STEVE JENSEN

BOARD OF SALT LAKE COUNTY COMMISSIONERS

PUBLIC WORKS DEPARTMENT

LEVEL II STREAM MORPHOLOGY CLASSIFICATION OF THE JORDAN RIVER IN SUPPORT OF THE JORDAN RIVER CHANNEL RESTORATION PROJECT

STEVEN F. JENSEN
AND
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TABLE OF CONTENTS

A GENERAL HISTORY OF THE RIVER

Since the pioneers arrived in 1847, humans have modified the Jordan River. The river has been heavily affected by both grazing practices and channel modification. As late as 1984 the Jordan River Terrestrial Wildlife Inventory stated that approximately 70% of the land in and adjacent to the river corridor was being grazed by livestock (U.S. Bureau of Reclamation p.5). This overgrazing altered the natural vegetation in the river corridor, changing the native willow/grass communities to grass/forb communities that do not grow the deep roots that maintain bank stability. Poor grazing practices led to many adverse stream channel adjustments. "These subsequent channel adjustments include: (a) accelerated bank erosion, (b) increased width/depth ratios, (c) altered channel patterns, (d) induced channel instability, (e) increased sediment supply (f) decreased sediment transport capacity, and (g) damaged fisheries habitat. Poor grazing management practices causes direct mechanical damage that changes the dimensions, pattern, and stability of alluvial channels" (1996, Rosgen 8-8).

Historical modifications on the Jordan River have had profound impacts on channel stability. The Corps of Engineers has channelized, dredged, and straightened the river. It has been constricted by the construction of bridges and utility crossings. The banks have been threatened by suburbanization and agriculture uses. These changes have increased bank erosion, channel scour and sediment deposition. The river's natural bed has been significantly modified by urbanization. In the 1950s, the river was straightened as a flood control device. This cut off river meanders, and steepened the banks and the slope of the channel. It also increased stream velocity and shear stresses. Consequently, stream erosion greatly increased (1992, CH_2MHill 3-9).

RIVER REACHES

The CH_2MHill report divided the river into 9 units, or reaches. Table 1 shows the reach locations and boundaries (Appendix A, Figure 1).

(1992, CH_2MHill 2-1)

Table 1
Jordan River Stability Study Reach Designations

Reach #	Begin	End
1	Turner Dam	Joint Diversion
2	Joint Diversion	14600 South
3	14600 South	12600 South
3	12600 South	10600 South
4	10600 South	N. Jordan Diversion
6	N. Jordan Diversion	6400 South
7	6400 South	Brighton Diversion
8	Brighton Diversion	Mill Creek Diversion
9	Mill Creek Diversion	2100 South

CURRENT PROJECTS WITHIN REACHES

There are nine projects currently under consideration within the boundaries of SLCo to be financed with a Federal EPA matching grant. These projects are listed in Table 2 below, along with their boundaries, length and the reach they are located in.

Table 2
Jordan River Parkway Projects, 1997

Project	Location	Length (linear feet)	Reach
Tri-Cities	12300 S.- 13800 S.	2,400	3
Loumis Property	13800 S. - 14600 S.	2,000	3
South Jordan	10600 S. - 11000 S.	9,600	4
Audubon/Tree Utah	10200 S. - 10600 S.	6,750	5
West Jordan	7800 S - 9400 S.	2,400	6
Sandy City	9000 S. - 9600 S.	7800	6
Murray/Price SLCo F & G	5300 S. - I-215	4,000	7
Oxbow Park	3500 S.	800	8
Redwood Nature Park	2100 S. - 2300 S.	2,000	9

Reach 3: 14600 South to 12300 South. In Reach 3, the Jordan River becomes more sinuous with numerous gravel bars, cut banks, and perched oxbow lakes. Reach 3 was straightened and dredged during the channelization project of the 1950s. This reach has experienced historical long-term channel migration, and severe short term bank erosion during the 1980s... Field data suggest that cutbanks are present throughout this reach and that bank erosion is continuing. A rock-filled trench and riprap bank protection have been constricted as part of recent golf course improvements just upstream of 12600 South. Elsewhere in Reach 3, excluding the bridges at 12300 South and 12600 South, channel movement is currently unrestricted by geologic controls or by development.

The stability analysis indicates that the channel will increase its width and sinuosity, and decrease its slope. The...modeling and historical data predict net scout and long-term degradation in Reach 3...The combination... will result in active bank erosion, channel bar formation and channel meander migration (4-40).

Reach 4: 12300 South to 10600 South. The Jordan River channel pattern in Reach 4 is similar to that of Reach 3; relatively sinuous with gravel bars and cutbanks. Reach 4 was also straightened and dredged as part of the channelization project of the 1950s. Reach 4 has experienced significant historical meander migration, as well as significant short-term bank erosion and channel migration during the floods of the 1980s. Field data suggest bank failure and long-term degradation will continue in the future. No bank stabilization has been constructed in Reach 4, but the lower portion of this reach...was dredged during the floods of the 1980s

The stability analysis indicates that sinuosity will increase through bank erosion and slope will decrease due to increased meandering and some long-term degradation....Active bank erosion with associated bar formation is likely to continue in Reach 4 (4-40,41).

Reach 5: 10600 South to North Jordan Diversion. In Reach 5, the Jordan River has retained the channel geometry, sinuosity, and alignment created by the straightening project of the 1950s. Reach 5 has experienced relatively little channel migration since the 1950s, even though some river migration occurred on the formerly sinuous channel prior to 1950.. Field data indicate that vertical cutbanks have formed and are forming in a significant portion of this reach. The apparent long-term channel stability may be due to dredging of the entire reach during the 1983-84 flood years. Channel bank stabilization exists only in the down stream portion of the reach, near the North Jordan Diversion.

Geomorphic indicators predict that the channel width/depth ratio and sinuosity will increase, and that channel slope will decrease if dredging of the reach is discontinued....Grade control provided by the North Jordan Diversion will prevent severe long-term degradation. Measured degradation at 10600 South is probably the result of dredging. Bank erosion will create a more sinuous, stable channel.

Channel stability problems in Reach 5 include potential bank erosion, minor long-term degradation in the upstream section of the reach, and sediment deposition upstream of the North Jordan diversion. Field data indicate that the channel may be in the process of reestablishing its pre-channelization meandering channel pattern. If dredging operations are discontinued, bank erosion will increase until dynamic equilibrium is achieve. (4-41,42).

Reach 6: North Jordan Diversion to 6400 South. Reach 6 is one of the most intensely urbanized reaches within the study area. Reach 6 was straightened and dredged as part of the channelization project of the 1950s, and completely relocated in much of the reach. From the bank protected reach at the North Jordan Diversion to the near-linear, dredged channel extending to 6400 South, the natural channel pattern has been obscured. In spite of these changes to the natural channel, Reach 6 has been one of the most stable reaches in the study area. Reach 6 experienced little historical channel migration or flood scour during the 1980 floods. Field evidence also suggests that the channel banks in this reach are relatively stable...

The stability analysis indicates that the channel may not adjust to a more natural sinuous pattern, except upstream of 9000 South...some increases in meander amplitude and associated bank erosion may occur in the dredged reach if dredging is discontinued. Overall, most of the reach should remain stable (4-42).

Reach 7: 6400 South to Brighton Diversion. Reach 7 encompasses the Jordan River Parkway in Murray City, which has been designated as an open space corridor. Reach 7 was straightened and dredged as part of the channelization project of the 1950s. Currently, the reach is characterized by a relatively straight channel with relatively stable banks and numerous perched oxbow lakes. Historically, there has been some meander migration in Reach 7, but little occurred during the floods of the 1980s. Bank stabilization has been constructed upstream of I-215, 5400 South, and on portions of both banks between the Brighton diversion and 4800 South...

The stability analysis indicates that the width/depth ration and channel sinuosity should increase, and a decrease in slope is likely....Channel stability problems in Reach 7 include probable bank erosion, sediment deposition, bridge scour at 5400 South and 4800 South, and long-term degradation. Significant bank erosion is not presently occurring, but could occur within the 100-year planning period. As a more sinuous channel pattern recurs, bank erosion may become more significant, particularly if channel deposition occurs...Several significant stability problems are found in Reach 7 (4-43,44).

Reach 8: Brighton Diversion to Mill Creek. In Reach 8, the Jordan River has retained much of its sinuous channel pattern, though the affects of encroachments, development, and channelization can be seen throughout the reach. Three bridges, seven utility crossings, several development encroachments, and numerous riprap sections impact the reach. Historically, portions of Reach 8 have experienced high meander migration rates. Local areas near sharp channel bends and near constricted reaches experienced significant bank erosion in the floods of the early 1980s. Field data indicate that numerous cutbanks exist in Reach 8 , and that gravel bars may be found in several locations. Periodic dredging has been required at the mouth of Big Cottonwood Creek to remove tributary sediment deposition in the channel.

The stability analysis indicates that the reach is relatively stable, although some increase in sinuosity and decrease in slope may be expected. Sediment supplied by Big Cottonwood Creek is excess sediment not considered in the... model. If this sediment is not removed, flood water surface elevations and bank erosion would likely increase.

Channel stability problems in Reach 8 include bank erosion and sediment deposition at the mouth of Big Cottonwood Creek, and long-term degradation. Bank erosion has the potential of undermining portions of several residential and industrial developments which have encroached on the flood plain in the reach....The presence of high density residential and industrial development within or near the erosion corridor gives Reach 8 a higher priority for erosion hazard mitigation (4-44,45).

Reach 9: Mill Creek to 2100 South. The Jordan River is channelized in Reach 9. Both banks of the river are stabilized. Grade control is provided by the Surplus Canal Diversion downstream of 2100 South. Salt Lake County dredges the reach periodically as part of a maintenance agreement with the Corps of Engineers. The trend of historical meander migration is checked by the bank protection. No significant bank erosion occurred during the floods of the early 1980s. Geomorphic indicators predict that some channel adjustment will occur, but the channelization will probably prevent these adjustments from occurring....

Reach 9 has no significant channel stability problems except periodic deposition of tributary sediment. This sediment deposition is removed by dredging when necessary (4-45).

Rosgen's Level II Analysis

A level II analysis, according to Rosgen's criteria, of the river in its current state, including explanations and how the decision was reached. A level II analysis consists of determining river type by shape, pattern, valley type and bed composition (Appendix A, Figure 2).

Table 3
Rosgen's Level II Criteria Applied To CH_2MHill's Reaches

Reach#	Projects Located within reach	Location	Classification
1			B4c* Moderate relief, colluvial deposition, and/or structural. Moderate entrenchment and W/D ratio. Narrow gently sloping valleys. Rapids predominate with scour pools.
2			B4c* Moderate relief, colluvial deposition, and/or structural. Moderate entrenchment and W/D ratio. Narrow gently sloping valleys. Rapids predominate with scour pools.
3	Loumis Property Tri-Cities	13800 S. - 14600 S. 12300 S.- 13800 S.	C4 Broad valleys w/terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channels. riffle/pool bed morphology.
4	South Jordan	10600 S. - 11000 S.	C4 Broad valleys w/terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channels. Riffle/pool bed morphology.
5	Audubon/Tree Utah	10200 S. - 10600 S.	C4 Broad valleys w/terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channels. Riffle/pool bed morphology.

6	West Jordan Sandy City	7800 S - 9400 S. 9000 S. - 9400 S.	B4c*Moderate relief, colluvial deposition, and/or structural. Moderate entrenchment and W/D ratio. Narrow gently sloping valleys. Rapids predominate with scour pools., some F4 sections
7	Murray/Price SLCo F & G	5300 S. - I-215	B4c* Moderate relief, colluvial deposition, and/or structural. Moderate entrenchment and W/D ratio. Narrow gently sloping valleys. Rapids predominate with scour pools.
8	Oxbow Park	3500 S.	C5 Broad valleys w/terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channels. Riffle/pool bed morphology.
9	Redwood Nature Park	2100 S. - 2300 S.	F5 Entrenched in highly weathered material. Gentle gradients, with a high W/D ratio. Meandering, laterally unstable with high band erosion rates. Riffle/pool morphology.

* 'c' refers to configuration. In this case, the reach has a B4 configuration, but the channel slope is shallower than expected.

LEVEL II CLASSIFICATIONS BEFORE HUMAN IMPACT

The Jordan does not fit neatly into any of Rosgen's categories because it is no longer a natural river. For example, all of the sections that show as B4 sections lack the narrow valley topography that is definitive of B type rivers. This raises a red flag of caution. It is more likely that these section are a degraded forms of another type of channel that now exhibit some B type features. Another example of misfit is that all of the C sections with the exception of Reach 8 have a sinuosity that is too low. C type streams normally exhibit a sinuosity level above 1.4 and all of these reaches are under 1.1. This lack of sinuosity also indicates a degraded channel. A historical analysis was performed using information from the CH_2MHill's Stability Report, maps in CH_2MHill's Attachment 1 for that study, and application of Rosgen's criteria to the data available. (Appendix B, Figures 1 and 2).

Table 4
Historical Rosgen's Level II Criteria Applied To CH_2MHill's Reaches

Reach#	Projects Located within reach	Location	Classification
1			C4
2			C4
3	Loumis Property Tri-Cities	13800 S. - 14600 S. 12300 S.- 13800 S.	C4
4	South Jordan	10600 S. - 11000 S.	C4
5	Audubon/Tree Utah	10200 S. - 10600 S.	C4
6	West Jordan Sandy City	7800 S - 9400 S. (?) 9000 S. - 9400 S.	C4
7	Murray/Price SLCo F & G	5300 S. - I-215	C4
8	Oxbow Park	3500 S.	C5
9	Redwood Nature Park	2100 S. - 2300 S.	C5

Vision Statement and Goals

Consolidated Jordan River Corridor Vision Statement
Adopted by Jordan River Sub-Basin Watershed Council
March 17, 1997

The Jordan River Corridor is a valuable and unique open space link between Utah Lake and the Great Salt Lake. We believe in a cooperative and coordinated approach to management of the corridor which promotes open space opportunities for restoration, conservation, and enhancement of the following systems or values in the interest of protecting public health, safety and welfare:

- Ecological systems which include diverse wildlife, aquatic, and riparian communities.
- Water quality and instream flows which fully support the beneficial uses of the river, including the corridor's ecological systems, instream recreation and aesthetics, domestic water supply and irrigation.
- Accessible recreational and educational opportunities.
- Flood conveyance capacity to safely store and transport flood waters within the river corridor.
- Public and private community partnerships that ensure the successful long-term operation and management of the Jordan River Corridor.
- Land uses which complement and support the above systems.

RIVER STABILITY

"Natural stream channel stability is achieved by allowing the river to develop a stable dimension, pattern, and profile such that, over time, channel features are maintained and the stream system neither aggrades nor degrades. For a stream to be stable it must be able to consistently transport its sediment load, both in size and type, associated with local deposition and scour. Channel instability occurs when the scouring process leads to degradation, or excessive sediment deposition results in aggradation. When the stream laterally migrates, but maintains its bankfull width and width/depth ratio, stability is achieved even though the river is considered to be an "active" or "dynamic"system" (1996, Rosgen 1-3).

OPTIONS

Hard approaches include grade controls, dredging and toe protection. Grade controls are inwater structures that are installed to prevent bed scour leading to entrenchment. It can be used separately, in tandem with other measures, or in clusters. Dredging involves removing sediment from the channel bed. It is used to prevent the buildup of excess sediment that leads to aggradation of the channel bed. Dredging increases head cutting and channel entrenchment. Toe protection (riprap) prevents under cutting of the bank and reduces lateral migration. It is often used as an insurance back up with revegetation of the banks.

Soft approaches included revegetation and changing the grade-slope of the banks. Revegetating the slopes of the channel banks with deep rooted species increases stability and reduces erosion and lateral migration. Modifying the slope of the banks to a lesser slope increases bank stabilization, increases flood control capabilities and prevents erosion and bank migration.

If left alone, the river will continue seeking stability by increasing sinuosity and trying to increase its width to depth ratio. It will be prevented from increasing its sinuosity by the bridges and utility crossings constraining the river. It will continue to suffer from bed scour at the bridges, preventing the width/depth ratio from increasing and it will be prevented from meandering as desired to protect development with in the meaner corridor. Since it will not be able to reach a stable dynamic, the river will remain out of equilibrium, continually trying to adjust to the valley, dropping its level and requiring increased human intervention and maintenance.

A mixed approach would use a combination of hard and soft approaches and doing nothing to let the river establish itself in areas without encroaching development. A mixed approach is the method of choice for the Jordan River projects, using grade control to prevent bed scour and entrenchment, bank slope adjustment to prevent lateral migration and revegetation to stabilize the bank and prevent soil erosion.

Appendix A

SALT LAKE COUNTY
PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION
2001 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84190-4600

AERIAL CONTOUR PHOTO MAP
JORDAN RIVER 2100 S. - UTAH COUNTY LINE

PHOTO DATE: 11-7-90
CONTOUR INTERVAL: 4' W/ 2' SUP.
SCALE: 1" = 800'
LOCATION:

SHEET INDEX B0133516.A0

Figure 1-9
SUMMARY OF PRIORITIZED RECOMMENDED MANAGEMENT AND MAINTENANCE ALTERNATIVES
JORDAN RIVER STABILITY STUDY

CH2M HILL

Appendix A

SALT LAKE COUNTY
PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION
2001 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84190-4600
AERIAL CONTOUR PHOTO MAP
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SHEET INDEX B0133516.A0

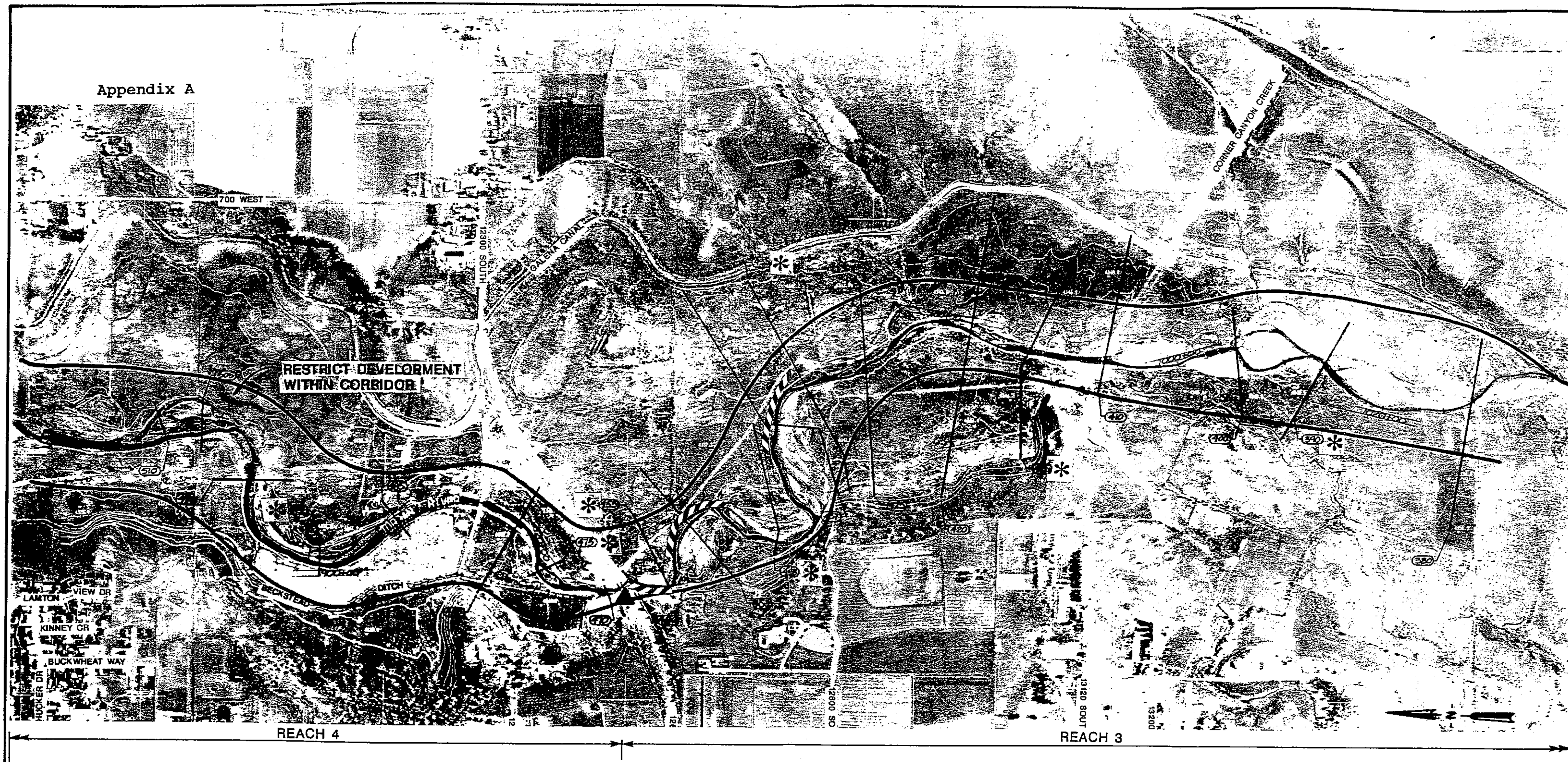
Figure 1-8

SUMMARY OF PRIORITIZED RECOMMENDED MANAGEMENT AND MAINTENANCE ALTERNATIVES

JORDAN RIVER STABILITY STUDY

CH2M HILL

Appendix A



SALT LAKE COUNTY
PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION
2001 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84190-4600
AERIAL CONTOUR PHOTO MAP
JORDAN RIVER 2100 S. - UTAH COUNTY LINE
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SCALE: 1" = 800'
LOCATION:
SHEET INDEX B0133516.A0

Figure 1-7

SUMMARY OF PRIORITIZED RECOMMENDED MANAGEMENT AND MAINTENANCE ALTERNATIVES

JORDAN RIVER STABILITY STUDY

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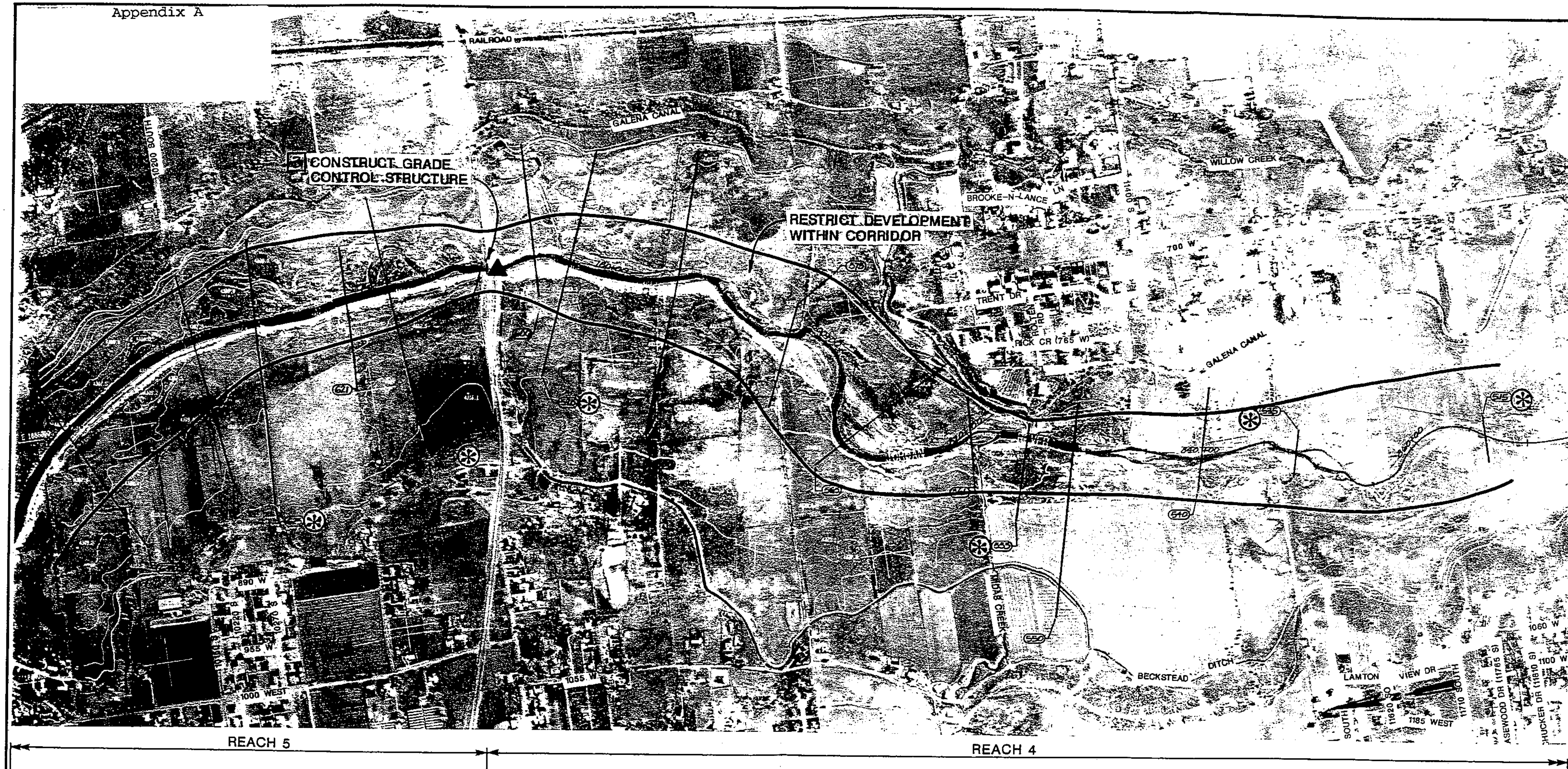
Appendix A



PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION

2001 SOUTH STATE STREET

SALT LAKE CITY, UTAH 84190

AERIAL CONTOUR PHOTO MAP

JORDAN RIVER 2100 S. - UTAH COUNTY LINE

PHOTO DATE: 11-7-90

CONTOUR INTERVAL: 4' W/ 2' SUP

SCALE: 1" = 800'

LOCATION:

SHEET INDEX B0133516.A0

Figure 1-6

SUMMARY OF PRIORITIZED RECOMMENDED MANAGEMENT AND MAINTENANCE ALTERNATIVES

JORDAN RIVER STABILITY STUDY

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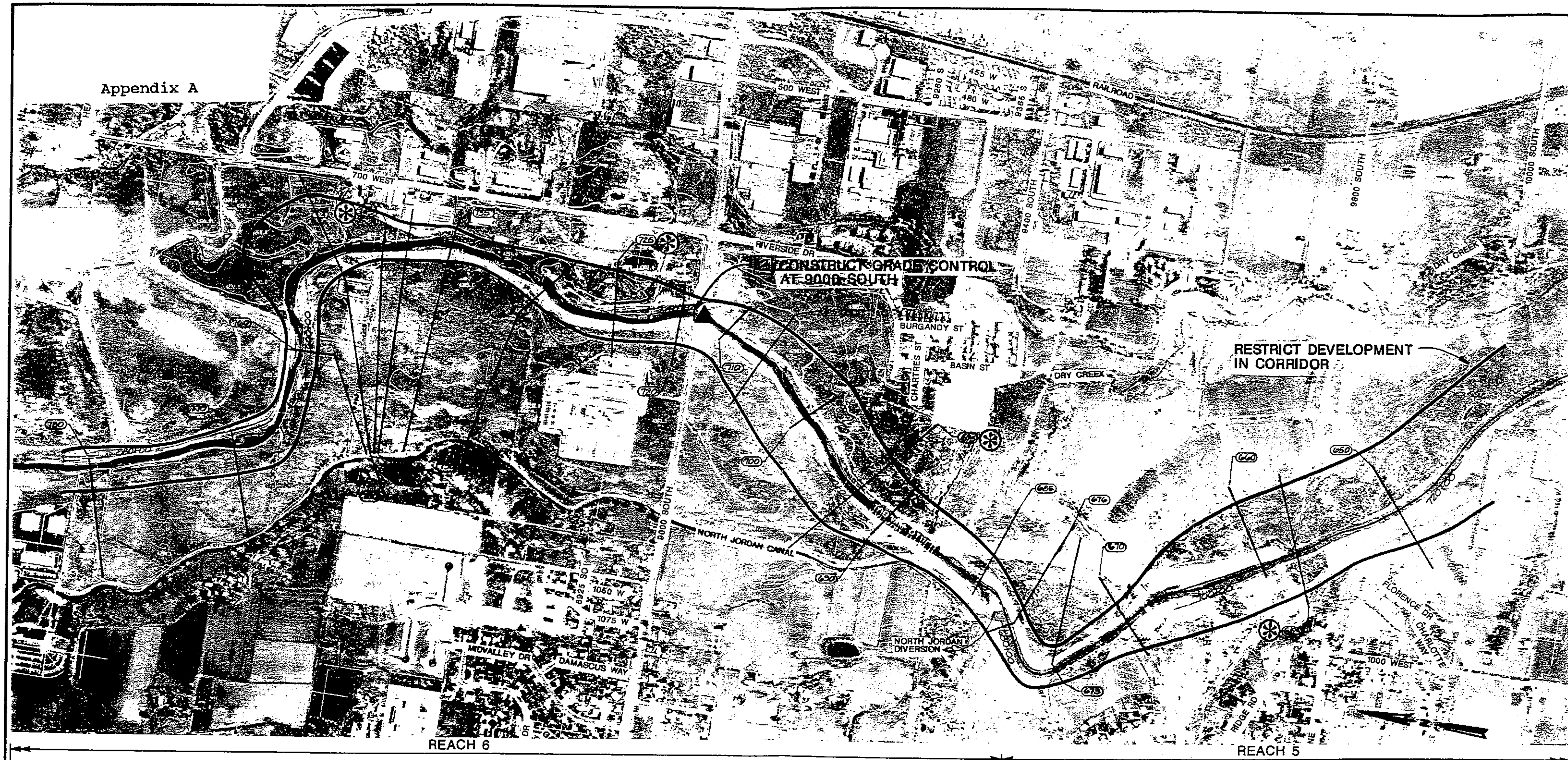
Appendix A



SALT LAKE COUNTY
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2001 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84190-4600

AERIAL CONTOUR PHOTO MAP

JORDAN RIVER 2100 S. - UTAH COUNTY LINE

PHOTO DATE: 11-7-90
CONTOUR INTERVAL: 4' W/ 2' SUP.
SCALE: 1" = 800'
LOCATION:

SHEET INDEX BOI33516.A0

Figure 1-5

SUMMARY OF PRIORITIZED RECOMMENDED MANAGEMENT AND MAINTENANCE ALTERNATIVES

JORDAN RIVER STABILITY STUDY

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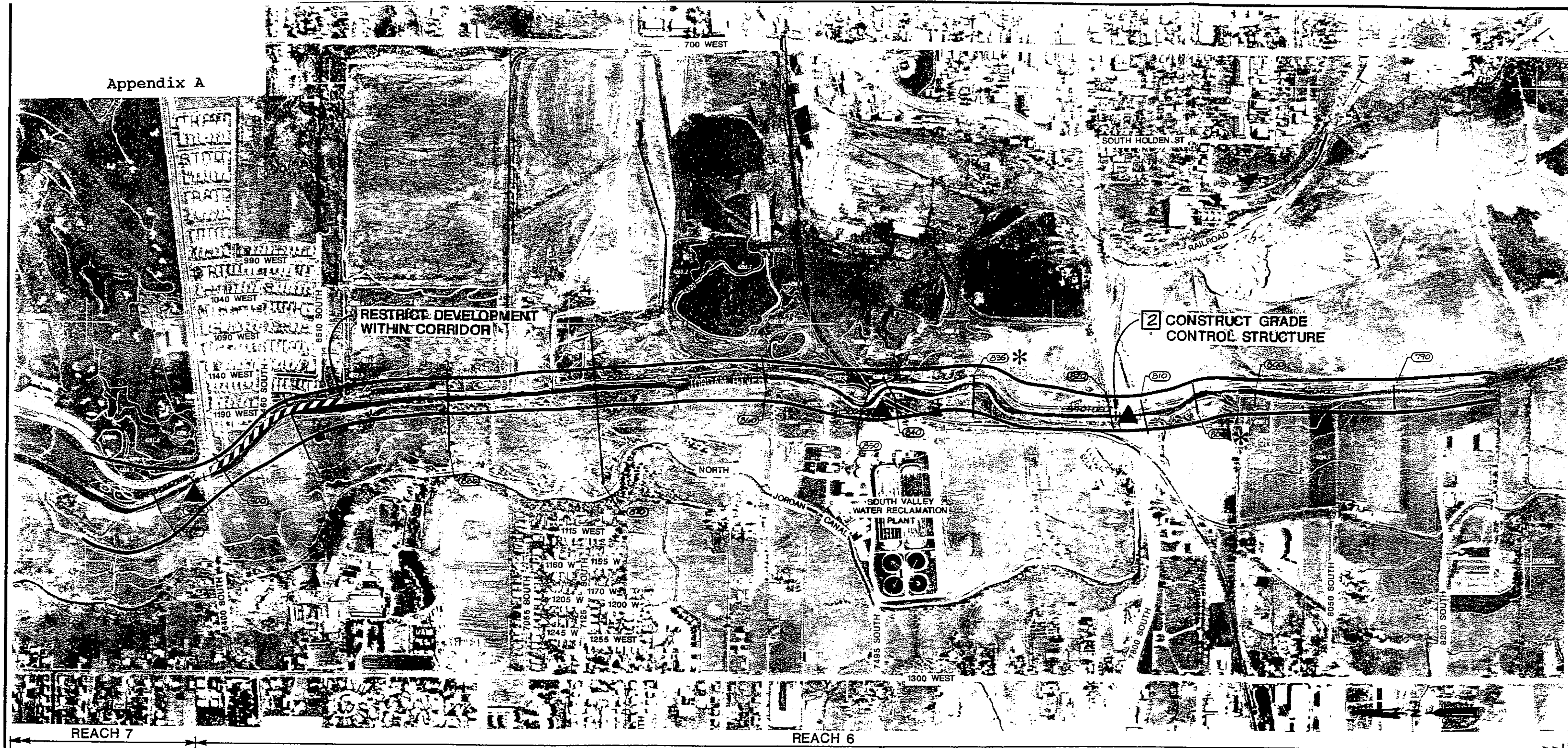
Appendix A



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2001 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84190-4600
AERIAL CONTOUR PHOTO MAP
JORDAN RIVER 2100 S. - UTAH COUNTY LINE

PHOTO DATE: 11-7-90
CONTOUR INTERVAL: 4' W/ 2' SUP.
SCALE: 1" = 800'
LOCATION:

SHEET INDEX BOI33516.A0

Figure 1-4

SUMMARY OF PRIORITIZED RECOMMENDED MANAGEMENT AND MAINTENANCE ALTERNATIVES

JORDAN RIVER STABILITY STUDY

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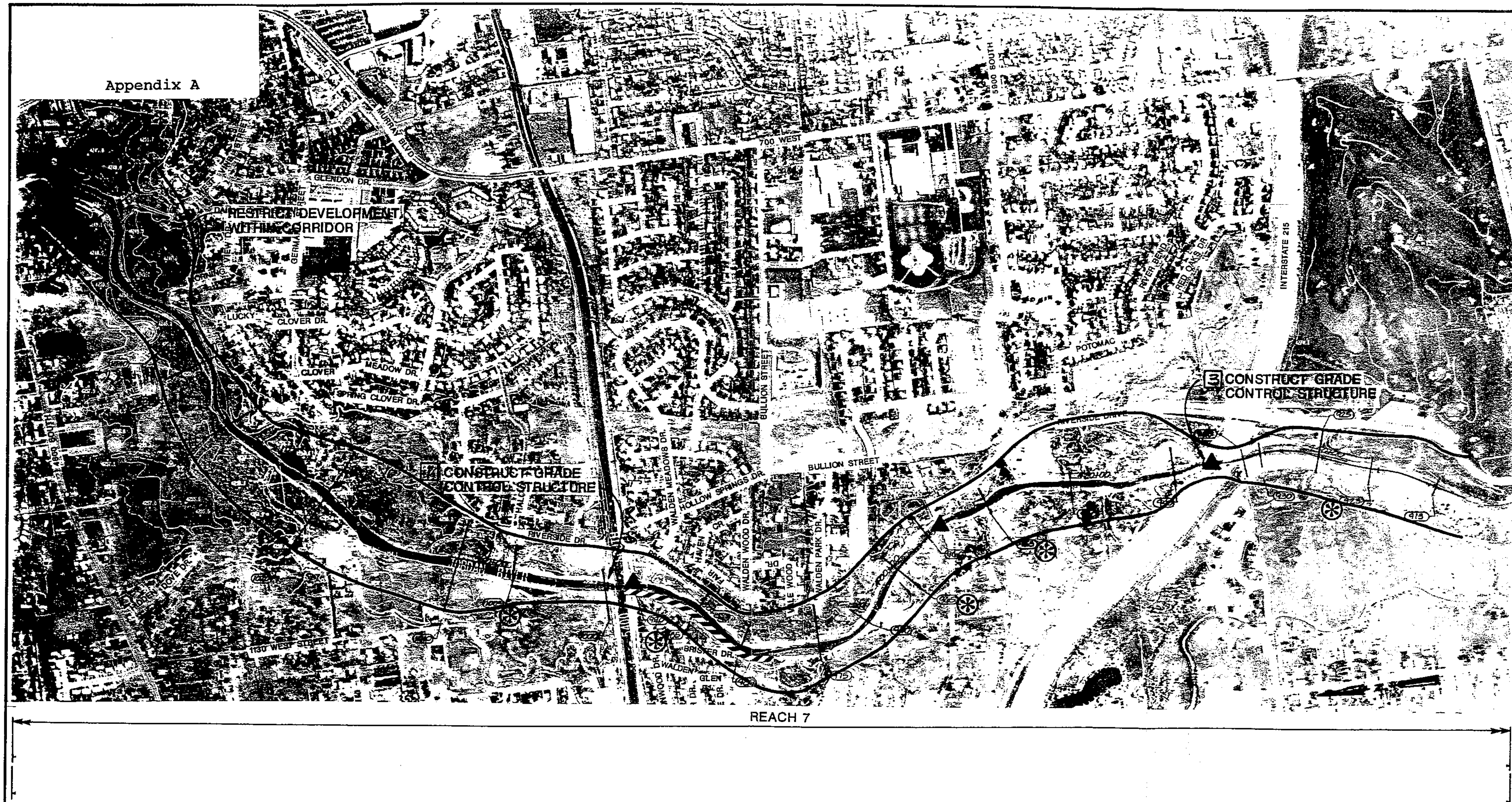
Appendix A



PUBLIC WORKS DEPARTMENT

2001 SOUTH

SALT LAKE CITY

AERIAL CONTOUR

JORDAN RIVER 2100 S. - UTAH

PHOTO DATE: 11-7-90	
CONTOUR INTERVAL: 4' W/ 2' SUP.	
SCALE: 1" = 800'	
LOCATION:	

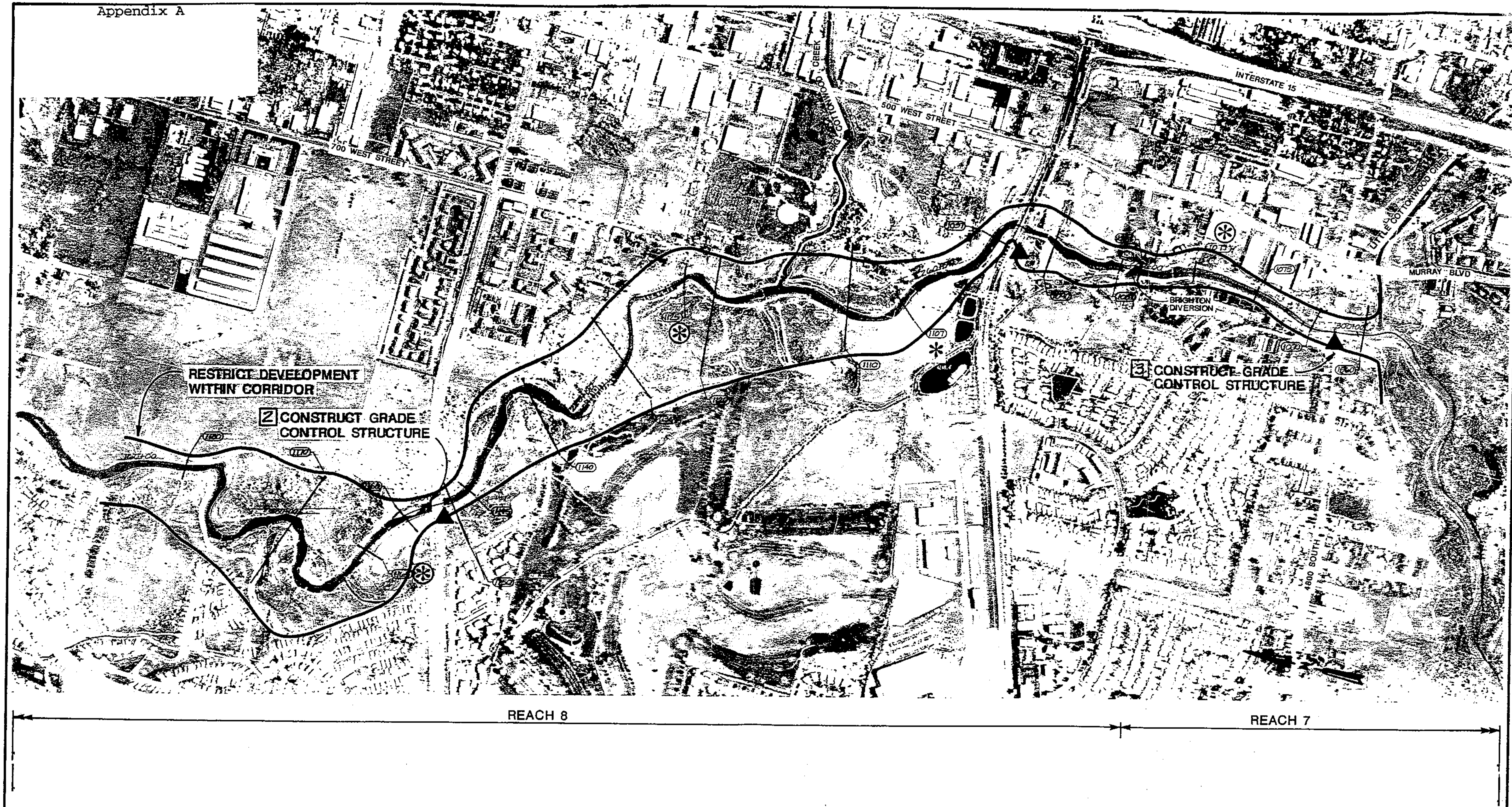
SHEET INDEX BO133516.A0

Figure 1-3

SUMMARY OF PRIORITIZED RECOMMENDED MANAGEMENT AND MAINTENANCE ALTERNATIVES

JORDAN RIVER STABILITY STUDY

CH2M HILL



PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION
2001 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84190-4600

AERIAL CONTOUR PHOTO MAP

JORDAN RIVER 2100 S. - UTAH COUNTY LINE

PHOTO DATE: 11-7-90
CONTOUR INTERVAL: 4' W/ 2' SUP.
SCALE: 1" = 800'
LOCATION:

SHEET INDEX BO133516.A0

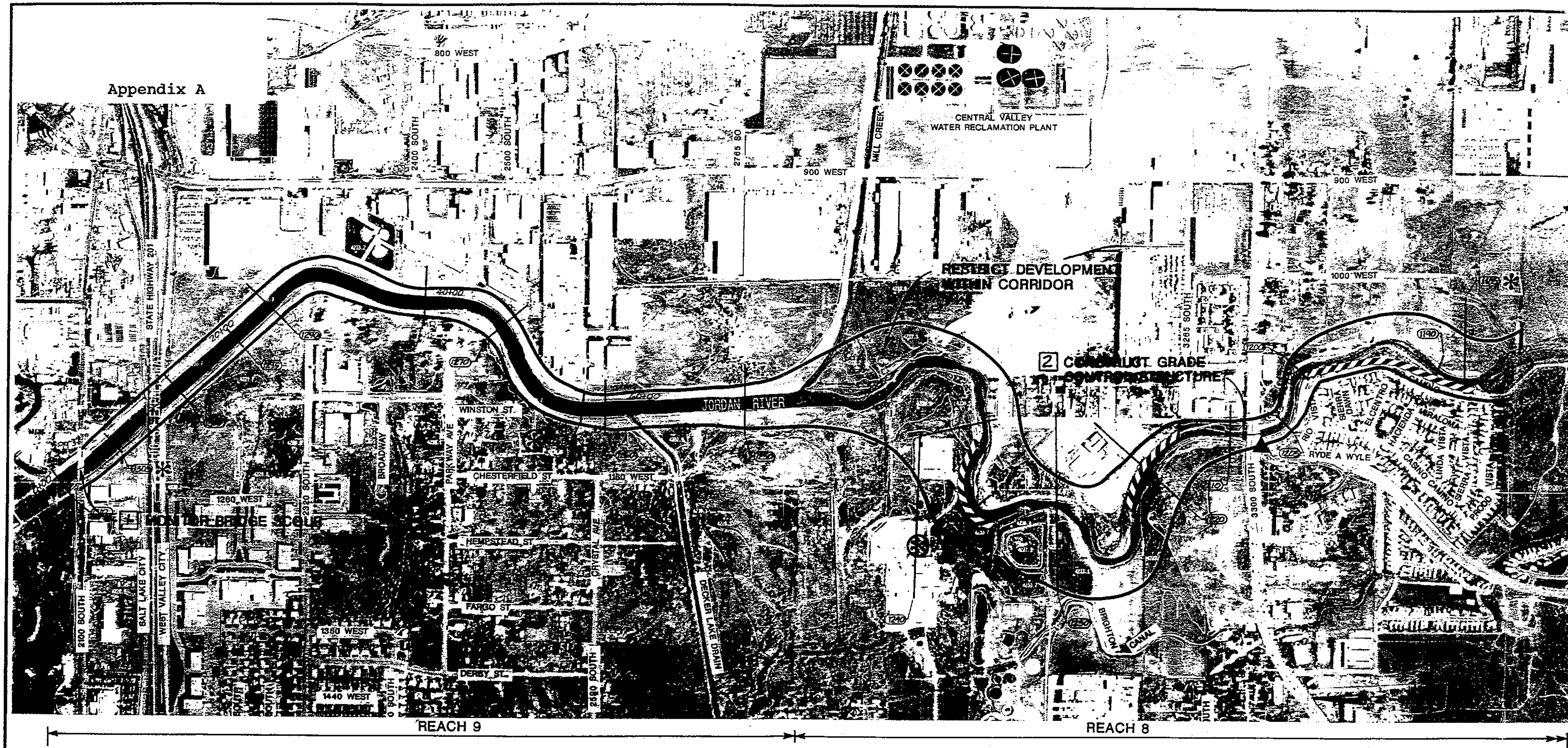
Figure 1-2

SUMMARY OF PRIORITIZED RECOMMENDED MANAGEMENT AND MAINTENANCE ALTERNATIVES

JORDAN RIVER STABILITY STUDY

CH2M HILL

Appendix A



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SALT LAKE CITY, UTAH 84190-4600

AERIAL CONTOUR PHOTO MAP

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LOCATION:

SHEET INDEX B0133516.A0

LEGEND

- ▲ INSPECT BRIDGE STABILITY & MONITOR BRIDGE SCOUR
- BANK STABILIZATION
- * SALT LAKE COUNTY MONUMENTED CROSS SECTION
- MONITOR SEDIMENTATION AT CROSS SECTION
- [1] PRIORITY FOR STRUCTURAL ALTERNATIVE
  - 1=HIGH
  - 2=MODERATE
  - 3=LOW

Figure 1-1

SUMMARY OF PRIORITIZED RECOMMENDED MANAGEMENT AND MAINTENANCE ALTERNATIVES

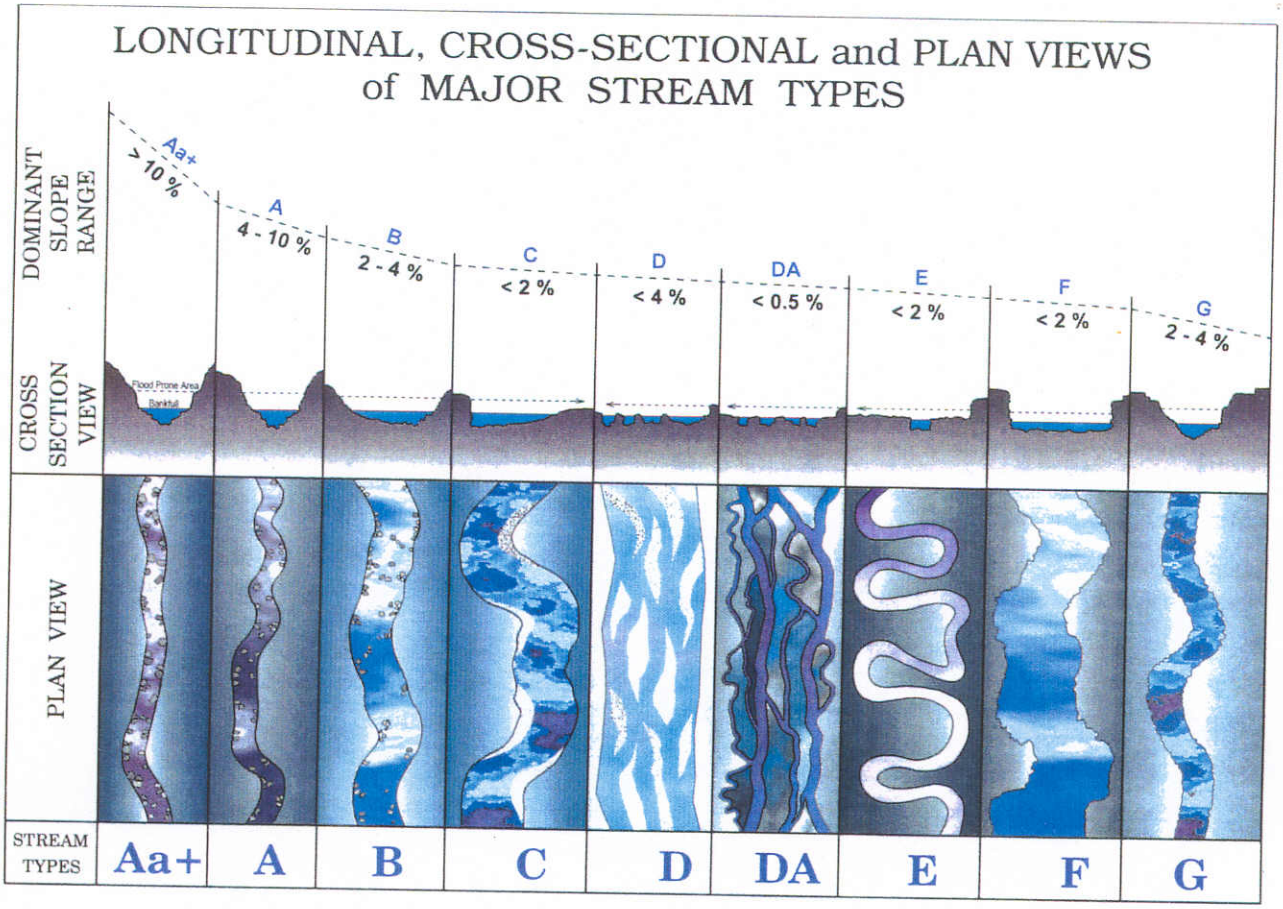
JORDAN RIVER STABILITY STUDY

CH2M HILL

APPENDIX A--Figure 2-1: Level Classifications

LEVEL I: THE GEOMETRIC CHARACTERIZATION (1996, Rosgen 4-4)

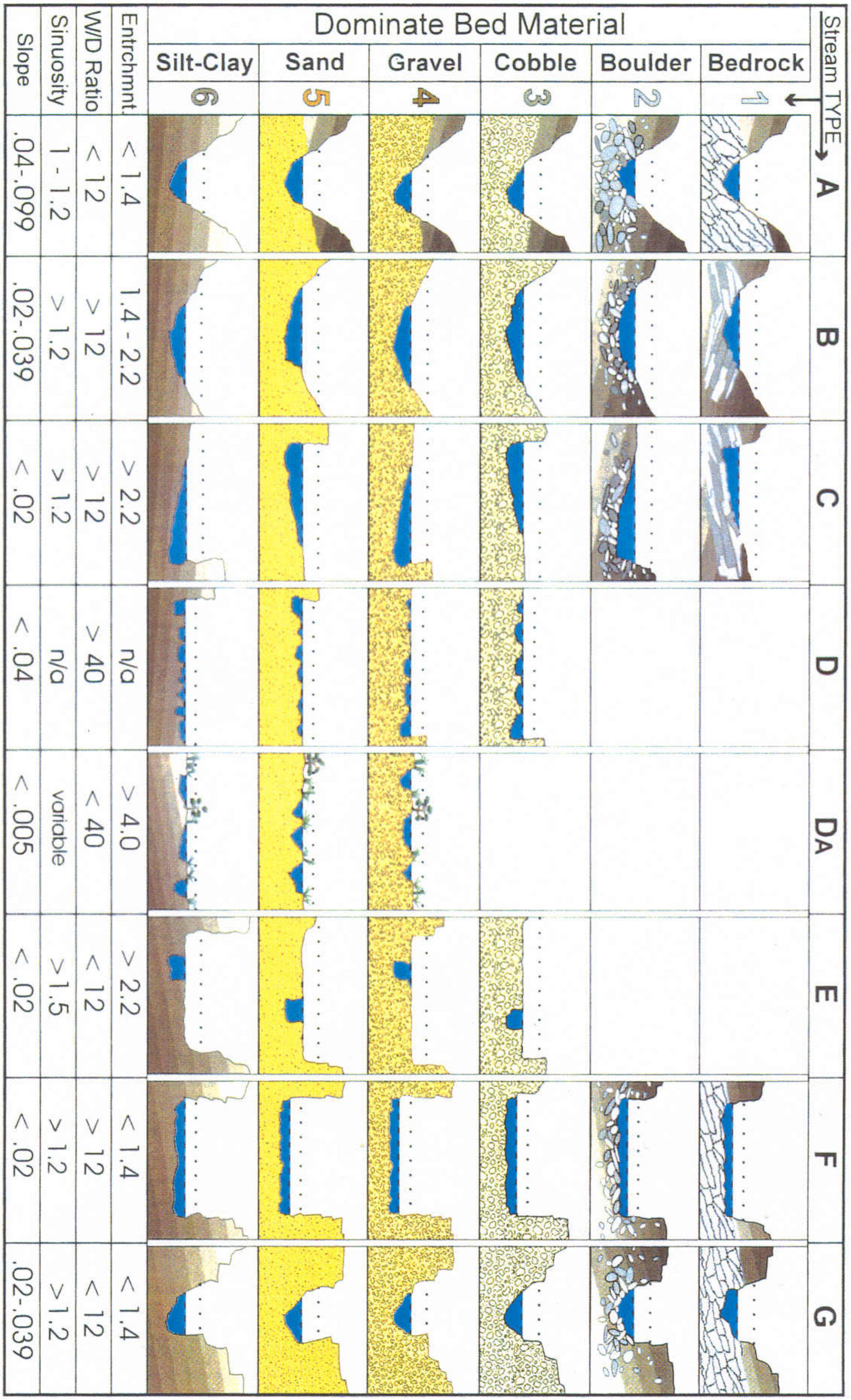
Broad level stream classification delineation showing longitudinal, cross-sectional, and plan-views for major stream types



APPENDIX A--Figure 2-1: Level Classifications

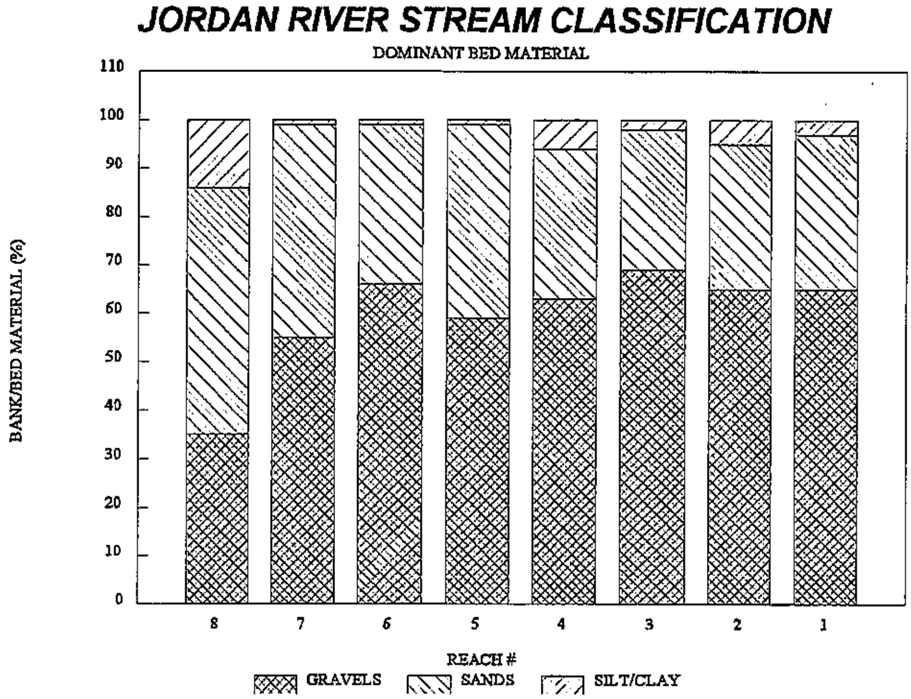
LEVEL II: THE MORPHOLOGICAL DESCRIPTION (1996, Rosgen 5-5)

Primary delineative criteria for the major stream types



Stream TYPE	Entrchmnt.	W/D Ratio	Sinuosity	Slope
A	< 1.4	< 12	1 - 1.2	.04-.099
B	1.4 - 2.2	> 12	> 1.2	.02-.039
C	> 2.2	> 12	> 1.2	< .02
D	n/a	> 40	n/a	< .04
DA	> 4.0	< 40	variable	< .005
E	> 2.2	< 12	>1.5	< .02
F	< 1.4	> 12	> 1.2	< .02
G	< 1.4	< 12	>1.2	.02-.039

APPENDIX A--Figure 3 Background Data for Jordan River



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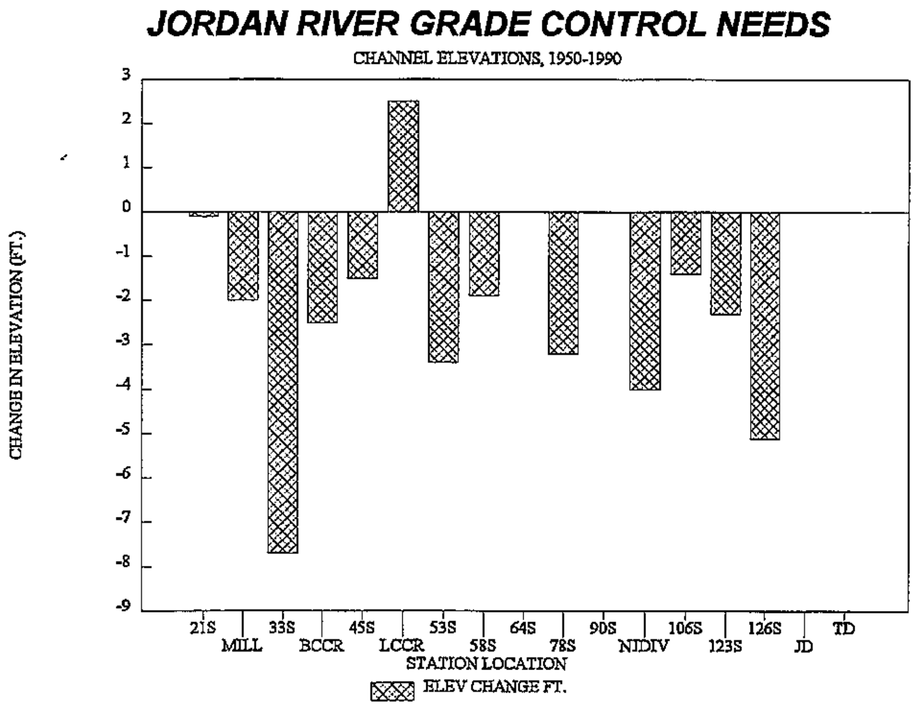
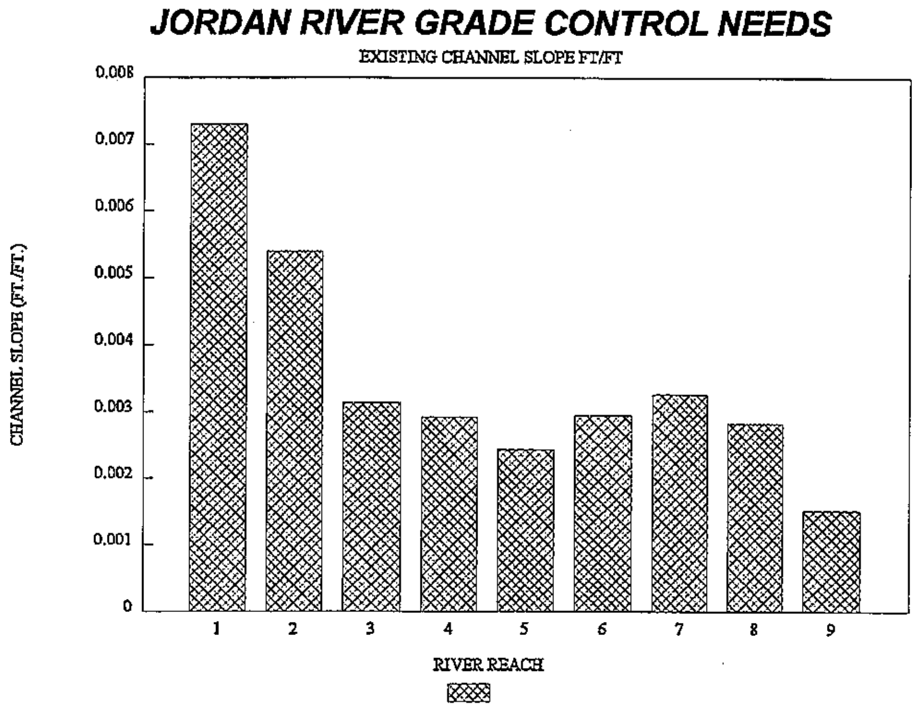


Figure 3-2

Appendix A



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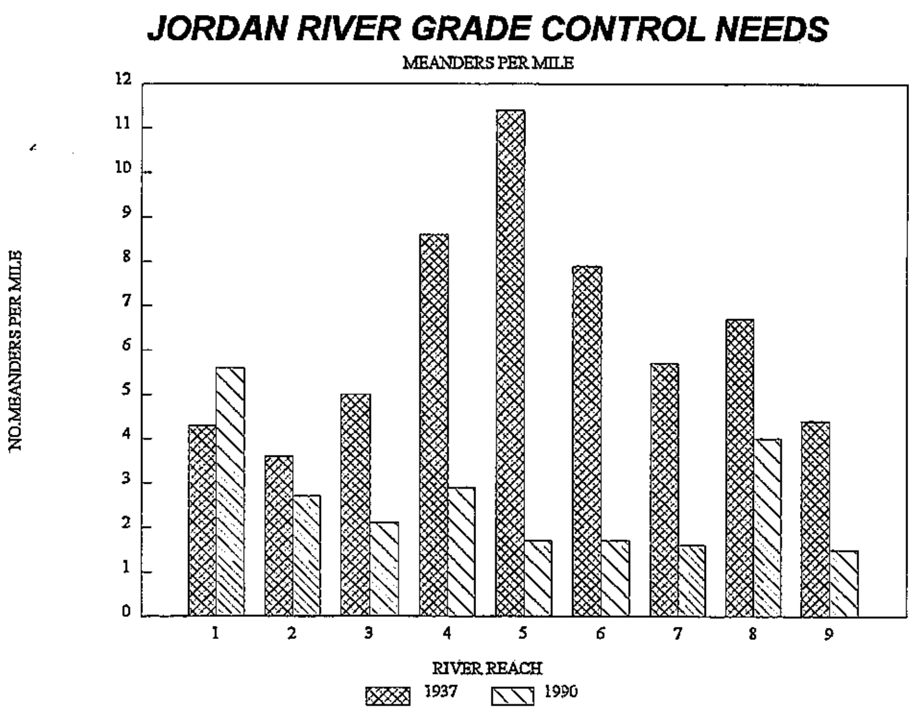


Figure 3-4

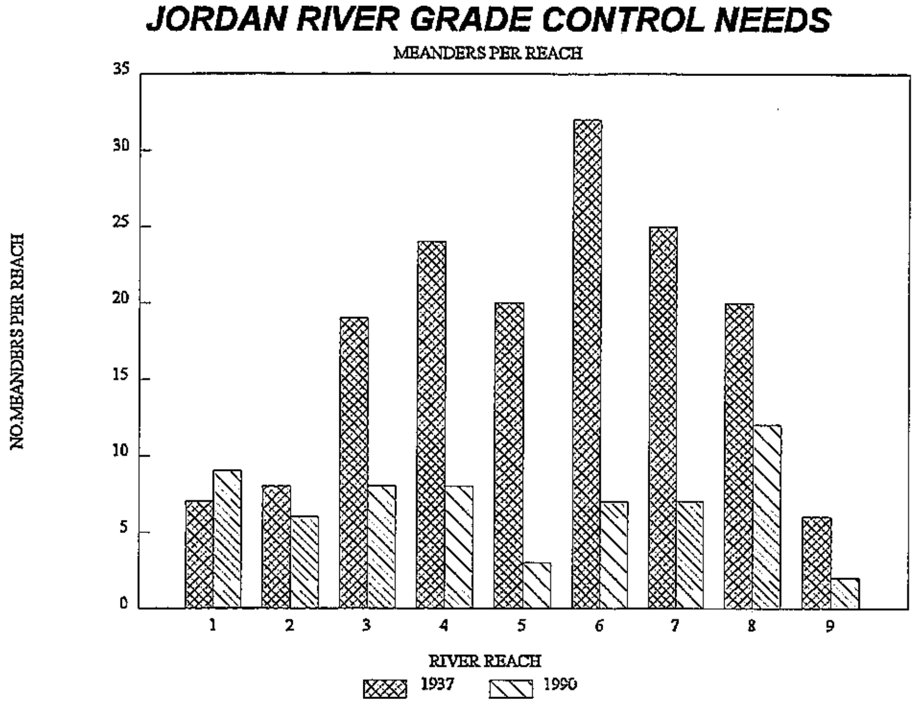
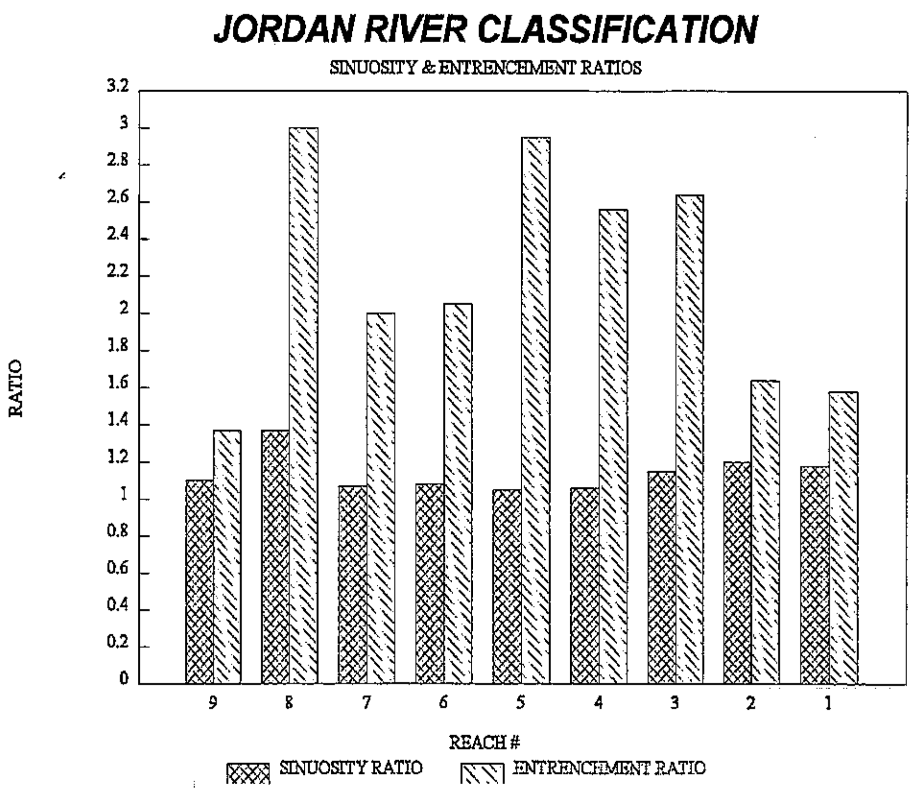


Figure 3-5



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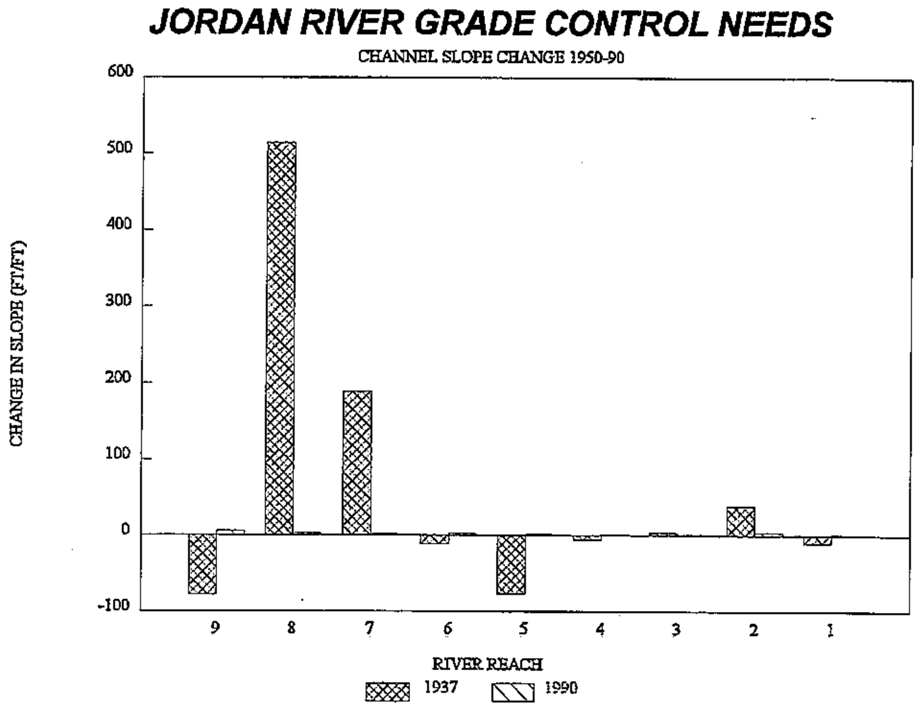

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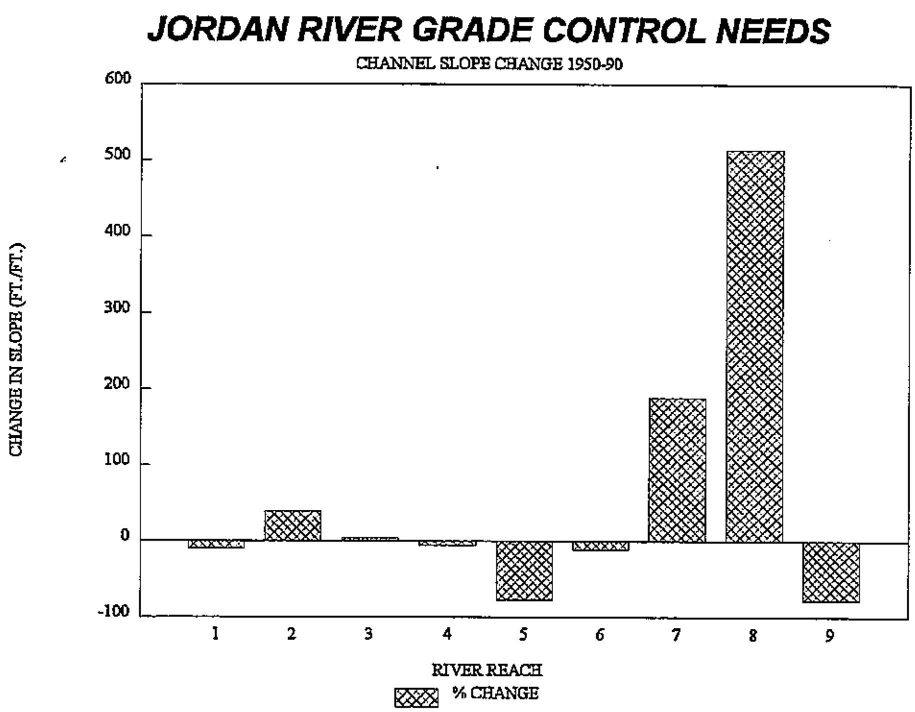

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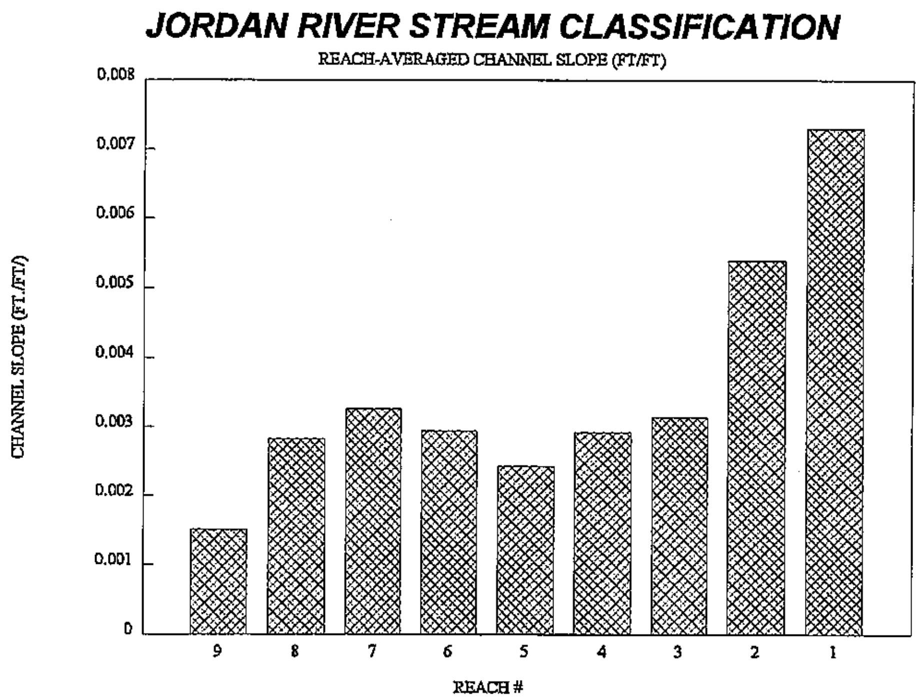

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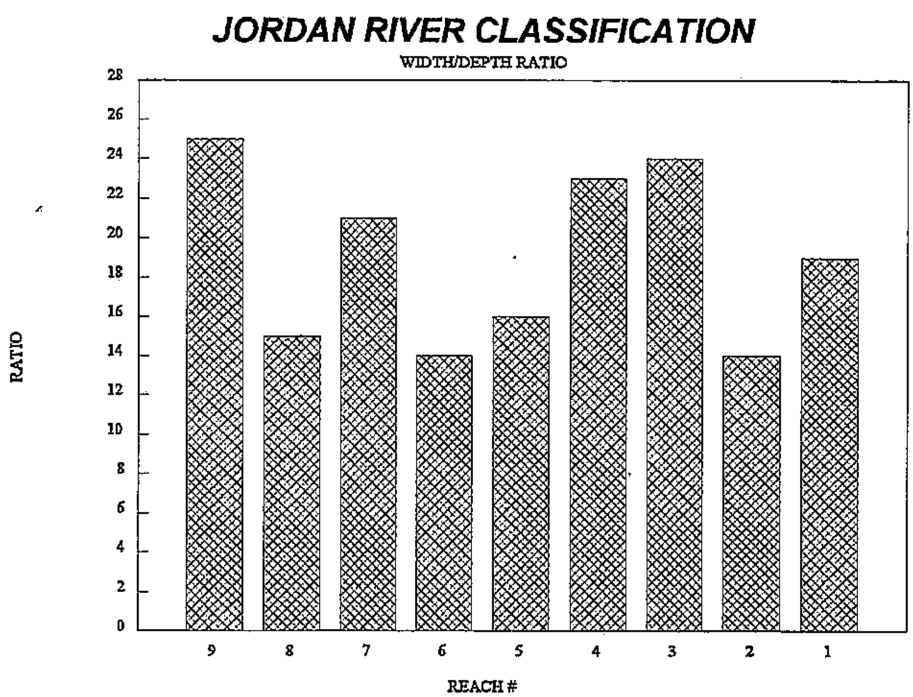

Figure 3-10

Appendix B

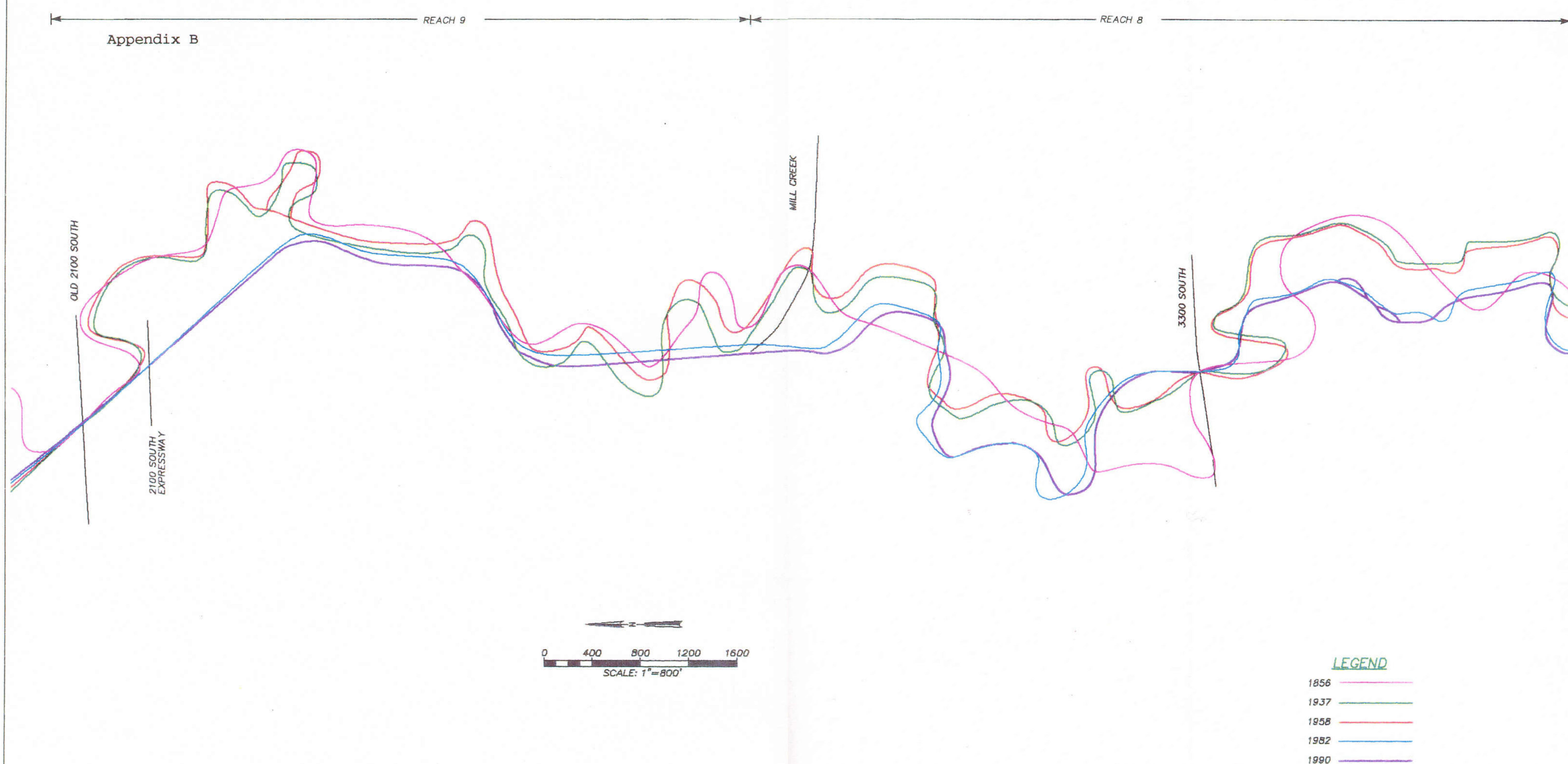

Figure 1-1

JORDAN RIVER CHANNEL LOCATIONS 1856-1990
JORDAN RIVER STABILITY STUDY

CH2M HILL

D:\833518\56-90-1.DWG

Appendix B

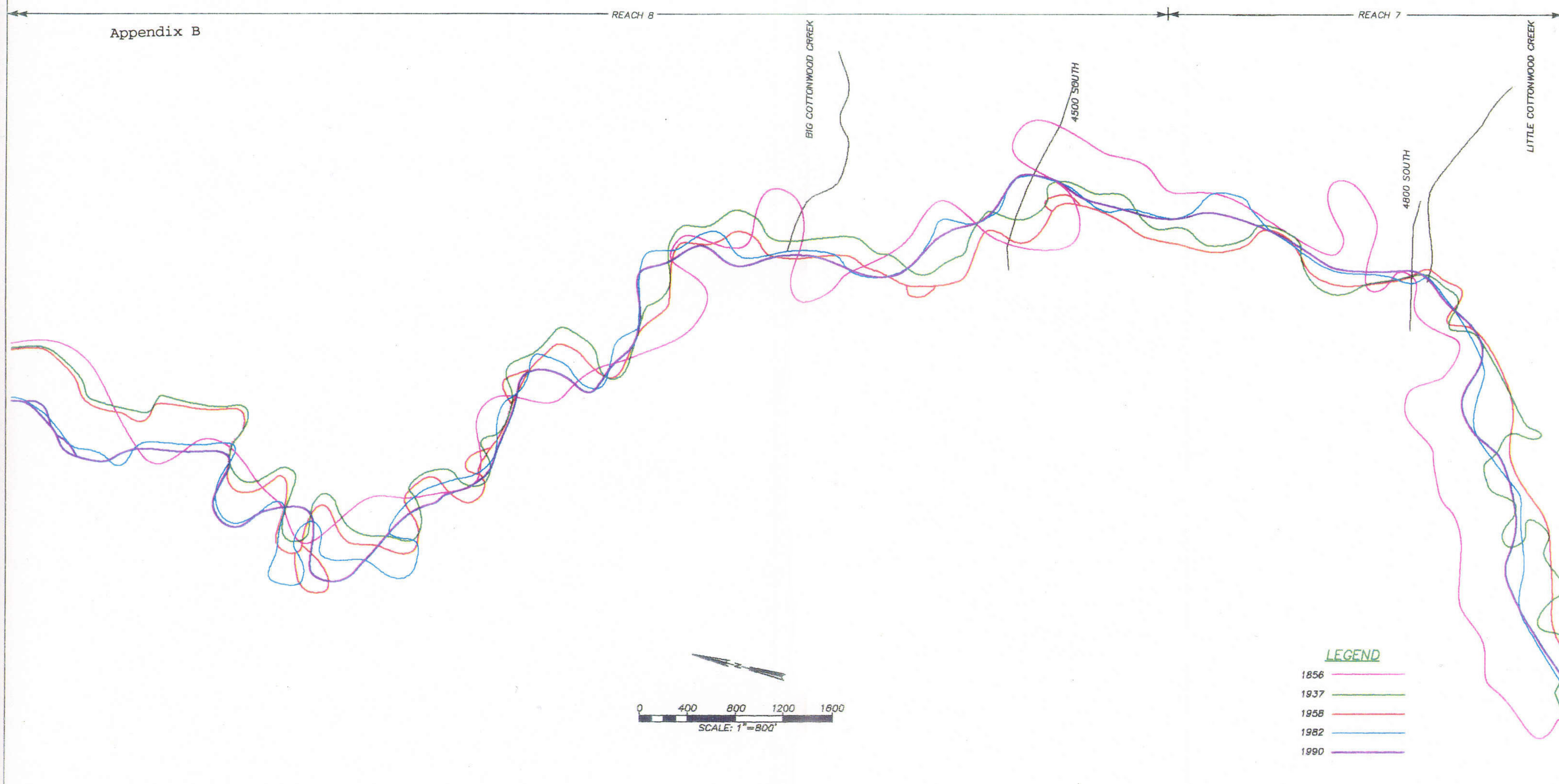

Figure 1-2

JORDAN RIVER CHANNEL LOCATIONS 1856-1990

JORDAN RIVER STABILITY STUDY

CH2MHILL

09-11-92

Appendix B

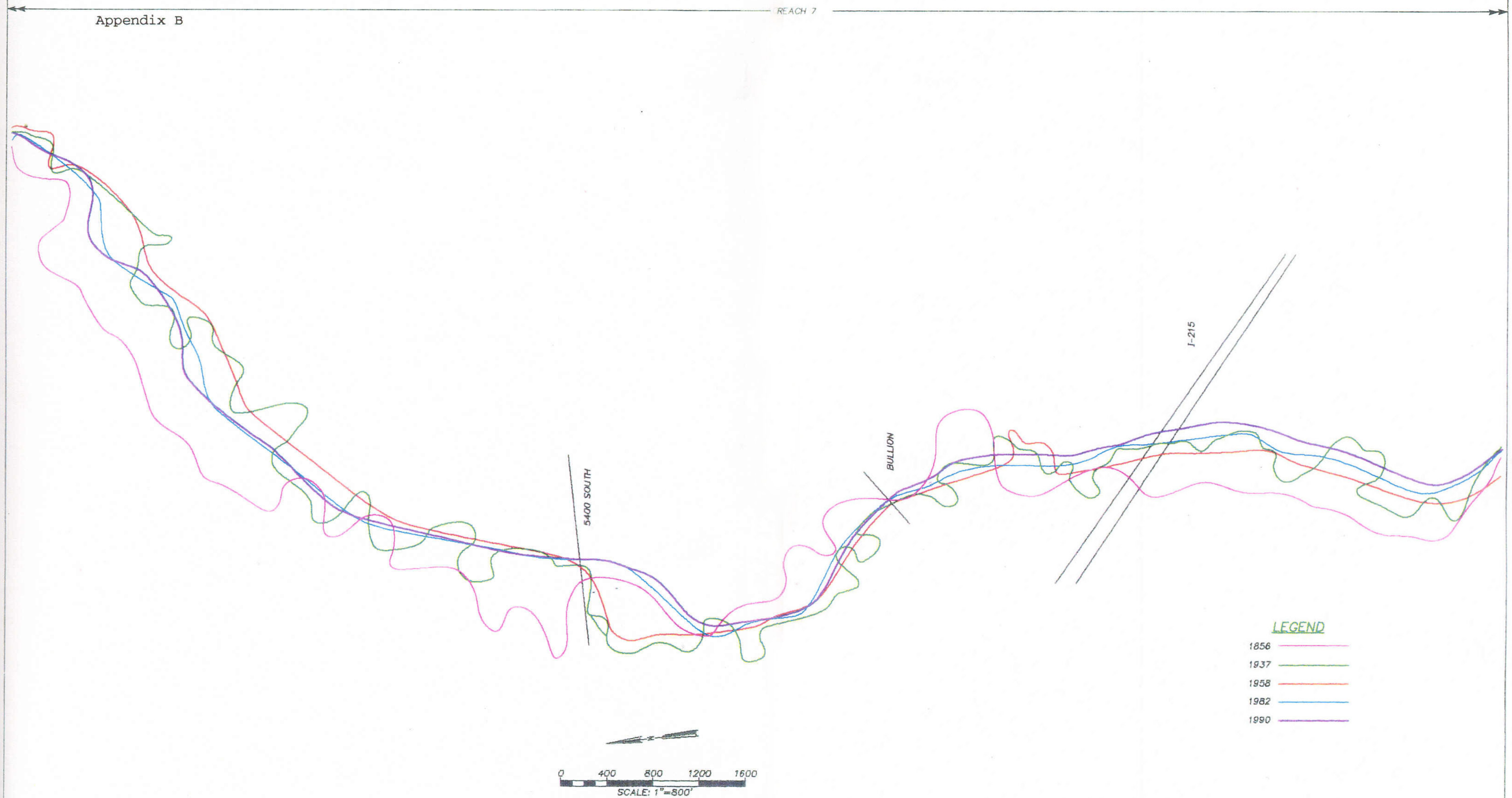

Figure 1-3

JORDAN RIVER CHANNEL LOCATIONS 1856-1990
JORDAN RIVER STABILITY STUDY

CH2M HILL

\B33818\56-90-3.DWG

09-11-92

Appendix B

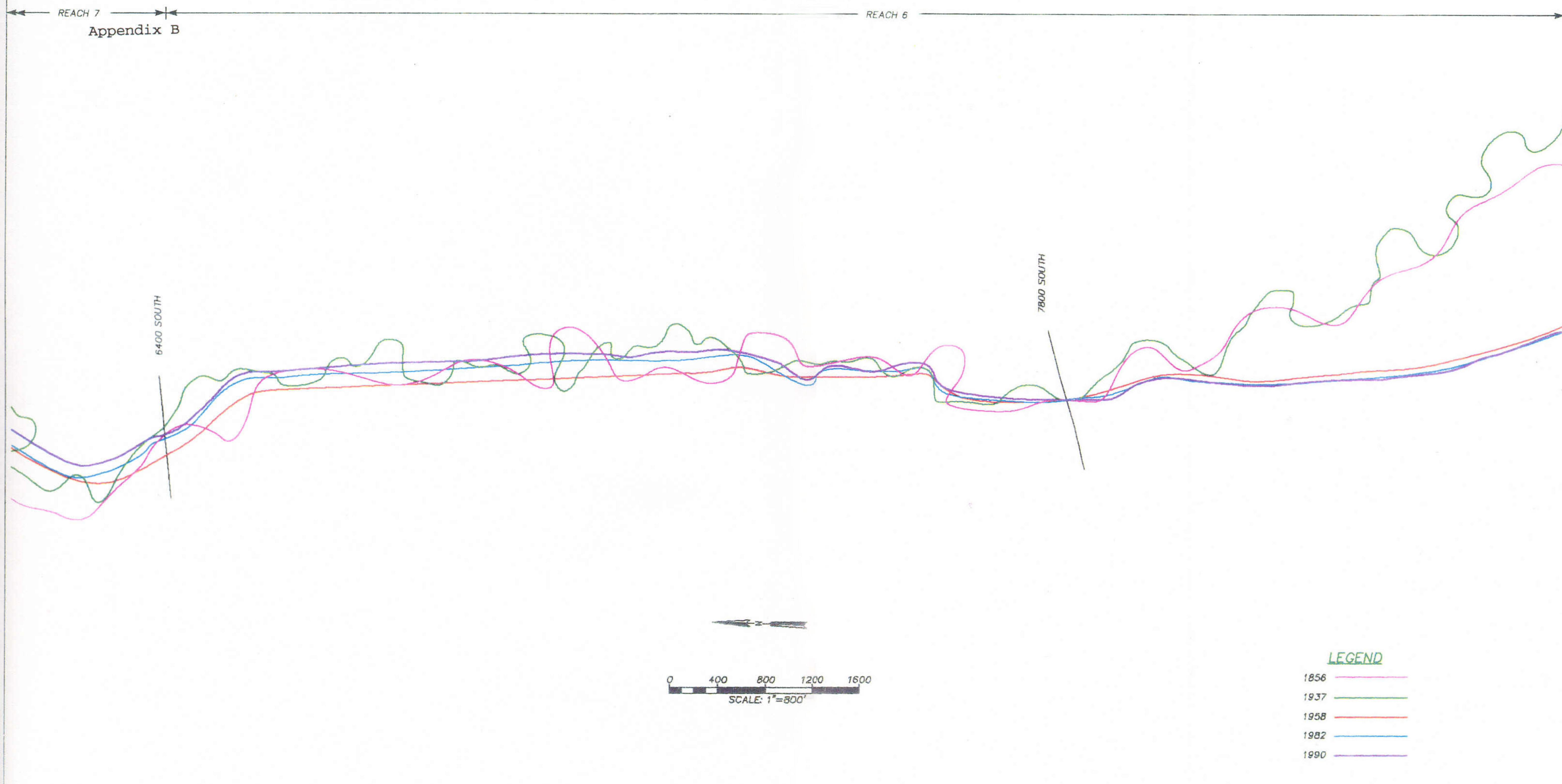

Figure 1-4

JORDAN RIVER CHANNEL LOCATIONS 1856-1990

JORDAN RIVER STABILITY STUDY

CH2M HILL

O:\B33818\56-90-4.DWG

Appendix B

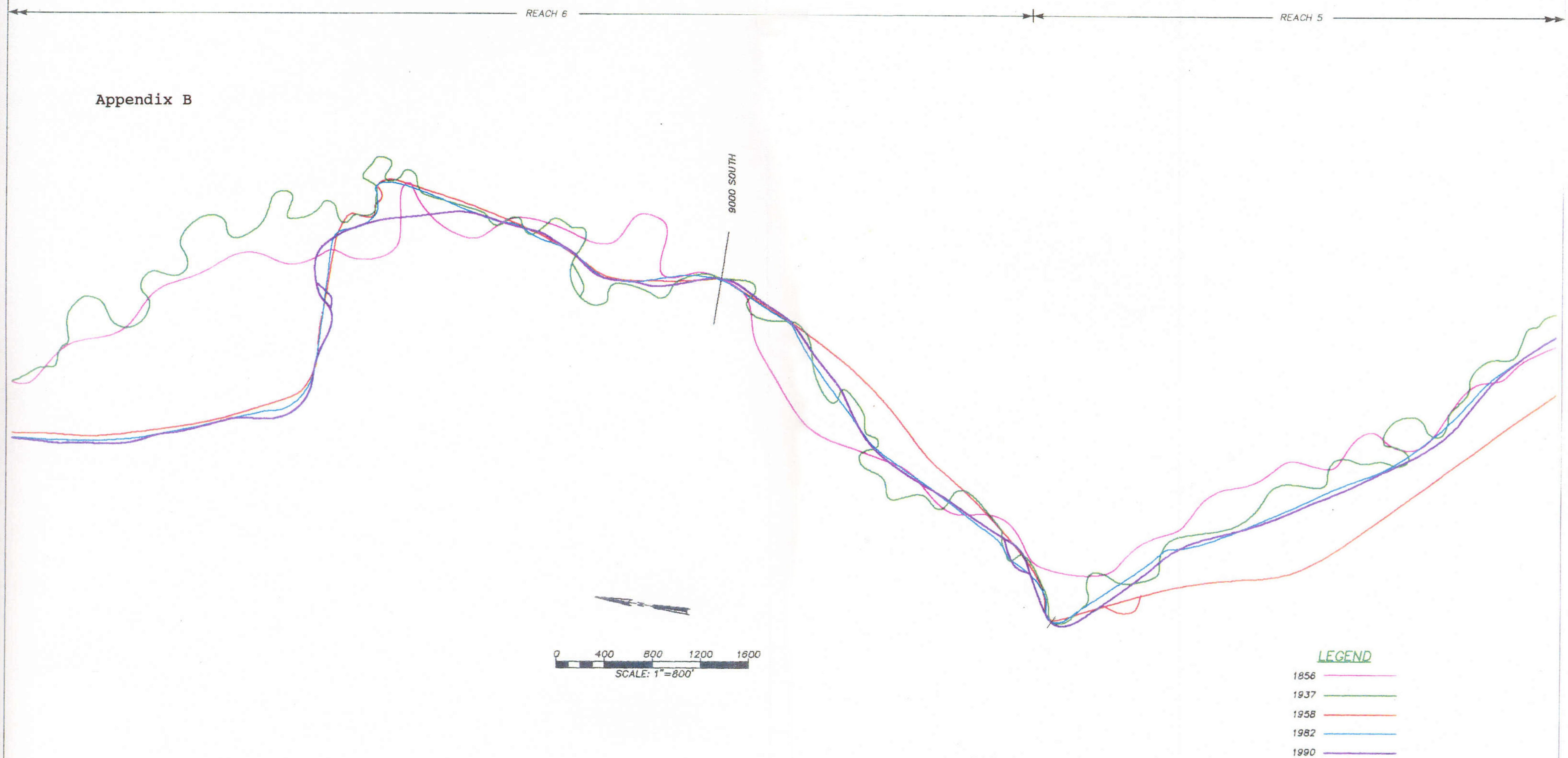

Figure 1-5

JORDAN RIVER CHANNEL LOCATIONS 1856-1990
JORDAN RIVER STABILITY STUDY

CH2M HILL

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Appendix B

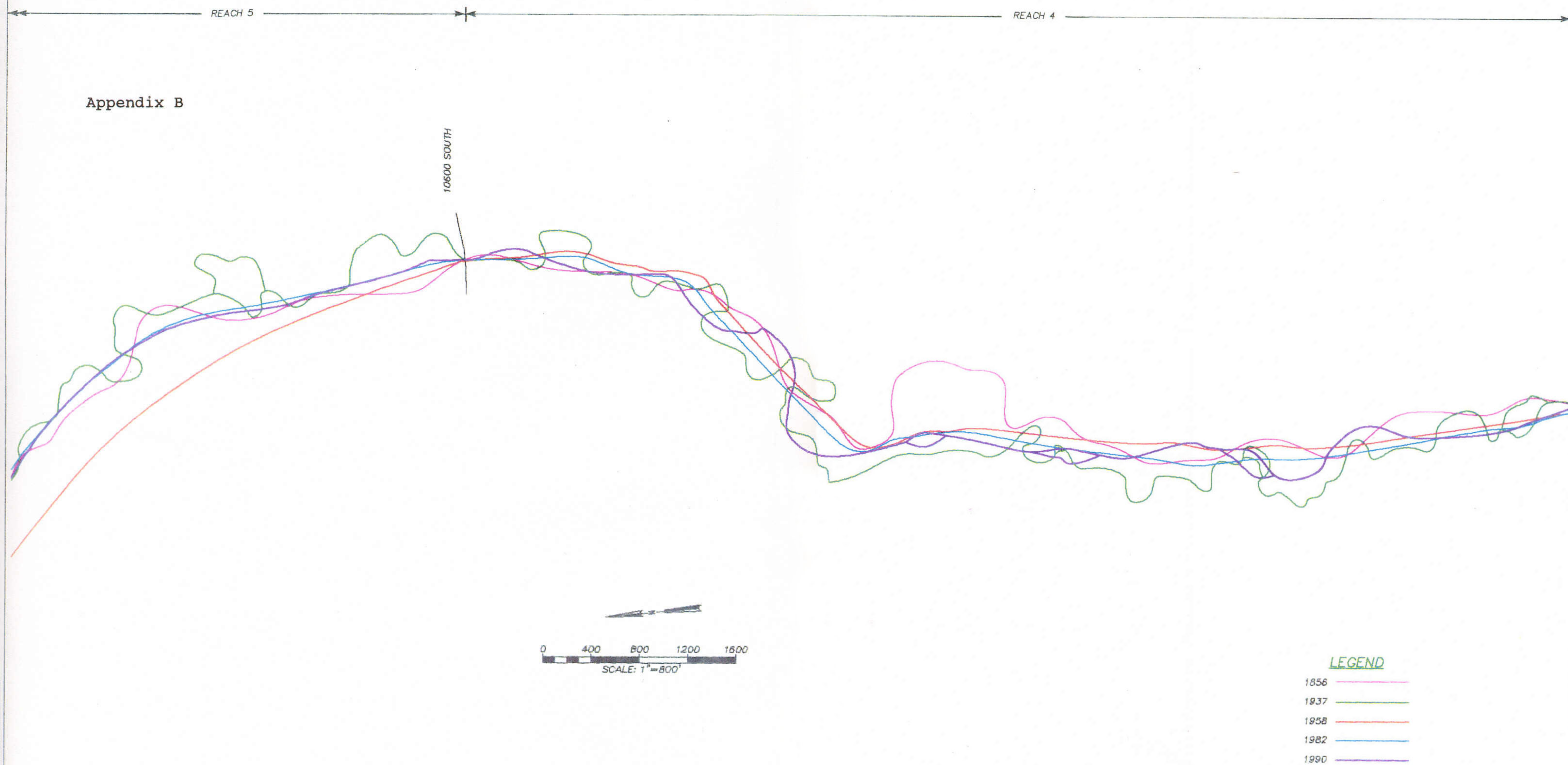

Figure 1-6

JORDAN RIVER CHANNEL LOCATIONS 1856-1990

JORDAN RIVER STABILITY STUDY

Appendix B

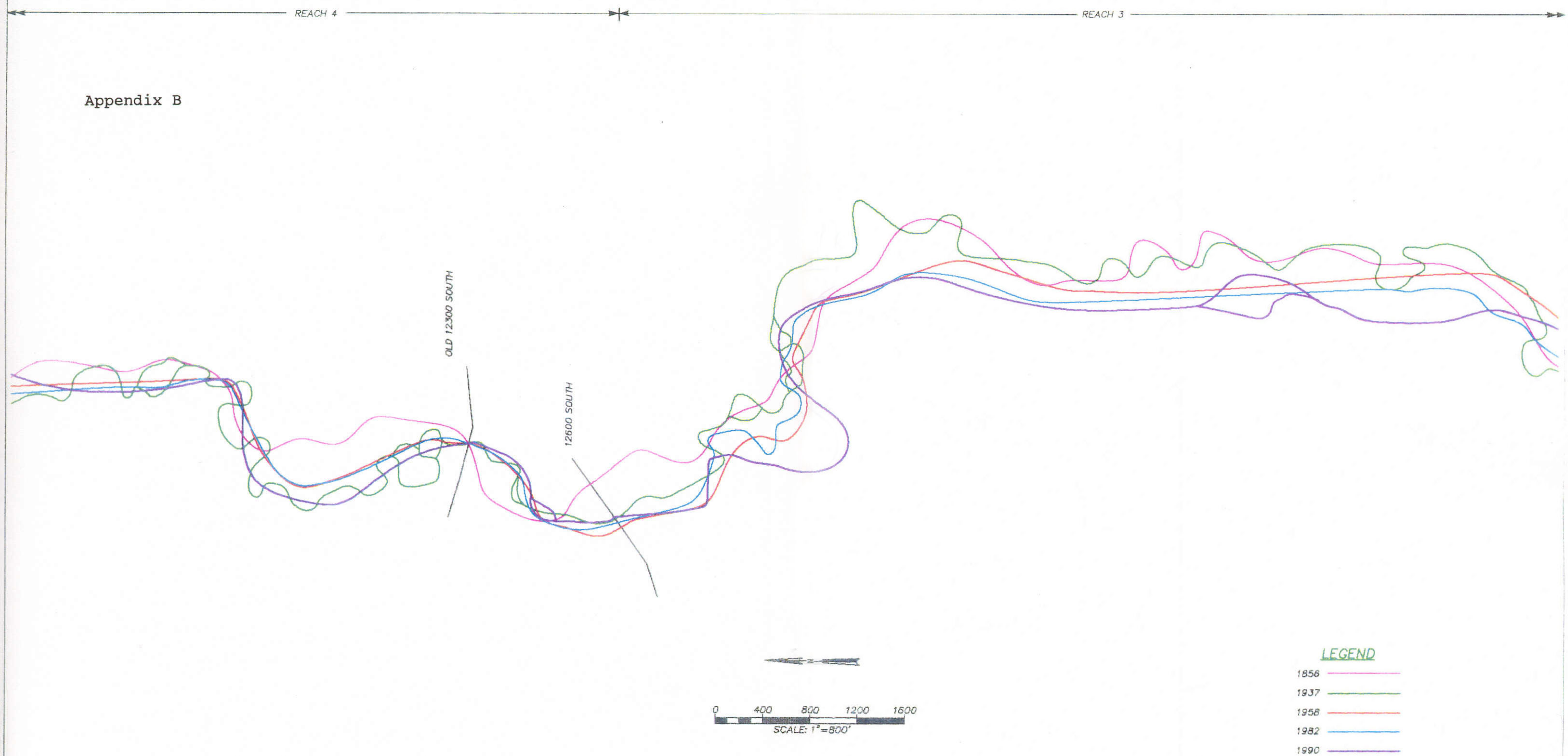

Figure 1-7

JORDAN RIVER CHANNEL LOCATIONS 1856-1990

JORDAN RIVER STABILITY STUDY

CH2M HILL

D:\833616\56-90-7.DWG

Appendix B

Figure 1-8

JORDAN RIVER CHANNEL LOCATIONS 1856-1990
JORDAN RIVER STABILITY STUDY

CH2M HILL

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09-11-92

Appendix B

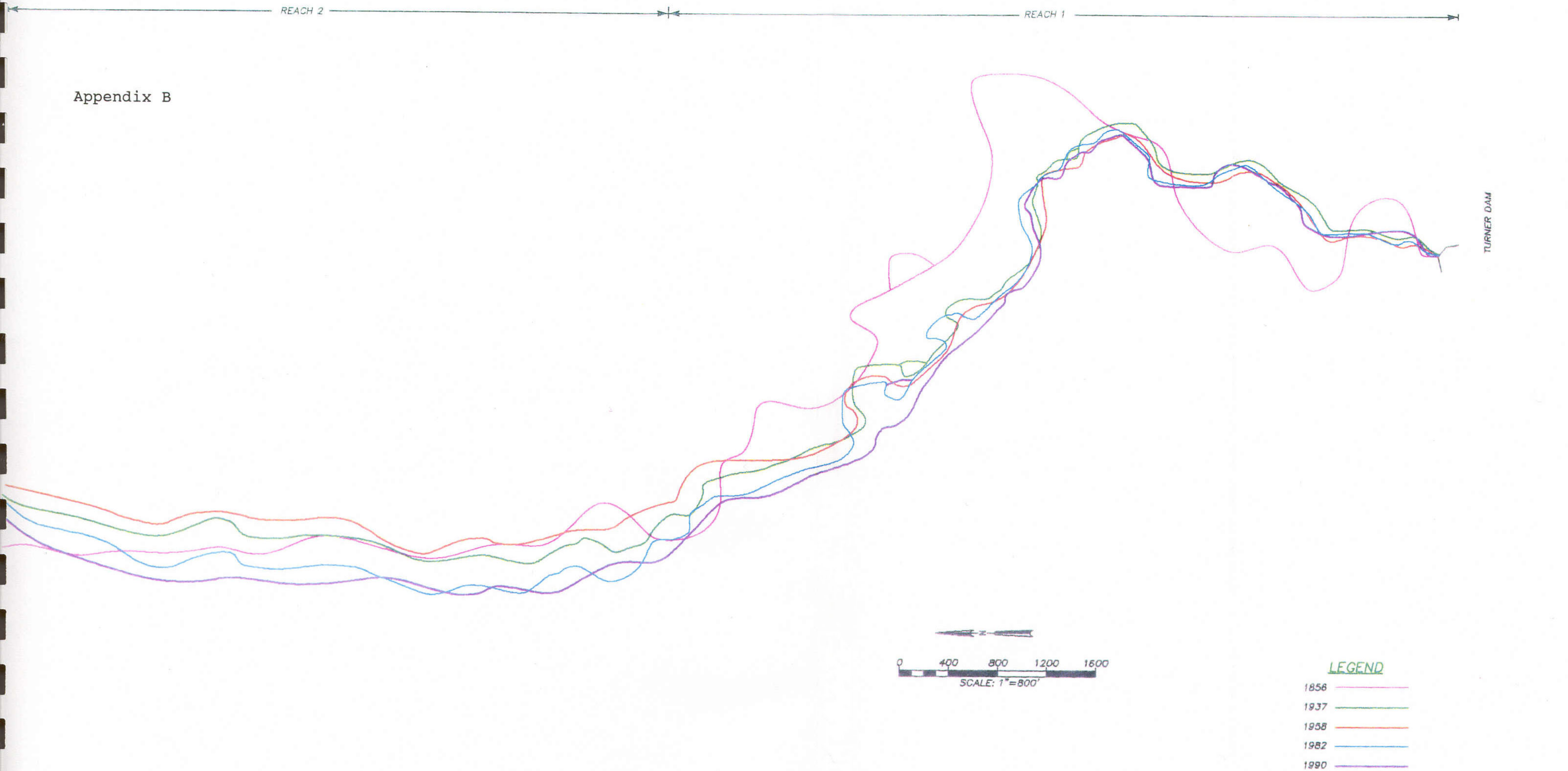

Figure 1-9

JORDAN RIVER CHANNEL LOCATIONS 1856-1990

JORDAN RIVER STABILITY STUDY

CH2M HILL

833516\56-90-9.DWG

APPENDIX B--Figure 2 Valley Type and Jordan River Data (past and present)

The Jordan River Valley is a fault controlled valley with deep alluvial and lacustrine deposits. It has a shallow valley slope and due to the depositional nature of the developed landforms, sediment supply is high, and the commonly occurring "C" and "D" stream types are associated with high rates of lateral migration. (1996, Rosgen 4-16)

Traditionally this valley supports streams with a high width to depth ratio, that is wide and shallow streams. The gravel and sand soils found in the river bed would make the stream banks susceptible to erosion that historically would have been mitigated by presence of vegetation on the banks. Early written records note that the bed was mainly composed of sand or gravel and the river was about 25 feet wide on average. The stream was also described as having one steep, sparsely vegetated bank and one gently sloping one, covered with willows and other vegetation (1995, US Fish & Wildlife p 10).

The B type reaches found on the river now are rarely found in this valley type. They are generally alpine streams found in deep valley where there is no room to meander. When this information is considered keeping in mind the lower than average slope for a B stream and remembering the history of human impact on the river, it is likely that the areas classified as B are C sections that have been deepened and straightened by human modification.

Current Classifications of Jordan River Reaches

#	Entrenchment Ratio[1]	W/D ratio[2]	Sinuosity[3]	Slope ft/ft[4]	Bed[5]	Flood Plain?	Type
1	1.5 (moderate)	19 (high-mod)	1.2 (mod)	.00682	gravel	yes	B4c
2	1.6 (moderate)	14 (high-mod)	1.2 (mod)	.00527	gravel	no	B4c
3	2.6 (slight)	24 (high-mod)	1.1 (low)	.00264	gravel	yes	C4
4	2.5 (slight)	23 (high-mod)	1.0 (low)	.00144	gravel	yes	C4
5	2.8 (slight)	16 (high-mod)	1.0 (low)	.00061	gravel	yes	C4
6	2.0 (moderate)	14 (high-mod)	1.0 (low)	.00143	gravel	little	B4c
7	2.0 (moderate)	21 (high-mod)	1.0 (low)	.00308	gravel	no	B4c
8	3.0 (slight)	15 (high-mod)	1.4 (mod)	.00310	sand	yes	C5
9	1.4 (entrenched)	25 (high-mod)	1.1 (low)	.00008	sand	no	F5

1 1992 CH_2MHill Appendix D
2 1992 CH_2MHill 4-8
3 1990 data, 1992 CH_2MHill 4-13
4 1990 data, 1992 CH_2MHill 4-26
5 1992 CH_2MHill Appendix A

Historical Classifications of Jordan River Reaches							
#	Entrenchment Ratio	W/D ratio[1]	Sinuosity[2]	Slope ft/ft[3]	Bed[4]	Flood Plain?[5]	Type
1	slight	±25	1.3	.00757	gravel	yes	C4
2	slight	±25	1.2	.00379	gravel	yes	C4
3	slight	±25	1.5	.00253	gravel	yes	C4
4	slight	±25	1.6	.00154	gravel	yes	C4
5	slight	±25	1.4	.00271	gravel	yes	C4
6	slight	±25	1.5	.00161	gravel	yes	C4
7	slight	±25	1.6	.00107	gravel	yes	C4
8	slight	±25	1.6	.00050	sand	yes	C5
9	slight	±25	1.7	.00034	sand	yes	C5

1 1995 USF&W Sharon Steel Conceptual Plan
2 1937 data, 1992 CH_2MHill Report 4-13
3 1950 data, 1992 CH_2MHill Report 4-26
4 1995 USF&W Sharon Steel Conceptual Plan
5 1937 aerial photos

USF&W, DuBois, K., Gutermuth, B. 1995. *Sharon Steel Damage Settlement: A Conceptual Restoration Plan.* USF&W service Lincoln Plaza, Suite 404, 145 E. 1300 S. Salt Lake City, Utah, 84115.

Rosgen, D. 1996. *Applied River Morphology*. Wildland Hydrology, 1481 Stevens lake Road, Pasoga Springs, Colorado.

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US Bureau of Reclamation. 1984. *Jordan River Terrestrial Wildlife Inventory Proposed Lampton Reservoir Area.* Utah Department of Natural Resources and Energy, Division of Wildlife Resources.