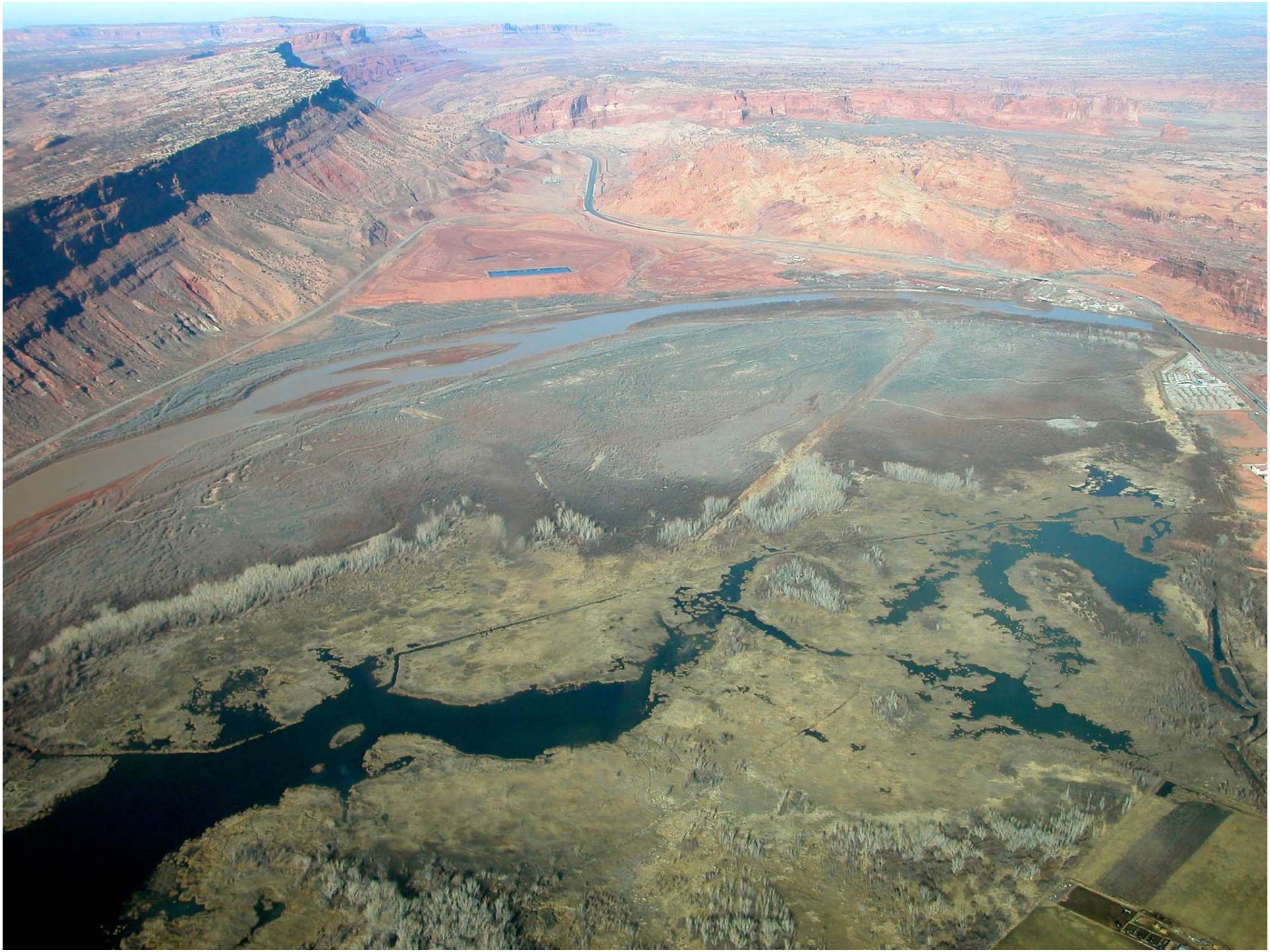

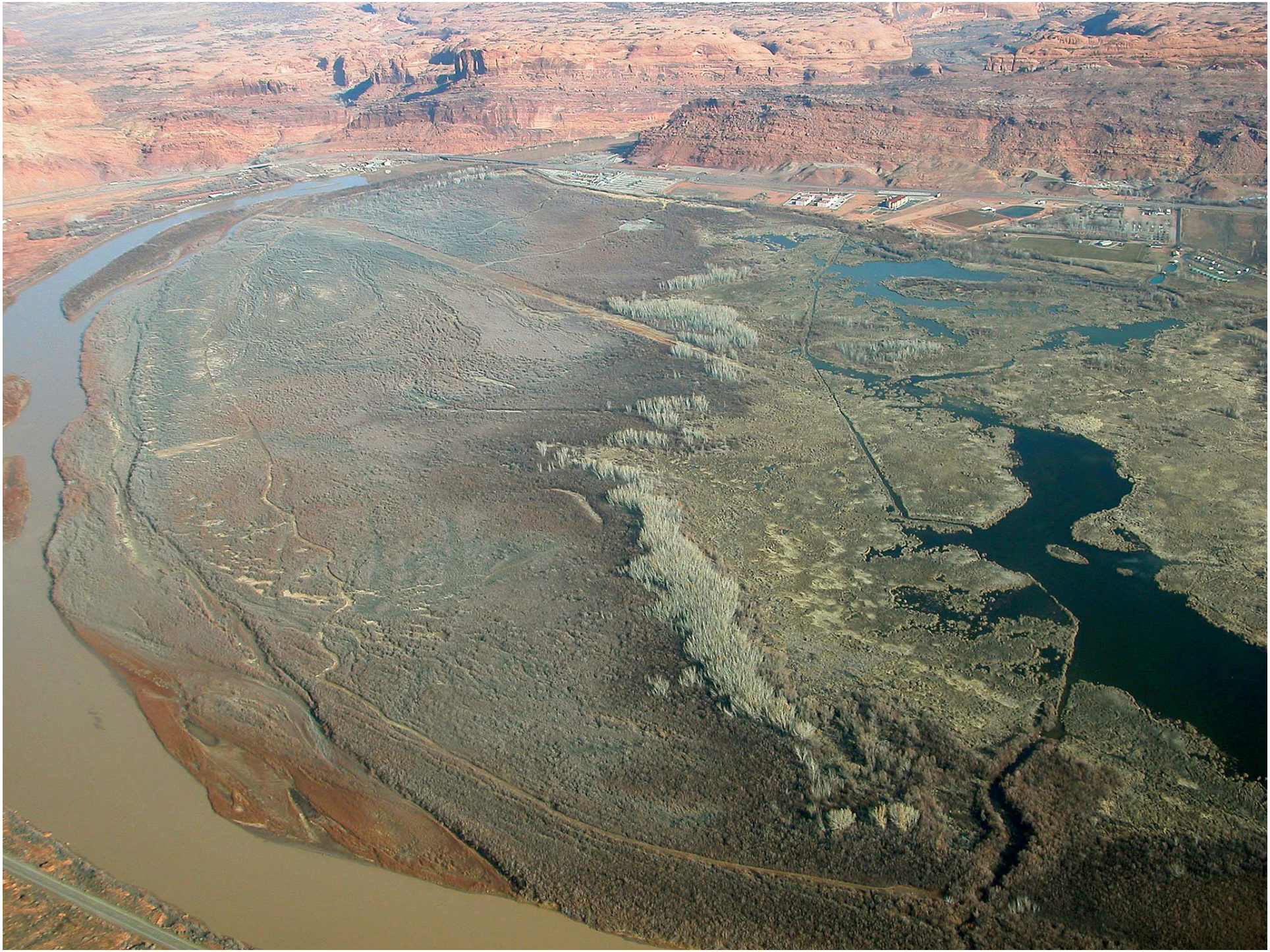

Lateral Migration of the Colorado River And other tales of the Moab Mill Site Fact - or Science Fiction?

John C Dohrenwend, PhD
Geosciences Department
The University of Arizona

Southwest Satellite Imaging
Teasdale, Utah


CONTROLLED
- AREA -
ENTER AT
DESIGNATED
ACCESS ONLY
No Trespassing
By Order Of The
United States
Department Of Energy
CAUTION
CONTAMINATION
AREA
ENTER AT DESIGNATED
ACCESS ONLY

Acknowledgements

- MTA Fund
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- Vic Baker, University of Arizona
- Adrien and Sam Taylor, Times-Independent
- Ginny Carlson, Sierra Club
- Kara & Ray, WildLand Scapes

DOE Position on Lateral Migration

According to the DOE, the following ‘evidence’ suggests that the Colorado River is and will continue migrating south and east away from the Atlas tailings pile:

- Morphology indicates a moderately stable to stable channel
- Historical maps & photos suggest rapid migration unlikely
- Location and age of river gravels indicate salt dissolution will continue a southward migration away from pile
- The River’s cobble-gravel bedload is being trapped by the subsidence of Moab Valley and is not being transported downstream of the Portal
- This subsidence is causing the river to move away from the pile

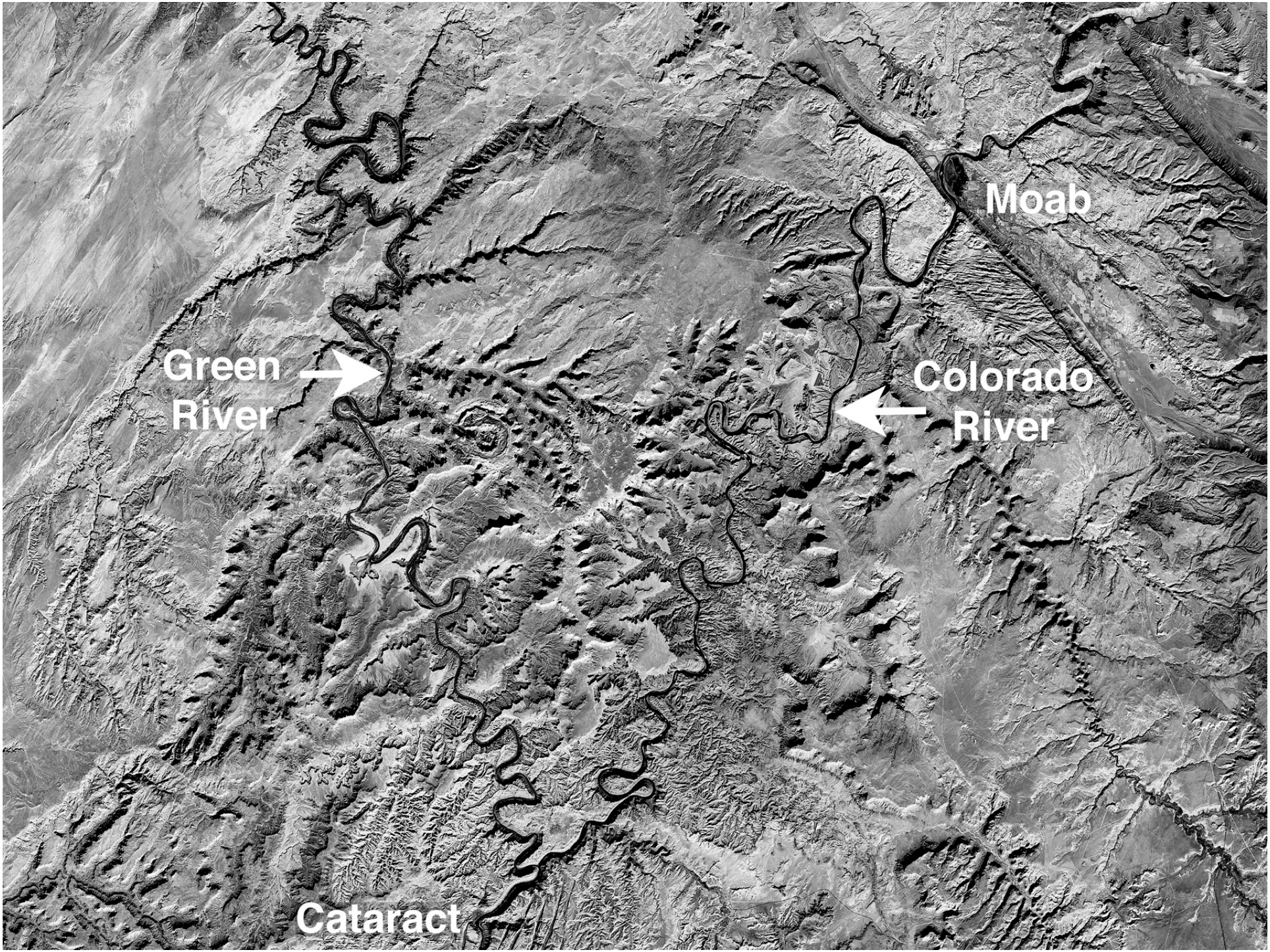
The Facts on Channel Migration

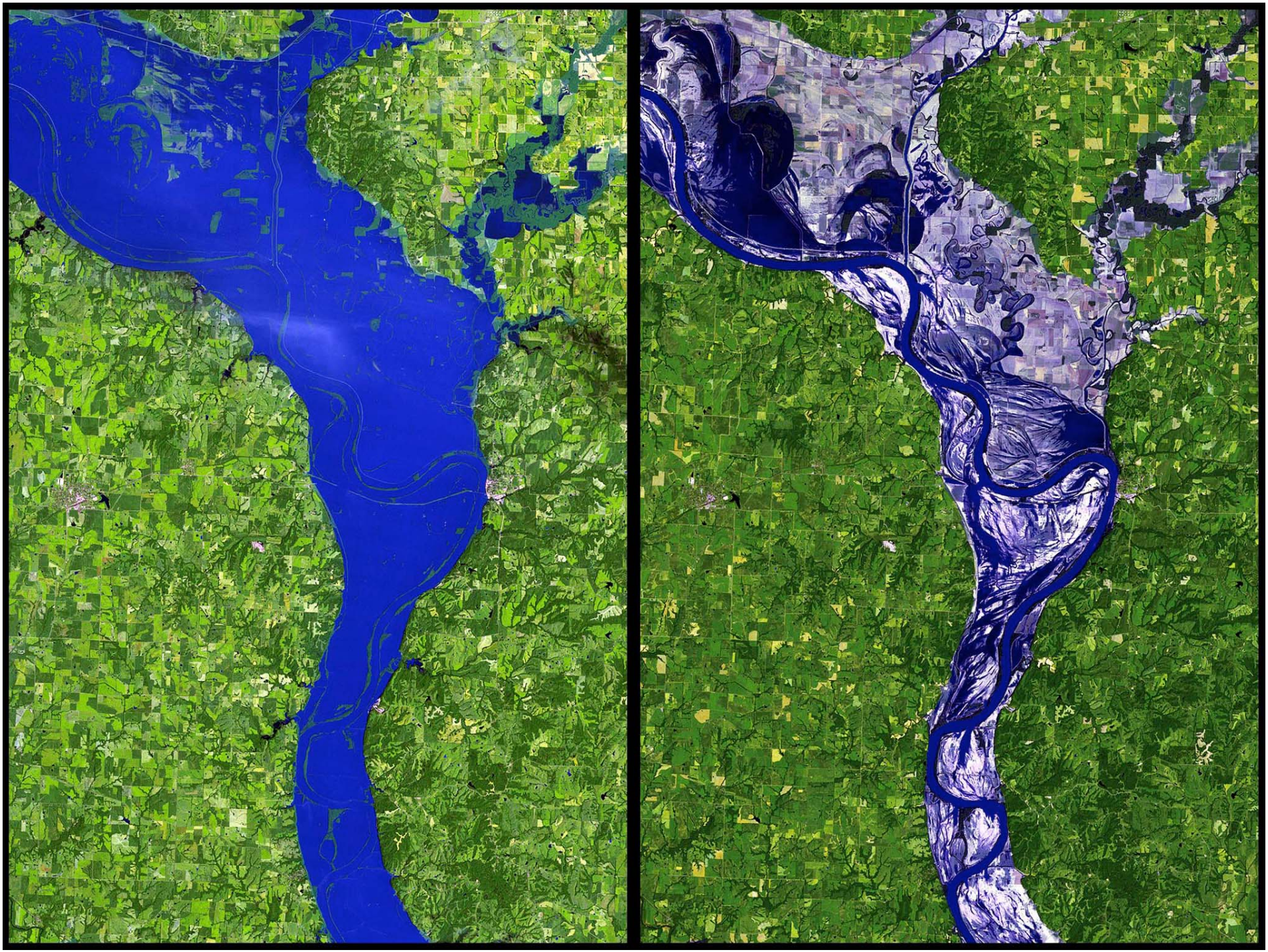
The following lines of evidence indicate that the Colorado River is **NOT** migrating away from the Atlas tailings pile:

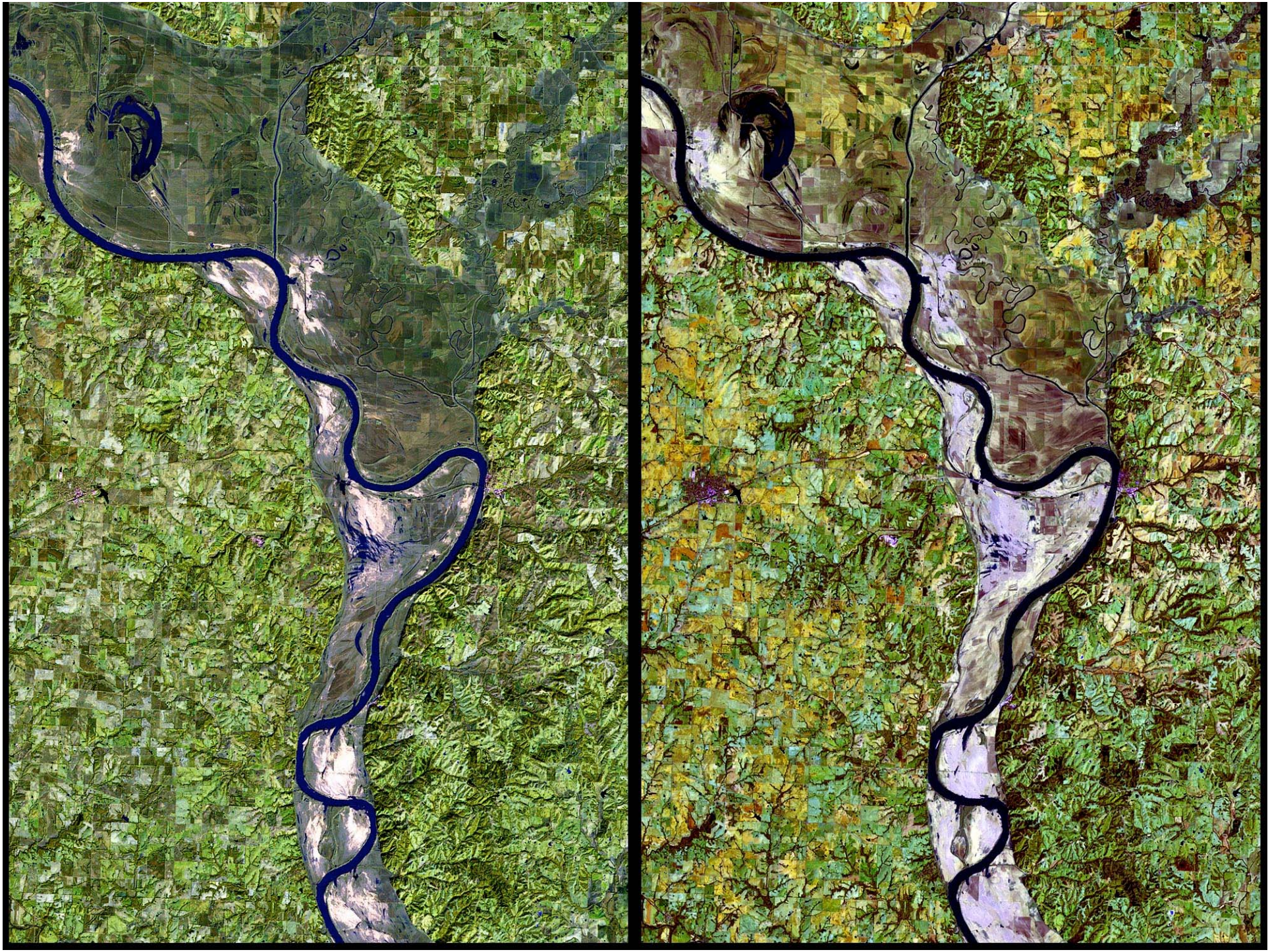
- Channel morphology indicates a moderately stable to unstable channel
- Historical maps & photos document a north-west shift of the south bank (river left) over the past 80 years. This shift has resulted in a 37% narrowing of the channel.
- The position and age of river gravels near Courthouse Wash indicate significant instability and/or deep channel scour northeast of the pile
- Only a very small portion of the River's bedload is being trapped by the subsidence of Moab Valley
- Valley subsidence does not appear to be significantly affecting the horizontal position of the river channel

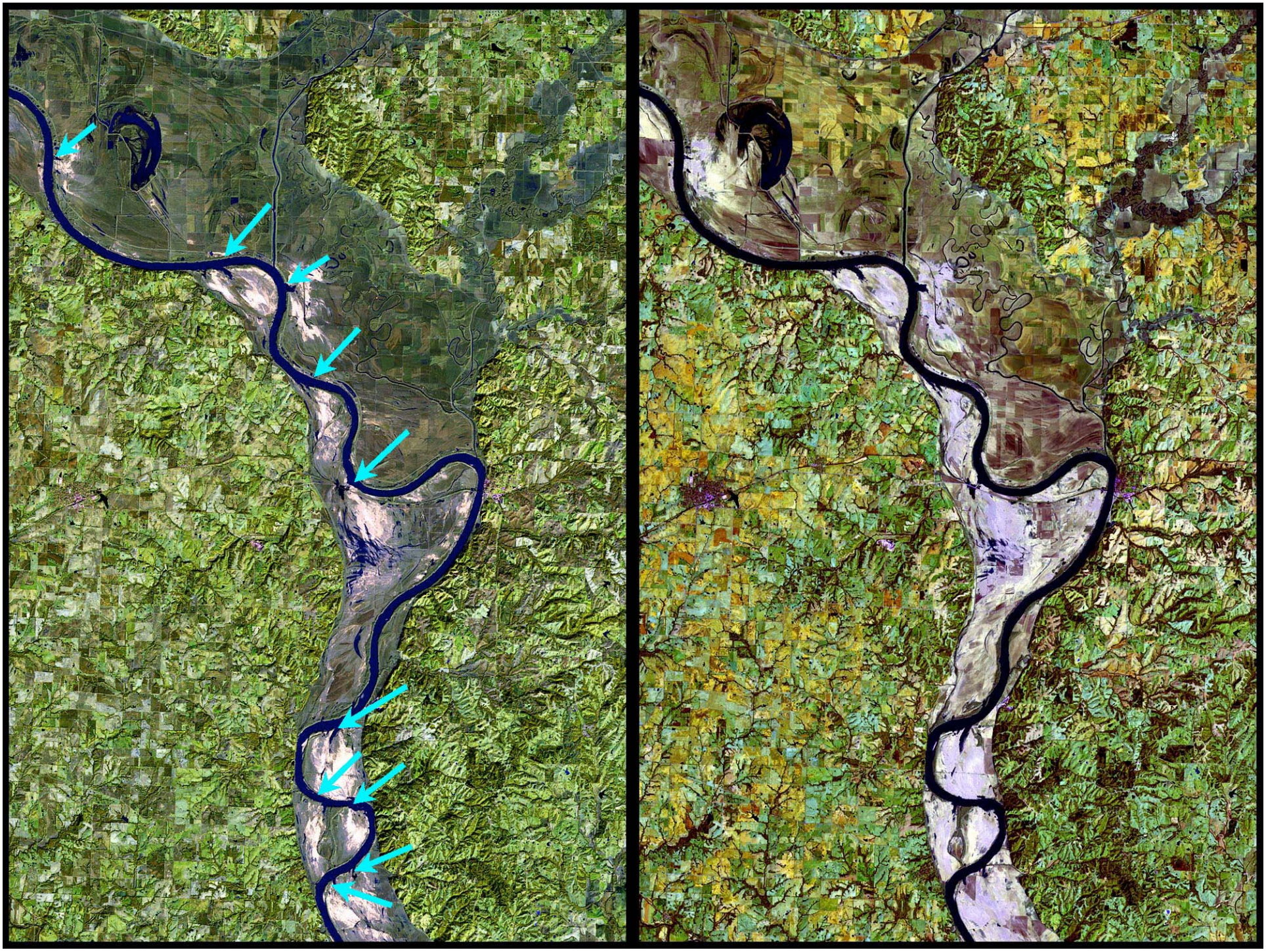
Channel Stability

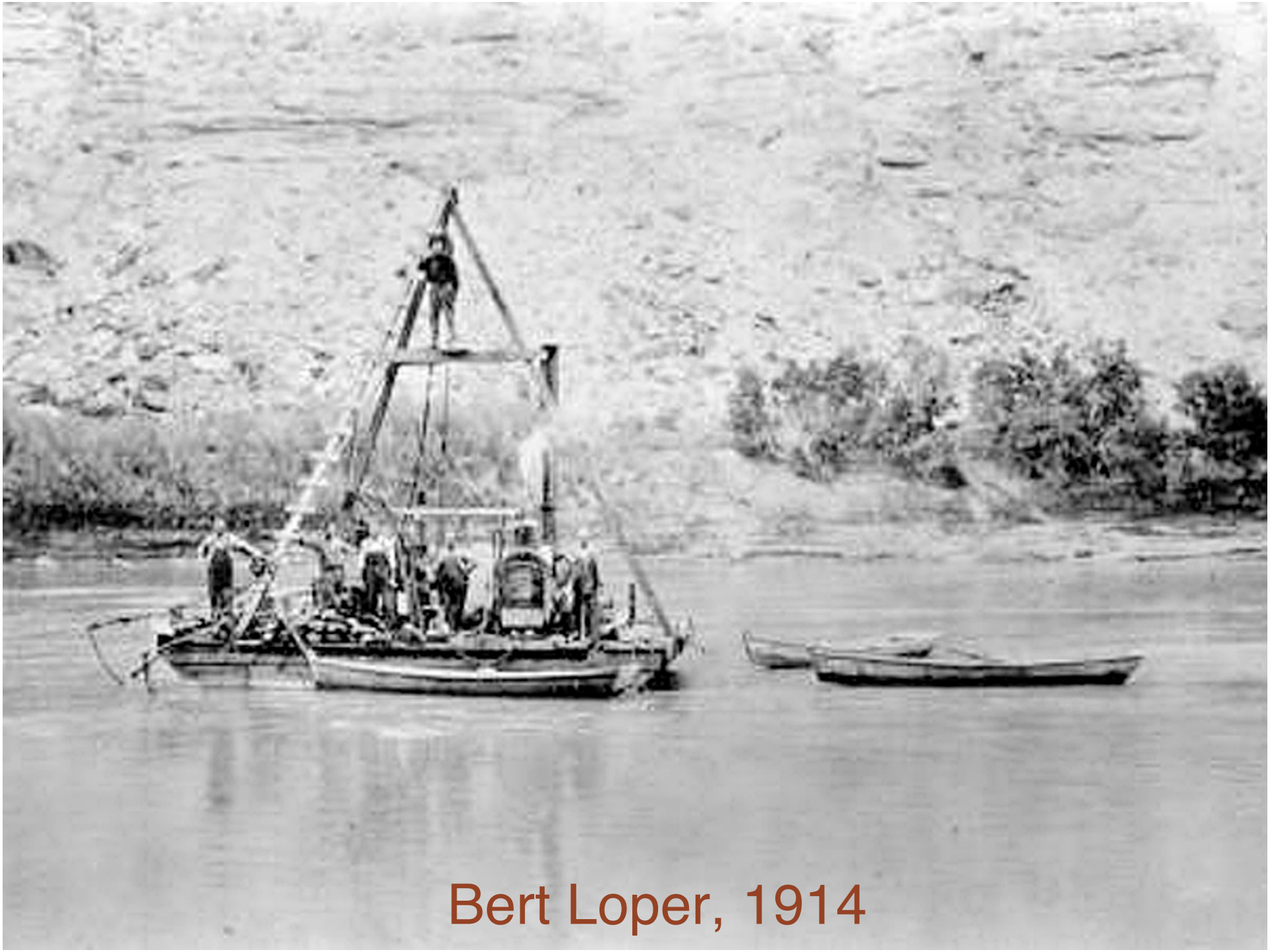
- The DOE argues that the Colorado River channel is straight, and therefore, stable
- However, the channel is almost continuously curving between Big Bend and Spanish Bottom
- In fact, this is the most sinuous reach along the entire length of the Colorado River
- Moreover, this reach has the most gentle gradient (0.025%) between Westwater Canyon and Lake Powell


Moab
Green River
Colorado River
Cataract

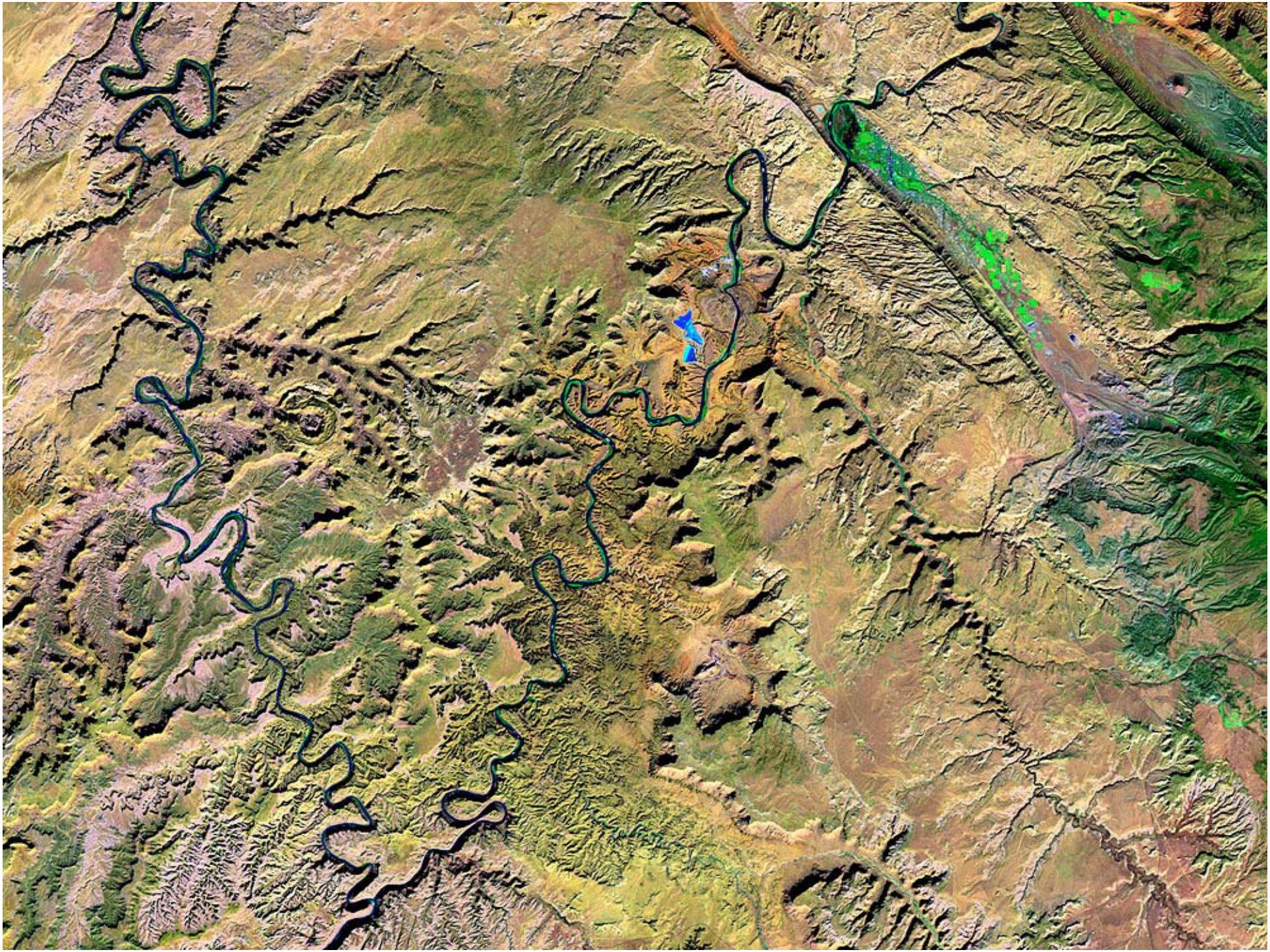








Bert Loper, 1914



Analysis of maps and aerial photos

- Several photos used in the DOE analysis were not accurately registered
- Accurate registration of maps and photos shows that:

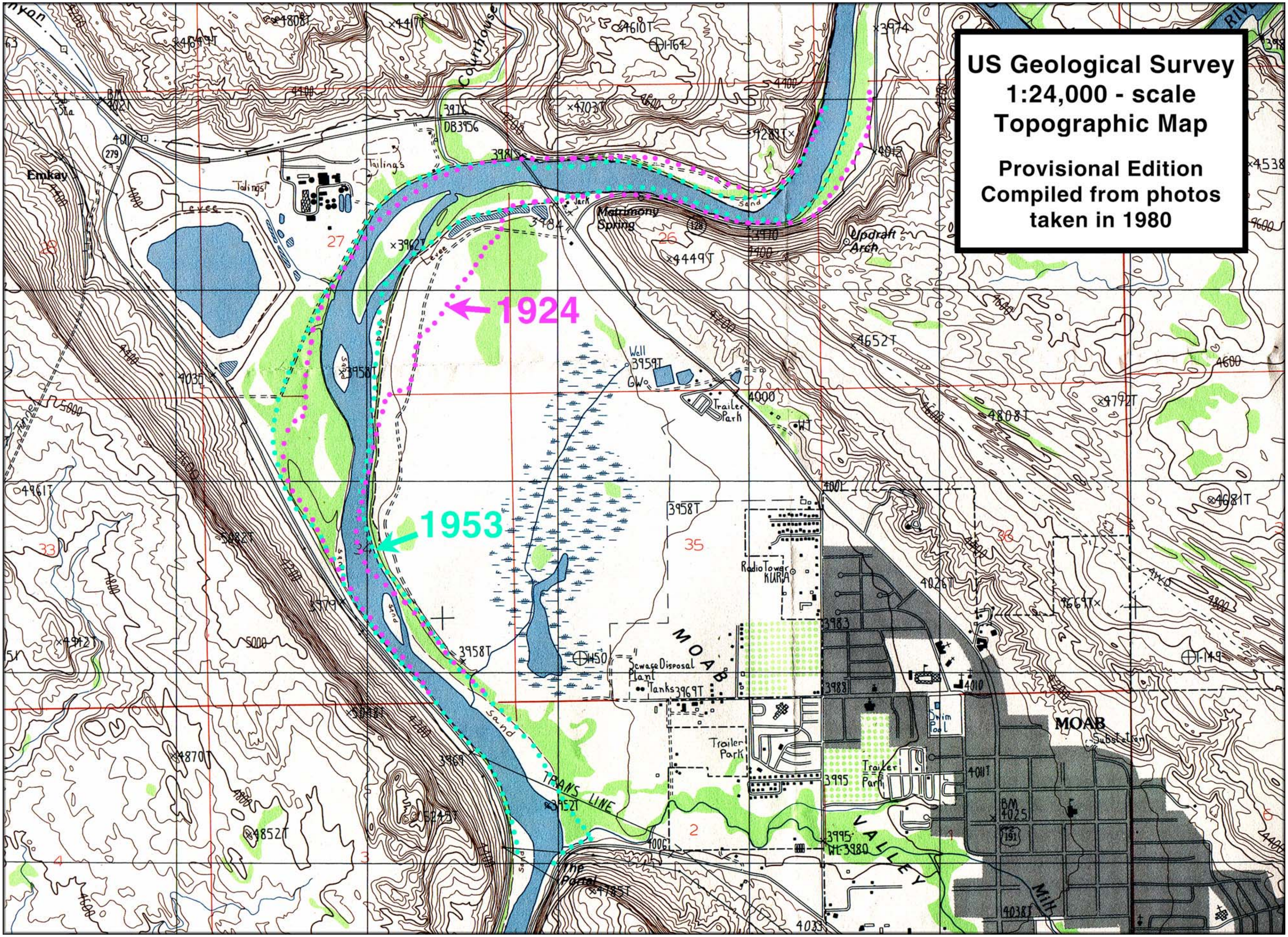
  The levee channel has not moved since 1924;

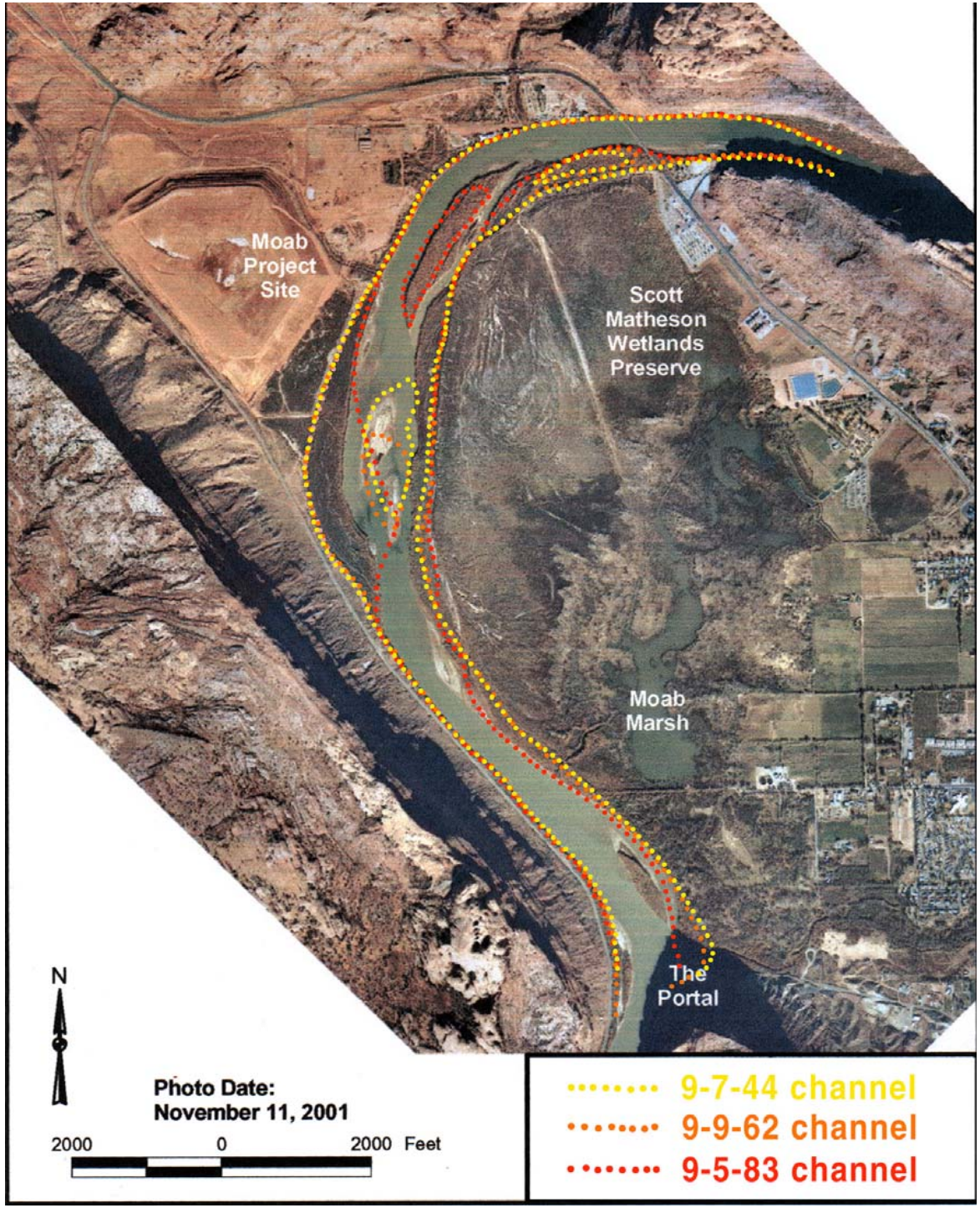
  The south/east bank (river left) has moved progressively north/west away from Moab and towards the pile;

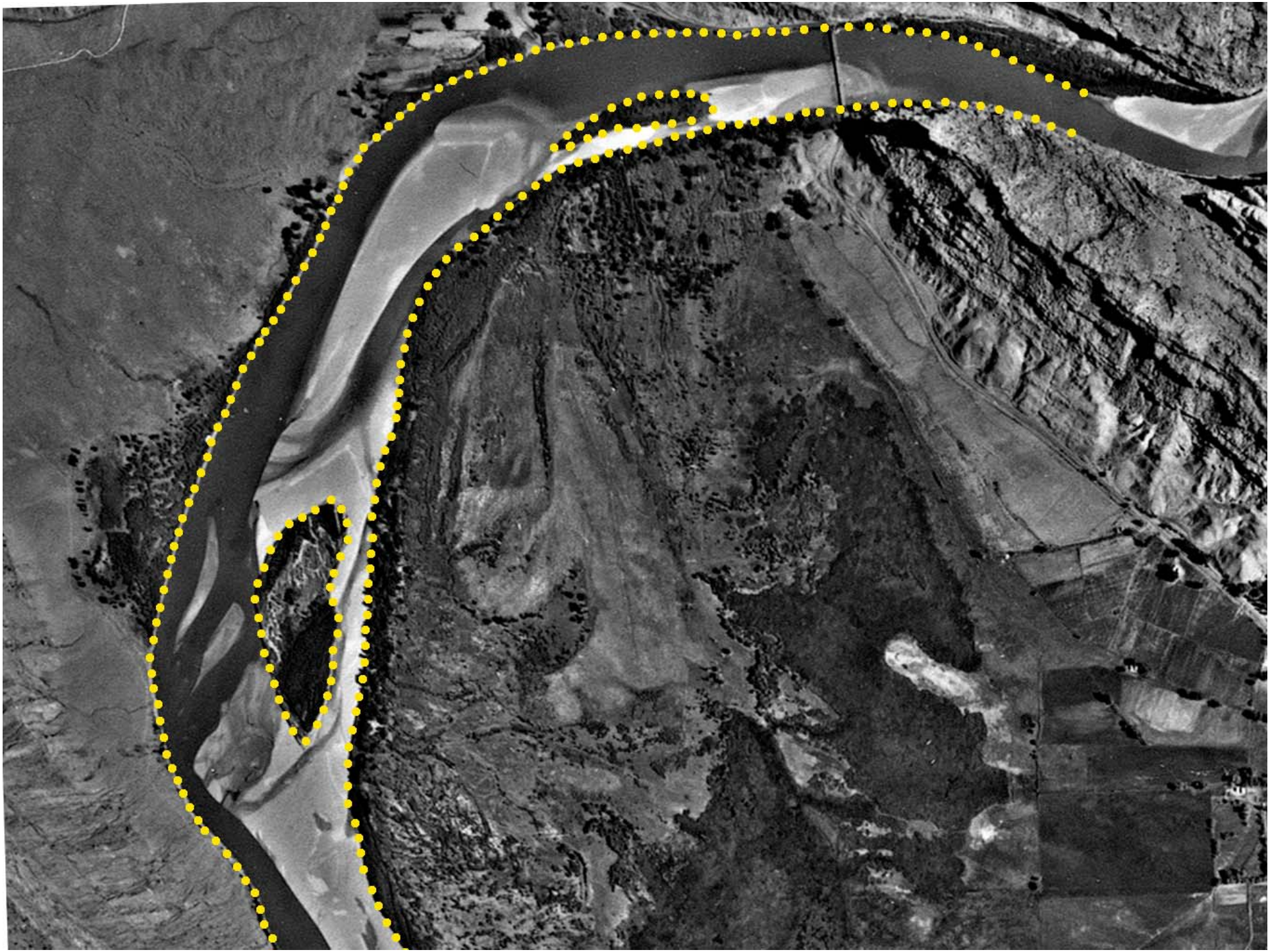
  Most of the north/west bank has remained in essentially the same position since 1924;

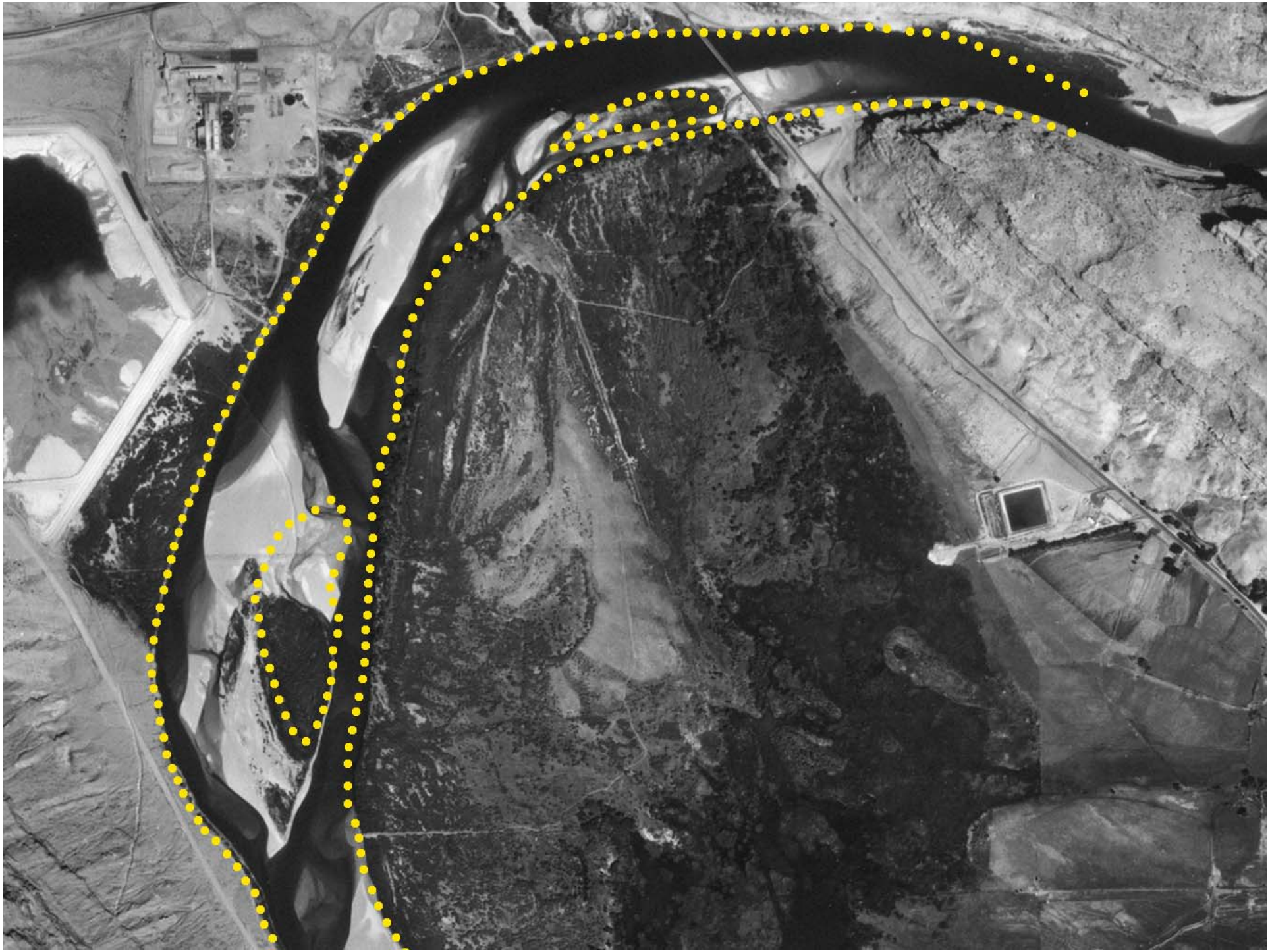
  The channel has been relatively unstable adjacent to the pile;

  The channel has narrowed 37% (mostly between 1962 & 1983)

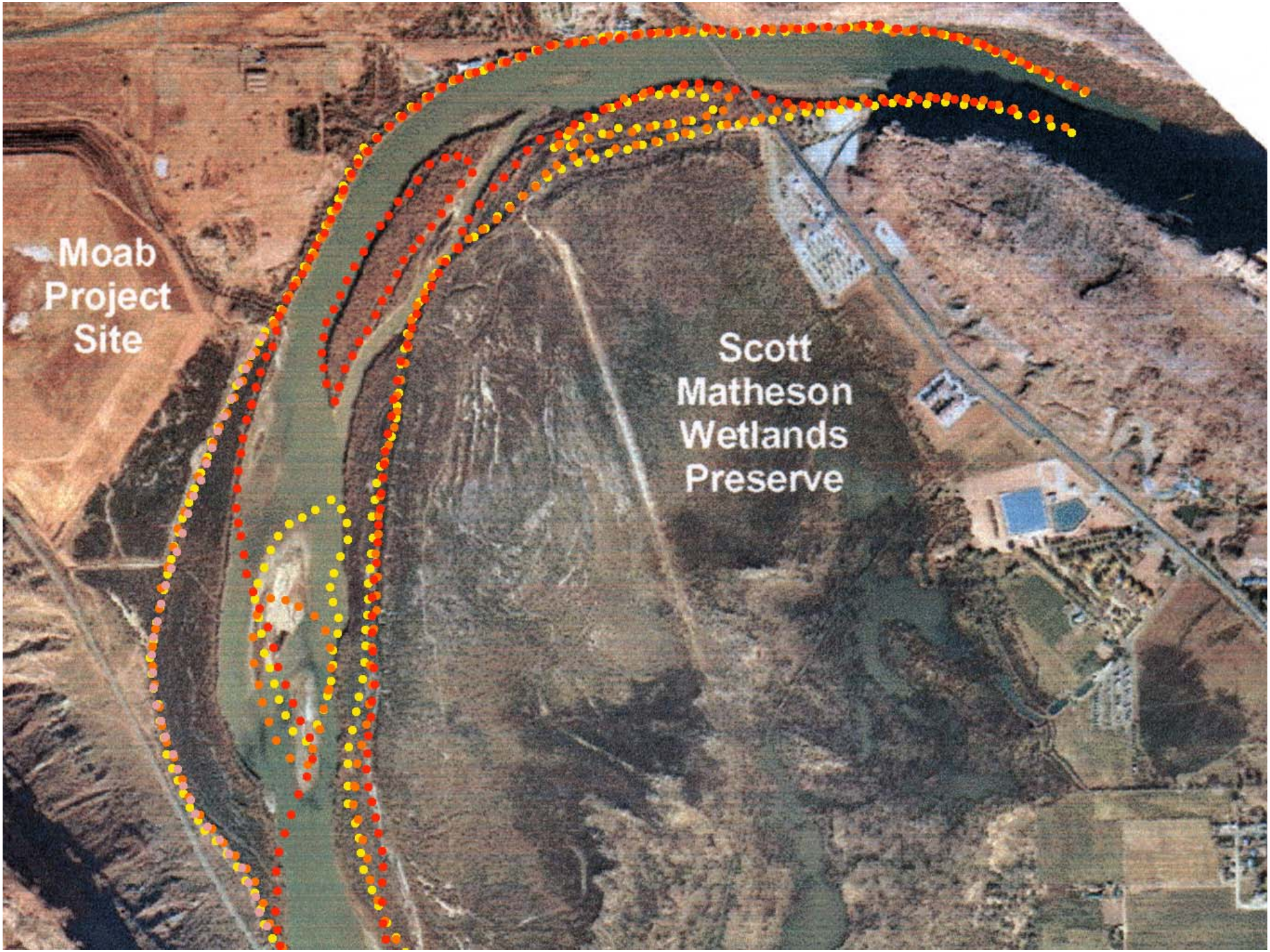

US Geological Survey
1:24,000 - scale
Topographic Map
Provisional Edition
Compiled from photos
taken in 1980
1924
1953
Emkay
Matrimony Spring
Updraft Arch
MOAB
MOAB VALLEY
Trailer Park
Sewage Disposal Plant
Radio Tower KURA
Swim Pool
The Portal
TRANS LINE
Courthouse
Tailings
Levee
Sand
Substation

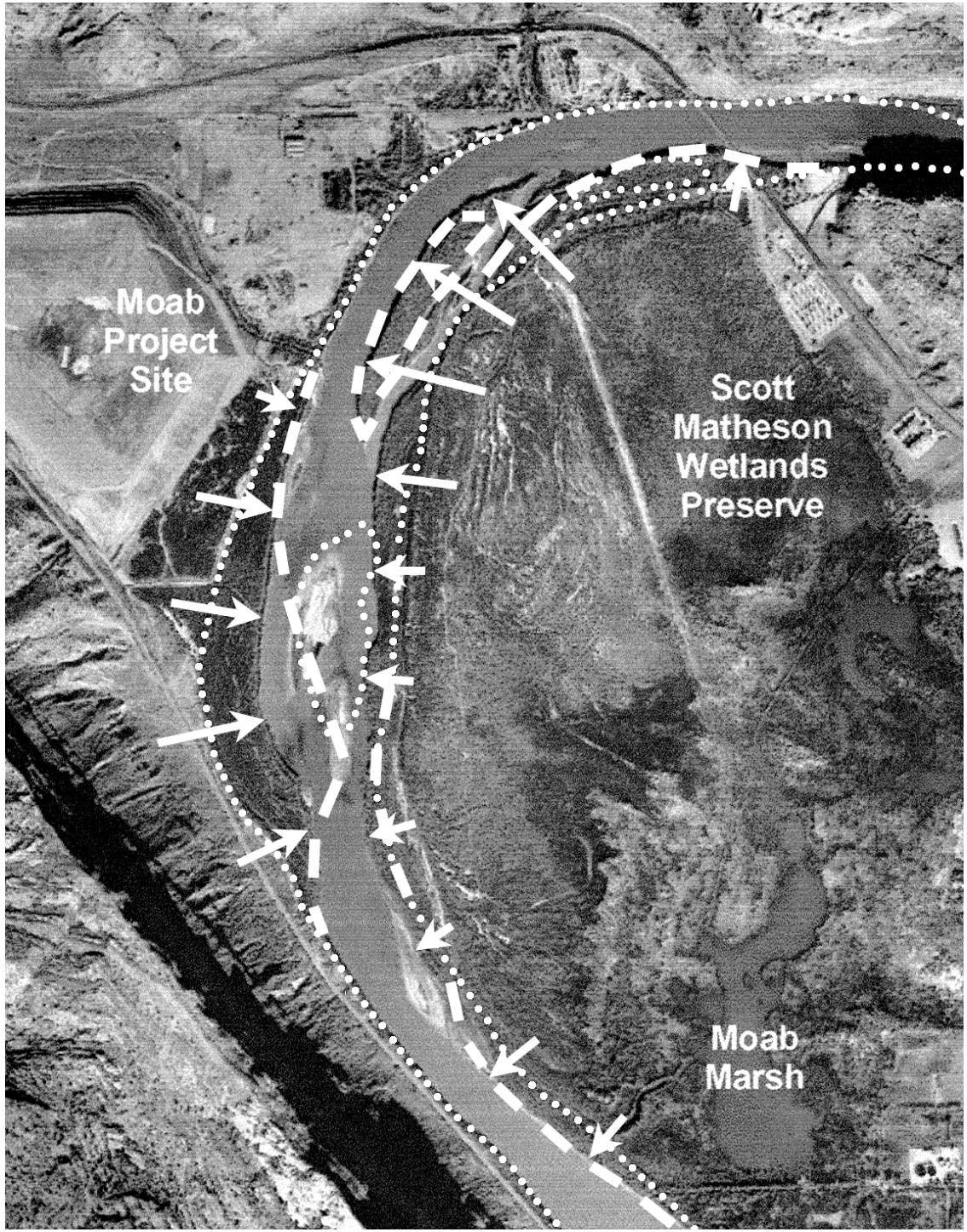

Moab
Project
Site
Scott
Matheson
Wetlands
Preserve
Moab
Marsh
The
Portal
N
Photo Date:
November 11, 2001
2000
0
2000 Feet
9-7-44 channel
9-9-62 channel
9-5-83 channel






Moab
Project
Site
Scott
Matheson
Wetlands
Preserve

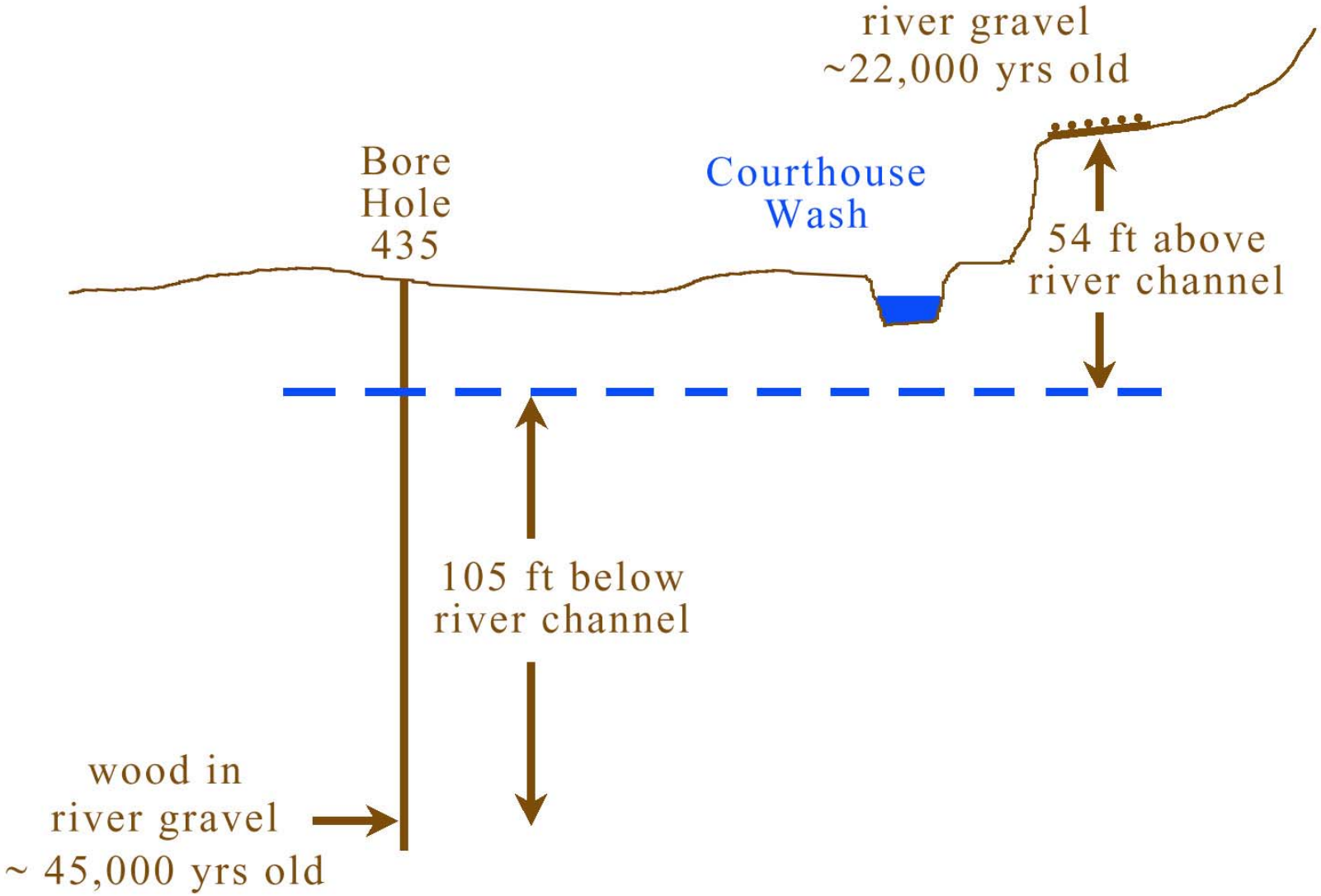

Moab
Project
Site
Scott
Matheson
Wetlands
Preserve


Moab
Project
Site
Scott
Matheson
Wetlands
Preserve
Moab
Marsh

Location & age of river gravels

- River gravels are preserved on a river terrace at the mouth of Courthouse Wash (estimate age of 12 to 30 Ka)
  These gravels are about 54 ft above the river channel
- Wood with a radiocarbon age of 45 ka was recovered from bore hole 435 located about 1200ft SW of the river terrace and about 600 ft from the north valley wall. This wood was recovered from a level about 105 below the river channel.
- DOE argues that the ages and locations of these samples demonstrate progressive river migration to the south and east away from the tailings pile
- However…..


River Terrace
~22,000 years old
elevation 4012
54 feet above channel
Bore Hole 435
~45,000 years old
elevation 3852
105 feet below channel


river gravel
~22,000 yrs old
Bore
Hole
435
Courthouse
Wash
54 ft above
river channel
105 ft below
river channel
wood in
river gravel
~ 45,000 yrs old

Possible Explanations

- A minimum displacement of 159 feet between the mouth of Courthouse Wash and the site of bore hole 435 within the past 45,000 yrs
- Extremely deep scour by the Colorado River sometime during the past 45,000 yrs
- Either possibility suggests significant instability and/or extreme river activity in the area immediately northeast of the tailings pile

The role of Courthouse Wash

- DOE argues that “sediment input form Courthouse Wash tends to push the river south and prevents lateral migration to the north”.
- In direct contradiction to this argument, the Colorado River channel has shifted northward more than 300 feet in the past 40 to 60 years
- During summer flash floods, the flow of the wash may exceed the flow of the river, and at such times the flow of the wash may jet all the way across the river to the opposite bank.


SPLORE
Page Holland


Page Holland

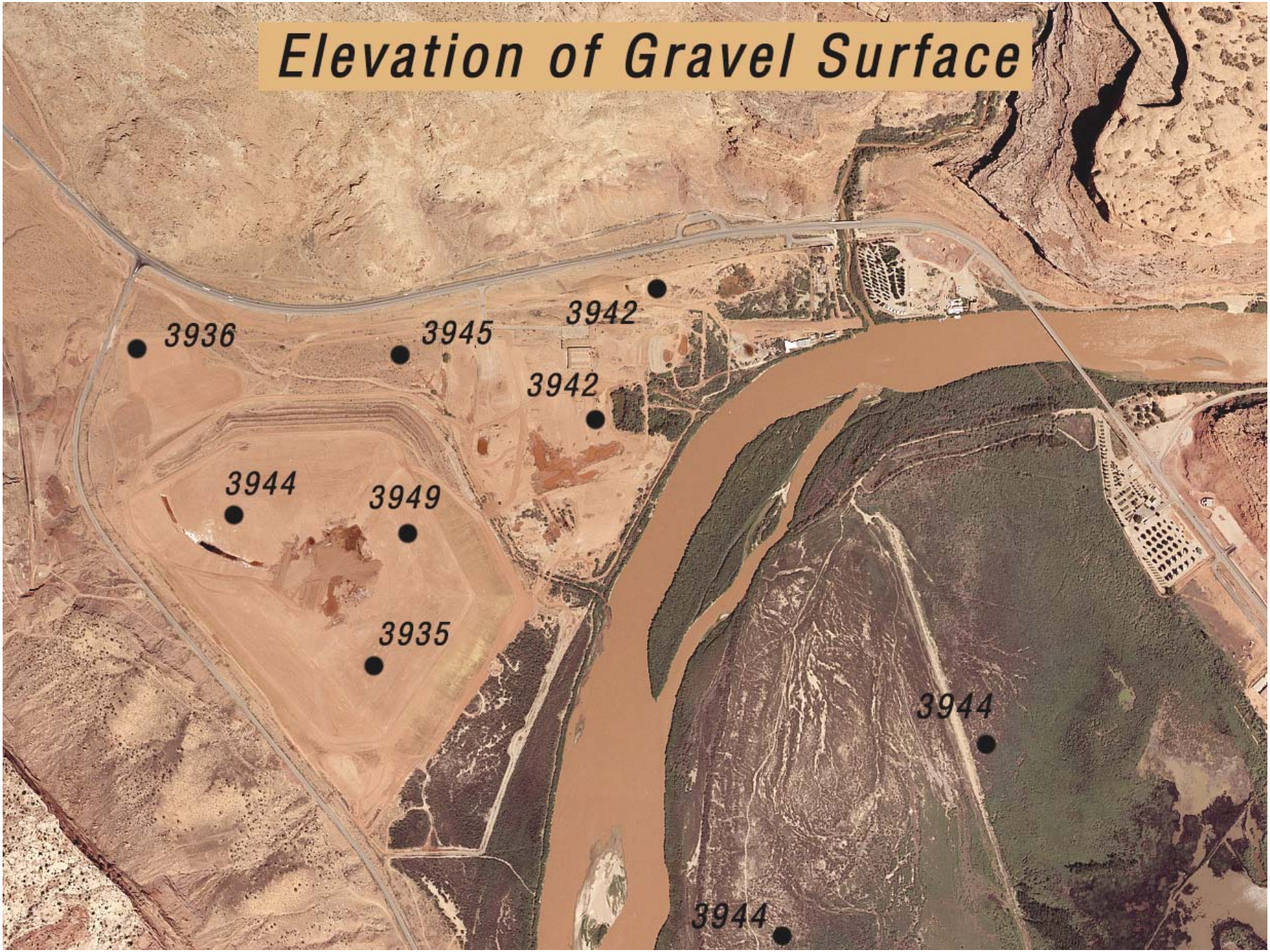
Evidence for Valley Subsidence

- According to DOE, valley subsidence is causing the river to move away from the pile because subsidence is greater south of the present river channel
- DOE reports that the upper surface of the valley filling gravels is lowest south of the river
- DOE suggests that the thickness of the valley fill is greatest south of the river

Elevation of river gravels beneath the surface of Moab Valley

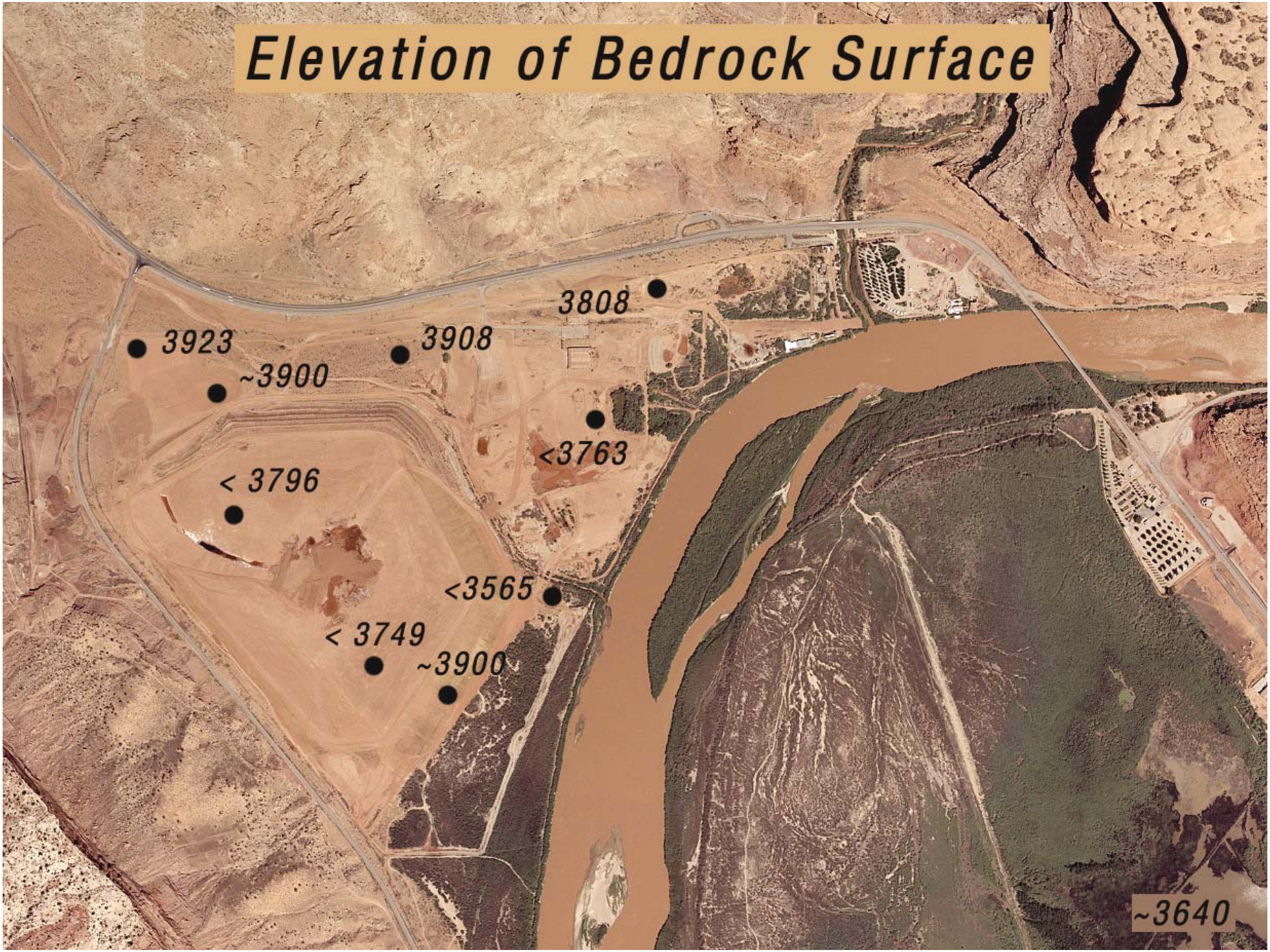
- Coarse river gravels are widely distributed beneath the surface of Moab Valley both north and south of the river.
- These gravels are, for the most part, shallowly buried beneath finer grained alluvial deposits.
- However, bore hole and well data indicates that the upper surface of these gravels occurs at about the same elevation across most of northern Moab Valley.
- In fact, DOE's bore hole data indicates that the upper surface may be deepest beneath and north of the pile.

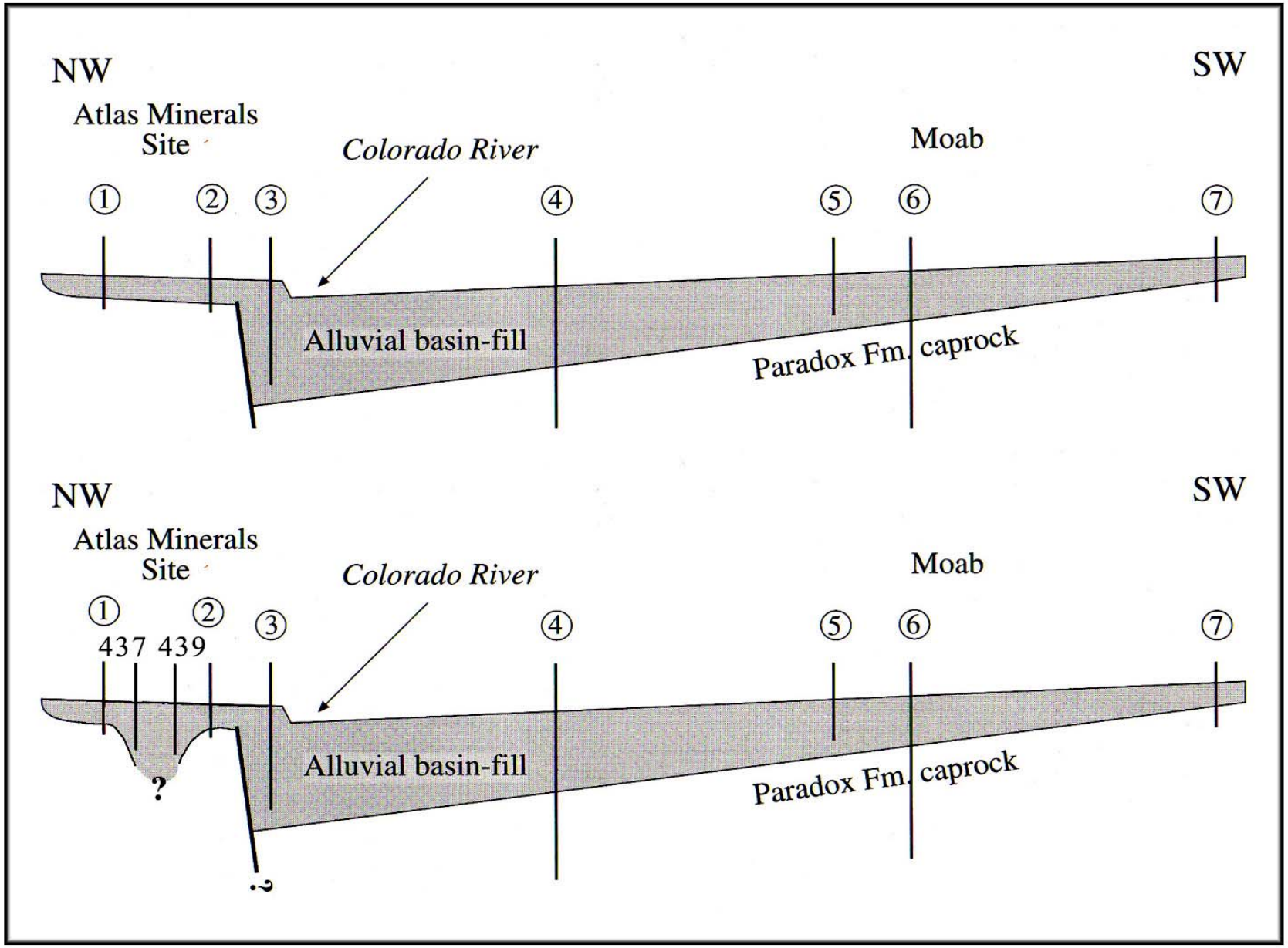

Minimum
Extent of
River Gravels

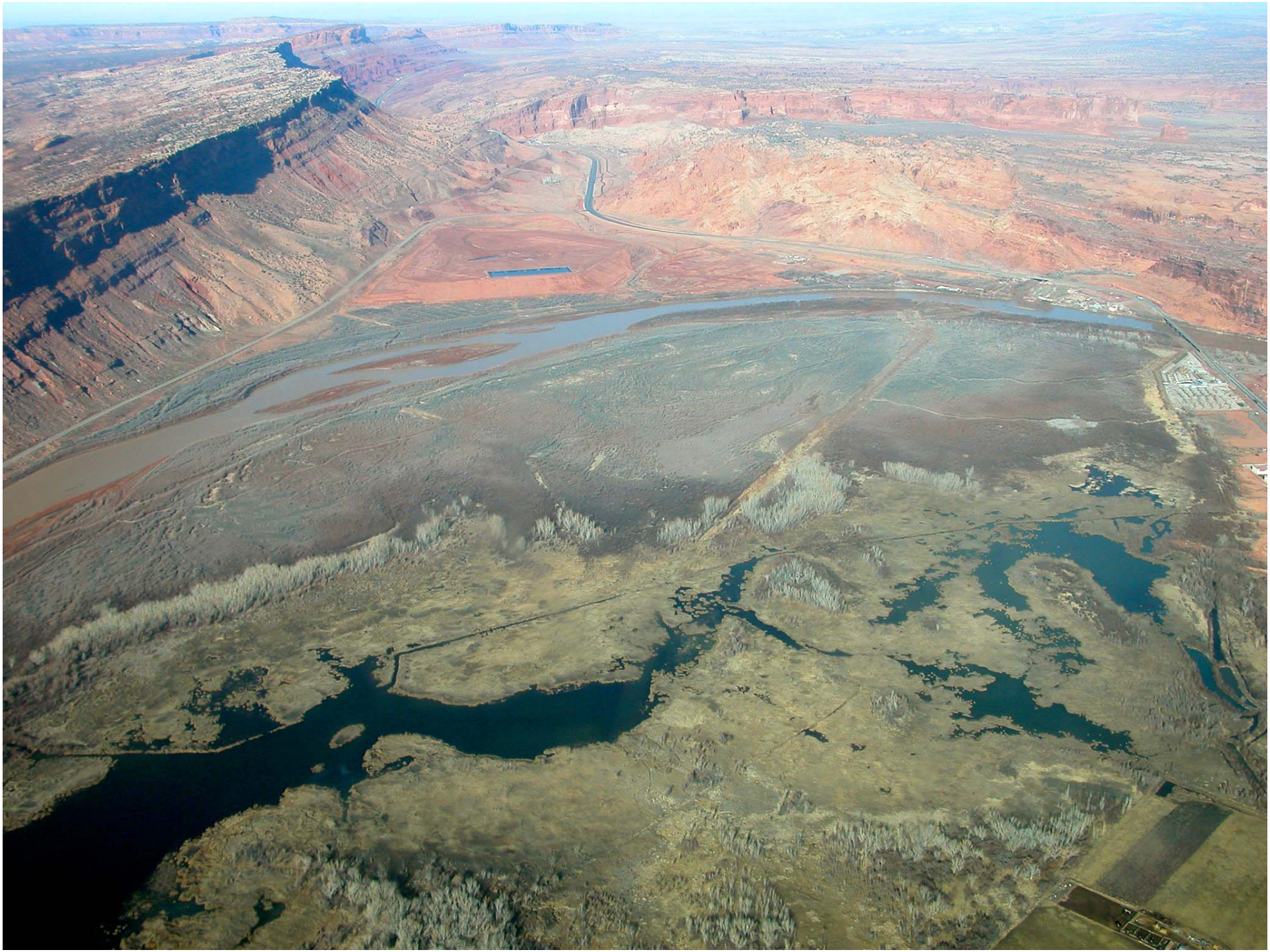

Elevation of Gravel Surface
3936
3945
3942
3942
3944
3949
3935
3944
3944

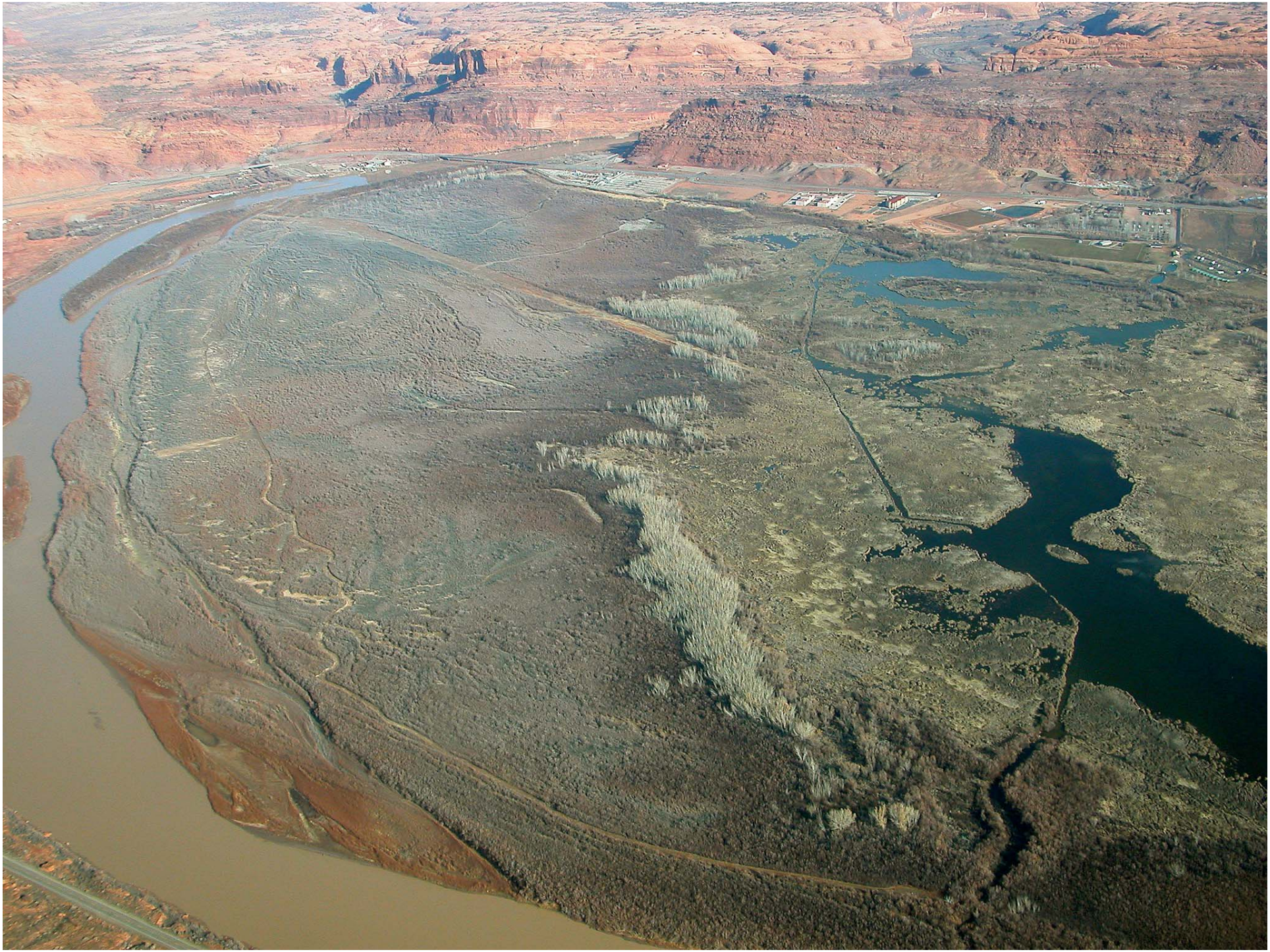
Thickness of river gravels beneath the surface of Moab Valley

- Coarse river gravels are widely distributed beneath the surface of Moab Valley both north and south of the river.
- However, bore hole and well data indicates that these gravels may be thickest (and deepest) just north of the present position of the Colorado River channel

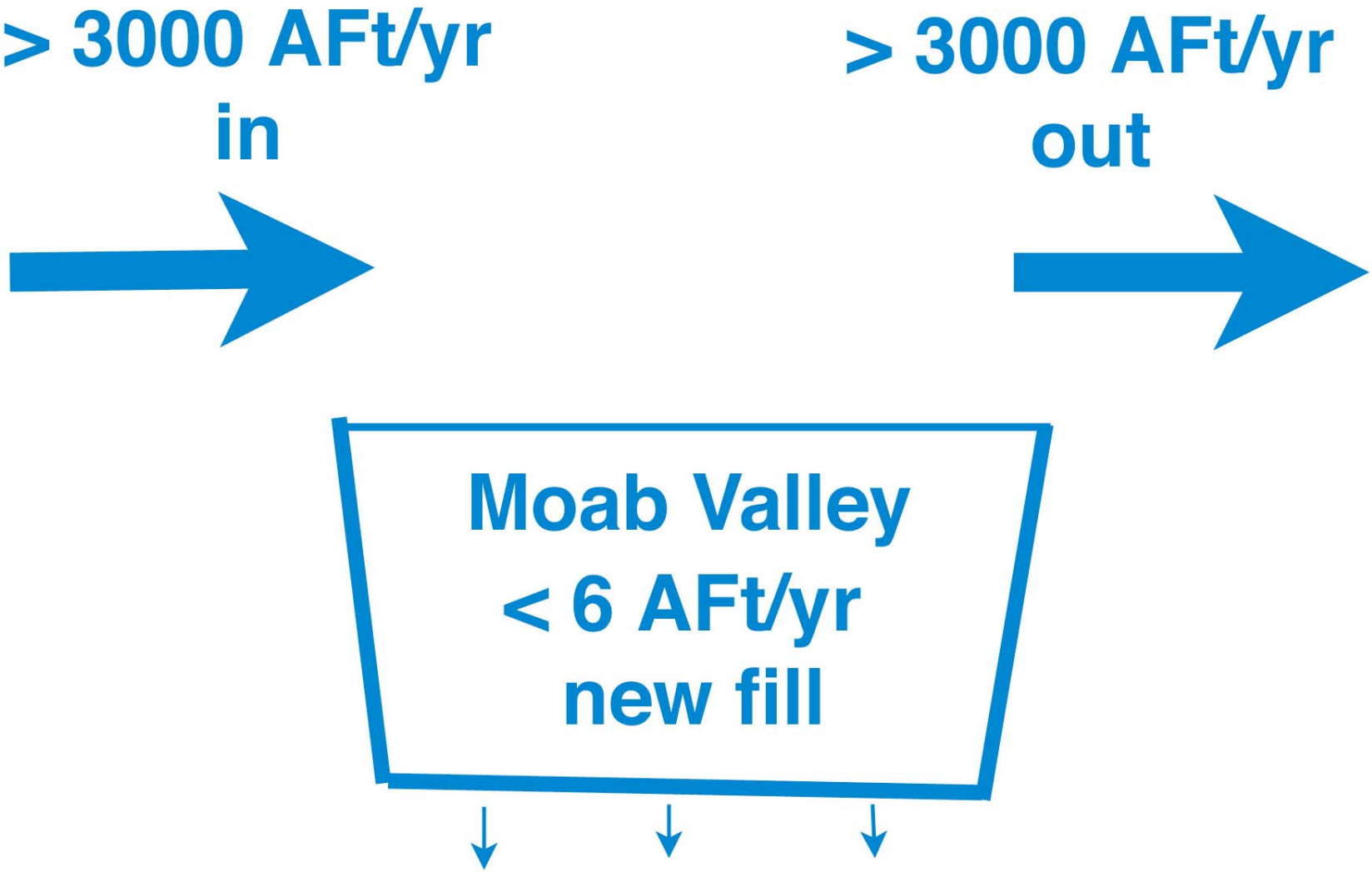

Elevation of Bedrock Surface
3808
3923
3908
~3900
<3763
< 3796
<3565
< 3749
~3900
~3640


NW
SW
Atlas Minerals Site
Colorado River
Moab
①
②
③
④
⑤
⑥
⑦
Alluvial basin-fill
Paradox Fm. caprock
NW
SW
Atlas Minerals Site
Colorado River
Moab
①
②
③
④
⑤
⑥
⑦
437
439
?
Alluvial basin-fill
Paradox Fm. caprock





Sediment budget for Moab Valley



Conclusions

- There is no evidence for southward/eastward lateral migration of the Colorado River channel during the past 80 years.
- Instead, there is compelling evidence for northward and westward migration of the south-east bank (river left).
- Courthouse Wash is not ‘pushing’ the river away from the tailings pile
- There is no geologic evidence for unidirectional migration of the river channel over the past 45,000 years.
- Instead, bore hole and well log data clearly show that river gravels underlie the tailings pile as well as most of the north end of Moab Valley.
- Moreover, there is evidence suggesting instability and/or deep channel scour northeast of the pile

Conclusions

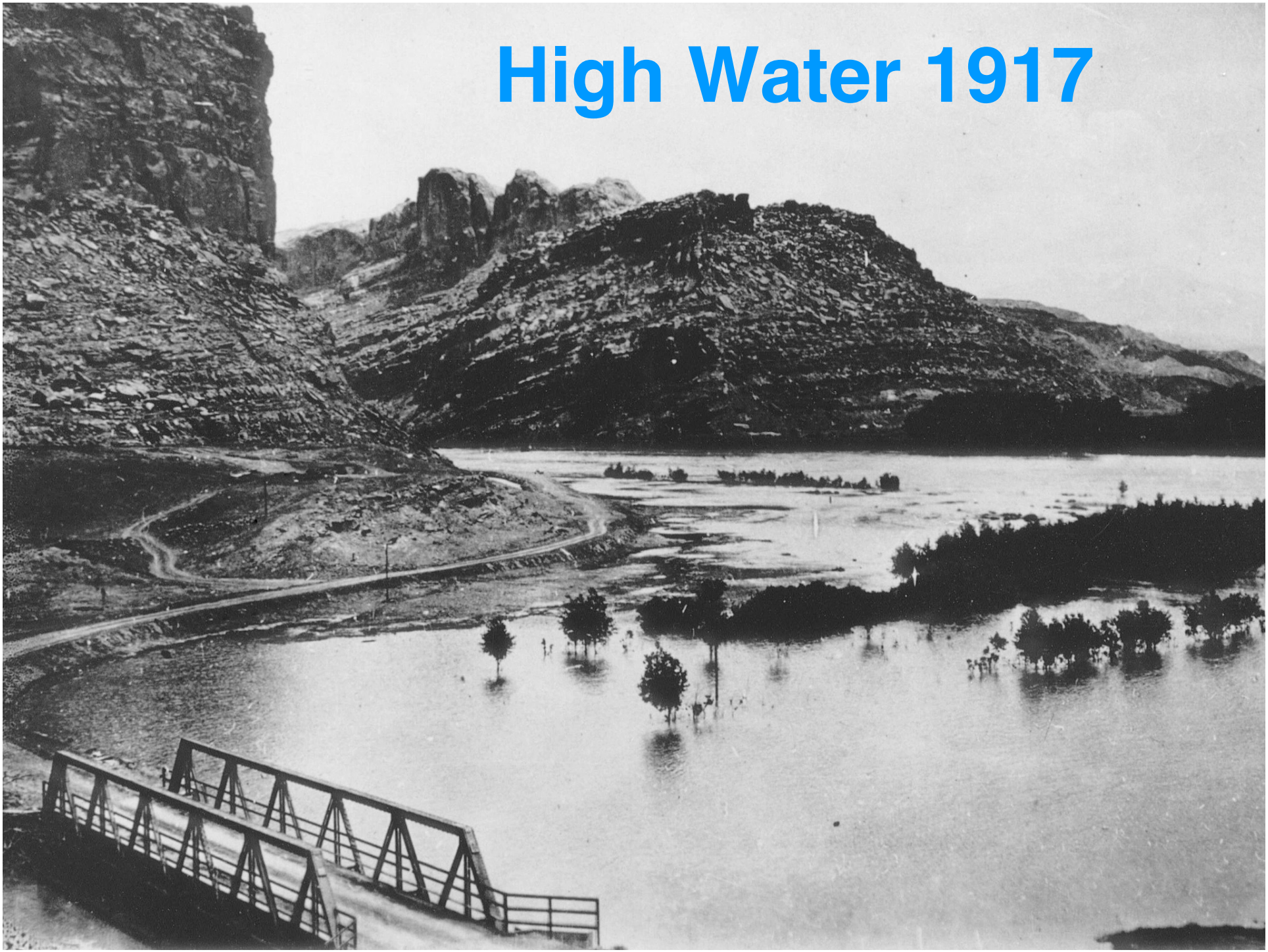
The Colorado River is not moving away from the pile.

The Department of Energy's analysis regarding river migration is 'all wet'.

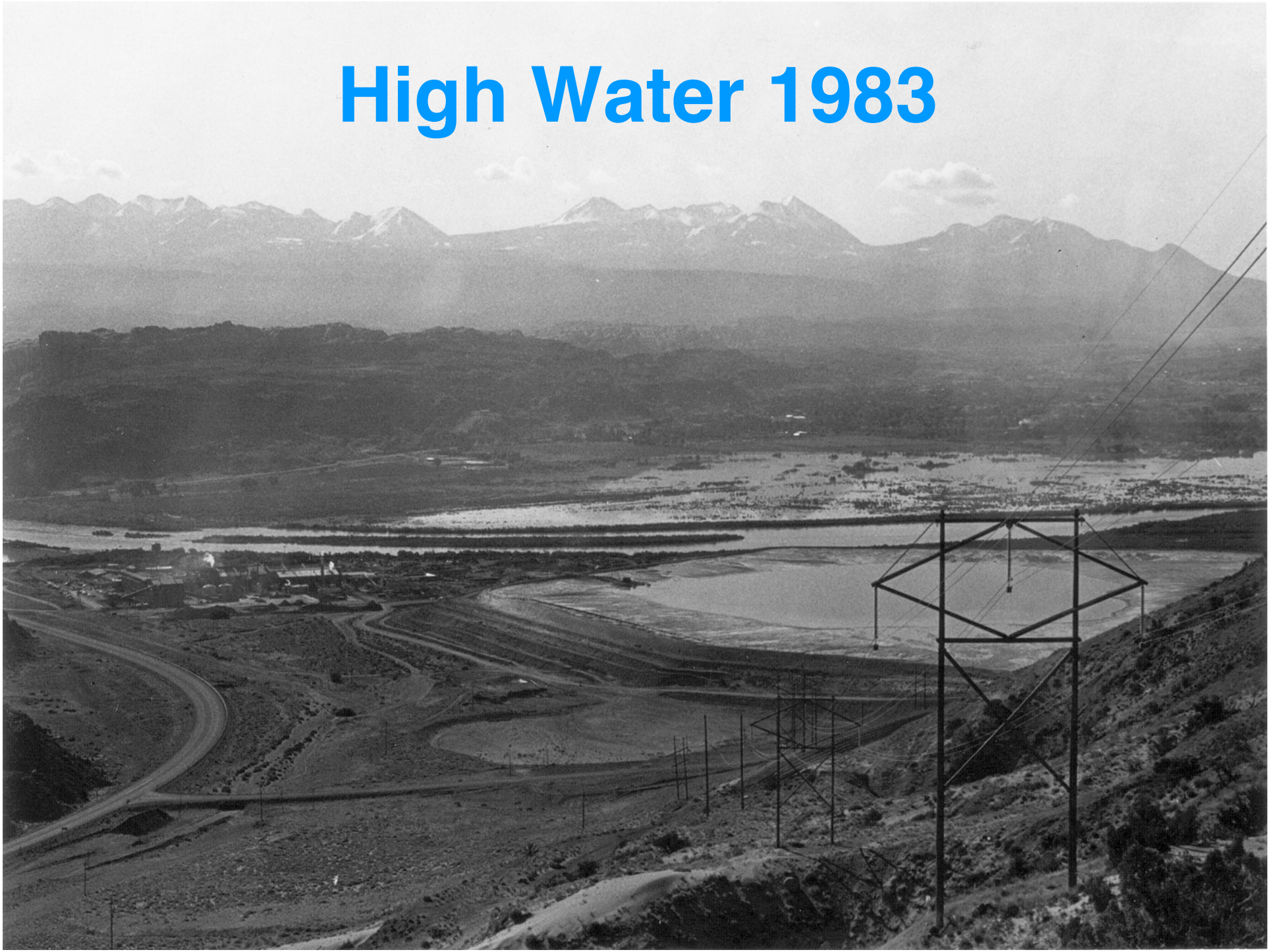
Historic Colorado River Floods in the Moab Valley

- **July 4, 1884 ~ 125,000 cfs**
- **June 3, 1914 ~ 66,100 cfs**
- **June 19, 1917 ~ 76,800 cfs**
- **June 1, 1928 ~ 65,000 cfs**
- **May 15, 1941 ~ 64,400 cfs**
- **June 9, 1957 ~ 64,200 cfs**
- **June 27, 1983 ~ 61,900 cfs**
- **May 27,1984 ~ 70,300 cfs**

cfs - cubic feet per second


High Water 1917

High Water 1983




Peggy McNeil

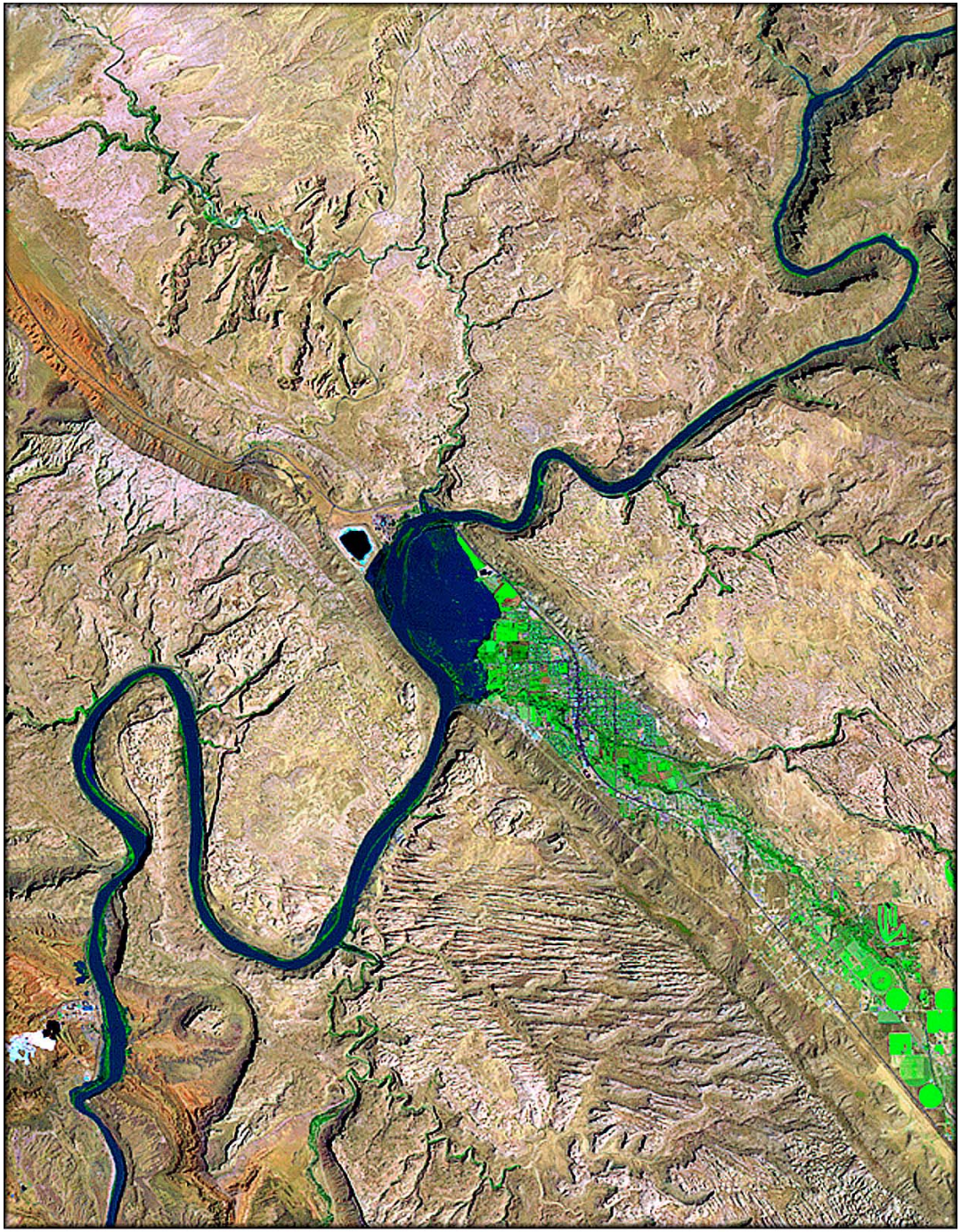

Peggy McNeil


Peggy McNeil

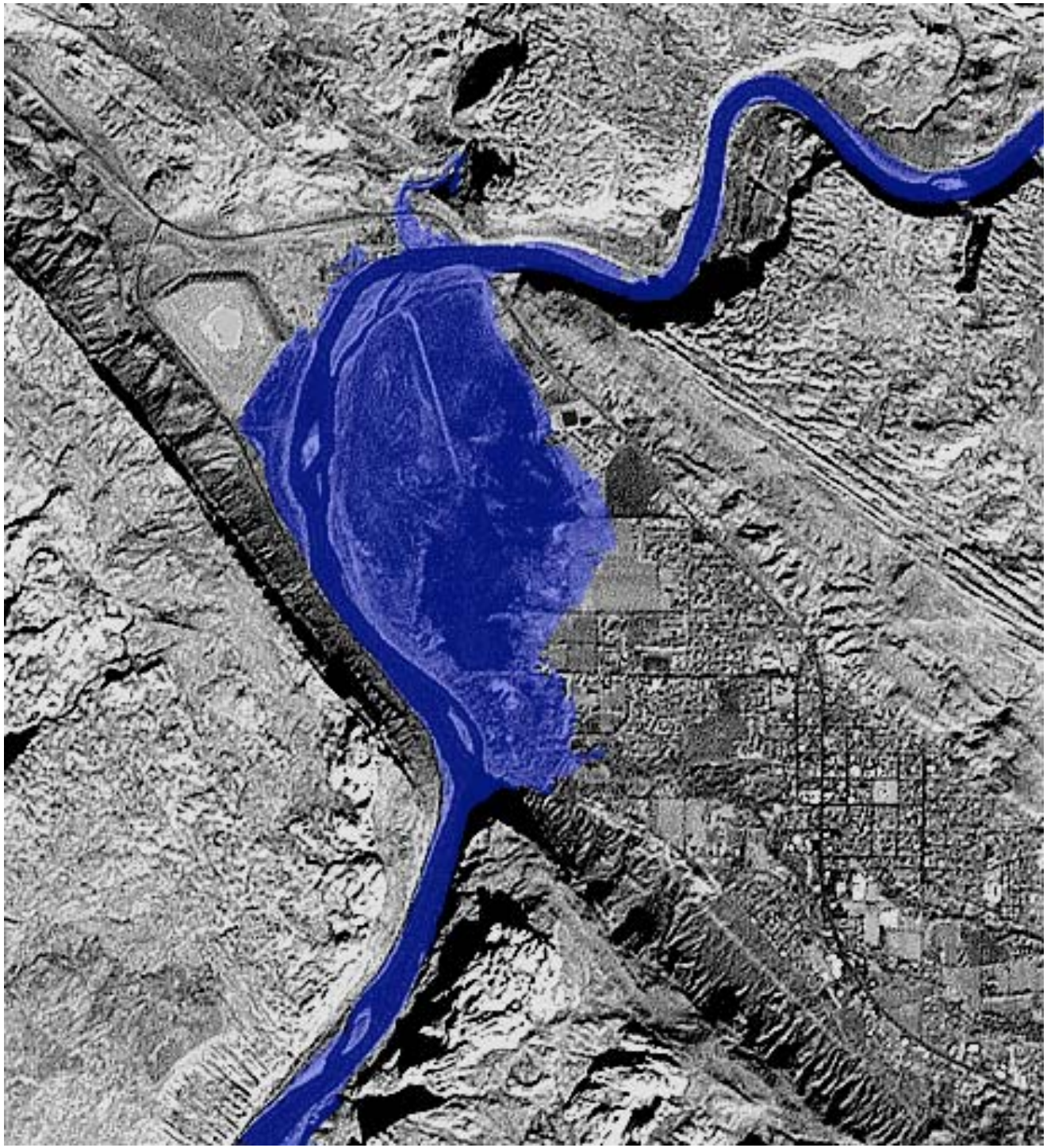

Peggy McNeil

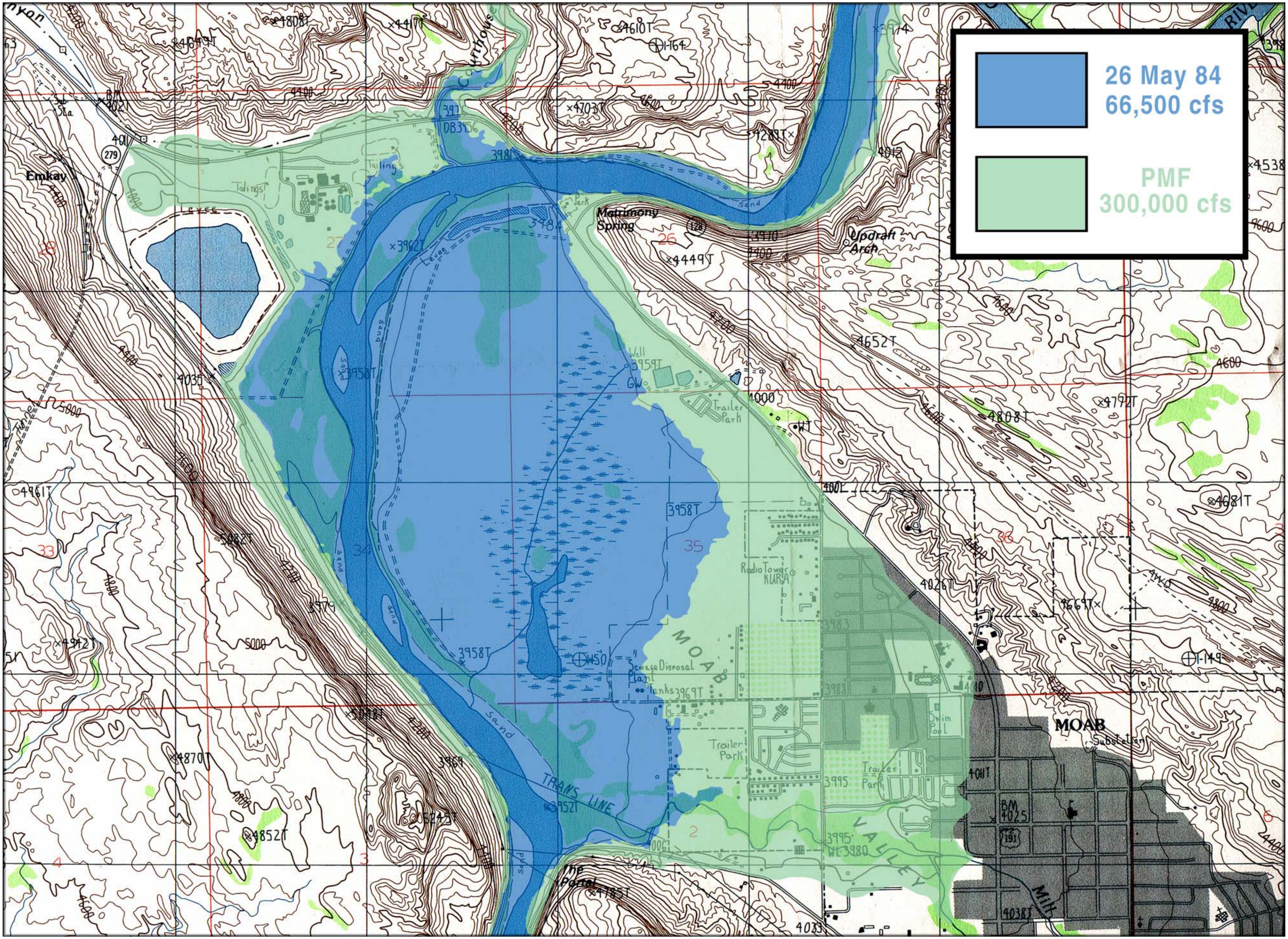
The 1984 Flood

- Second largest flood of record
- Flood peaked on 27 May 1984
- Peak flow at Dewey Bridge - 70,300 cfs
- Maximum flood height about 4 feet above the base of the tailings pile



Landsat 5 Satellite Image - May 26, 1984 - 66,500 cfs




26 May 84
66,500 cfs
PMF
300,000 cfs
Emkay
Matrimony Spring
Upcraft Arch
MOAB
MOAB VALLEY
Sewage Disposal Plant
Trailer Park
Radio Tower KURA
The Portal
TRANS LINE