weighted values was developed, where weights are based on the years of observed data at the station and the average equivalent years of record for the regional regression equations. Finally, the weighted estimate was adjusted for the larger drainage area at the downstream project site (Curran et al., 2003). Details are found in Appendix 1.

The estimated flood frequency magnitudes for the Q2 through Q500 floods for both sites are shown in Table 1 and Figure 2.

Table 1. Flood magnitudes for Q2 through Q500 flood, Lowe River at project site.

Exceedance Probability (%)	Recurrence Interval (Years)	Discharge (cfs)	
		Lowe River at Keystone Canyon Gaging Station	Lowe River at Alpine Subdivision
50	2	10200	12300
20	5	13200	17000
10	10	15400	20400
4	25	18700	24800
2	50	21300	28300
1	100	24000	31900
0.2	500	31300	40800

It should be noted that these estimated flood magnitude values are somewhat smaller than those used for the Alpine Woods Estates Flood Evaluation conducted in 1983 (WCC, 1983). In that report, the flood values used were derived from a study to review the 1980 Valdez FEMA flood insurance study. For the Lowe River at the confluence with Port Valdez, with a drainage area of 350 square miles, the estimated flood magnitudes were: Q10-31,100 cfs, Q50-46,300 cfs, Q100-54,900 cfs, and Q500-77,500 cfs. These values were calculated for a slightly larger watershed, using regression equations. Additionally, a regression equation was used to estimate the magnitude of glacier dammed-lake releases, based on lake volume. The lake volume data collected for that study were obtained in the late 1970s and have not been updated.

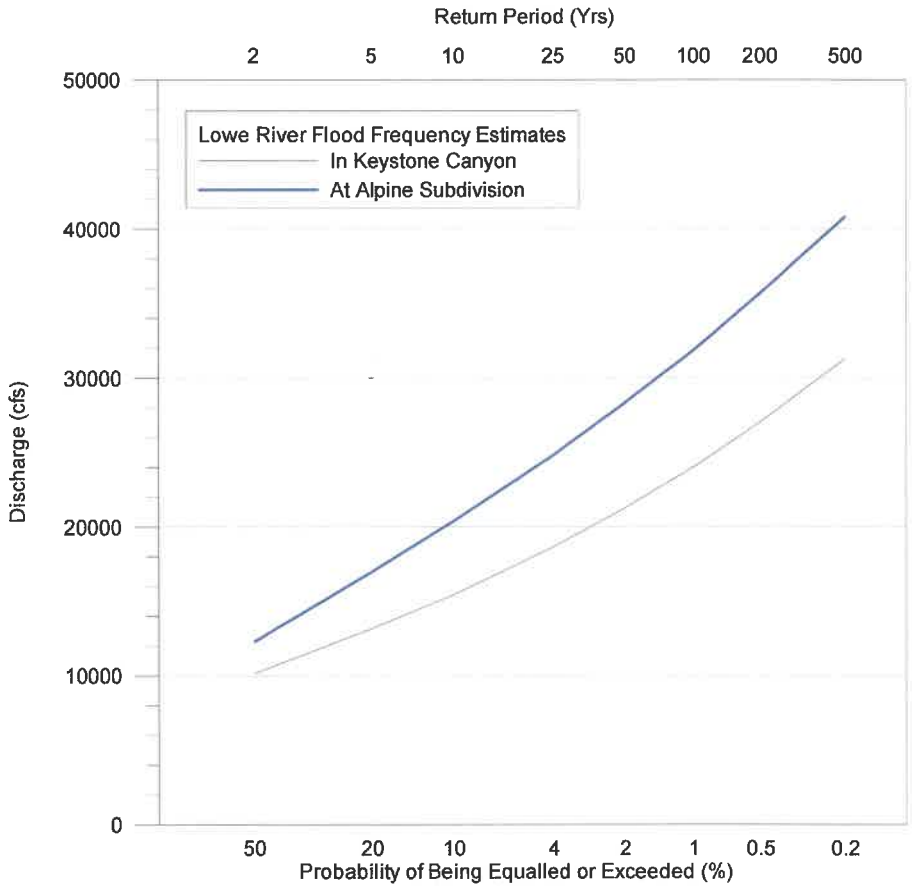

Figure 2. Estimated discharge and exceedance probability for Lowe River.

Hydraulic Modeling

Overview

The hydraulic analysis for the Lowe River at Alpine Subdivision project site consisted of modeling the flow characteristics using the U.S. Army Corps of Engineers Hydrologic Engineering Center water surface profiling computer program HEC-RAS version 3.1.3 for the existing conditions, including the two City of Valdez groins and a newer temporary dike

installed immediately following the October 2006 flood event. The basic computational procedure for the HEC-RAS program is based on the solution of the one-dimensional energy equation. Energy losses are evaluated by friction (Manning's equation) and contraction/expansion. The momentum equation is utilized in situations where the water surface profile is rapidly varied, such as at bridges (USACE, 1998).

Numeric models of study sites are created using stream geometric data. Once the models are constructed and calibrated, estimations of channel velocities and stage are calculated for each cross-section for a range of discharges. The hydraulic analysis is used to develop a map showing flooding extents for the 1-percent-annual-chance (100-year) event. However, regulatory agencies often will require determinations of the 10-percent-annual-chance (10-year), 2-percent-annual-chance (50-year), and 0.2-percent-annual-chance (500-year) flood discharges as well.

Calibration

The cross-section conditions present at a typical braided river site present many unique computational problems for numerical modeling efforts. At low and intermediate flows, the occurrence of flowing water in any of the many channels spaced across the wide braided drainage course appears often as a randomized process. In fact, channels with a higher thalweg elevation may contain significant flow while lower channels on the same section are often dry. Such an effect has been noted by local residents familiar with flow conditions on the Lowe River.

Such conditions cannot be replicated in a numerical model, where hydraulic calculations assume flowing water initiates at the lowest point in a cross-section. This results in a situation where a numerical model cannot be properly calibrated at low flow, even using observed discharges and water surface elevations in numerous channels across the section. The use of hydraulic models for braided rivers is significantly improved for high flood flows, where high water conditions inundate the smaller channels and the mass of flow is essentially contained in one or two major channels. The HEC-RAS program is widely used and accepted in particular for floodplain management and flood insurance studies to evaluate floodway encroachments. However, results from such modeling efforts should be used in conjunction with on-the-ground observations from persons familiar with the river.

A numerical model of the Lowe River at the project site was constructed in HEC-RAS. Nine major cross-sections, labeled 1.0 through 9.0, were surveyed in November 2007; the survey was refined with additional points in December 2007. Techniques were employed to increase the functional stability of the hydraulic analysis process; this is accomplished by increasing the number of cross-sections in the model by interpolating new cross-sections between the surveyed cross-sections. Within the model, some cross-sections were adjusted to insure perpendicularity to the flow. Cross-section locations are found in Figure 3, and Alaska State Plane coordinates (Northing, Easting) for the major cross-section endpoints are found in Appendix 4. The elevation benchmark for the cross-section survey is USC&GS benchmark number E11C964, which was also used for the development of the FEMA FIRM map. See Appendix 5.

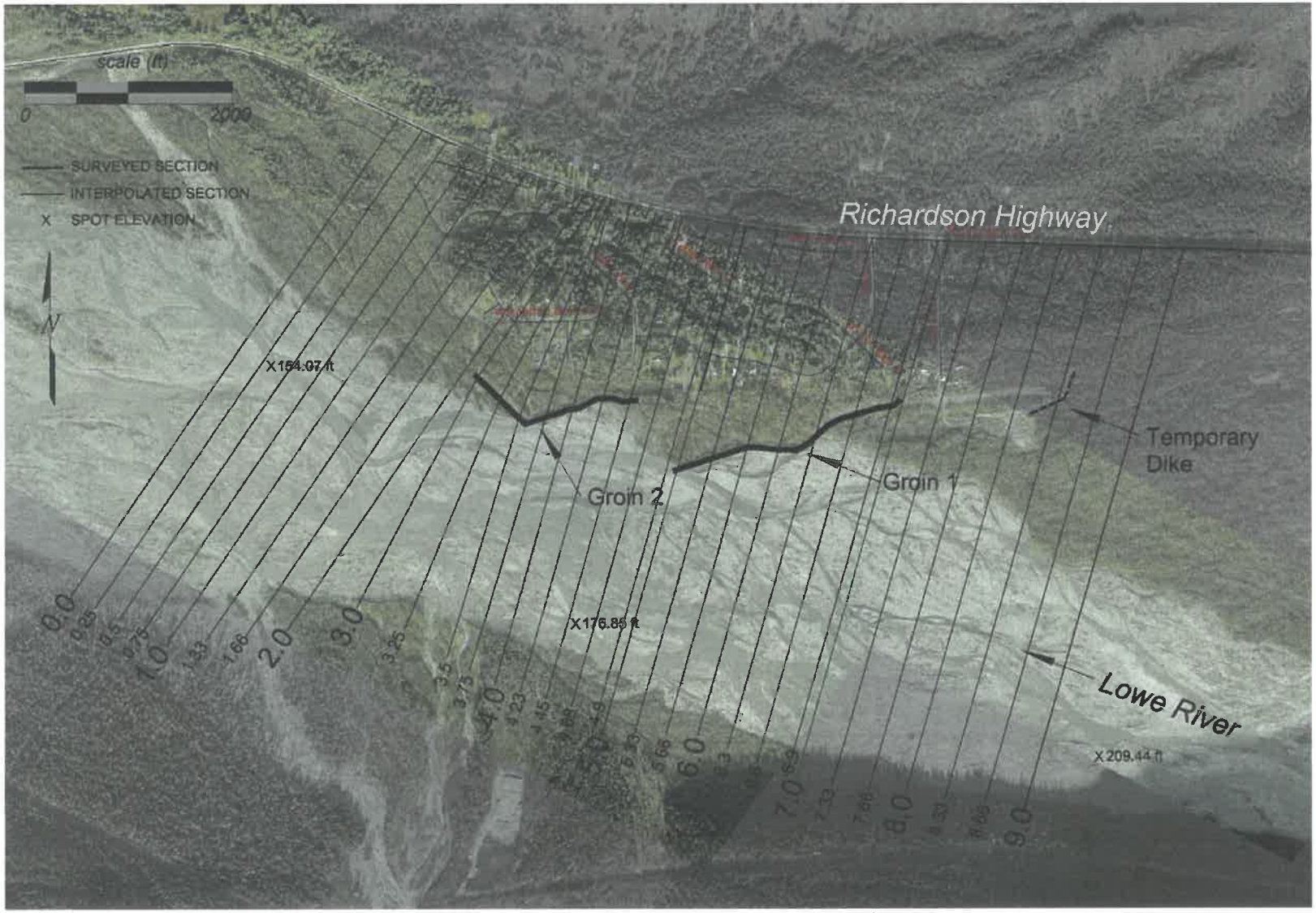

Figure 3. Aerial photograph of project site, with HEC-RAS cross-sections and existing groin locations.

Manning 'n' values were selected for this study based on engineering judgment, published values, and a sensitivity analysis. They were subsequently adjusted during the calibration process. The values used are listed in Table 2.

Table 2. Selected Manning's n values.

Condition	Manning's n
Channels and active floodplain	0.035-0.040
Light vegetation on floodplain	0.10-0.12
Heavy vegetation on floodplain	0.12-0.15

The Lowe River HEC-RAS model was calibrated using data from the October 2006 flood event. The USGS reports that the estimated peak discharge at the Lowe River gaging station in Keystone Canyon is 42,000 cfs. Using standard techniques, this value was adjusted to account for the additional area that drains to the project site downstream of the gaging station. The estimated Lowe River peak discharge at the Alpine Subdivision is 48,650 cfs.

Observers reported a water surface elevation during the October 2006 flood event of approximately 1.5 feet below the top of the levee near Cross-section 6, or 189.5 feet. The model was calibrated to this elevation at the 48,650 cfs flow.

Model Results

Flood calculations were done for the 2-year through 500-year flows. Water surface elevations at selected cross-sections are presented in Table 3, along with top-of-groin elevations at those sections that cross groins.

Table 3. Water surface elevations from HEC-RAS analysis.

Cross-section	Water surface elevation for design floods (feet)				Top of groin elevation (feet) and groin #
	2-year	50-year	100-year	500-year	
0.0	153.31	154.29	154.45	154.81	
1.0	159.53	160.54	160.71	161.10	
2.0	164.50	165.61	165.80	166.16	
3.0	166.66	167.69	167.87	168.27	172.37 (#2)
3.5	170.93	171.89	**172.07***	**172.47**	174.50 (#2)
4.0	174.46	175.53	175.70	176.11	180.51 (#2)
4.45	176.95	178.25	**178.43**	**178.83**	180.50 (#2)
4.90	179.32	180.63	180.82	181.43	
5.0	181.12	182.53	182.73	183.04	186.21 (#1)
6.0	186.89	188.41	**188.61**	**189.03**	191.01 (#1)
6.9	192.12	193.54	193.75	194.22	197.44 (#1)
7.0	192.65	194.06	194.29	194.85	
8.0	199.36	200.89	201.09	201.46	
8.33	202.58	203.77	203.95	**204.40**	207.00 (temp dike)
9.0	208.20	209.21	209.37	209.74	

*Water surface elevations that are less than three feet from the top of groin elevation are noted in bold.

The approximate extent of floodplain inundation for the 100-year flow is mapped in Figure 4. Some variations may be expected in the flood extents during actual flooding conditions, due to river processes and modeling limitations. The major cross-sections, with water surface elevations plotted for the 2-year, 10-year, 100-year, 500-year, and September 1995 floods, are found in Appendix 2.

Discussion

In the cross-section alignments used for this study, the far right sections of the floodplain, especially in the sections that pass through the Alpine and Nordic subdivisions, contain elevations that are lower than the thalweg of the main channel. This is especially true of a drainage channel that runs adjacent to the south side of the Richardson Highway. Other channels that run through the subdivisions are either intermittent or spring-fed. The HEC-RAS model was adjusted through the use of ineffective flow areas to keep the flood flows out of these lower far-right sections, unless the higher elevation points between them and the main channel were first overtopped. This is a feature in HEC-RAS that defines areas of the cross-section that are not part of the active flow area. Ineffective flow areas are denoted in the Appendix cross-sections with cross-hatching.

The extent of flood inundation through the study reach appears to be controlled by several different features along the right bank of the Lowe River in the study area. In the upper section of this reach (Cross-sections 7.0 to 9.0) a high broad ridge 2 to 4 feet in elevation above the bank level confines the flow to the center channel and adjacent floodplains. From Cross-section 7.0 to 8.0, the gravel pit also acts to limit flood extents on the right floodplain. Water entering the upstream end of the pit will drain back into the river at the lower end. Across from the lower end of the pit, an intermittent channel is located between the west end of the air strip and the subdivision. Modeling indicates that the channel's left bank at Cross-section 7.0 may be overtopped by several inches of water during the 100-year flood, introducing flood water into the channel.

Two City groin structures are located along the right bank from Cross-section 6.9 to 3.0. Though these structures were constructed to prevent channel migration, they also act to limit the right extent of flow. Water surface elevations at the design flood generally stay at two feet or more below the top of the groin elevations for the 100-year flood, and slightly less for the 500-year flood.

A gap between Groin 1 and Groin 2 does allow some water to flow laterally through the gap toward the subdivision at flood flows. Though difficult to model exactly with HEC-RAS, local observers have stated that flood water flowing between the two groins does not flow into the subdivisions, but is diverted by an old gravel pit/pond, and flows west through small drainage channels. These features are apparent on the aerial photographs.

Downstream from Cross-section 3 and the lower end of Groin 2, the design flow is generally contained on the right floodplain by the bank, and by a narrow band of ground at a slightly higher elevation of 1 to 2 feet. Again, this analysis is confirmed by local observers who reported that the vegetated floodplain downstream of and to the immediate

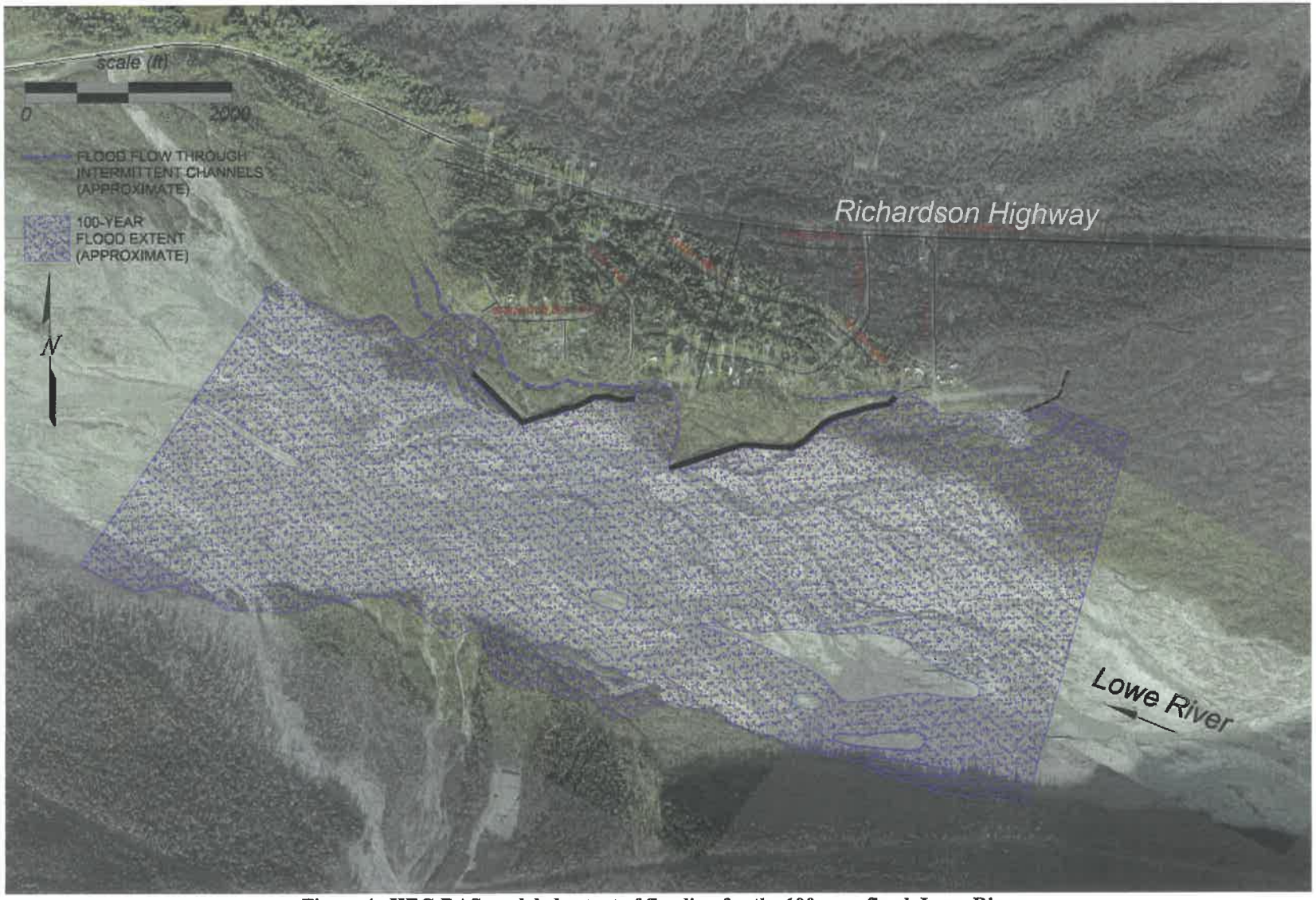

Figure 4. HEC-RAS modeled extent of flooding for the 100-year flood, Lowe River.

west of the subdivisions was not inundated during the October 2006 flood, though smaller channels through that floodplain were at or above capacity.

The HEC-RAS model shows that on several of these downstream cross-sections, the high point on the right side of the floodplain is overtopped during the 500-year flood, with inundation occurring to the Richardson Highway. However, this analysis is somewhat uncertain, as it conflicts with reports from observers during the October 2006 flood. No large floodplain inundation or highway overtopping was reported in this section.

It is important to note that HEC-RAS is a one-dimensional model, and topographic variations on the ground that were not captured during the cross-section surveys can cause inaccuracies during the flood analysis and mapping. Unmapped high areas can act to constrict flows, while unmapped areas can be inundated by backwater.

Additional Flood Protection

Results from the HEC-RAS analysis indicate that the Alpine and Nordic subdivisions are generally outside of the modeled 100-year floodplain. However, physical topography can be altered before or during a flood, which may result in flooding extents that are different than the modeled results. For example, the cause of subdivision flooding during the October 2006 event was a breeched dike upstream, which allowed water to travel down the right floodplain out of the Lowe River right bank. Random events during extreme floods, such as dike or culvert failures and highway embankment breaches, were not modeled for the development of the 100-year flood plain map.

The Lowe River is a large braided river with coarse bed material, and flows in several dividing and uniting, relatively wide and shallow channels. The primary causes of braiding are an abundant sediment load, large and sudden discharge variations, erodible banks, and a steep gradient. Such conditions can readily lead to lateral channel migrations, and flooding in areas that are generally dry.

The HEC-RAS results should be used to assess existing flood protection structures, and help guide the design of additional flood protection measures for the Alpine and Nordic subdivisions. Several suggestions for designs and improvements to existing structures are found below:

Existing Structures-Top Elevations

The profile graph in Figure 5 shows the water surface elevation of the river at the 100-year and 500-year flood levels, along with the top elevations of the two City of Valdez groins. Some sections of the two city groins and the new temporary dike do not meet a 3 foot minimum freeboard requirement for the 100-year flood elevation, as described in Section 65.10 of the FEMA National Flood Insurance Program (NFIP) regulations (FEMA, 2003).

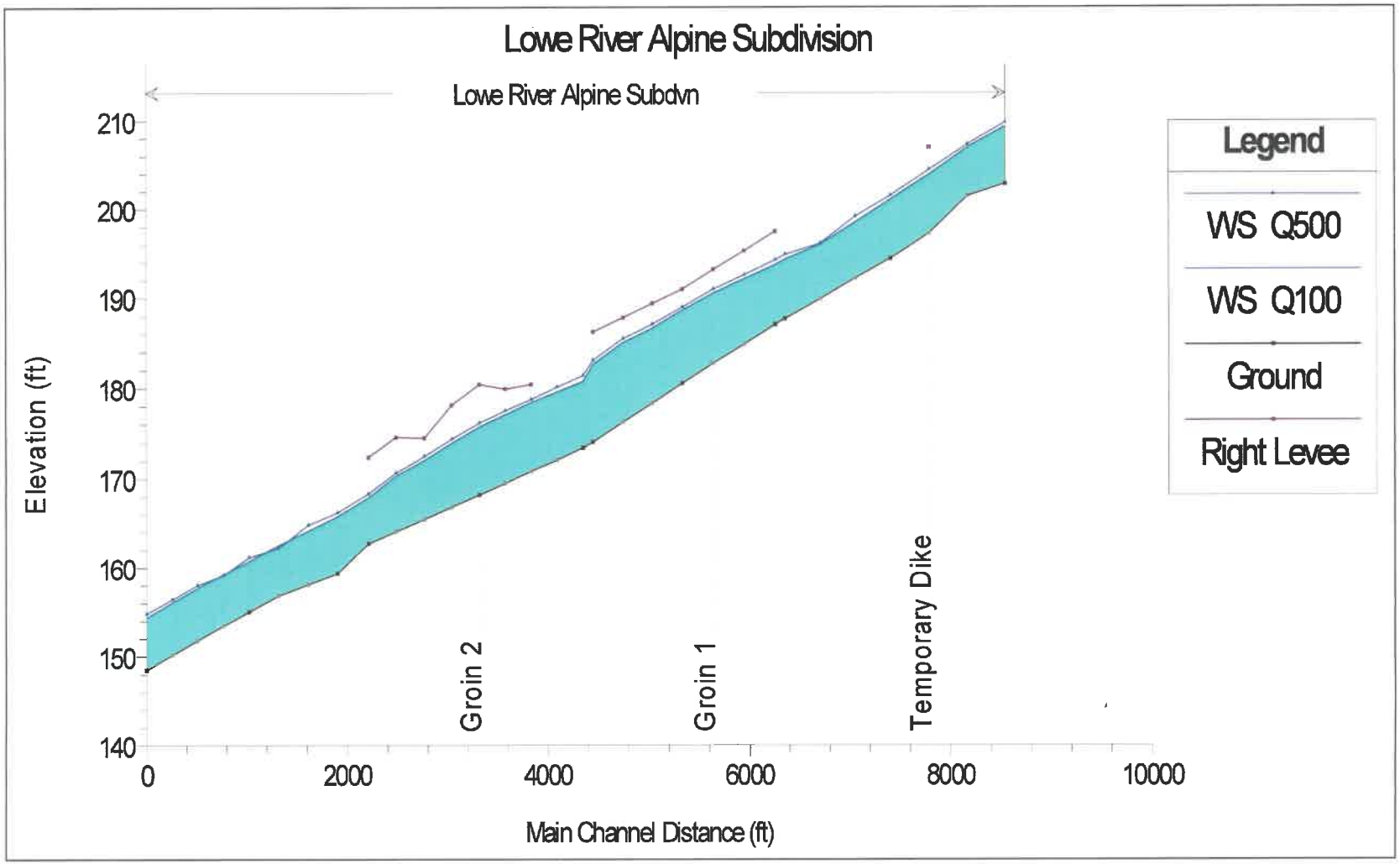

Figure 5. Profile of the 100-year and 500-year flood elevations.

New designs for groin improvements or extensions may include increasing the top elevations to meet the minimum FEMA freeboard requirements, especially if new levee design/certification is conducted by a registered professional engineer, rather than a federal agency. If the U.S. Army Corps of Engineers is the certifying agency, FEMA allows the use of a risk based analysis to design levee crest heights as an alternative to the 3 feet of freeboard above the 100-year flood.

Existing Structures-Riprap Facing

The riprap used to face and protect the existing groins should be evaluated to determine whether the proper size and gradation of rock was used. The factors that determine riprap size include water velocity, water depth, and bank angle.

Average velocities at each cross-section are calculated as part of the HEC-RAS hydraulic analysis. For the 100-year flood, average velocities are found for each of the cross-sections that are located at a groin or dike in Table 4.

Table 4. Average channel velocities for the Q100 at cross-sections crossing groins.

Groin 1		Groin 2		Temporary Dike	
Cross-section	Average Velocity (ft/sec)	Cross-section	Average Velocity (ft/sec)	Cross-section	Average Velocity (ft/sec)
5	6.4	3.0	6.6	8.33	5.1
5.33	5.1	3.25	5.7		
5.66	5.6	3.5	6.0		
6.0	5.5	3.75	5.3		
6.3	4.7	4.0	4.8		
6.6	4.5	4.25	4.6		
		4.45	5.0		
		4.68	2.0		

In addition to the average velocities, HEC-RAS has an option that allows users to plot estimated velocity distributions across a cross-section. It is important to note that these estimated velocities are based on the results of a one-dimensional hydraulic model, and that true velocity and flow distribution varies vertically as well as horizontally. The velocity distribution at the 100-year flood for Cross-section 5 is found in Figure 6. At this section, the maximum estimated velocity of 11 feet per second is at the groin.

Existing Structures-Culverts

At least one 36 inch culvert is installed on the City Groin #1, and provides hydraulic connectivity between the Lowe River and the protected side (Figure 7). Such culverts should be removed or plugged to reduce flows into the protected area during floods.

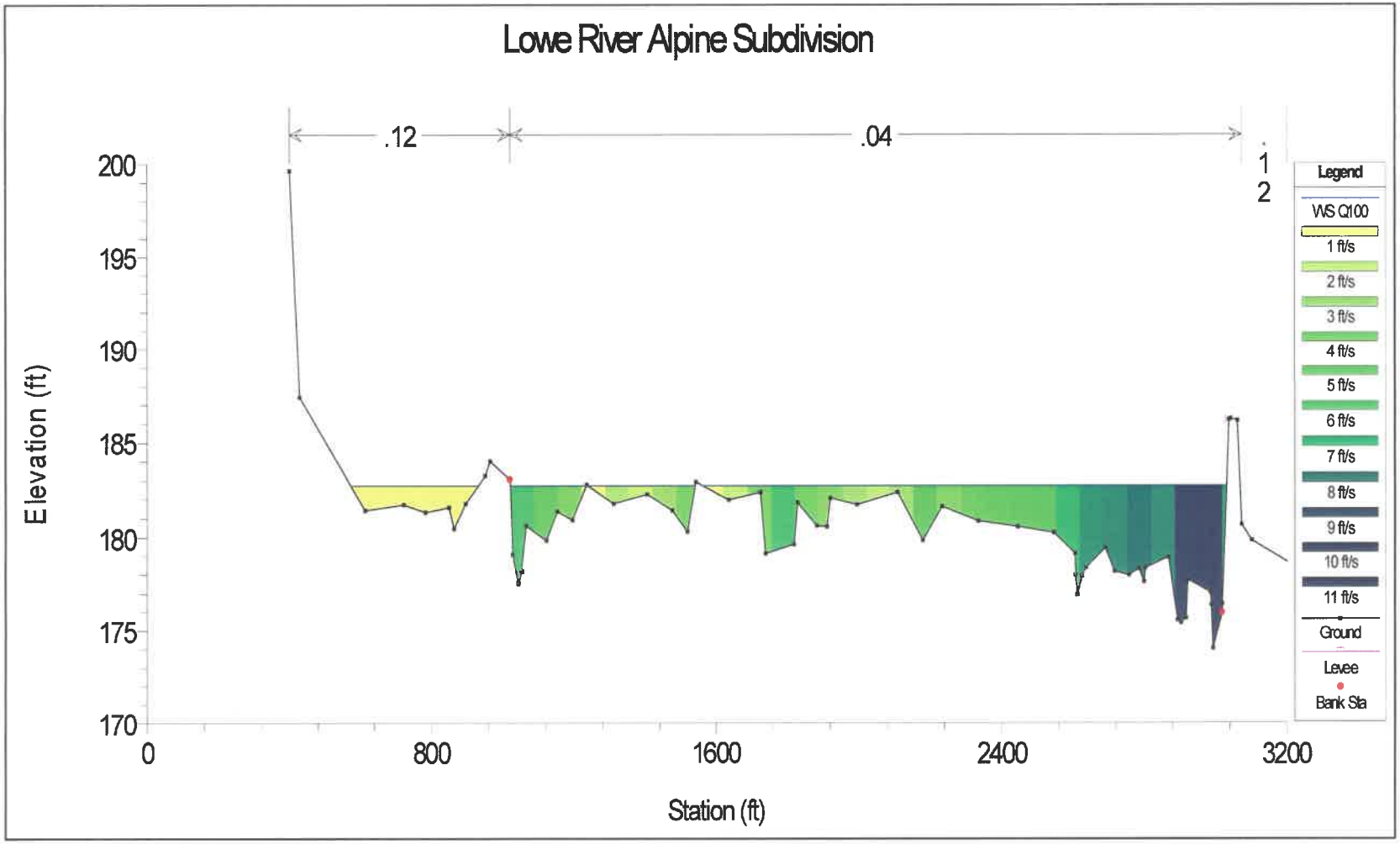

Figure 6. Velocity distribution across the channel at Cross-section 5.

Figure 7. Culvert in Groin 1 connects Lowe River to protected area.

Upstream of Existing City Structures

The HEC-RAS analysis shows that in the upper study area, the 100-year inundation extents from a river flood event are controlled by a high broad ridge approximately halfway between the right river bank and the Richardson Highway. Additionally, flow coming from east to west on the right floodplain will be intercepted by the new temporary dike and diverted into the large gravel pit adjacent to the river.

For flood events such as the October 2006 flood, additional protection may be obtained by several methods. These include extending a new dike to the west and north of the subdivisions, to capture and train flow traveling outside of the right bank down the floodplain. In lieu of constructing a new groin or dike, the existing temporary dike might be utilized by increasing its top height and length, and improving drainage from the lower end of the gravel pit to the river. However, methods and materials used to construct the temporary dike may not meet standard specifications or design requirements. A qualified inspection will be required to determine the competency of the temporary dike as part of a permanent flood protection structure.

A large intermittent stream flows into the subdivisions from the east. This channel is observed in Figure 3 just north of the temporary dike. Local residents report that it is generally groundwater-fed and flows only certain times of the year. Any new levee

structure that may be extended north to the high point of the right floodplain will cross this channel and require some sort of closure device. The closure device, which allows channel flow during normal operations, is a movable and essentially watertight barrier, and would be used in flood periods to close an opening in the levee, securing but not increasing the levee design level of protection.

Several earlier flood control concept plans included a dike or ring levee that wraps around the entire subdivisions, terminating at the road (Engles and Engles, 2007). The hydraulic analyses for those design features were not available for review during this project. However, the existing HEC-RAS analysis (this report), field observations that note lack of channels or historic flood activity, and observations from residents during the October 2006 event indicates little probability of river flooding between the intermittent channel described above and the Richardson Highway. The construction or extension of a dike or levee in this section appears to be unnecessary. However, increasing the capacity of the culverts for Nordic Drive and other roads that drain the ditch immediately adjacent to the south side of the Richardson Highway would greatly improve drainage conditions during high water events. Subdivision drainage is discussed in another report.

Floodplains and gravel bars are often excellent sources of gravel in Alaska, and several borrow pits are located within or adjacent to the right floodplain upstream of the subdivisions. Any future area gravel pits should be situated such that they do not encourage lateral channel migration into the floodplain. They should also be located away from any existing or planned groins or levee structures, to reduce the threat of scour and toe erosion.

In-Between Existing City Structures

Local residents have noted that though water flows through the gap between the upstream and downstream City groins during flood events, the flows are generally diverted downstream before reaching the subdivisions. However, adding a groin section between the existing two groins will provide additional structural protection to those groins by preventing the river from outflanking or eroding them from behind. Computer modeling should be used to determine the necessary height and desired freeboard of the groin extension.

Downstream of Existing City Structures

The HEC-RAS analysis shows that in the reach downstream from Cross-section 3 and the lower end of Groin 2, the design flow is generally contained on the right floodplain by the bank, and by a narrow band of ground at a slightly higher elevation of 1 to 2 feet. Minor flooding at a few residences in the southwest corner of the subdivision was perceived to be from the river around the lower end of the groin, and the HEC-RAS analysis indicates that low spots between the surveyed cross-sections could lead to flood flow in that direction.

Additional flood protection would be obtained by extending the lower end of Groin #2 downstream for a distance of several hundred to several thousand feet. The groin could follow the small ridge running down the right floodplain approximately 400-600 feet to the north of the right bank. A downstream extension of Groin 2 would further reduce the potential for downstream backwater flooding into the subdivision, especially given the steep channel slope and few downstream obstructions.

As mentioned earlier, earlier flood control designs included plans for a dike or ring levee to wrap around the lower subdivision and terminate at the road (Engles and Engles, 2007). Though an analysis of topographic data indicates little probability from downstream backwater flooding on the north side of the lower end of Groin 2, additional modeling is recommended.

Additionally, perennial spring-fed streams flow from the subdivision; the channels are easily observable in Figure 3. At least one of the channels supports anadromous fish, and is likely classified as a fish-bearing stream by ADFG (Figure 8). A ring levee that connects Groin 2 to the Richardson Highway will intersect this channel, and will likely have to include a gravity outlet that meets fish passage requirements. If subsequent modeling determines that high exterior stages would occur during a flood event, the outlet would have to be equipped with a gate to prevent riverflows from entering the protected area. In addition to the gate, a pumping station would then be needed to discharge the interior flow over or through the levee.

Figure 8. Perennial anadromous stream flows west from subdivisions.

Design-Hydraulic Modeling

The general recommendations described above for additional flood protection through new groin extension or levee construction projects are illustrated in Figure 9. Additional hydraulic analysis is required to finalize design parameters such as length, height of dike/levee, size of required riprap, and others. The HEC-RAS program should be used to conduct the design hydraulic analysis and dike/levee modeling.

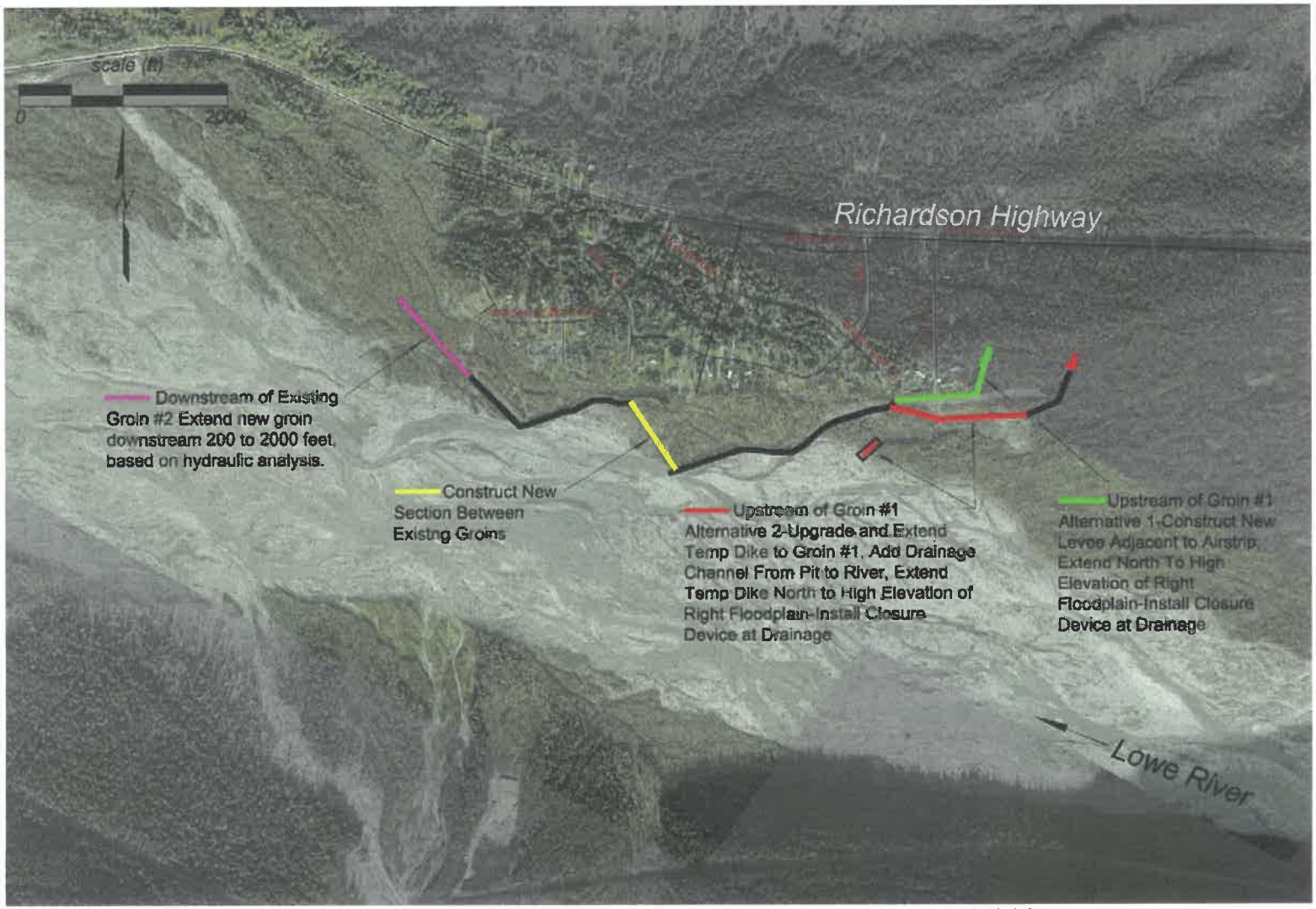

Figure 9. Options for additional flood protection at Alpine/Nordic subdivisions.

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City of Valdez or other documents

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- Valdez Comprehensive Plan. City of Valdez (?). Date unknown.
- City of Valdez Floodplain Ordinance.
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Appendix 1-Hydrologic Analysis

The USGS Bulletin 17B guidance (annual flood frequency analysis) requires at least 10 years of data before conducting a probability analysis. Since the available peak flow record for the Lowe River is so short as to be below the minimum necessary to develop flood estimations based on probability analysis alone, the following methods were used. First, flood magnitude estimations were developed using USGS regression equations for estimating the magnitude of peak streamflows in Alaska. Estimations were developed for the Lowe Rive at the USGS gaging station site in Keystone Canyon.

The latest USGS regression method for estimating peak streamflows at ungaged locations is described in the USGS Water Resources Investigations Report 03-4188 (Curran et al., 2003). Basin characteristic information is used in the USGS regression analysis. For Region 3, the characteristics include:

- drainage area upstream from the site
- percentage of the total drainage area shown as lakes and ponds
- mean minimum January temp
- mean annual precipitation averaged over the drainage area.

Drainage areas and areas of lakes and ponds were obtained by planimetric techniques used with USGS 1:63360 quad maps. The mean annual precipitation value for the watershed was obtained from Plate 2 of the Jones and Fahl report (1994). Basin characteristics are as follows:

Drainage areas - 222 square miles (Lowe River-Keystone Canyon);
Area of lakes and ponds - 0.0 %
Mean min January temp - 4 degrees F
Mean annual precipitation - 100 inches

The USGS report provides several methods to evaluate the accuracy and limitations of the regression equations. One measure of predictive ability of each equation is the average equivalent years of record, or the number of years of systematic streamflow data that would have to be collected for a given site to estimate the streamflow statistic with accuracy equivalent to the estimate from the regression equations. Methods are also provided to estimate the average standard of error of prediction. Finally, confidence limits provide a measure of the error in a particular prediction. The 5% and 95% confidence limits provide a 90% prediction interval for a particular site. These values are listed in Table 5 to provide the user with an understanding of the accuracy of the equations. Additional description of these methods is found in Curran et al. (2003).

A statistical flood-frequency analysis of the annual-maximum peak flows was developed using a log-Pearson Type III probability distribution and the USGS Bulletin 17B methods (USGS, 2006). USGS records at the USGS gaging station site in Keystone Canyon provided 7 annual peak flow values; two were treated as historic peak values outside of

the systematic record (1995 and 2006), and one peak was not used in the analysis because of data problems. Results and confidence limits are found in Table 6.

Table 5. Flood frequency estimations and accuracy of regression equations.

Recurrence Interval (years	Discharge (cfs)	Standard Error (+%)	Standard Error (-%)	Confidence Limits		Equivalent Years
				5%	95%	
2	8770	45.6	-31.3	4700	16400	0.9
5	12200	45.0	-31.0	6580	22600	1.4
10	14600	45.5	-31.2	7860	27300	2.0
25	17900	47.0	-32.0	9420	33900	2.7
50	20400	48.8	-32.8	10500	39400	3.1
100	22900	51.0	-33.8	11600	45400	3.5
200	25700	53.6	-34.9	12600	52300	3.8
500	29400	57.4	-36.5	13800	62400	4.1

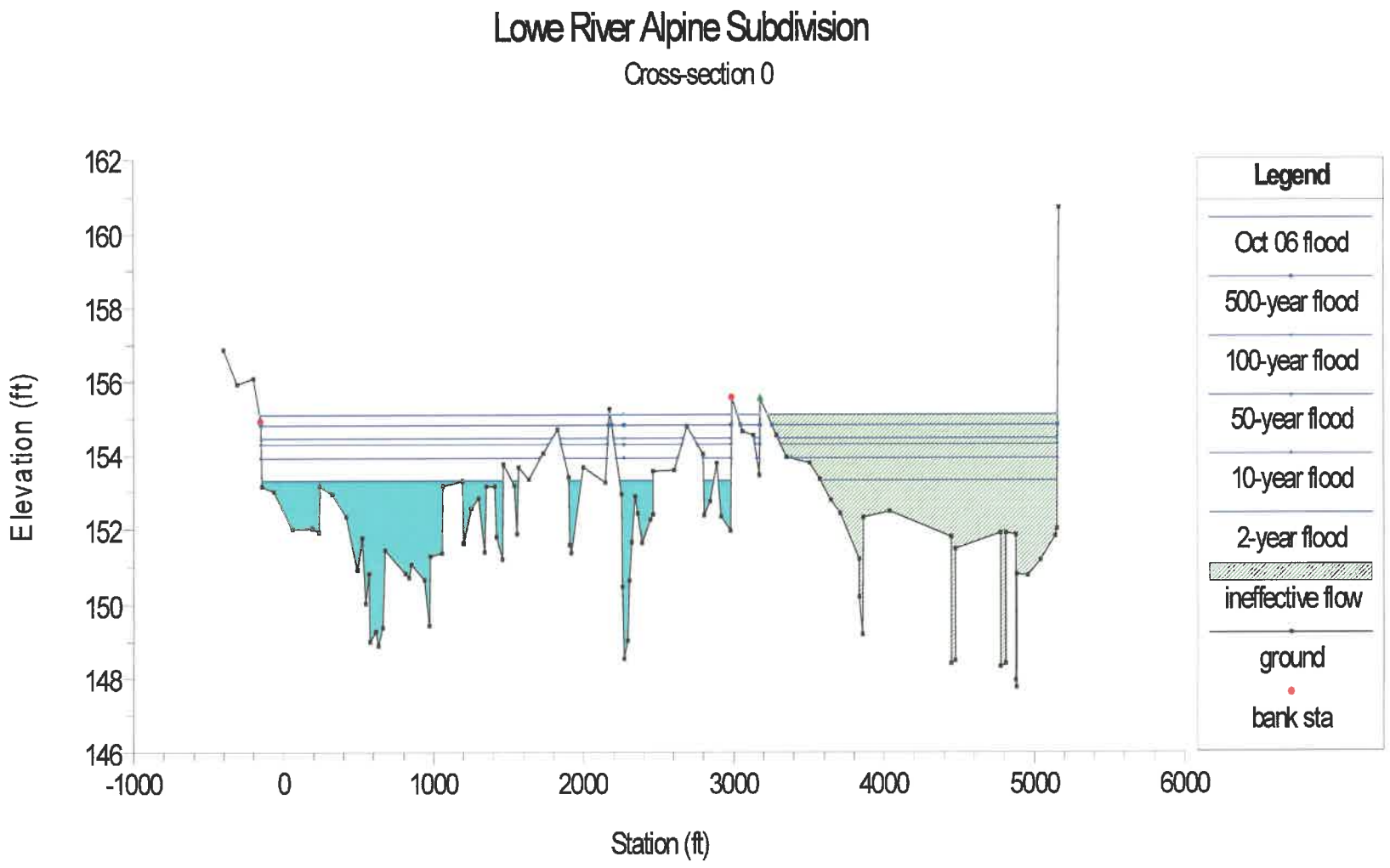
To improve estimates, Bulletin 17B recommends that a generalized skew computed from nearby long-term stations be used to weight individual station skews within a region. In Alaska, average station skews for each region, are estimated and provided in Curran et al. The average skew coefficient of 0.16 was used in the analysis.

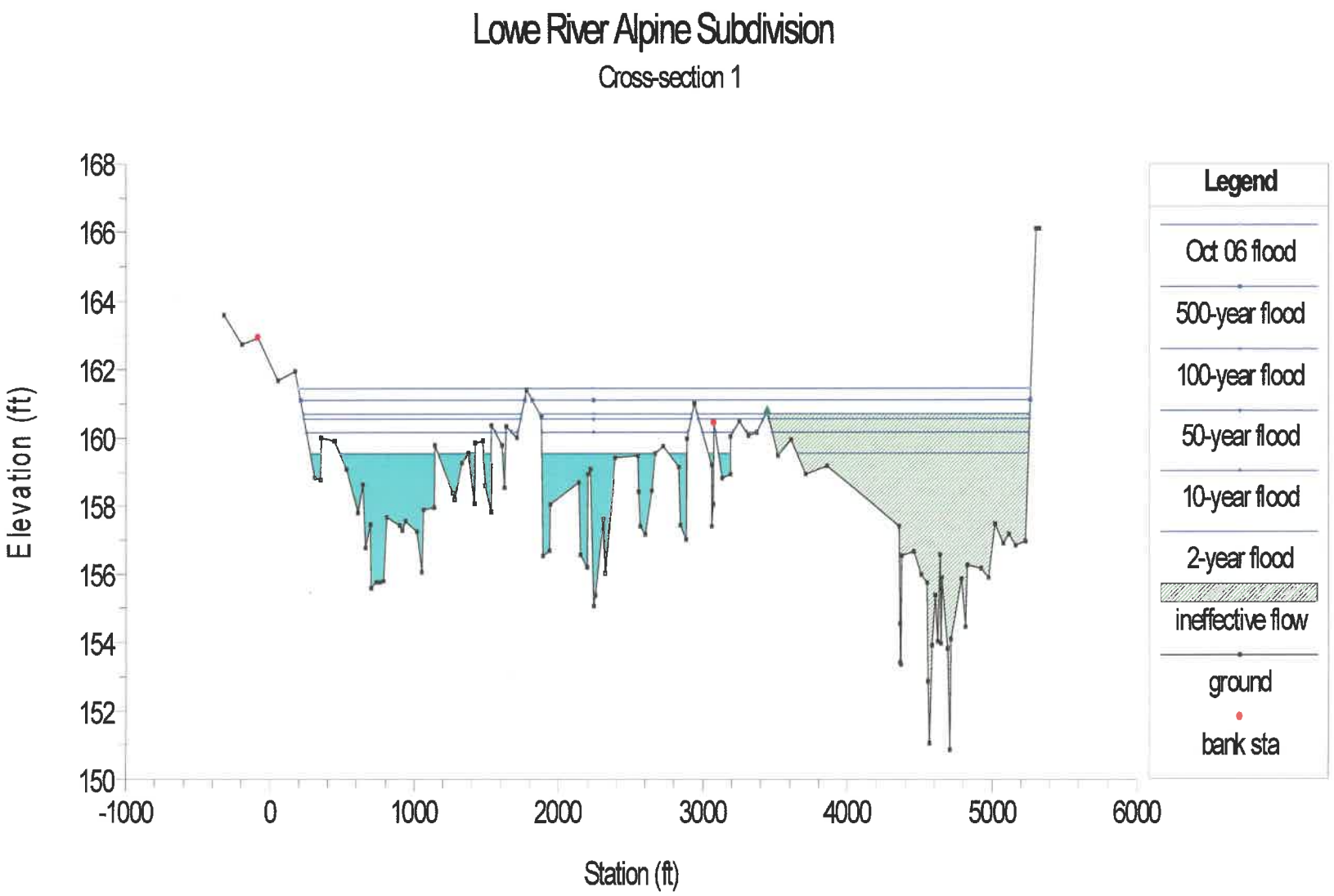
Table 6. Probability estimates and confidence limits.

Annual Exceedance Probability	Bull. 17B Estimate (cfs)	Confidence Limits	
		Lower	Upper
0.9950	6557	2189	8640
0.9900	6732	2363	8810
0.9500	7363	3056	9440
0.9000	7813	3612	9917
0.8000	8496	4540	10710
0.6667	9305	5730	11820
0.5000	10380	7320	13780
0.4292	10910	8042	15020
0.2000	13430	10650	24190
0.1000	15740	12300	37430
0.0400	19020	14170	64710
0.0200	21730	15530	95920
0.0100	24690	16900	140200
0.0050	27910	18290	202700
0.0020	32660	20210	325200

Following that estimation, a weighted estimate was developed from both the regression estimate and the probability distribution, using methods described in Curran et al. The weights are based on the years of observed data at the gage, and the average equivalent years of record for the regression equation. Finally, the new weighted estimate was then adjusted for the larger watershed at the ungaged site (328.5 square miles at Alpine Subdivision). The weighted estimates for both sites are found in Table 1 and Figure 2.

Appendix 2-HEC RAS Results




Lowe River Alpine Subdivision
Cross-section 1
Elevation (ft)
168
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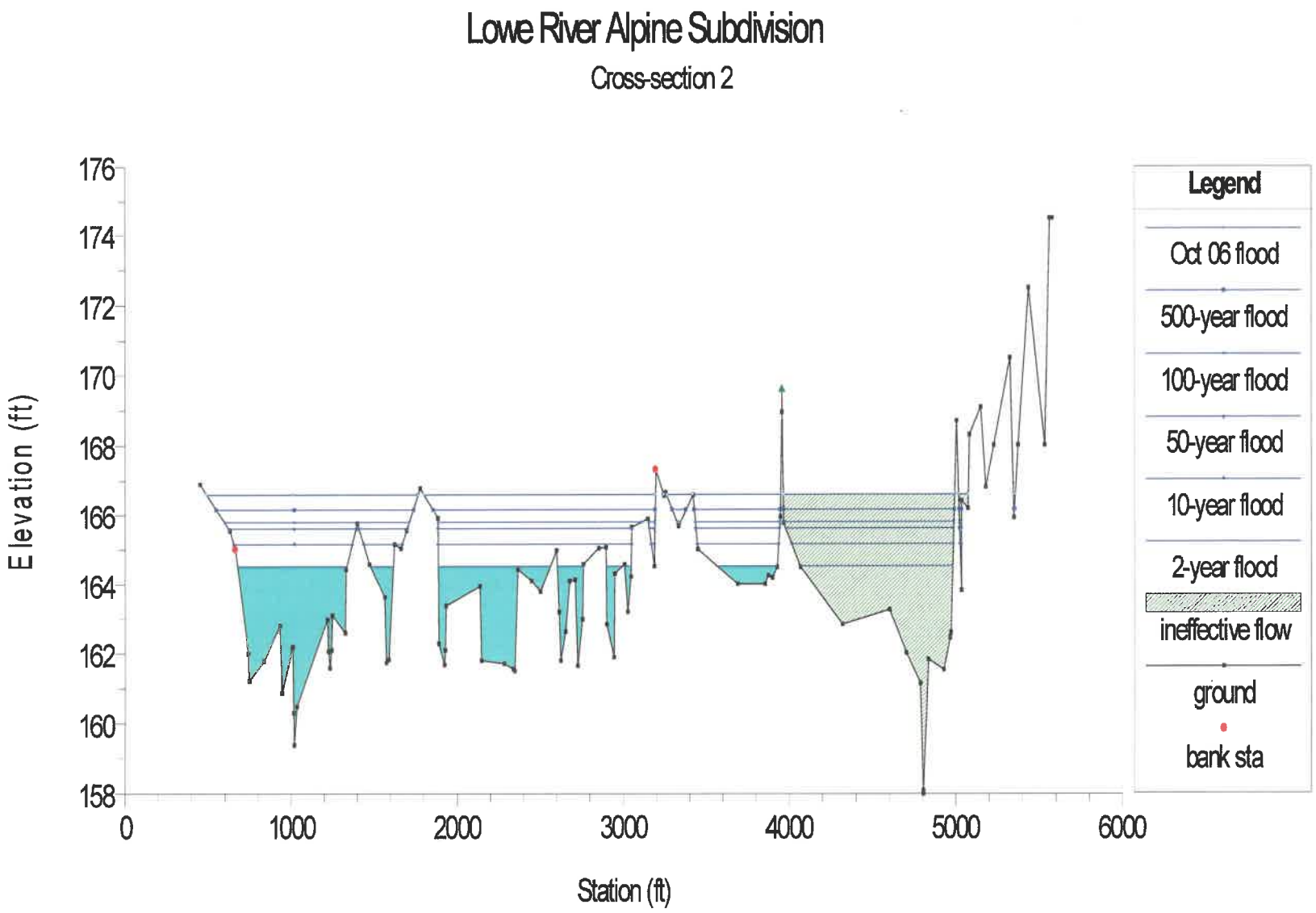
Lowe River Alpine Subdivision
Cross-section 2
Elevation (ft)
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Station (ft)
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10-year flood
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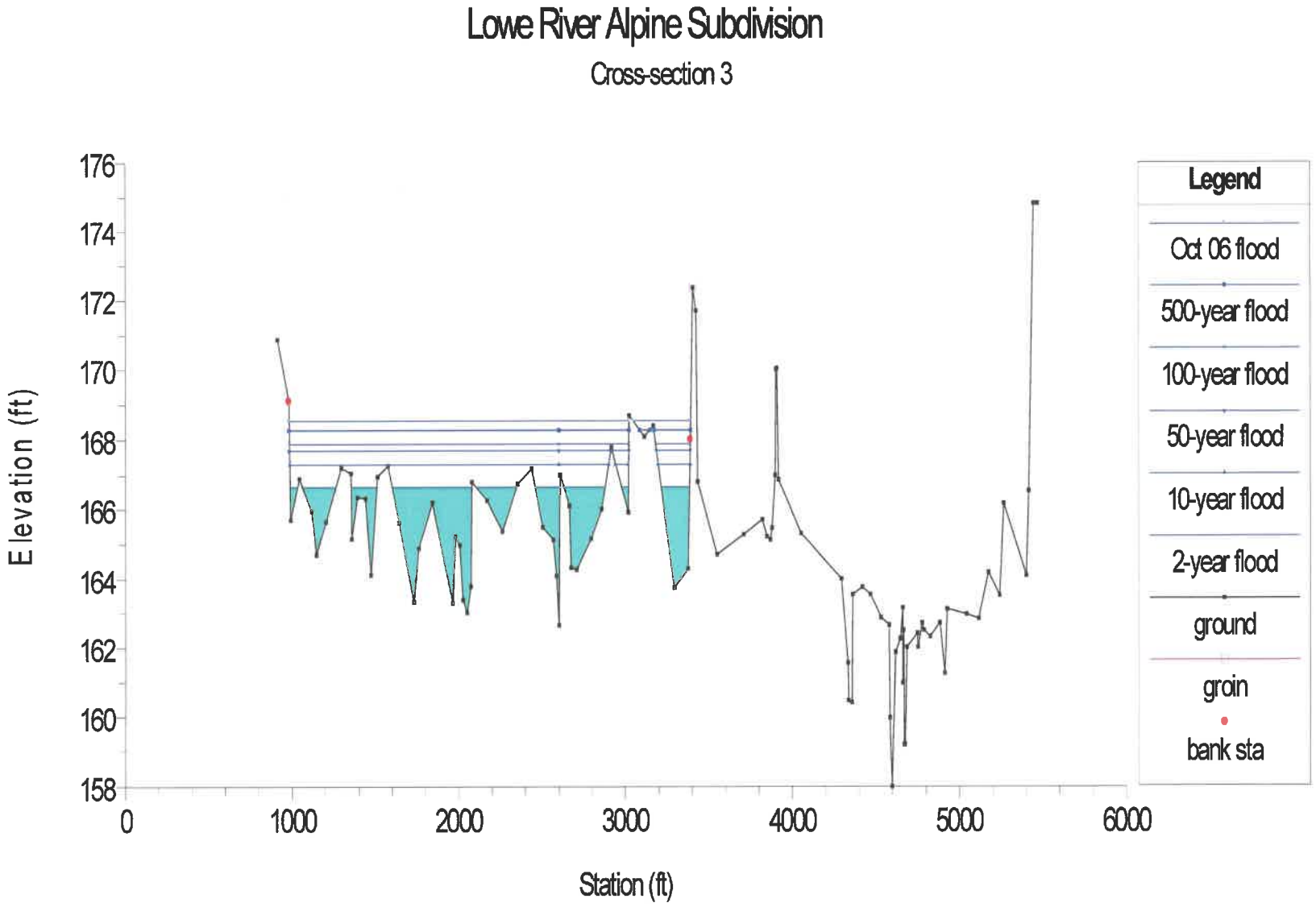
Lowe River Alpine Subdivision
Cross-section 3
Elevation (ft)
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50-year flood
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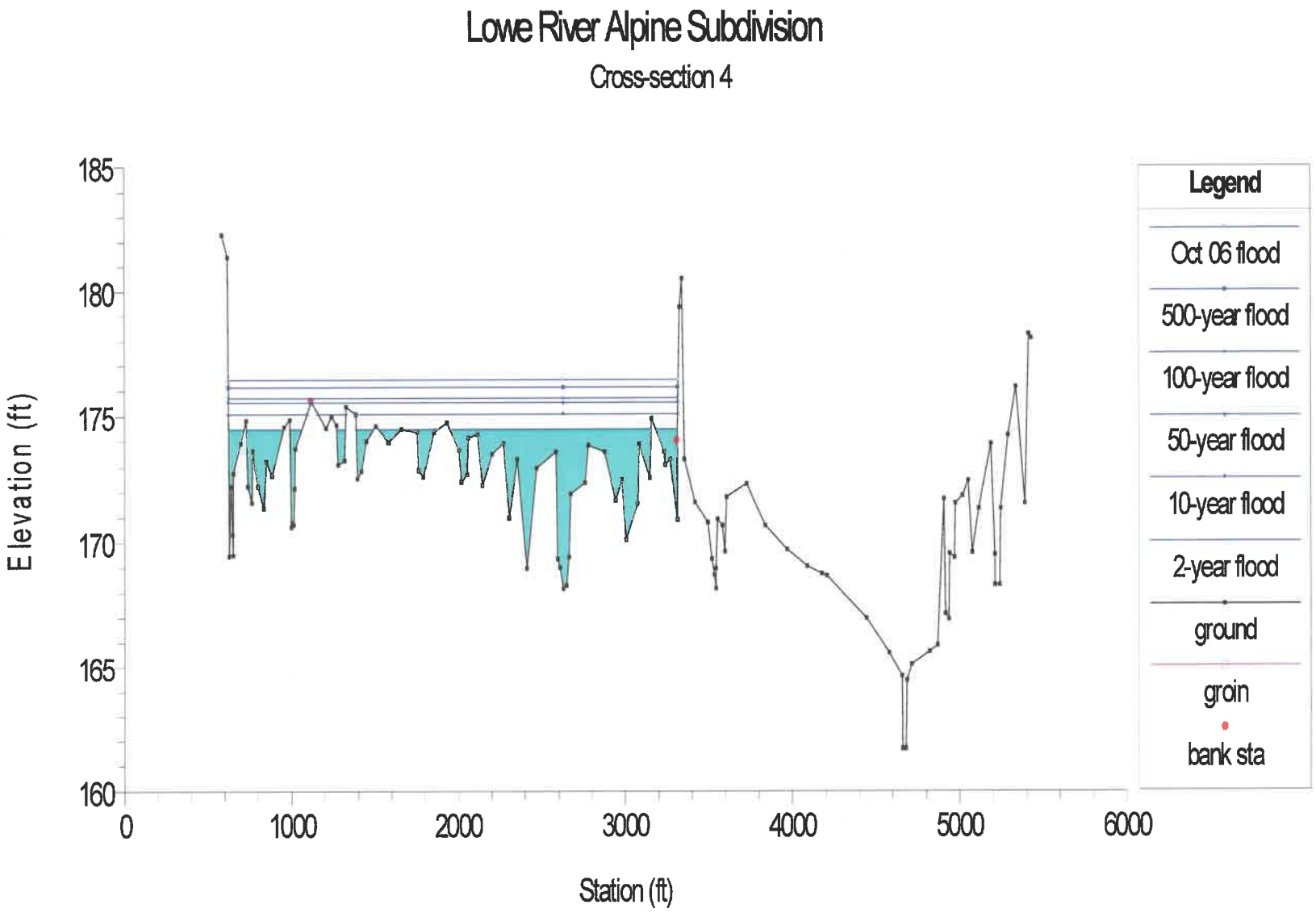
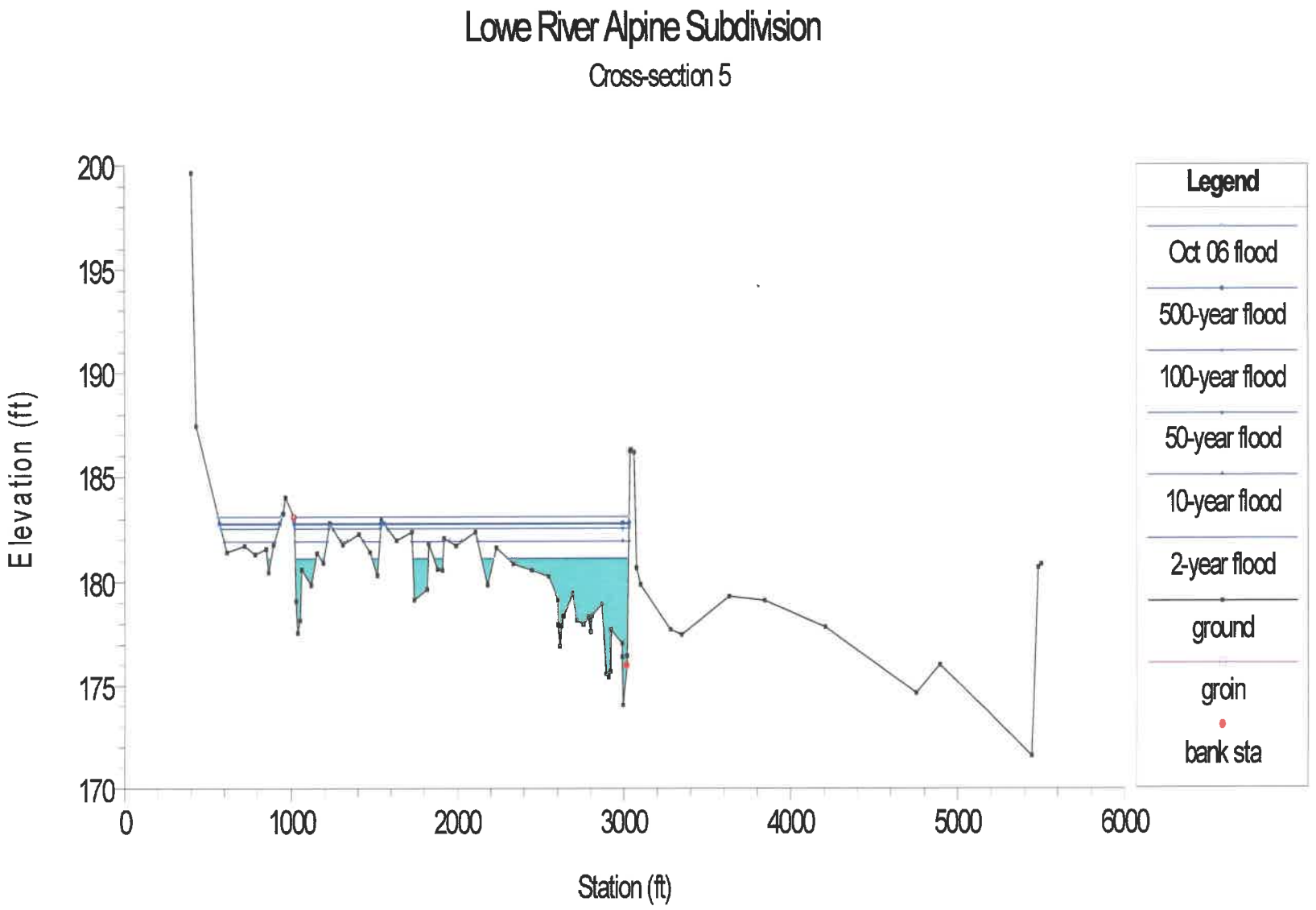
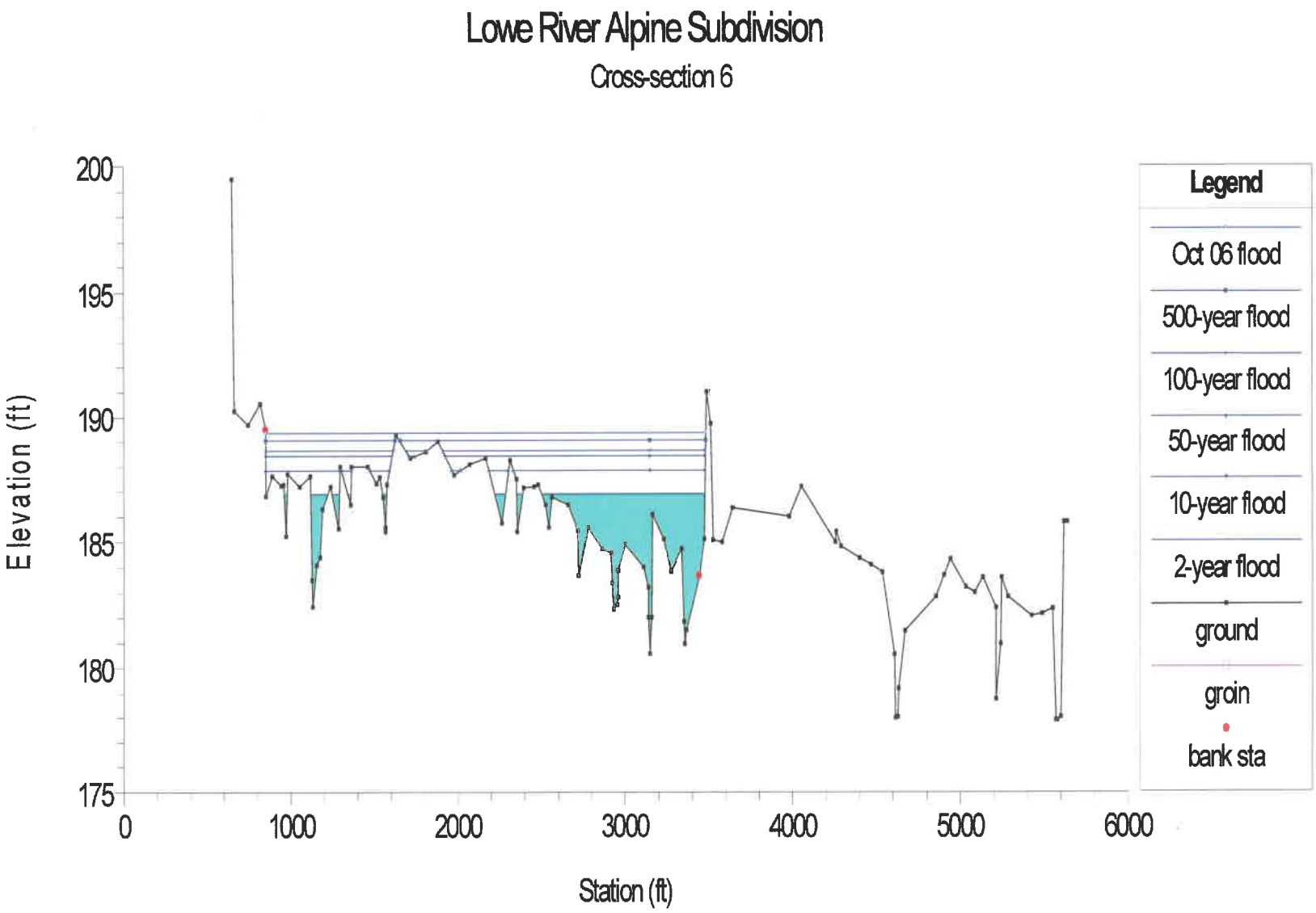
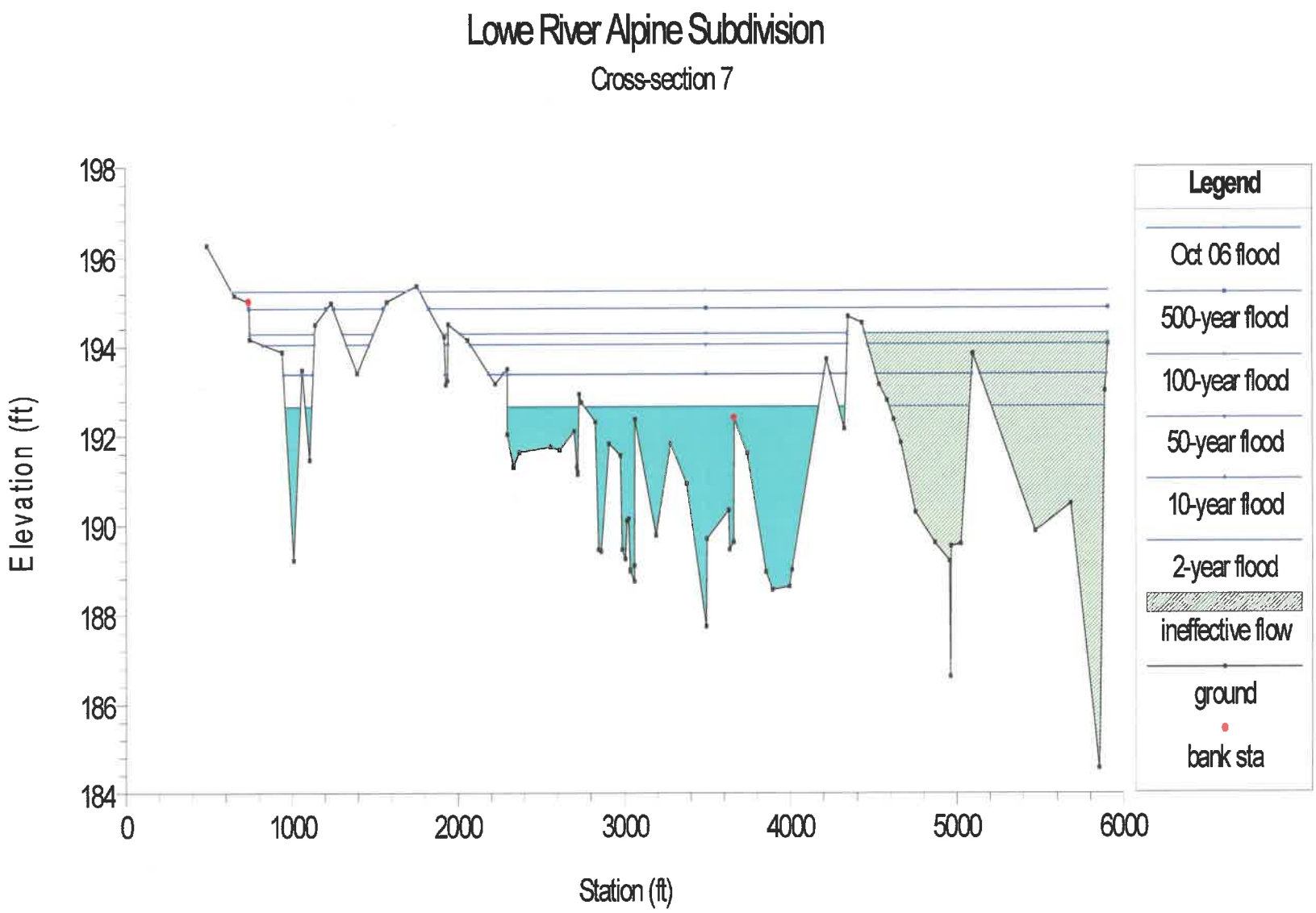
groin
bank sta

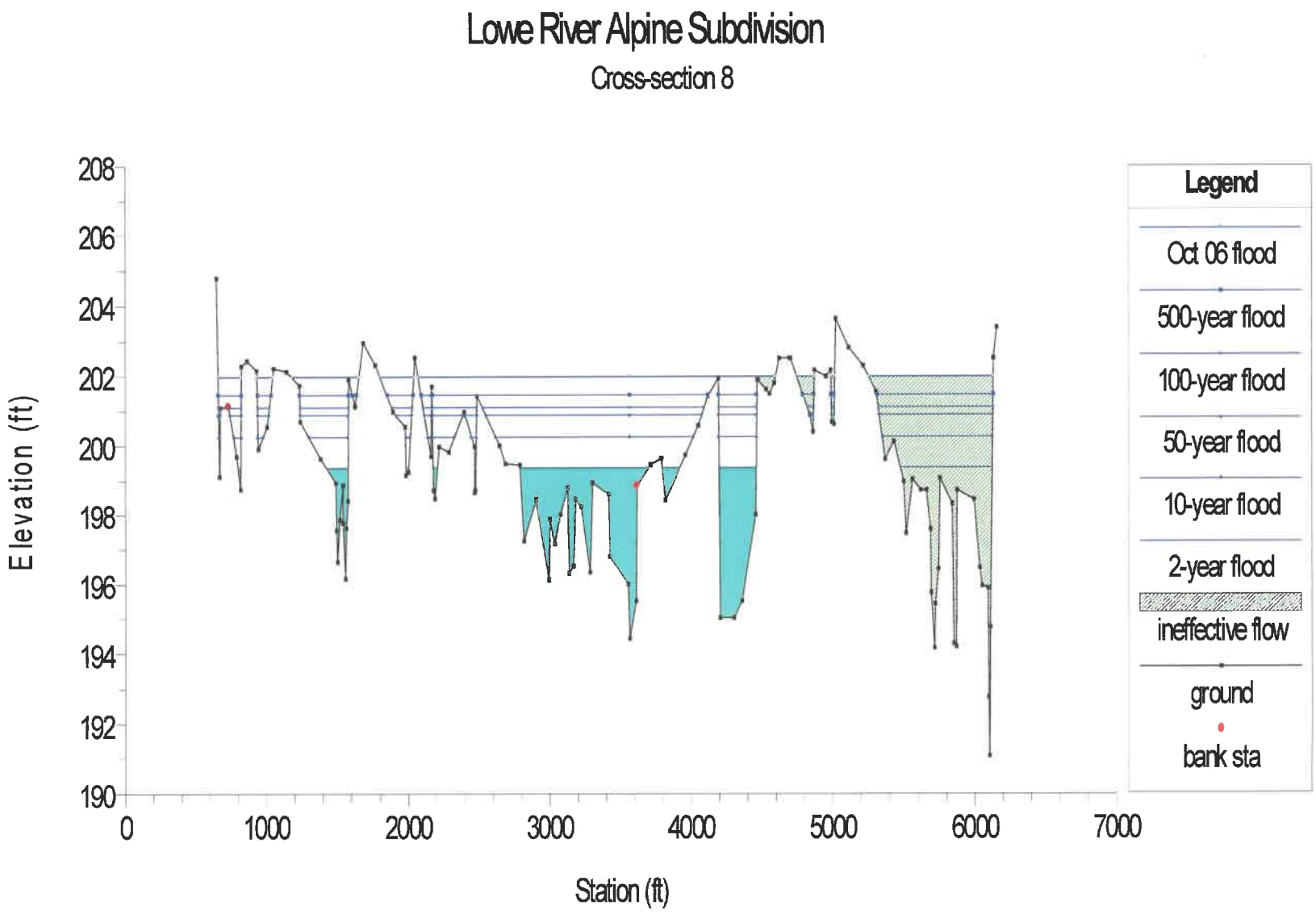

Lowe River Alpine Subdivision
Cross-section 4
Elevation (ft)
185
180
175
170
165
160
0
1000
2000
3000
4000
5000
6000
Station (ft)
Legend
Oct 06 flood
500-year flood
100-year flood
50-year flood
10-year flood
2-year flood
ground
groin
bank sta

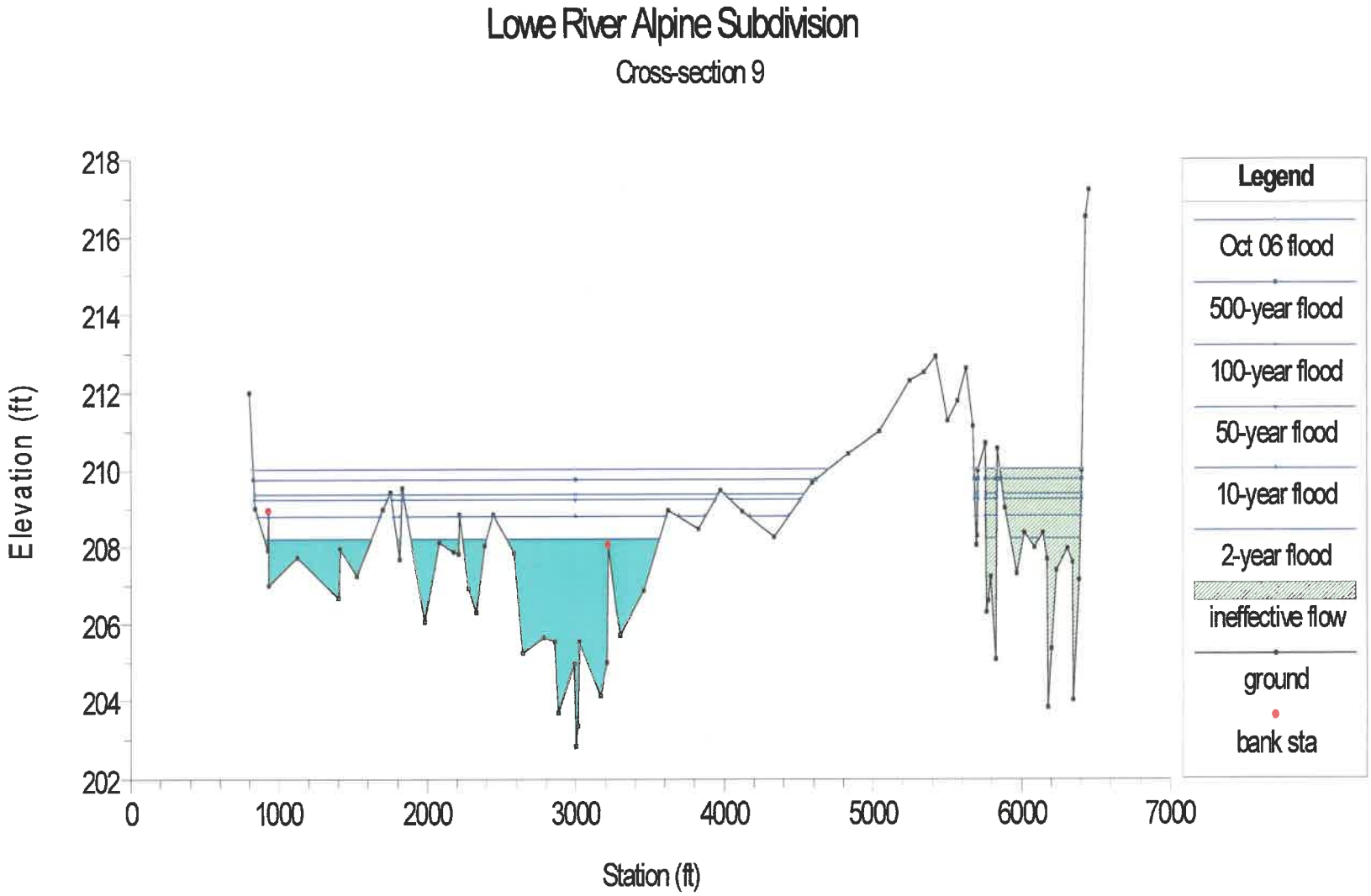

Lowe River Alpine Subdivision
Cross-section 5
Elevation (ft)
200
195
190
185
180
175
170
0
1000
2000
3000
4000
5000
6000
Station (ft)
Legend
Oct 06 flood
500-year flood
100-year flood
50-year flood
10-year flood
2-year flood
ground
groin
bank sta


Lowe River Alpine Subdivision
Cross-section 6
Elevation (ft)
200
195
190
185
180
175
0
1000
2000
3000
4000
5000
6000
Station (ft)
Legend
Oct 06 flood
500-year flood
100-year flood
50-year flood
10-year flood
2-year flood
ground
groin
bank sta


Lowe River Alpine Subdivision
Cross-section 7
Elevation (ft)
198
196
194
192
190
188
186
184
0
1000
2000
3000
4000
5000
6000
Station (ft)
Legend
Oct 06 flood
500-year flood
100-year flood
50-year flood
10-year flood
2-year flood
ineffective flow
ground
bank sta

77


Lowe River Alpine Subdivision
Cross-section 8
Elevation (ft)
208
206
204
202
200
198
196
194
192
190
0
1000
2000
3000
4000
5000
6000
7000
Station (ft)
Legend
Oct 06 flood
500-year flood
100-year flood
50-year flood
10-year flood
2-year flood
ineffective flow
ground
bank sta


Lowe River Alpine Subdivision
Cross-section 9
Elevation (ft)
218
216
214
212
210
208
206
204
202
0
1000
2000
3000
4000
5000
6000
7000
Station (ft)
Legend
Oct 06 flood
500-year flood
100-year flood
50-year flood
10-year flood
2-year flood
ineffective flow
ground
bank sta

Appendix 3-Glossary Of Flood Control Structures

Various terms have been used to describe the flood control structures along the right bank of the Lowe River. The following definitions are provided to assist the reader with definitions and terms.

Levees: Manmade structures, usually earthen embankments, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

Ring levees: Levees that completely encircle or "ring" an area subject to inundation from all directions.

Setback levees: Levees that are built on the land side of existing levees, usually because the existing levees have suffered distress or are in some way being endangered, as by river migration.

A levee system usually consists of a main levee, tie back levees, a gravity outlet, and pumps. Some levee systems may also include pressure conduits, closure structures, ring levees, setback levees, sublevees, and spur levees.

Dikes: Embankments constructed of earth or other suitable materials to protect land from overflows or to regulate water (from FEMA, 2003).

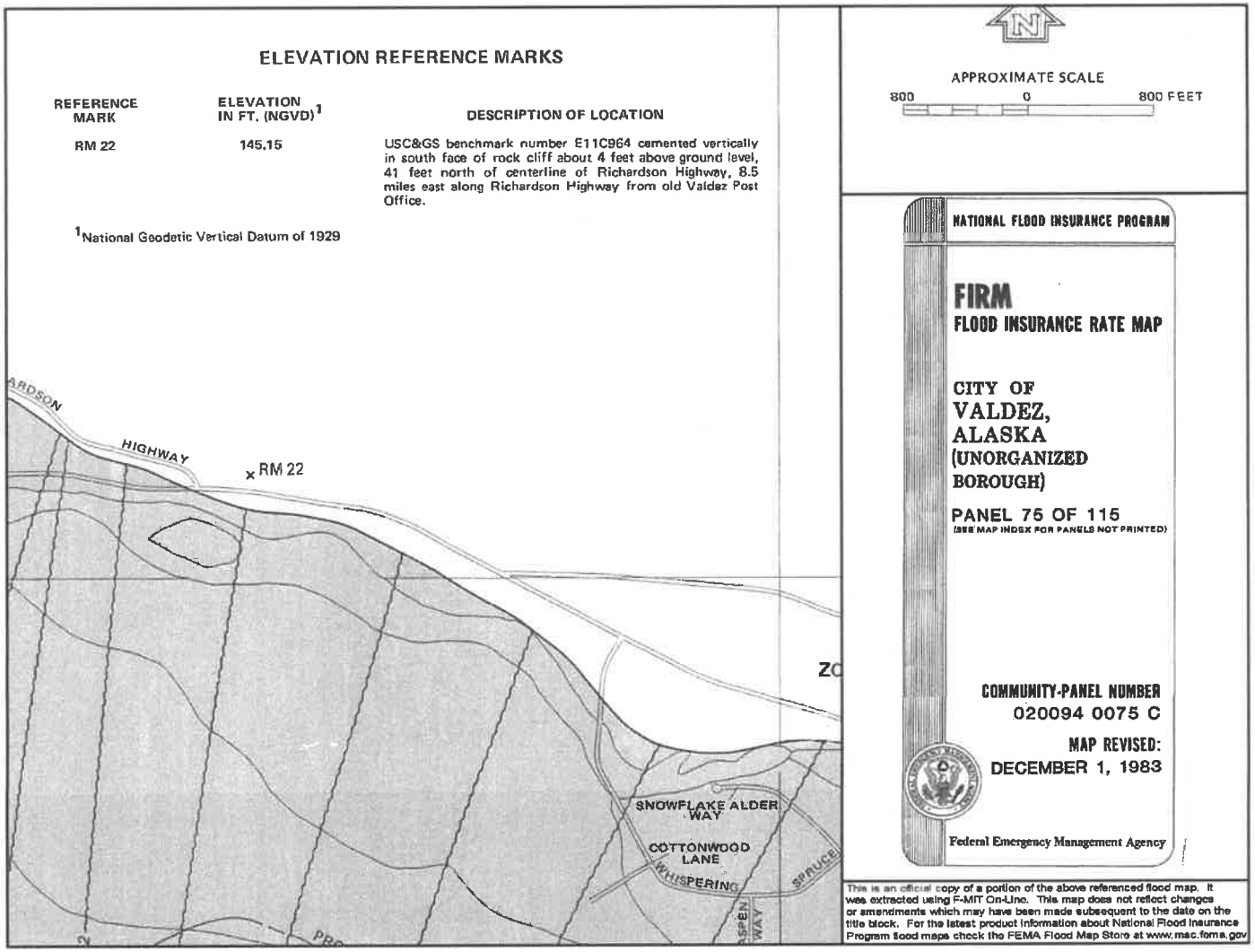
Groins: Groins are dikes extending from the bank of the river to a specified distance, which may usually be up to the normal waterline. They are constructed to protect the bank against erosion or to control channel meanders. Groins are more effective when constructed in series. They may be oriented perpendicular to the bank or at angles inclined slightly upstream or downstream (from Prakash, 2004).

Appendix 4-Cross-section Coordinates

Table 7. Major cross-section endpoints, in Alaska State Plane coordinates. Cross-sections are viewed looking downstream.

Cross-section	Left Endpoint		Right Endpoint	
	Northing (ft)	Easting (ft)	Northing (ft)	Easting (ft)
0.0	2576792	1632277	2581380	1635435
1.0	2576297	1633177	2580948	1636378
2.0	2576446	1634353	2580672	1637260
3.0	2576672	1635029	2580642	1637375
4.0	2575922	1636358	2580561	1637679
5.0	2575438	1637392	2580347	1638786
6.0	2575434	1638313	2580255	1639686
7.0	2575003	1639258	2580214	1640740
8.0	2574860	1640308	2580161	1641817
9.0	2574737	1641457	2580117	1642995

Appendix 5-Elevation Reference for Cross-section Survey



Community Development Dept.
January 28, 1991

Property Owners Alpine Woods/Nordic Subdivision:

On January 22, 1991 the Valdez City Council took action to accept the Lowe River Stabilization/Relocation Study. In accepting the study the City Council also accepted the preferred alternative for providing flood control protection to the Alpine Woods/Nordic Subdivision as was recommended by the plans author, CH2M Hill, Inc.

By adopting this preferred alternative the City will now have a plan from which to proceed providing protection to the property in the Alpine Woods/Nordic Subdivision area.

If you should have any questions concerning the City Council's actions or the preferred alternative as outlined in the plan do not hesitate to call me.

Sincerely,

David Denged
David Denged
Director of Community Development

DD/cls
#51FloodCC.J28

P.O. BOX 307 • VALDEZ, ALASKA 99686
TELEPHONE (907) 835-4313 • TELEX 25-381 • TELECOPIER (907) 835-2992

TECHNICAL NOTE - OPTION 2
DIKE CONNECTING THE OPTION 1 DIKE AND THE GROIN 1 DIKE

A2.1 At the present time there is risk that flood water will overtop the right bank along the recently placed rock riprap. The downstream Groin 1 dike has been raised to an acceptable height for now and it is proposed by Option 2 to provide a similar height of dike between Groin 1 and the proposed Option 1 dike.

A2.2 The length of new dike will be about 390 ft. It is to be aligned along the recently placed riprap for a distance of about 150 ft (upstream end) such that its sideslope on the river side merges smoothly with the armored bank. Thereafter, the dike alignment is to be shifted away from the bank, directly towards the upstream end of the Groin 1 dike. Some trees will have to be removed to accommodate the downstream end of the dike.

A2.3 Figure A2 provides a conceptual design for the proposed Option 2 dike.

A2.4 Design parameters:

- The dike section can be constructed of pitrun gravel, alluvial material or quarry reject material, whichever is most economic.
- The design top of dike is El. 187.5 and 184.0 ft at the upstream and downstream ends, respectively.
- The dike sideslope facing the river shall be covered by a minimum 2 ft thick layer of coarse quarry reject material. Sizes of this material should be in the range of 4 to 10 in.

anc:prj2:004.51

- The floodplain area between the dike and armored bank, to the end of the recently placed riprap, must be provided with a 1 ft thick layer of quarry reject material similar in size to that specified above for the dike sideslope. In addition to this, a 9 ft wide mound of riprap material should be placed between the river bank and dike. The riprap mound should be located near the bend in the dike, near the downstream end of the armored bank. The mound should be aligned perpendicular to the bank and dike. This riprap mound is to be equal in height to the dike and graded down to top of river bank level, sloping towards the river.

TECHNICAL NOTE - OPTION 3
UPGRADE RIPRAP UPSTREAM OF THE GROIN 1 DIKE

A3.1 Approximately 200 feet of river bank has recently been armored upstream of the Groin 1 dike. As construction activity took place under somewhat emergency conditions, placement procedures used for the stone did not include monitoring of stone gradation, durability or rate of placement. Based on the number of truckloads reported by the City, the rate of rock placement along the bank averaged about 4 cubic yards per foot, which by itself suggests that an acceptable volume of rock was placed. However, a site inspection revealed some possible gaps in the riprap where there is an inadequate quantity of rock.

A3.2 The procedure to be adopted by the construction inspector requires that he carefully inspect the 200 ft of armored bank to assess where there are shortages of rock. Additional rock is to be placed in these areas. As part of this process, the inspector must conduct a sampling of rocks to establish the size gradation of the existing riprap material. The 'by-number' procedure of sampling and analyzing has been described to City personnel. If this sampling indicates that rock sizes are significantly too small, then large rock will have to be added to increase the overall size gradation. This process will require considerable judgement on the part of the inspector. It is not possible to establish at this time the quantity of additional rock needed, but for costing it has been assumed that 100 to 150 cubic yards will be required.

A3.3 The rock gradation required is to be the same as for Option 1 (Class III).

TECHNICAL NOTE - OPTION 4
RAISE THE LEVEL OF GROIN 2 AND ITS ATTACHED DIKE

A4.1 Groin 2 needs to be raised at least 2 ft, on average. Surveys show there to be a considerable number of undulations along the top of the grain. These need to be eliminated as the groin is raised. The upstream end of Groin 2 and the attached dike were raised in the last two years to prevent overtopping and downstream flooding. The left side of the dike and upstream portion of the groin are about 1.5 feet higher than their right sides. The recently added fill consists of rounded gravel and cobbles.

A4.2 Figure A3 provides a plan of Groin 2, the location of 3 surveyed embankment sections, plots of these sections, and recommended raised profiles.

A4.3 Approximately 2500 cubic yards of embankment would be required to raise the groin by an average of 2 ft.

A4.4 Design parameters:

- Embankment material should consist of reject quarry material that has a large percentage of coarse sizes (4 to 10 in).

- Embankment material should be placed such that none will spill over the existing sideslopes of the groin. This will conserve material and may reduce or eliminate any permitting requirements.

A4.5 If budgetary factors prevent the full implementation of this option, then at the very least the depressed portions of the embankment should be raised by no less than 1 ft. In general, if the selection of areas has to be prioritized, then the raising process should first proceed from Section A-A (Figure A3) downstream to about Section B-B, then upstream from section A-A towards the upstream end of the groin, and finally downstream from section B-B to the end of the groin.

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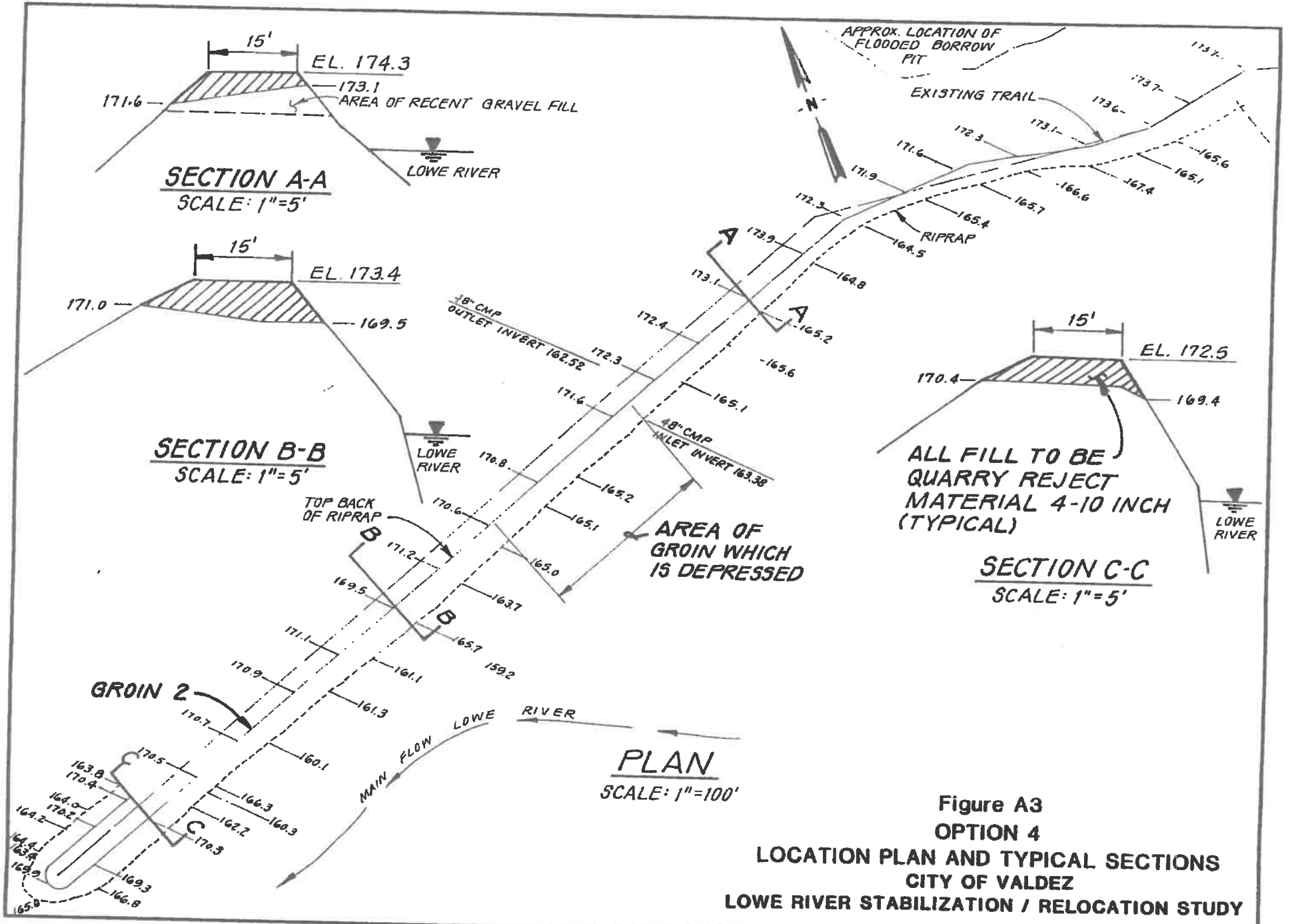

Figure A3
OPTION 4
LOCATION PLAN AND TYPICAL SECTIONS
CITY OF VALDEZ
LOWE RIVER STABILIZATION / RELOCATION STUDY

CH2M HILL

TECHNICAL NOTE - OPTION 5
REPAIR GROIN 2 RIPRAP ARMOR AT ITS DOWNSTREAM END

A5.1 The objective is to upgrade the rock armor at and near the nose of Groin 2 on the left side, facing the river. Field measurements indicate that the rock sizes are significantly below specification (Class III) for the entire groin, but for this short term program it is only necessary to upgrade the rock on the groin's left face in a section extending from the groin nose to 100 ft upstream of the nose. This section of rock has been judged to be the most vulnerable at this time.

A5.2 It will be the responsibility of the construction inspector to establish what portions of the armor layer need to be upgraded. This will first require an inspection of the rock to determine where material has obviously been eroded away by river flows. Because of high water it will be difficult to establish whether this eroded material remains in the vicinity of the groin. The following procedure is recommended to assist the inspector's work:

- Assume 150 cubic yards of rock will be used for the upgrading effort.
- Only rock sizes equal to and larger than the 50% size (700 lbs or 17 in) will be used.
- Gaps in the armor layer are to be filled as the first part of this option; all remaining rock is then to be placed along the toe of the groin to develop a sideslope of 2(H):1(V) or less. This process should begin at the groin nose and proceed upstream.
- Coarser quarry reject material should be used to fill in the interstices of the armor layer until a reasonably smooth surface on the 2(H):1(V) slope is attained.

TECHNICAL NOTE - OPTION 6
IMPROVE THE EXISTING DIKE BETWEEN GROINS 1 AND 2

A6.1 Approximately 450 ft of existing dike is to be raised; the location of this dike is immediately upstream of Groin 2. The purpose of this dike is to reduce the potential for flood-waters to bypass Groin 2 via the subdivision. In the long term it may be necessary to extend this dike upstream to connect with Groin 1.

A6.2 Figure A4 provides a plan and conceptual design for Option 6.

A6.3 Design parameters:

- Material to be used for the raised embankment portion may be pitrun gravel, alluvial material or quarry reject material.
- Material may be placed directly on top of the existing dike. Limit the amount of material spilling over the existing dike sideslopes.
- The design top of raised dike shall be El. 175 and 177.5 ft at the downstream and upstream ends, respectively.

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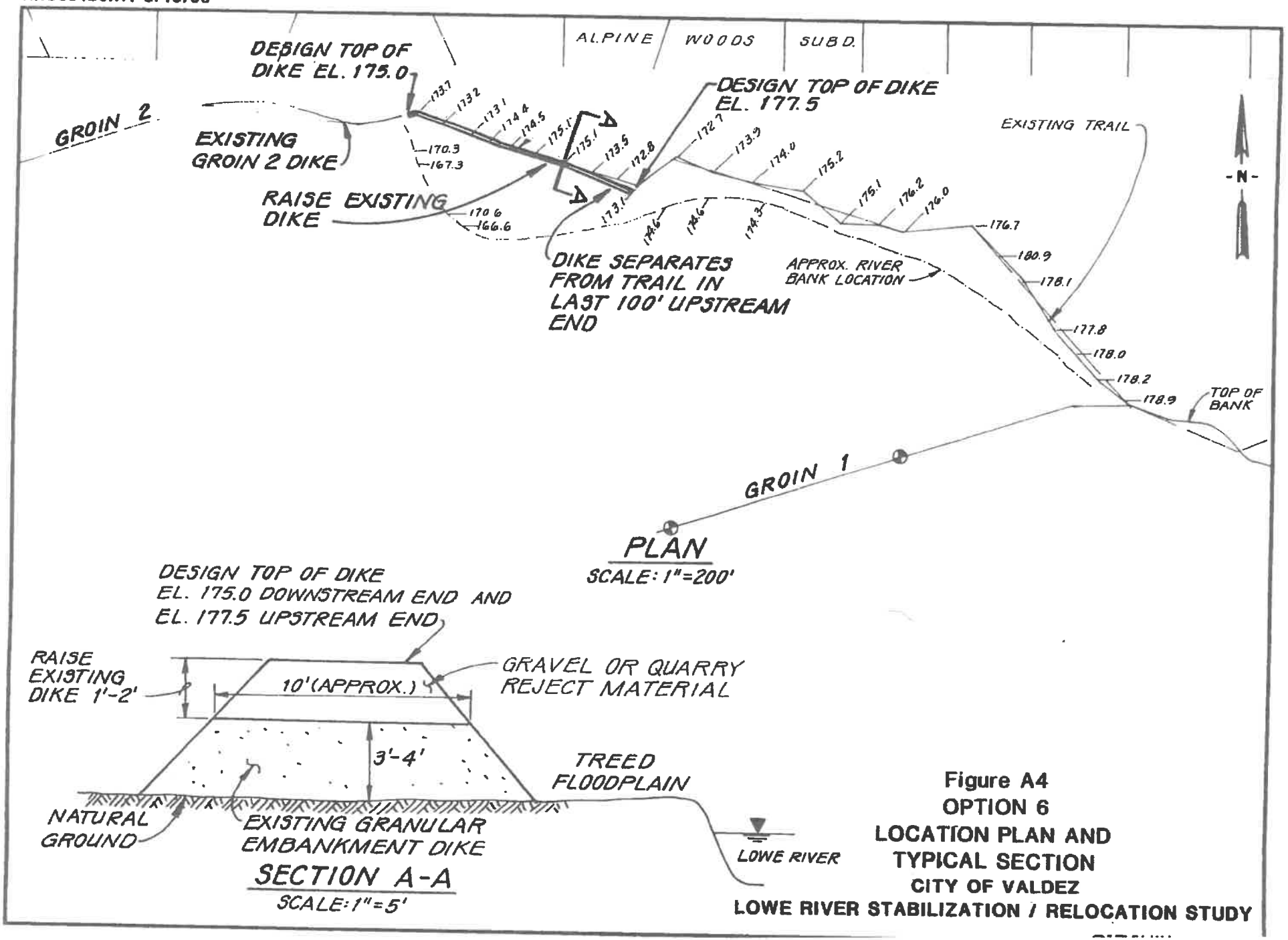


Figure A4
OPTION 6
LOCATION PLAN AND TYPICAL SECTION
CITY OF VALDEZ
LOWE RIVER STABILIZATION / RELOCATION STUDY

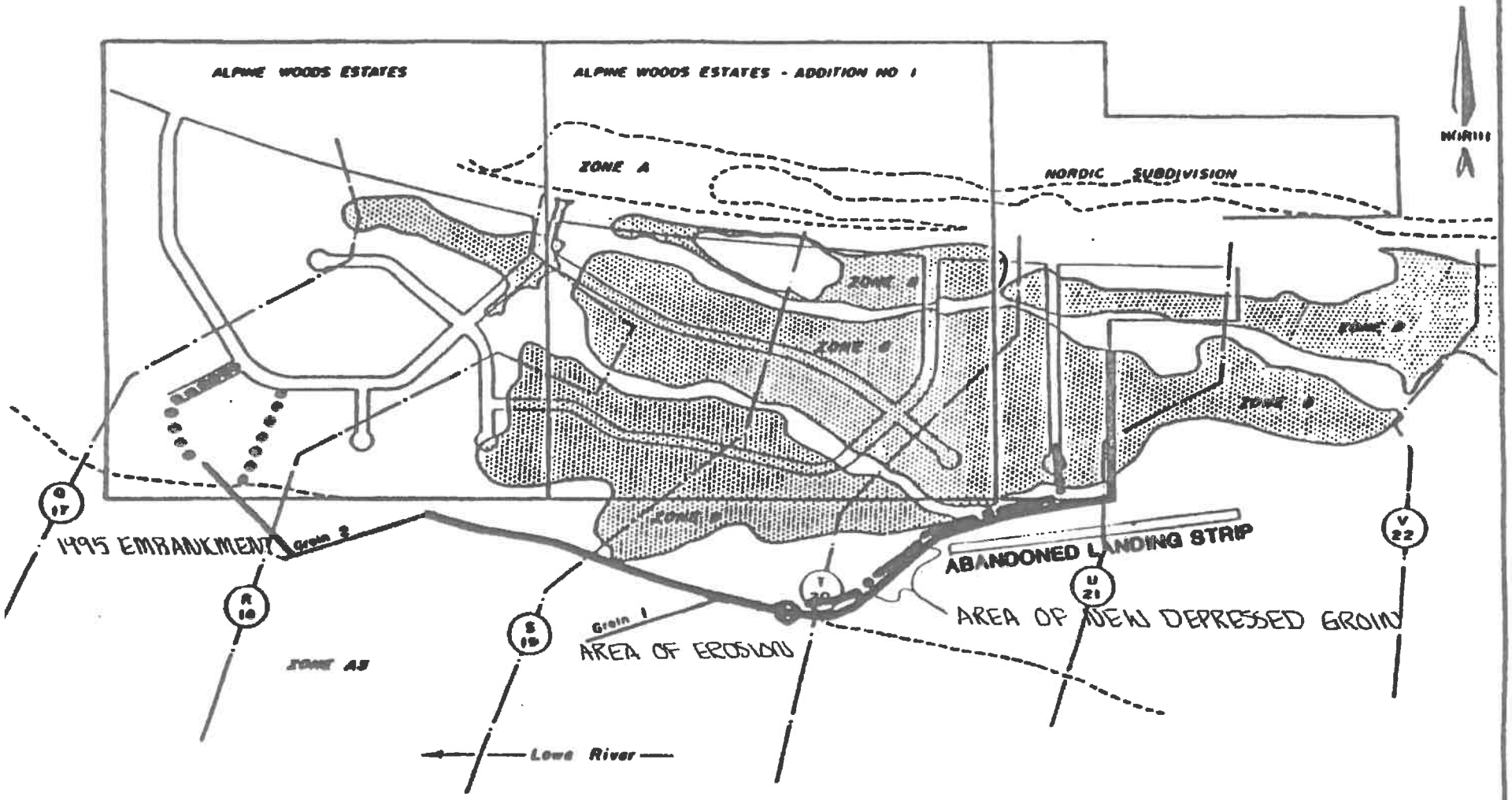
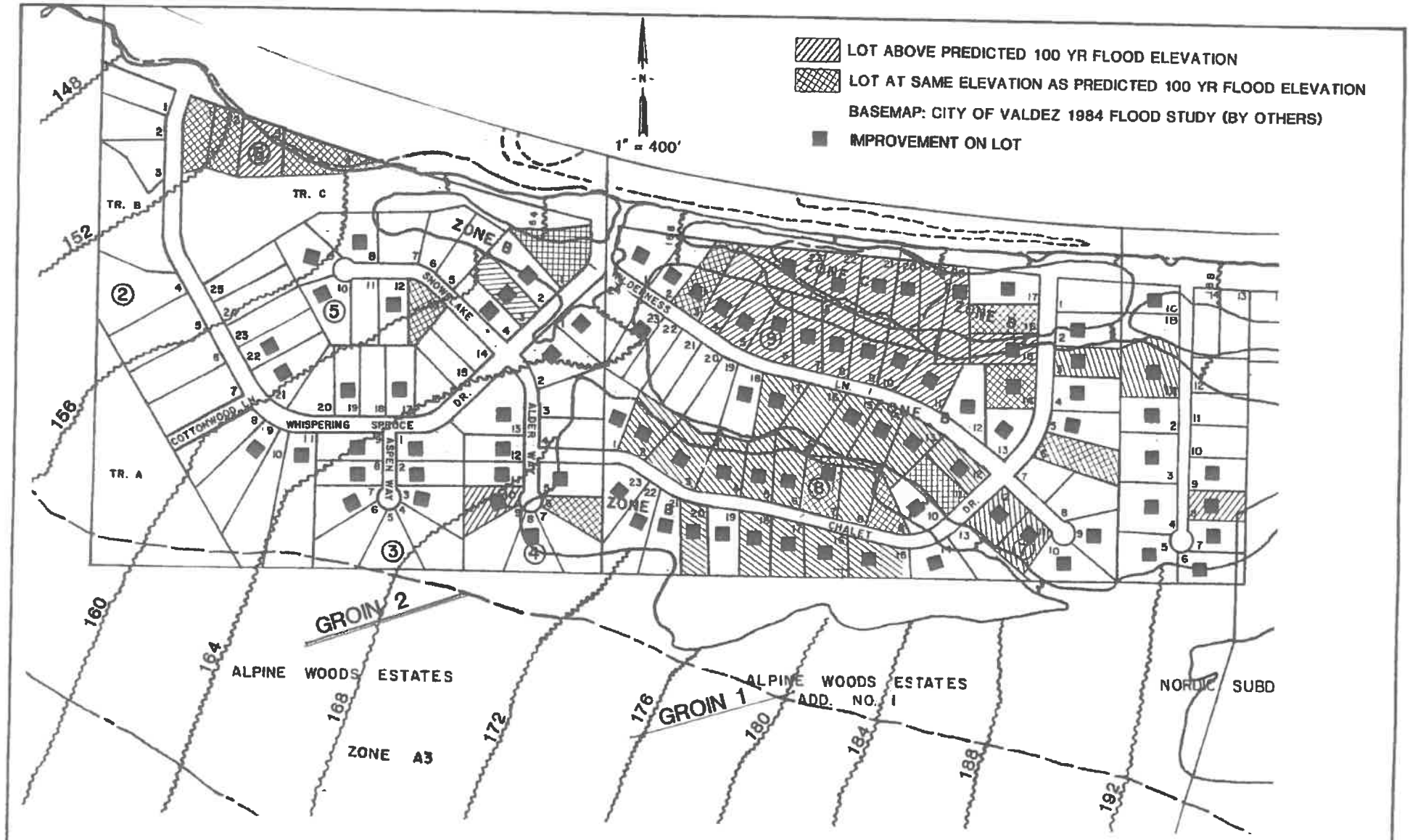


FIGURE A3

CITY OF VALDEZ

RECOMMENDED PLAN

CH2MHILL



SEPT 1990 ANC30126.A0

FIGURE 1

Sent to attorney
12-12

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
P.O. BOX 898
ANCHORAGE, ALASKA 99506-0898

5-10-91

REPLY TO ATTENTION OF:

Regulatory Branch
Permit Processing Section

PERMITTEE: City of Valdez

EFFECTIVE DATE: MAY 6 [redacted]

REFERENCE NO. 0-850414
Lowe River 18

DEPARTMENT OF THE ARMY
PERMIT MODIFICATION

Department of the Army permit No. 4-850414, Lowe River 18, was issued to the City of Valdez on August 9, 1985, to:

> "place approximately 5,000 cubic yards (cy) of gravel and 2,400 cy of riprap to construct a 500' long diversion dike, remove approximately 1,600 cy of gravel bar material to construct a 450-foot-long diversion channel in the Lowe River, and stockpile 50-75 cy of riprap at the site to replace rock eroded away from the toe of the diversion dike, approximately 1,000' south of Whispering Spruce Drive and Aspen Way intersection, Alpine Woods Estates Subdivision, in Valdez, Alaska."

The permit was modified (M-850414) on May 13, 1986 to:

> "retain a 300' extension to the existing diversion dike; place approximately 4,200 cubic yards (cy) of rock riprap and 7,300 cy of adjacent gravel bar material and construct a 700' long diversion dike east of the existing dike; place approximately 1,600 cy of gravel and 3,000 cy of rock riprap along a 1,100' area for bank protection upstream of the new diversion dike; and place 1,100 cy of gravel bar material and 750 cy of quarry waste along a 450' area to provide bank protection downstream of the existing diversion dike, to provide flood protection."

A subsequent modification (N-850414) issued August 8, 1988 authorized:

> "the discharge of approximately 1,500 cy of shot rock and armor rock below the ordinary high water mark to construct four channel control groins. The footprint dimensions of each groin would measure approximately 60-70' in length and 10-12' in width."

Pursuant to your request dated December 4, 1990, the permit is hereby modified as follows:

> "to place additional riprap along a 200' section of shoreline, construct a 425' long dike, and a 150' long depressed groin/dike. Approximately 400 cy of riprap will be placed along a 200' section of shoreline to reinforce existing riprap. Approximately 780 cy of quarry reject material and 30 cy of riprap will be used to construct a 425' long dike located between the existing dike and the proposed depressed groin/dike. To construct the 150' long depressed groin/dike, approximately 360 cy of riprap will be placed in the trench to construct the depressed groin. The purpose of the project is to improve flood control protection for the Alpine Woods Subdivision."

The following special condition has been added to the permit and applies to the work authorized by this modification:

> "That all inwater work shall occur during the period of May 15 through July 15."

This authorization and the enclosed plans in 3 sheets will now become part of the permit. All other terms and conditions of the original permit and subsequent modifications, except for the time limit, remain in full force and effect. Condition (o) of your Department of the Army permit is hereby amended to read as follows:

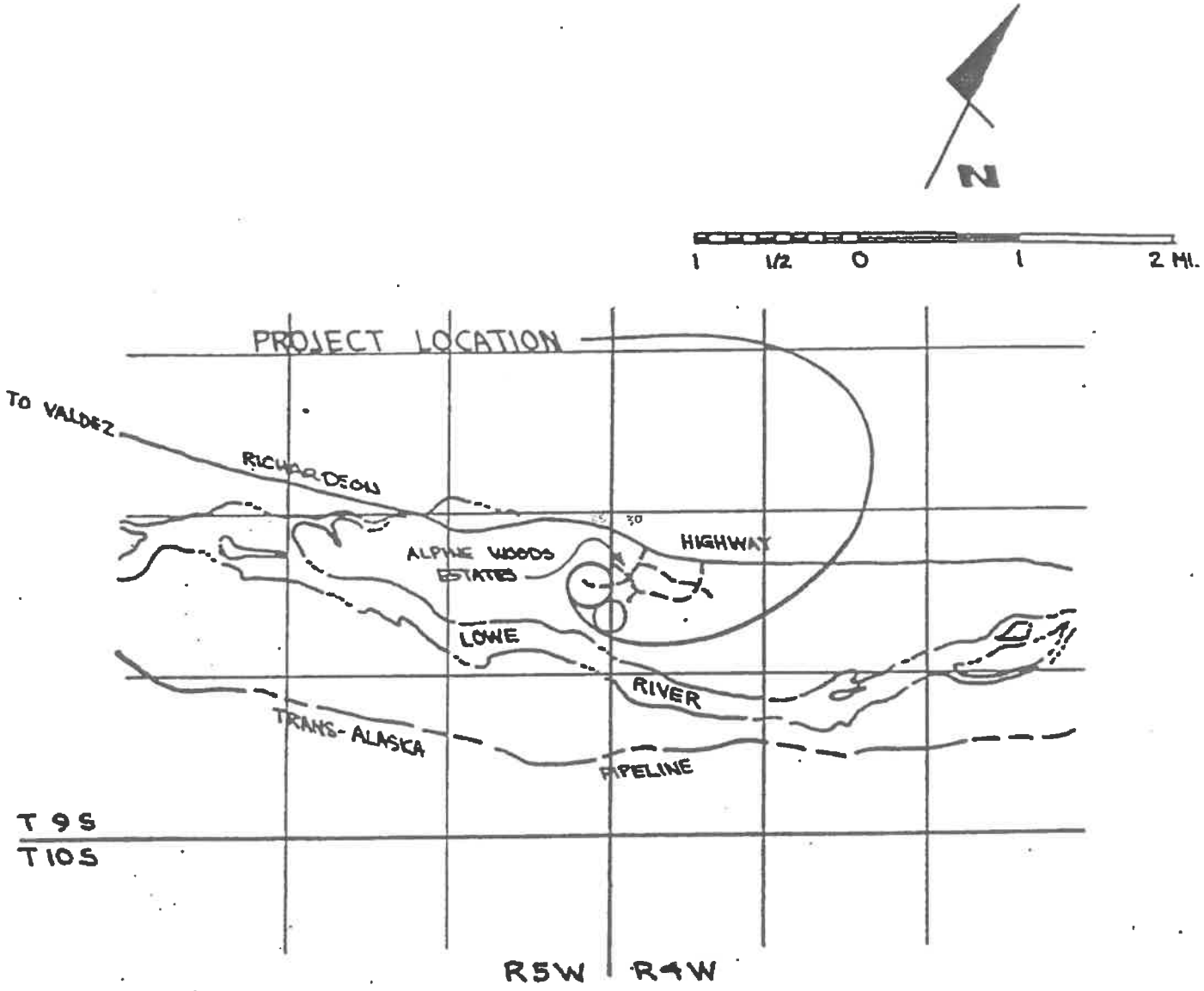
> "That if the activity authorized herein is not completed on or before the 31 day of May 1994 this permit, if not previously revoked or specifically extended, shall automatically expire."

This authorization and the enclosed plans should be attached to the original permit. Also, enclosed is a Notice of Authorization which should be posted in a prominent location near the authorized work.

BY AUTHORITY OF THE SECRETARY OF THE ARMY:

Kevin D. Morgan
Chief, Southern Unit
Permit Processing Section

Enclosure



O-850414

VICINITY MAP

CITY OF VALDEZ
ALPINE WOODS FLOOD CONTROL

IN: LOWE RIVER DRAINAGE SYSTEM
AT: VALDEZ, ALASKA
APPLICATION BY: CITY OF VALDEZ

Sheet 1 of 2

ANC30126.A1 8/15/90

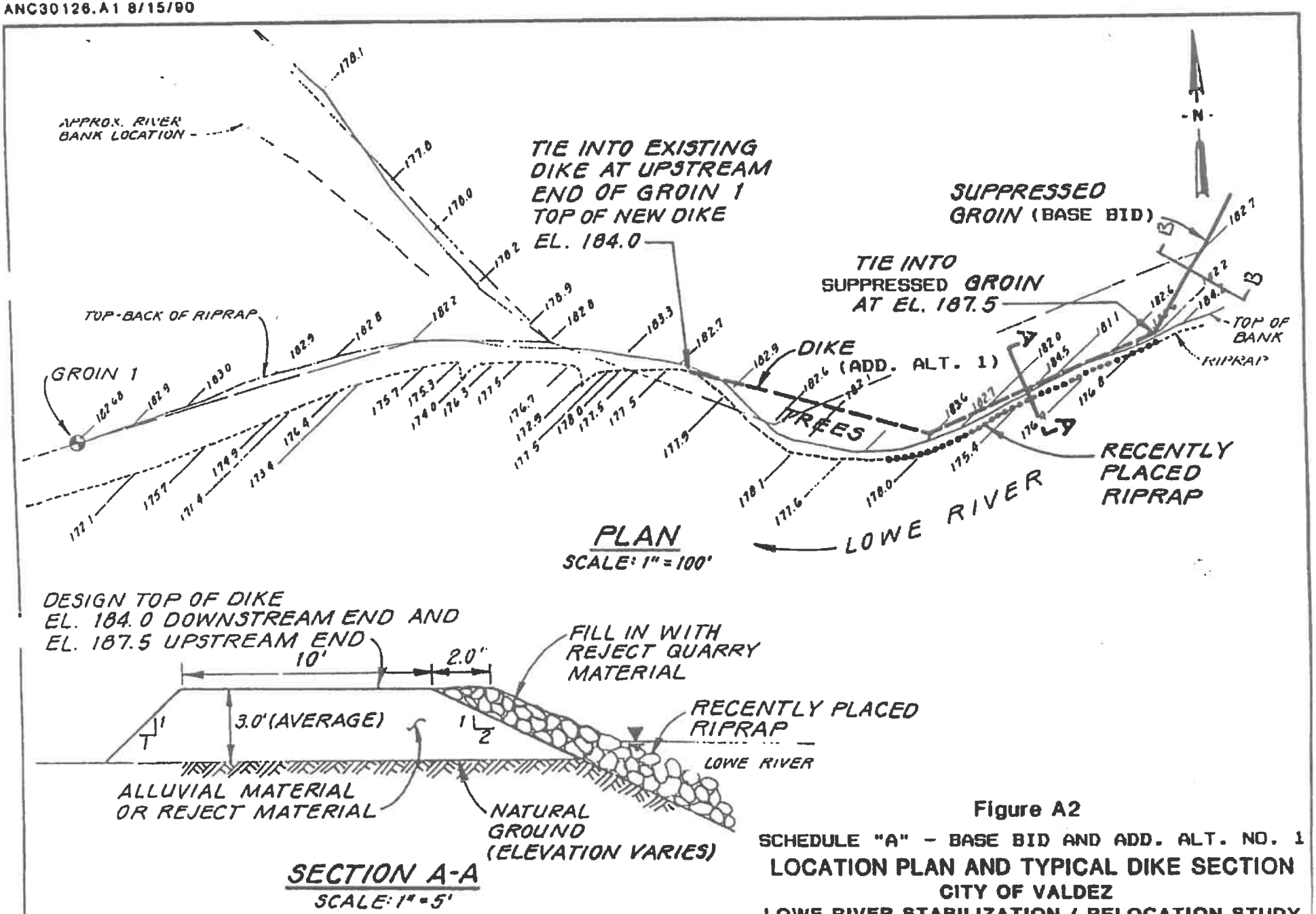


Figure A2

SCHEDULE "A" – BASE BID AND ADD. ALT. NO. 1

LOCATION PLAN AND TYPICAL DIKE SECTION

CITY OF VALDEZ

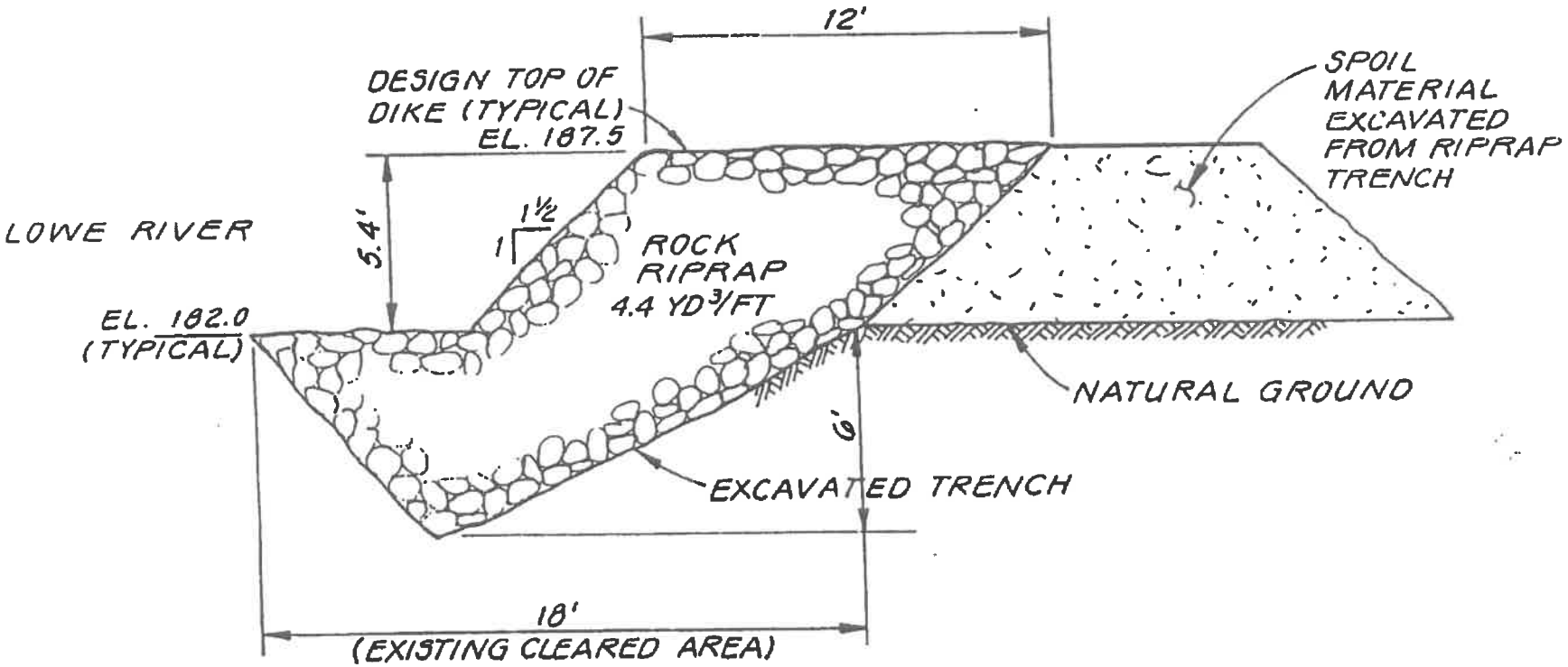
LOWE RIVER STABILIZATION / RELOCATION STUDY

CH2MHILL

Lowe River 18 0-850414

Sheet 2 of 3

ANC30126.A1 8/15/90



DEPRESSED GROIN TYPICAL SECTION

SCALE: 1"=5'

SECTION B-B

Figure A1

SCHEDULE "A" - BASE BID

DEPRESSED GROIN TYPICAL SECTION

CITY OF VALDEZ

LOWE RIVER STABILIZATION / RELOCATION STUDY

CRM HILL

Lowe River 18 0-850414 Sheet 3 of 3

OFFICE OF ADMINISTRATION
February 12, 1986

Alaska Department of Natural Resources
Division of Land and Water Management
South Central Region
3601 'C' Street, Pouch 7-005
Anchorage, Alaska 99510-7005
Attn: Margaret J. Hayes, Regional Manager

Dear Ms. Hayes:

Re: Lowe River Flood Control
City of Valdez, Alpine Woods Estates Subdivision

The City of Valdez requests that the Alaska Department of Natural Resources process the two attached material applications for approximately 10,000 cubic yards of gravel bar material and 7,800 cubic yards of rock riprap for the construction of a diversion dike with upstream bank protection and bank protection downstream of the existing diversion dike (constructed in 1985) to provide protection of the subdivision up to the 100-year flood.

City staff presented various alternatives and costs to the City council on October 7, 1985, to solve the problem of encroachment and flooding of the subdivision by the Lowe River. The City council was advised at that time of the legal considerations associated with the various alternatives.

Although the Valdez City council has not formally adopted a policy addressing the flooding and river encroachment problem at Alpine Woods Estates Subdivision, council has appropriated $200,000 in 1985 and $250,000 in 1986 for construction of additional flood-control facilities at the subdivision.

The proposed 1986 project is anticipated to control flooding and encroachment for the foreseeable future.

The City of Valdez also requests that the Alaska Department of Natural Resources process the attached application for right-of-way permit for both the existing diversion dike and the proposed 1986 diversion dike with upstream bank protection. The City currently possesses Land Use Permit SCR 86-019 which expires August 15, 1986 for the existing dike.

per Pinol Patterson, DNR in Anch.
3-6-86, DNR rec'd. this w/encl.
2-26-86

xc COE 4-1-86

The right-of-way centerline as shown on the enclosed plat was determined graphically by plotting the location of the existing and proposed improvements on a 1" = 200' scale topography map. The right-of-way widths are tabulated for each course on the plat as follows:

50' ROW: Access route to the existing dike and proposed dike with upstream bank protection;

100' ROW: Site of proposed upstream bank protection for 1986 diversion dike;

200' ROW: Site of existing and proposed diversion dike. The dike right-of-way centerline shown is a 50' offset upstream from the top of the dike embankment centerline.

It is the City's intent to advertise for bids in mid-March with construction activity beginning when the river can be entered in accord with the Alaska Department of Fish and Game permit requirements.

Please contact Mr. John F. Thorp, P.E., City Engineer, at 835-4313, extension 221, if additional information is required. Your consideration is greatly appreciated.

Respectfully,

Jim Watson

Jim Watson
City Manager

JW:PAU:jd
pau

Attachments: DNR R/W Permit Application w/plat
177 DNR Material Applications (2)
COE, DA 404 Permit Application
CMZ Questionnaire

154AKDNRLTR.JW

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF LANDS

ADL _____

APPLICATION FOR RIGHT-OF-WAY PERMIT

DATE _____

The undersigned City of Valdez residing at Valdez, Alaska hereby applies to the Director of the Division of Lands, Department of Natural Resources, for Rights-of-Way, the centerlines, widths, lengths and location within Township 9 South, Copper River Meridian, of which are shown on the plat attached hereto, in triplicate copies, as follows:

Right-of-Way 1, for the purpose of providing access to, and operating and maintaining thereon, the existing 1985 diversion dike and diversion channel, construction completed October 2, 1985, DNR Land Use Permit SCR 86-019.

Right-of-Way 2, for the purpose of providing construction, operation and maintenance access to, and constructing, operating and maintaining thereon, the proposed 1986 diversion dike with upstream bank protection, containing an area of 8 acres.

State briefly the standards of construction of proposed improvements:

D-8 Caterpillar tractor with blade to push-up gravel bar material for dike and bank protection embankments; end/belly dump trucks to place rip-rap.

Construction R/W 1 Aug.-Oct. 1985 Construction to begin R/W 2: April 1986

To be completed R/W 2: May 1985 (Four week construction period)

If this application is approved, I agree to construct and maintain the improvements authorized in a workmanlike manner, to keep the area in a neat and sanitary condition; if said right-of-way is to be constructed across leased lands, I agree to reimburse the lessee for all damages to crops and improvements, to the extent of the fair market value thereof, which may be damaged or destroyed as the result of the construction of said right-of-way, and to comply with all the laws, rules and regulations pertaining thereto: and *provided further that upon termination or relocation of the Right-of-Way for which application is herein made, I agree to remove or relocate the improvements and restore the area without cost to the State and to the satisfaction of the Director.

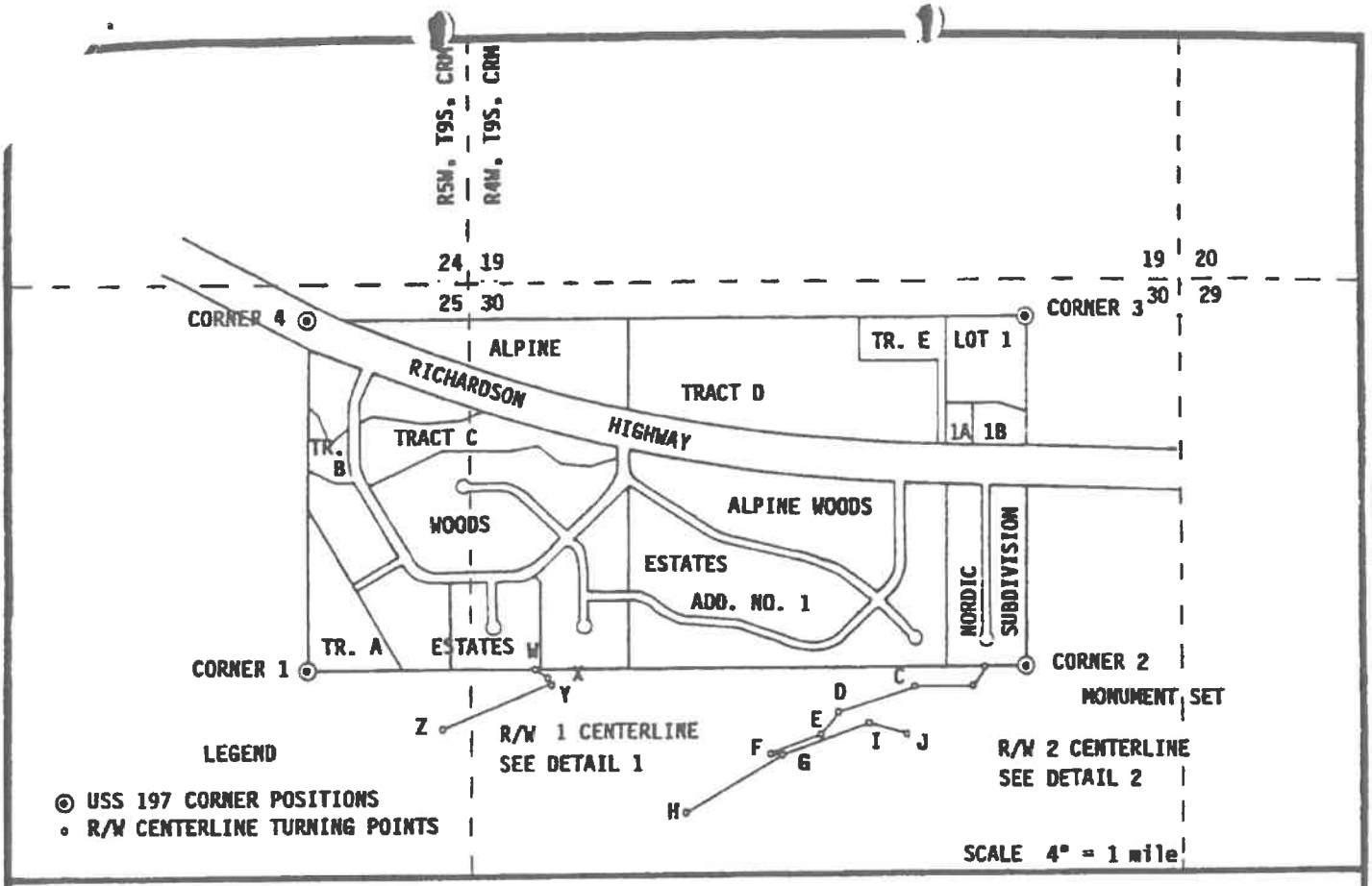
Signature of Applicant
Jim Watson, City Manager

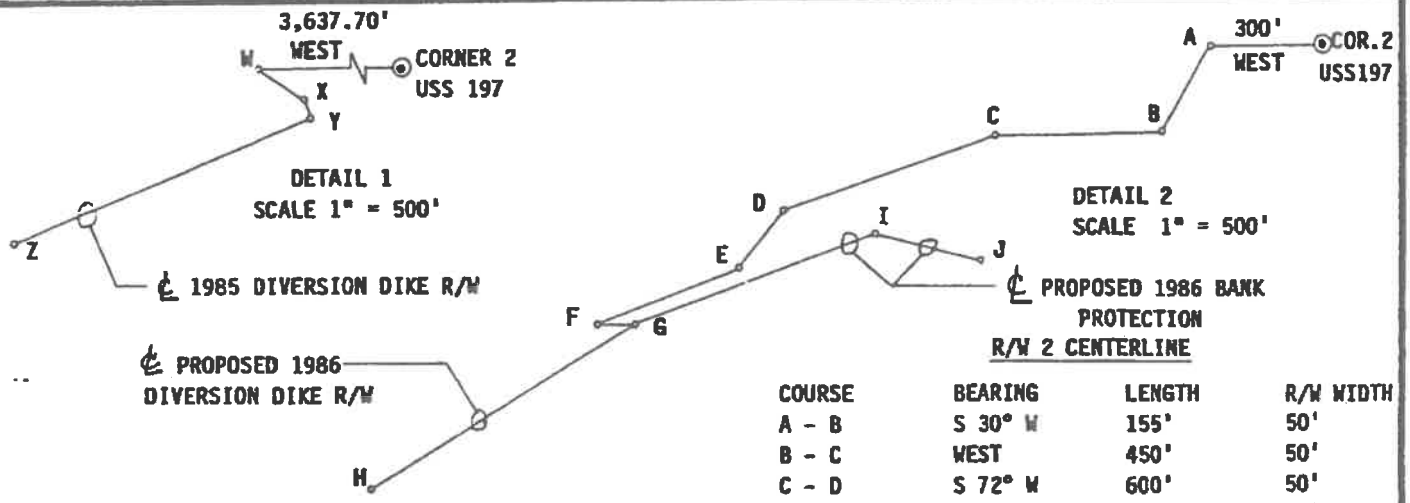
(Instructions for preparation of plat: Attach a copy of a letter-size plat, show centerline and boundaries of right-of-way, who ties from centerline to established monuments and section corners, show conflicts with other rights-of-way, if any, scale 3"-4" per mile, type of survey.)

*Not applicable to State Agencies.

10-112 (75)
11/84

pau





R/W 1 CENTERLINE

COURSE	BEARING	LENGTH	R/W WIDTH
W - X	S 59° E	145'	50'
X - Y	S 22° E	50'	50'
Y - Z	S 68° W	850'	200'

R/W 2 CENTERLINE

COURSE	BEARING	LENGTH	R/W WIDTH
A - B	S 30° W	155'	50'
B - C	WEST	450'	50'
C - D	S 72° W	600'	50'
D - E	S 40° W	200'	50'
E - F	S 70° W	400'	50'
F - G	EAST	100'	50'
G - H	S 59° W	835'	200'
G - I	N 70° E	680'	100'
I - J	S 75° E	300'	100'

LEGEND

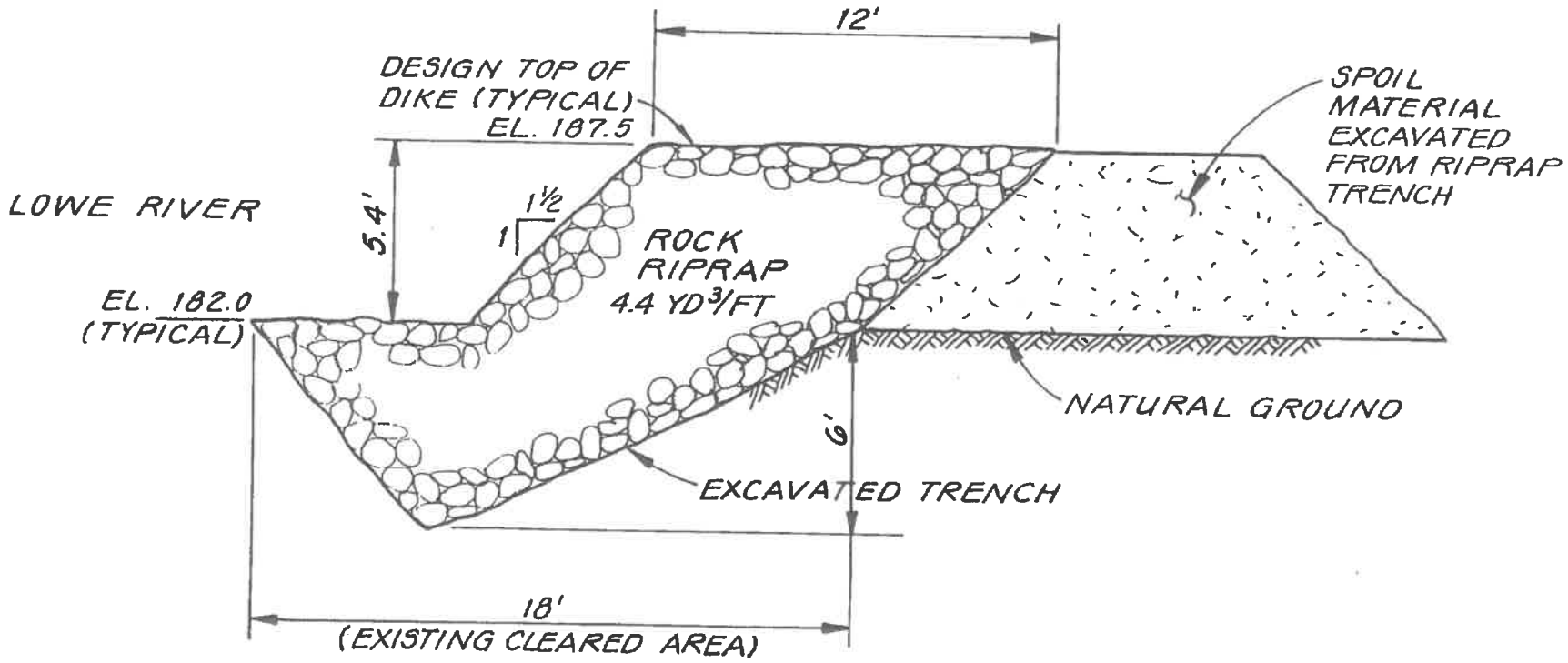
USS 197 CORNER 2, MONUMENT SET
R/W CENTERLINE TURNING POINTS

City of Tulsa

ALPINE WOODS FLOOD CONTROL
R/W 1 - 1985 DIVERSION DIKE & ACCESS
R/W 2 - 1986 DIVERSION DIKE, BANK PROTECTION & ACCESS
R/W PROCUREMENT, GRAPHIC SURVEY
PROJECTS 85805, 86805

DESIGN	DRAWN	CHECK	SCALE	DATE	SHEET NO. OF
	PAU	JFT	AS NOTED	1-31-86	1 / 1

ANC30126.A1 8/15/90



DEPRESSED GROIN TYPICAL SECTION

SCALE: 1"=5'

Figure A1

OPTION 1

DEPRESSED GROIN TYPICAL SECTION

CITY OF VALDEZ

LOWE RIVER STABILIZATION / RELOCATION STUDY

CH2MHILL

- Rock used should be blocky in shape to resist erosion forces. It must not have a shape which is overly platy or elongated (generally, the length dimension of a stone should not be greater than 3 times its thickness dimension). Rock must have a specific gravity of no less than 2.3, and it should not be susceptible to easy weathering or fracturing. The typical Keystone canyon slide material should not be used since it is very susceptible to weathering.

- Design elevation for the top of rock/dike has been established as El. 187.5 ft; this elevation can be maintained for the full length of structure.

- As a general condition, no further tree cover should be removed from the area between the proposed groin and the right river bank. Any vegetation cover tends to retard erosion and reduce overbank flow velocity.

MEMO

TO: ALPINE WOODS FLOOD CONTROL TASK GROUP

FROM: DIRECTOR OF COMMUNITY DEVELOPMENT Dave

DATE: MAY 25, 1990

Attached is a letter I received from Floyd Damron of CH2M Hill. Mr Damron"s letter makes some recommendations as to what actions the City could take this summer to mitigate potential flooding this fall.

The order-of-magnitude costs to complete all five projects is $87,000 to $143,000. I have asked Mr. Damron's office to list the projects by priority. The City presently has approximately $60,000 remaining in the Flood Control Capital Improvements Project fund. Unless the Council appropriates more money, only one or two of the recommended projects will be able to be accomplished in 1991.

The adminsitration will be working on a recommendation next week. The recommneation will be presented to the City Council at the June 4th meeting. I would like to schedule a meeting of the Task Group for Wednesday, May 30th at 7:30 PM at the Alpine Woods Fire Station. I will have more information as to which of the recommended projects area a higher priority.

If you are unable to attend but would like to comment on the recommendations give me a call.

P.O. BOX 307 • VALDEZ, ALASKA 99686
TELEPHONE (907) 835-4313 • TELEX 25-381 • TELECOPIER (907) 835-2992

Engineers
Planners
Economists
Scientists

May 24, 1990

ANC30126.A0

Mr. David Dengel, Director
Community Development Department
City of Valdez
P.O. Box 307
Valdez, Alaska 99686

Dear Mr. Dengel:

Subject: Lowe River Stabilization/Relocation Study
Task No. 8

This report was prepared as part of a preliminary effort to determine the need to provide Alpine Woods Estates and Nordic Subdivision with immediate, short-term flood and river control works along the Lowe River[1]. Northwest Hydraulic Consultants assisted in preparation of this letter report. Our assessment included a site visit and attendance at a public meeting involving the Alpine Woods Flood Protection Committee during the week of May 14, 1990. Future work will involve long-term solution analysis and reporting.

1. DESCRIPTION OF PROBLEM

The Alpine Woods Estates and Nordic Subdivision, in existence for about 15 years, occupy a portion of the Lowe River flood plain (Figure 1). the subject property has a variety of forest cover, with the older growth (75+ years) located in the northern half of the area. The newer tree growth in the southern half may be in the order of 35+ years. Within the subdivision area, south of the Richardson Highway, there are remnants of ancient Lowe River subchannels that can still carry flows at high flood levels.

[1]This part of the study is defined as Task 8 in the Scope of Work, "Recommended Gravel Extraction Methods."

Two problems face subdivision residents:

1. The threat of their properties being eroded away by shifting Lowe River subchannels; and

2. General flooding of the area.

The first problem has its greatest potential during low to intermediate floods (2- to 10-year flood events), when the larger subchannels reach near-bankfull. During this condition, these subchannels are prone to rapid erosion and migration of their banks. As old subchannels are intercepted, flood waters can enter into areas of the subdivision that might normally not have been flooded. This is possibly what occurred during the September 1988 flood.

General flooding of the subdivision, likely begins somewhere in the 10- to 20-year flood range. Figure 1 provides a flood plain map[2] showing predicted areas of complete inundation during a 100-year flood peak (identified as Zone A). During a 100-year flood, the Zone B areas are expected to experience pockets of flooding, principally within depressions and along ancient channels. General flooding of Zone B begins at some flood greater than the 100-year event. It is evident from Figure 1 that the westerly half of the subdivision is more prone to flooding than the easterly half.

Solutions to alleviating the above problems have been offered by several groups:

1. Woodward-Clyde Consultants[3] recommended a dike plus channel control (groins) system.

2. The U.S. Army Corps of Engineers (Alaska District)[4] considered as options river channelization, diking, or subdivision relocation (the latter option was recommended).

[2]Based on a 1983 flood plain study by Woodward-Clyde Consultants.

[3]*Alpine Woods Estates Flood Evaluation,* October 3, 1983.

[4]*Special Flood Hazard Report, Alpine Woods Estates Subdivision,* January 3, 1984.

3. Geomax, P.C. (Dr. Reichmuth)[5] proposed a systematic abandonment of flood prone properties, but recommends a detailed assessment first be made of channel stability and aggradational rates of the Lowe River.

To date, two long groins have been constructed at the locations shown on Figure 1. These structures were constructed during the period 1985-86 to prevent further encroachment of Lowe River subchannels into the Alpine Woods Estates subdivision. These structures have performed fairly well, but there have been some problems which became evident during the September 1988 flood when the downstream groin (No. 2) was nearly overtopped and outflanked. During this time, flooding also occurred at the westerly end of the subdivision. This was not a particularly severe flood, so local residents have expressed a concern that more needs to be done **immediately** to protect their properties.

2. LOWE RIVER

The Lowe River generally flows within a 3,500-foot-wide flood plain. It is a steep, heavily braided river that has an average longitudinal slope of 0.7 percent. This means the river drops an average of about 8-1/2 inches every 100 feet of downstream direction. The river reach of interest, as shown in Figure 2, extends from the west end of Keystone Canyon to the westerly end of the Alpine Woods Estates subdivision. Due to several factors within this reach, the active portion of the river is only about one half of the flood plain width. By "active width," we mean the portion of the flood plain that the active subchannels continuously occupy as compared to the remainder which floods only occasionally. Features which have acted to control the location of the active channel are as follows:

1. The Alaska Department of Transportation and Public Facilities (DOT&PF) dike at "A" on Figure 2, constructed about 35 years ago, forced the Lowe River through the Brown Creek alluvial fan and toward the south flood plain boundary. The river now flows in a relatively new channel and flows through an area narrower and more southerly than its natural course. The bedrock outcrop at "B", and possibly some entrenchment of the active channels, has resulted in the north half of the flood plain becoming less "floodable." Consequently, a dense new tree cover has become established in this area.

[5] *Evaluation of Stream Stability in the Valdez, Alaska Area,* July 27, 1989.

2. From momentum and entrenchment effects, confinement of the active channel width is maintained to about "C." A cross section near this point (Section 22, Figure 3) shows ground levels near the entrenched segment at the south edge relative to the flood plain ground levels near the north edge. The situation upstream of "C" is such that, in the foreseeable future, it is highly unlikely that the Lowe River will be able to shift its active channel segment much north of its present location.

3. Downstream of "C," the river becomes much more braided. Several large subchannels are prominent in recent aerial photography, but a particularly large one, which begins at "C," crosses the active section and heads directly toward Alpine Woods. It is apparently this action that is the source of concern to subdivision residents. Reasons as to why the subchannel crossover occurs in this area are not clear at this time. Some may argue that the alluvial fan opposite the subdivision is acting to constrict and force channels to the north, but this is not likely, considering the steepness and large width of the river. Section 20 (Figure 3B) indicates that the north side of the active channel width (near mid-point of the section) is considerably lower than the south one. This condition may perhaps act to attract the primary flow paths to the north side but, again, considering the river's steepness, this is not considered likely.

Additional observations which can be made with respect to the Lowe River are as follows:

1. The opinion by some that the river bed is experiencing significant aggradation is not substantiated by available information. In fact, since the late 1950s, the reach upstream of the subdivisions, to Keystone Canyon, may have degraded below previous levels.

2. The sizes and pattern of subchannels can change substantially with intermediate and higher floods when flows break out of the primary subchannels and develop new ones. Areas under attack prior to such a flood may then become passed by as the attacking bend moves downstream.

3. Large floods, which reach bankfull in the primary subchannels, may enlarge these channels. This can cause them to begin shifting much more rapidly than before. This may be what occurred during the 1982 flood, which is estimated to have had a 2-year return period.

3. EXISTING STRUCTURES (GROINS)

As indicated previously, the two long groins constructed during 1985 -86 have the purpose of preventing further erosion of the river banks they are tied into. Length, spacing, and orientation of these structures are important in steep gravel streams. Problems typically arise when a large subchannel is given room to migrate into the area between structures. This can result in erosion of the tie-in bank and outflanking of the structure or overtopping of the groin shanks. Overtopping of the structure can also sometimes result when high bed levels immediately upstream of the groin nose causes water to pond along the structure's upstream side. In this case, it is necessary to provide an outflow route for a subchannel.

From an inspection of the groins on May 15, 1990, the following comments and tentative conclusions are offered:

1. The general concept is considered appropriate, but additional structures will be necessary before the system can be made to provide adequate protection for the subdivisions.

2. An additional groin may be required between the two existing ones. A large subchannel can presently migrate into the area upstream of each groin, providing the opportunity for direct and severe attack on the upstream face of each structure, or the river bank between structures.

3. A dike has not been provided between each groin, so there remains the opportunity for overbank flow to affect the westerly area of Alpine Woods Estates subdivision in somewhat the same manner as occurred in 1988.

4. We have not had the opportunity to check stone riprap sizes and volumes of rock placed along each groin. Visually, at least, quality of stone placement was considered good for Groin 1 and not quite so good for Groin 2. From photos and a video, it appears that the 1988 flood provided the structure with a reasonably good test. No major failures of the riprap were reported, although there was evidence of recent repair work along Groin 2.

5. Return channels were apparently excavated along the upstream sides of both groins, and these appeared to be working effectively. However, Groin 2 came close to being overtopped in 1988, and it was not a particularly severe flood event. There is no information at this time as to

the elevation of the top of this groin but, in principle, we believe that structure should be raised.

4. RISK TO SUBDIVISION

At the public meeting held in conjunction with the City of Valdez and the Alpine Woods Flood Protection Committee, residents expressed great concern that the Lowe River was making a concerted effort to shift into their subdivision. The near failure of Groin 2 and subsequent flooding of some residential properties during a not unusual 1988 flood have left them with a low level of confidence that the existing structures are adequate. Some strengthening of this groin was completed in the shank tie-in area during and immediately after the 1988 flood, but it is believed that potential for a flooding problem still remains.

The overall flood risk to the subdivision remains unchanged from the Woodward-Clyde study; Figure 1 provides an outline of flood risk zones. The existing groin system will probably have no significant impact in preventing flooding during the extreme events (20-year return period and higher), but the groin system can be made more effective in handling the smaller floods (2- to 10-year floods).

In the short term, the existing groin system will be effective in preventing migration of a large subchannel into the subdivision area. But, in the long term, there can be problems associated with frequent maintenance of the structures and outflanking (to the north) of the groin system.

5. PROGRAM FOR IMMEDIATE ACTION

The recommended program is as follows:

1. Raise the upstream end of Groin 1 by 1.5 feet, tapering it to the existing elevation at the nose.

2. Raise the upstream end of Groin 2 by 3 feet and the downstream end by 1.5 feet.

3. Construct a dike between the two groins.

4. Construct a 500-foot-long dike upstream of Groin 1.

Stock pile rock for breach

5. Add riprap to the existing structures where they are inadequate or in need of repair and extension.

This approach takes advantage of the existing flood protection and river channel control system and should function adequately for floods in the low to intermediate range (up to about the 10-year flood peak). Some of the properties at the westerly end of the subdivision may still experience flooding in this range of flows, but at least the area should have reduced risk from the threat of a breakthrough by a major subchannel. In the long term, this groin/dike system can be integrated into an expanded system which may be capable of protecting the entire subdivision from direct river attack during the 100-year flood event.

6. GRAVEL MINING

This task was originally intended to assess the feasibility of mining gravel in the active channel zone of the Lowe River with the idea that it may be possible to encourage the river to flow away from the subdivision or at least be of less threat. The subject of gravel mining was of great interest at the public meeting, largely as a result of comments and ideas previously put forth by Dr. Reichmuth. Our recommended program for immediate action does not include gravel mining for the following reasons:

1. An opinion was expressed by one resident that, if the river bed were lowered near the mouth (at the Dayville Road bridges), the lowered channel will work upstream several miles to the subdivision. It was felt that lower water levels and a controlled channel could be achieved at the subdivision through a mining program that started near the river's mouth.

   For practical reasons, a program such as the above will have to take place where the river is reasonably confined. In order to initiate channel degradation upstream of the excavation, it will be necessary to remove an amount of gravel much greater than the amount of gravel carried by the river. This could amount to perhaps 50,000 to 100,000 cubic yards per year, on average. Given enough years, the river bed upstream will degrade, but likely only over a short distance. Also, whether the excavation zone was selected to be upstream or downstream of the bridges, degradation of the bed at the bridges could jeopardize the foundations of the bridges. Moving the excavation zone further upstream is not considered feasible, as there are no areas where the Lowe River is sufficiently confined for this work to be effective.

2. Degradation of the river bed at the subdivision may also be achieved by mining gravel upstream near the outlet of Keystone Canyon. To make this work, similar amounts of gravel as indicated above will need to be removed every year. Many years of excavation will be required before anything significant to the river bed elevation develops in the subdivision area. After much work and expense, the degree of impact on flood levels may be insignificant. As well, the Alyeska bridge at Keystone Canyon could be jeopardized by excavation of river bed gravel in this area.

3. Excavation of a bypass channel opposite the subdivision was also considered. To make this work, a channel about the size of the largest subchannel should be excavated starting at a point upstream. Generally, this channel would follow a course along the center of the active channel zone and be of sufficient length to carry flows beyond the subdivision's westerly boundary. The argument for this option is that the largest subchannels presently impinging on the subdivision are the primary cause of recent flooding and erosion problems, so there may be a reasonable benefit in relocating them.

   There may be some technical merit in this option, but we have not recommended it for several reasons. First, there is a concern that relocation of a major subchannel could initiate attack and erosion of the alluvial fan opposite the subdivision. Erosion of the associated unnamed stream outlet could then initiate bed degradation. This could ultimately affect Alyeska's pipeline crossing of this stream. Second, because low water conditions favorable to excavation of a bypass channel will not occur until next March and April, it is prudent to instead carry out measures which can be implemented this year.

7. PERMITS

We contacted the Alaska Department of Fish and Game (ADF&G) and the Land and Water Management Division of the Alaska Department of Natural Resources (DNR) regarding work directly in the river to control flooding.

ADF&G said that work in the river is very site specific but that, in general, work can be accomplished from late July to April. Silt loading and impact on spawning areas are important considerations for approval or denial. Work in the river requires a Fish Habitat Permit (Title 16). This permit requires drawings, specifications, reasons for

work, and impact on fishery and takes 30 days for ADF&G approval. However, federal review by the Corps of Engineers usually takes much longer than 30 days.

DNR requires a land use permit, part of the Coastal Zone Management process that goes through ADEC, ADF&G, and the Corps of Engineers. DNR staff said they may not have objections to working in the river if materials are moved within the river (rearranging location of existing materials).

8. PROGRAM COSTS

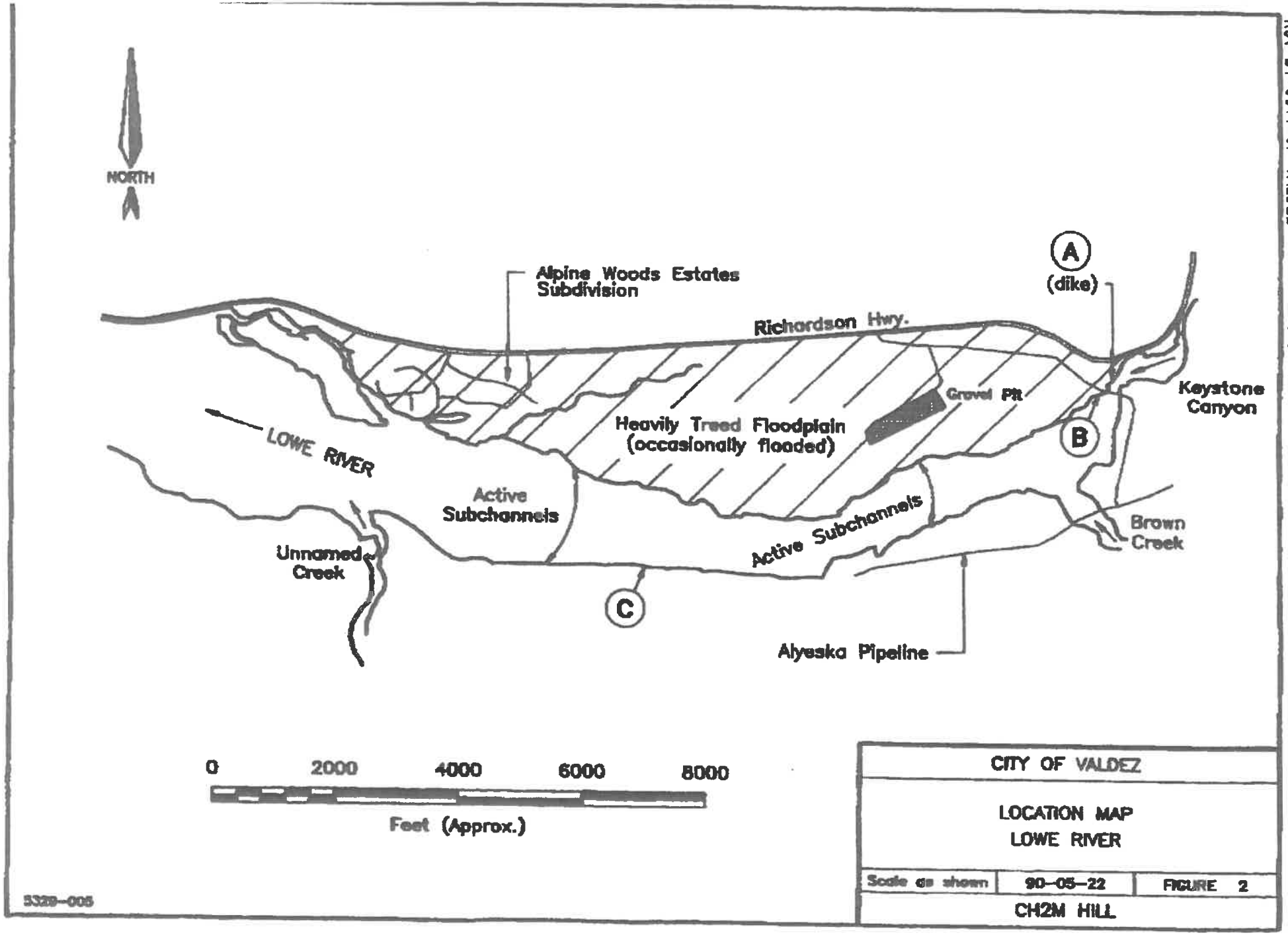
The order-of-magnitude construction cost to complete the recommended remedial program outlined in Section 5 will be in the range of $75,000 to $125,000. Detailed engineering design, field surveys and some permitting assistance to the City of Valdez is estimated to cost $12,000 to $18,000. A more definitive estimate is not possible until field surveys have been completed and there has been a thorough inspection of the existing riprap.

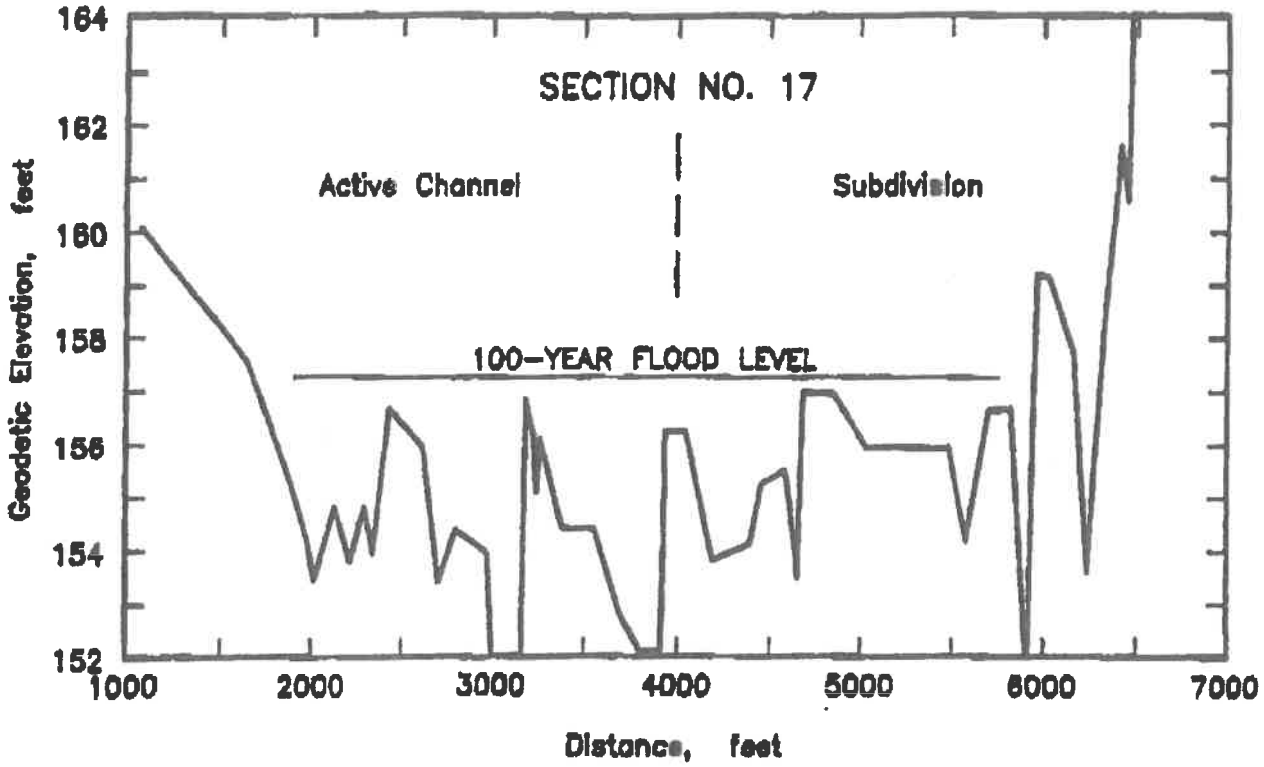
Sincerely,

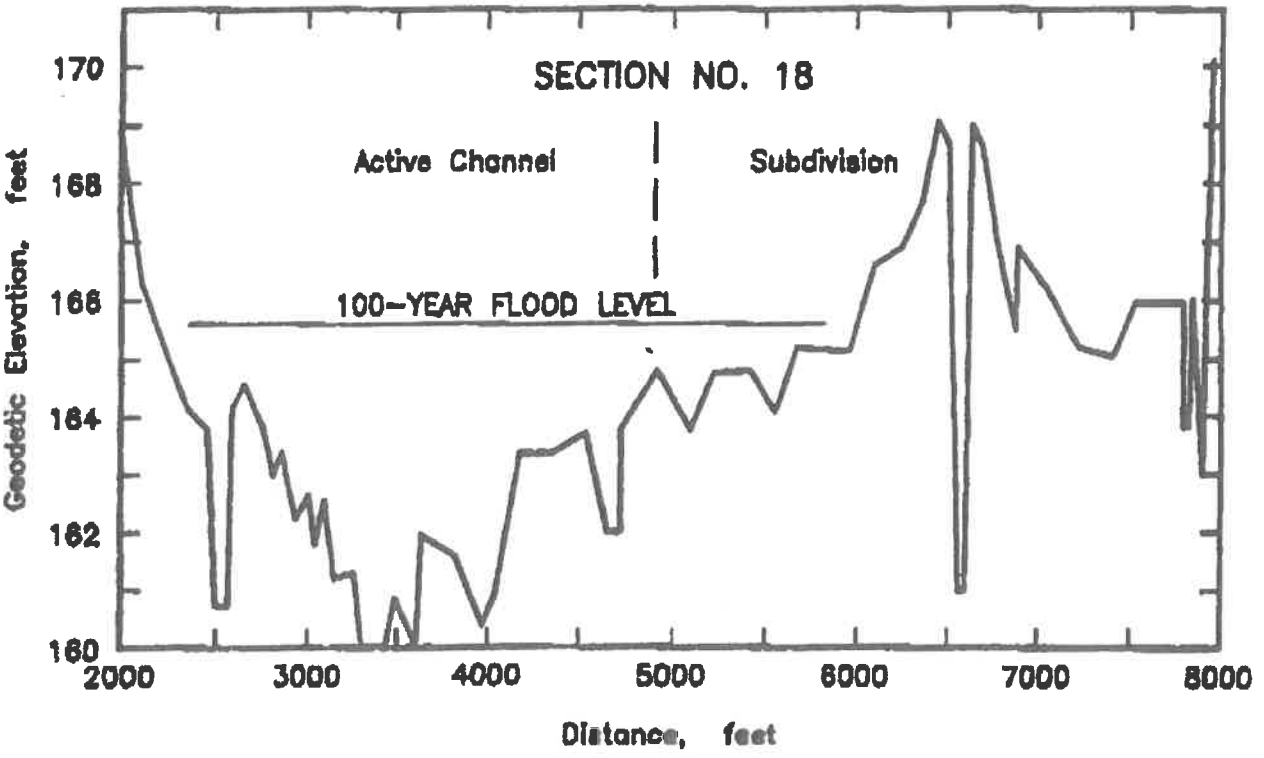
CH2M HILL

Floyd J. Damron, P.E.
Project Manager

bja:lr:b166.51
cc: E. K. Yaremko, P.E., NHC
Loren Bottorff





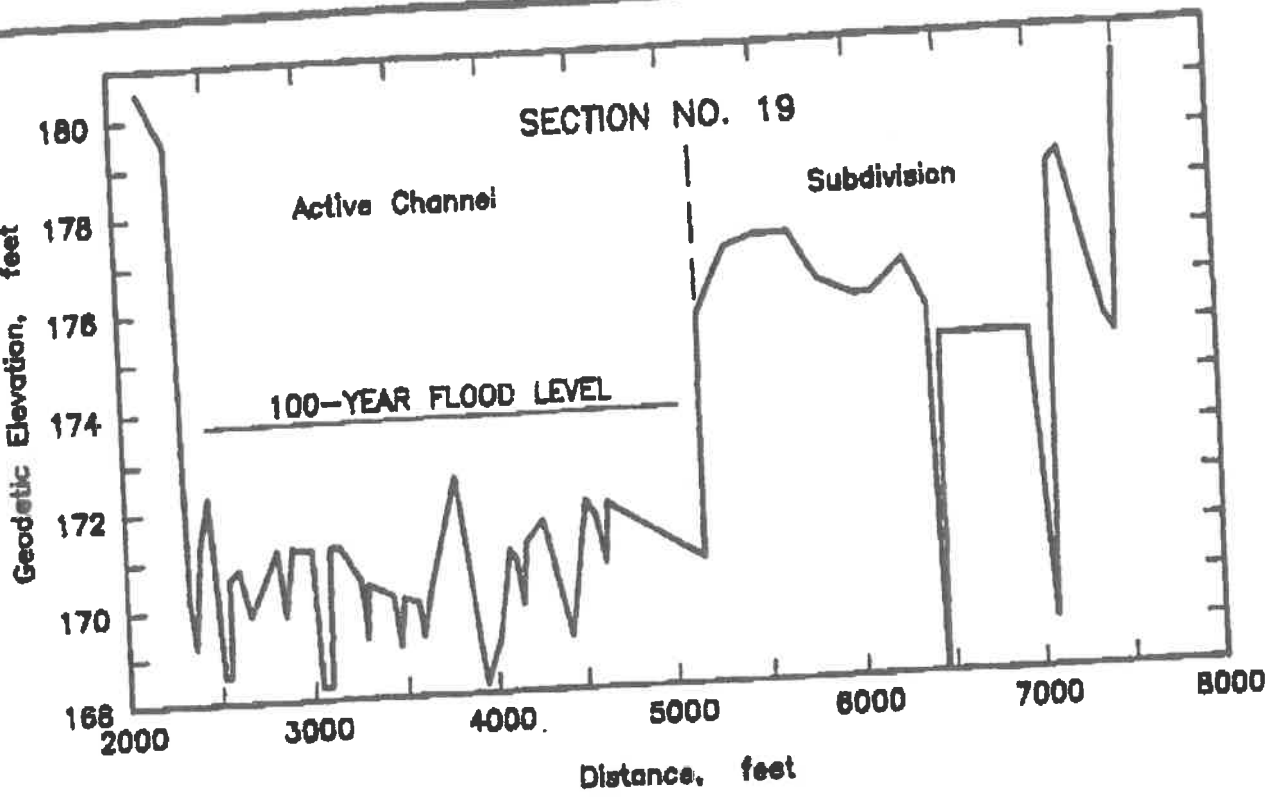


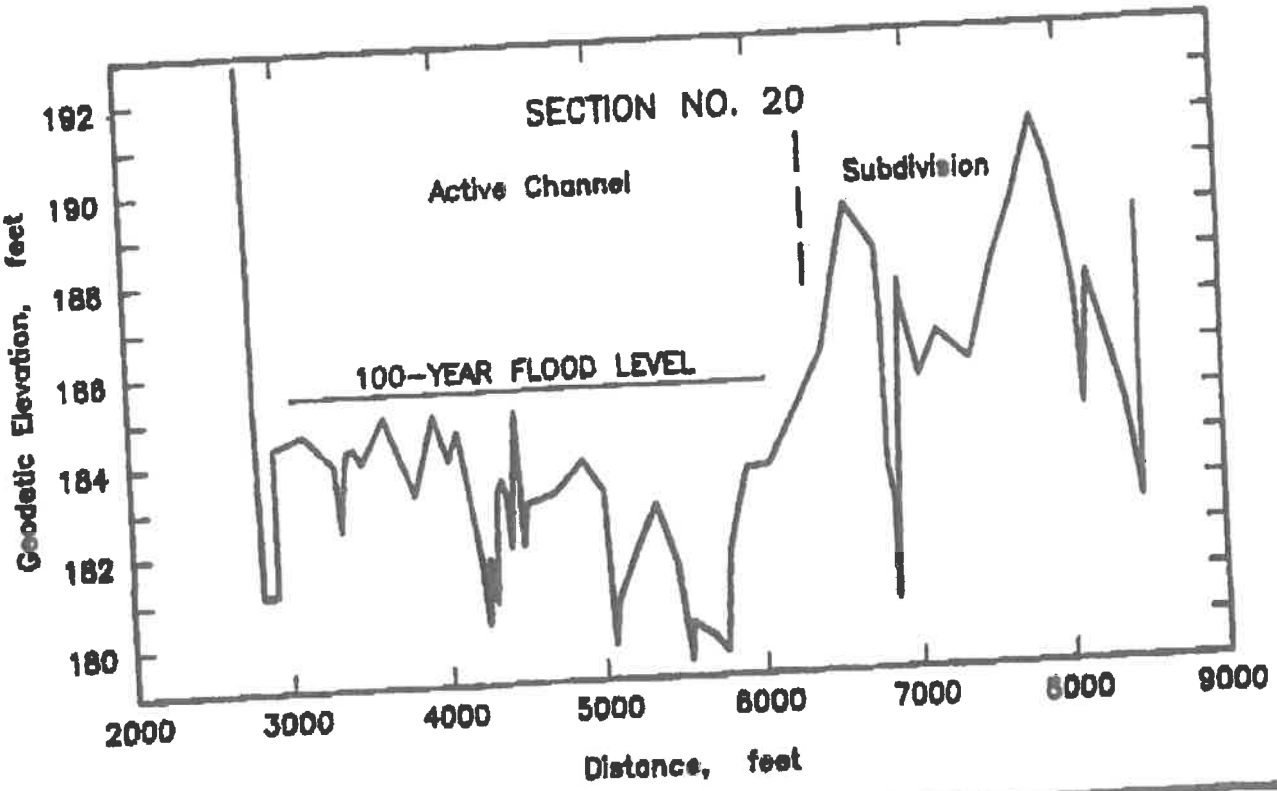
NOTE

CROSS-SECTIONS VIEWING DOWNSTREAM.
SEE FIGURE 1 FOR SECTION LOCATIONS.

CITY OF VALDEZ		
LOWE RIVER SECTIONS SECTIONS 17 & 18		
Scale as shown	90-08-22	FIGURE 3A
CH2M HILL		

5329-002





NOTE

CROSS-SECTIONS VIEWING DOWNSTREAM.
SEE FIGURE 1 FOR SECTION LOCATIONS.

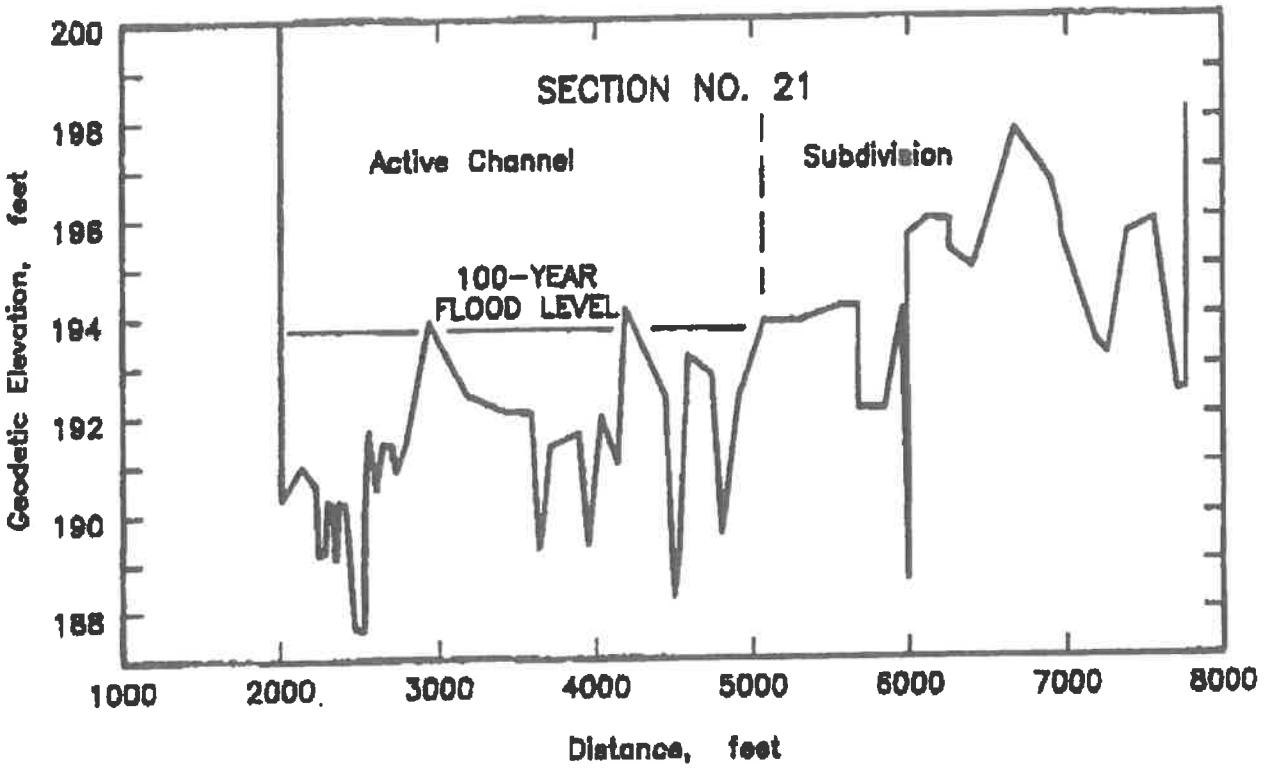
CITY OF VALDEZ

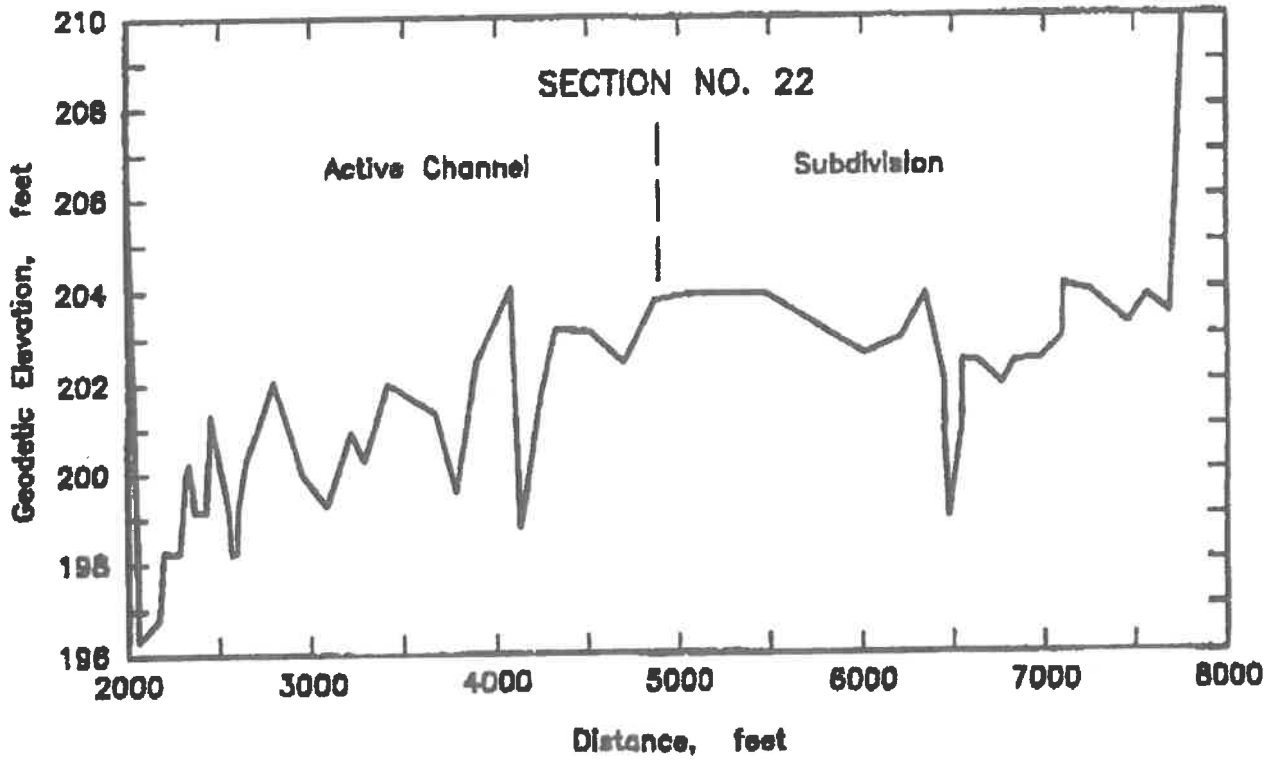
LOWE RIVER SECTIONS
SECTIONS 19 & 20

Scale as shown	90-05-22	FIGURE 3B

CH2M HILL

0329-003





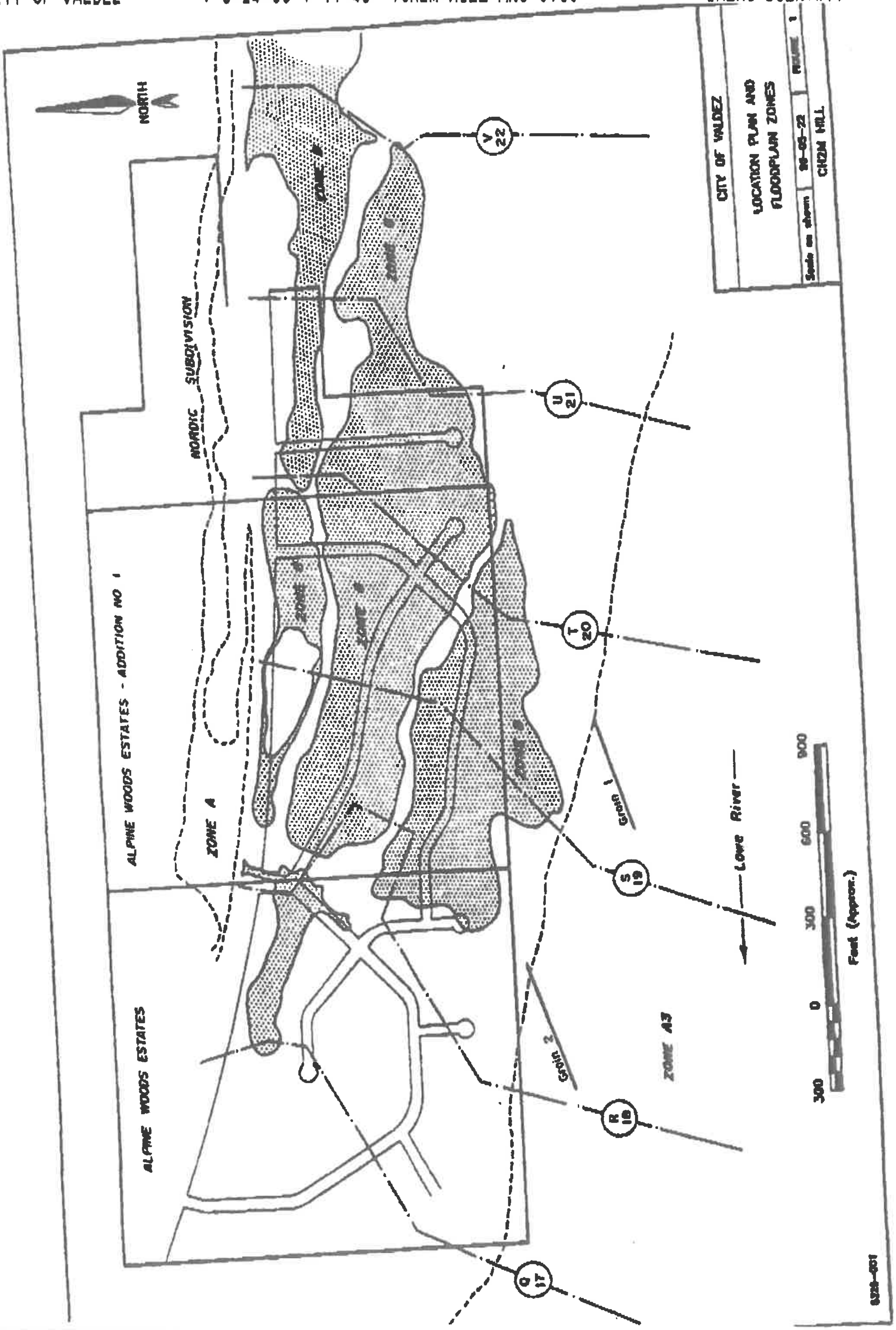
NOTE

CROSS-SECTIONS VIEWING DOWNSTREAM.
SEE FIGURE 1 FOR SECTION LOCATIONS.

CITY OF VALDEZ		
LOWE RIVER SECTIONS SECTION 21 & 22		
Scale as shown	90-05-22	FIGURE 3C
CH2M HILL		

5329-004

RCV BY:CITY OF VALDEZ ; 5-24-90 ; 11:43 ;CH2M HILL ANC 9736 → SHERI BUEN;#11



Memorandum

To:	Valdez City Council
CC:	Charlotte Burrill, Project Manager
From:	William L. Wilcox, City Engineer
Date:	May 19, 1997
Subject:	Alpine Woods Flood Control

At the May 12th work session, there was some discussion on the approach to flood control in Alpine Woods. Attached is the final report and executive summary from the flood control study that was prepared by CH²M Hill in 1990. The City is still following the plan recommended in this study.

If you have any further questions or comments, please do not hesitate contact me.

H:\ENG\DATA\97-05\CIP805.519

Engineers
Planners
Economists
Scientists

December 7, 1990

ANC30126.A0/A1

Mr. David Dengel, Director
Community Development Department
City of Valdez
P.O. Box 307
Valdez, Alaska 99686

Dear Mr. Dengel:

Subject: Lowe River Stabilization/Relocation Project
Final Report

At your request we have prepared this summary technical letter and appendix compilation of our technical memorandums and letters. This is the project final report. This project was completed with the assistance of the following approved subconsultants:

- Northwest Hydraulic Consultants, Ltd.
  Eugene K. Yaremko, P.E.
- Appraisal Company of Alaska
  Michael C. Renfro, Partner
- Hartech Surveying
  Kim Hartman

The work scope for this project consisted of nine work tasks. This summary and the Appendixes are organized by task in the following order (this summary is the product of Task 7):

- Tasks 1 and 2--Inventory of Existing Properties/Develop Flooding Estimates
- Tasks 3 and 6--Review Conceptual Design/Analyze Alternatives

- Tasks 4 and 5--Mass Appraisal for Existing Condition/Mass Appraisal With Concept Design
- Task 8--Recommend Gravel Extraction Methods and Immediate Short-term Flood and River Control Works
- Task 9--Program for Immediate Action

RECOMMENDATIONS

The City of Valdez needs to make a final determination on the future of Alpine Woods Estates and Nordic Subdivision with respect to flood risk. During the course of this study, considerable erosion of the river bank near Alpine Woods Estates No. 1 and minor flooding of the westerly portion of Alpine Woods Estates occurred several times. Emergency dike construction was initiated by the City near Alpine Woods Estates No. 1. No measurable private property damage was reported, but considerable time and money were expended by the City.

The City of Valdez needs to decide if this area is to remain available for existing and new residential development or be abandoned for this type of use. Absent a decision for total abandonment of the area, the following actions are recommended:

- The City of Valdez needs to assess its building codes/flood plain regulations for building elevations, basements, water well construction, waste disposal systems, and acceptable flood proofing methods.
- Complete the work recommended in Task 9--Program for Immediate Action. This work was bid this fall and is planned to be constructed in 1991.
- Construct the recommended plan, the full subdivision dike, as described in Task 6--Analyze Alternatives.

The Task 6 recommended plan is compared to five other options, including doing nothing, in Table 1.

Table 1
COMPARISON OF FLOOD CONTROL OPTIONS
ALPINE WOODS/NORDIC SUBDIVISION/VALDEZ, ALASKA

Options	Initial Cost ($)	Annual Cost ($)	Annual Benefit ($)	Initial Mill Rate (20-Year Period)	Maint. Mill Rate	Risk of Failure	Benefit/Cost Ratio*	Advantages/Disadvantages
Option 1: Do Nothing	0	15,000[a] 40,000[b]	0	0	11.6	1:50 Erosion 1:10 Flooding	N/A (No benefit)	- Minimal initial and annual maintenance costs - Faced with eventual flood damage costs
Option 2: Buy Out Owners	3,150,000	0	15,000[a] 40,000[b] 14,200[c]	N/A	0	0	0.30	- Immediately eliminates the problem - High initial cost - Substantial administration and legal requirements
Option 3: Gravel Extraction	30,000	15,000[a] 30,000[d] 40,000[b]	0	0.7	18.0	1:1 Gravel Ext. 1:10 Flooding 1:50 Erosion	N/A (No benefit)	- Low probability of subchannel excavation being successful - Special permitting requirements
Option 4: Minor Improvements to Dikes and Homes	75,000	15,000[a] 35,000[e]	900[c] 5,000[e]	1.71	10.6	1:50 Erosion 1:10 Flooding	0.30	- Keeps property values depressed
Option 5: Partial Dike and Buy Out Remaining (Unprotected) Properties	1,165,000	17,000[a] 4,150[f]	40,000[b] 5,100[c] Property tax[g] Property Value Increase[h]	26.51	3.7	<1:100 Erosion[i] 1:100 Flooding	1.27	- Maintains part of development having least flood risk - May reduce insurance rates
Recommended Plan: Full Subdivision Dike	830,000	20,000[a]	40,000[b] 5,100[c] Property tax[g] Property Value Increase[h]	18.9	4.2	<1:100 Erosion[i] 1:100 Flooding	1.77	- Primary benefit is increase in property value/reduced risk of failure - May reduce insurance rates

*Present value of benefits divided by present value of costs (assume 5 percent inflation, 8-3/4 percent interest, 20 years)
[a]Annual maintenance cost. Need to add long term average annual flood damage cost; damage begins occurring at floods equal to or greater than 1:10 probability
[b]Long term average annual flood damage cost (rough estimate)
[c]Flood Insurance Premium Savings
[d]Annual cost to excavate subchannels
[e]Annual flood damage; assumes several homes are floodproofed
[f]Lost tax revenue due to buy-out
[g]Assumes two new homes per year will be built ($80,000 home, 16 mills)
[h]15 percent increase, realized over 3-year period
[i]Risk of erosion not assessed since flood data not available for floods greater than 100-year

SUMMARY

All work for this study is based on the December 1, 1983, Federal Emergency Management Agency's published flood elevations for Alpine Woods Estates and Nordic Subdivision. No review or analysis of the methods used to determine the flood elevations was performed.

TASKS 1 AND 2--INVENTORY OF EXISTING PROPERTIES/DEVELOP FLOODING ESTIMATES

Tasks 1 and 2 present data for the 148 properties within the boundaries of this study. The following type of development exists within this area:

- 62 percent (92 lots) have improvements, 38 percent (56 lots) have no improvements.
- The 92 lots that have improvements are divided as follows:
  - 33 percent (30 lots) have wood frame or log houses.
  - 46 percent (42 lots) have mobile homes.
  - 17 percent (16 lots) have modular "Alyeska" type houses.
  - 2 percent (2 lots) have small cabins.
  - 2 percent (2 lots) have garages only.

The 148 properties have the following predicted flooding characteristics (see Figure 1):

- 64 percent (95 lots) of the properties are below the predicted 100-year flood elevation.
- 37 percent (55 lots) of the properties below the predicted 100-year flood elevation have improvements on them.
- 16 structures (6 mobile homes, 2 houses, 1 modular house, 3 cabins, and 4 garages) have first floor elevations below the predicted 100-year flood elevation. One of these structures has a basement.

- Nine structures with first floor elevations above the predicted 100-year flood elevation have basements that are estimated to be below the predicted 100-year flood elevation.

The Tasks 1 and 2 technical memorandum describes how some property owners may obtain a "letter of map amendment" from the Federal Emergency Management Agency if their property is incorrectly shown on current flood maps to be within the 100-year flood zone. Corrections may assist property owners with property transactions and reduce flood insurance rates.

TASKS 3 AND SIX--REVIEW CONCEPTUAL DESIGN/ANALYZE ALTERNATIVE

Task 3 was the review of the 1983 concept design to protect the Alpine Woods Estates/Nordic Subdivision. The conclusion of Task 3 is that the concept should not be constructed because the City has proceeded, after 1983, with construction of major river control works that did not follow the concept. The City has constructed two long groins and provided bank armoring.

Task 6 was the analysis of alternatives. Six options were analyzed for initial cost, annual cost, mill rate impact for the property owners of Alpine Woods Estates/Nordic Subdivision, risk of failure, and benefit cost ratio. Table 1 is a summary list of the options. The six options requested to be analyzed by the City are:

- Option 1--Do nothing, except maintain the existing river protection system. There are no identified benefits compared to the current situation.

- Option 2--Purchase properties and relocate improvements to another Valdez location. The benefits are the elimination of maintenance, damage, and flood insurance costs. The benefit/cost ratio is estimated to be 0.30.

- Option 3--Gravel extraction to help encourage flow away from the developed area. There are no identified benefits compared to the current situation.

- Option 4--Provide only minor improvements to the existing river protection system and floodproof the existing improvements within the developed area. The benefits are the reduction in flood damage and flood insurance costs. The benefit/cost ratio is estimated to be 0.30.

- Option 5--Purchase all properties within the westerly portion of Alpine Woods Estates and relocate improvements to Alpine Woods Estates Addition No. 1 and Nordic Subdivision. Build only the upstream portion of the river protection system. The benefits are elimination of flood damage, flood insurance cost reduction, general increase in property values, and increased property tax revenue from new development. The benefit/cost ratio is estimated to be 1.27.

- Recommended Plan--Extend the existing dike system upstream of Groin 1 and between the groins and extend Groin 2. See Figure 2. The benefits are elimination of flood damage, flood insurance cost reduction, general increase in property values, and increased property tax revenue from new development. The benefit/cost ratio is estimated to be 1.77.

The recommended plan is estimated to cost $830,000 for the new dike and have a $20,000 annual maintenance cost. The benefits are estimated to be a savings of $40,000 per year for elimination of flood damage, $5,100 in flood insurance cost reduction, 15 percent $\pm$ increase in property values, and an increase in property taxes (based on the assumption that two new houses will be constructed each year for the next 20 years, valued at $80,000 each and a 16 mill rate).

TASKS 4 AND 5--MASS APPRAISAL FOR EXISTING CONDITION/MASS APPRAISAL WITH CONCEPT DESIGN

Tasks 4 and 5 were prepared by Appraisal Company of Alaska. The estimated fair market value (August 1, 1990) for the Alpine Woods Estates and Nordic Subdivision, south of the Richardson Highway, is $5,127,200. If flood control structures are completed, and existing structures improved, it is felt that this will have a positive effect on the property values and within 3 years of dike construction, the projected market value will increases approximately 15 percent.

Using State Farm Insurance rate book information, current flood insurance rate is estimated by be $14,200 ($0.45 per $100 of improvement valuation) per year for the

improvements. After flood control measures are in place, the estimated annual flood insurance rate is $9,100 ($0.25 per $100 of improvement valuation). This results in a projected annual savings of $5,100.

TASK 8--RECOMMEND GRAVEL EXTRACTION METHODS AND IMMEDIATE SHORT-TERM FLOOD AND RIVER CONTROL WORKS

Alpine Woods Estates and Nordic Subdivision have been in existence for about 15 years. They occupy a portion of the Lowe River flood plain. Previous studies have recommended either a dike plus groins, subdivision relocation, or systematic abandonment of flood prone areas.

Two river related problems exist for this property:

- Property can be eroded by shifting Lowe River subchannels.
- General flooding can occur due to high water elevation.

Erosion is expected to have the greatest potential during 2- to 10-year flood events (50 percent to 10 percent chance per year). General area flooding can be expected for flood events greater than 10-year (10 percent chance per year). The westerly portion of the developed area is more subject to general flooding than the easterly portion.

The City has constructed two long groins and reinforced banks with riprap. From a May 1990 inspection of the groins, recommendations were made to: 1) consider an additional groin; 2) build a dike between the groins; 3) groin riprap needed to be checked and upgraded where necessary; 3) the groins may need to be raised to prevent overtopping. The groins were believed to be doing the job they were built to do, but require frequent maintenance and river bank work to prevent the river from outflanking them.

Task 8 presents a program for immediate action, which resulted in a contract change to include new work. The additional work is described in Task 9.

Gravel mining was addressed as a means to reduce flooding potential of the developed area. Gravel mining was not recommended for the following reasons:

- 50,000 to 100,000 cubic yards of gravel will have to be excavated each year, on the average.

- Many years of work may be required before benefits are realized.

- Excavation of a new subchannel away from the subdivision may have negative secondary impacts to other property owners (Alyeska, for example), and special permits may be required.

TASK 9--PROGRAM FOR IMMEDIATE ACTION

Task 9 was initiated as a direct result of the Task 8 recommendation to construct improvements in the near future. Several options were proposed for the 1990 construction season. The options addressed the identified weak points in the natural and man-made river bank system. Due to possible budget limitations, six immediate action options were presented to the City in the following order of priority (see Figure 3):

1. Construct a depressed groin upstream of the Groin 1 dike.

2. Add a dike between the Groin 1 dike and Option 1.

3. Upgrade the existing riprap upstream of Groin 1.

4. Raise Groin 2 and its attached dike.

5. Repair the Groin 2 riprap armor.

6. Improve the existing dike that partially connects Groins 1 and 2.

The Task 9 construction cost estimate was $91,000. Some modifications were made to these recommendations and a construction project was bid by the City. Construction is expected to occur during early 1991.

We have appreciated this opportunity to work with you and your staff on this interesting and challenging project. Important decisions remain for the City of Valdez. We trust that our work has met your expectations and enables you to develop a long-term solution to flood damage risk in the project area.