

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

SEDIMENTATION SURVEYS
OF
PATHFINDER AND SEMINOE RESERVOIRS
NORTH PLATTE RIVER, WYOMING

Sedimentation Section Report

HYDROLOGY BRANCH



PROJECT PLANNING DIVISION
DENVER, COLORADO

MAY 1953

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

SEDIMENTATION SURVEYS
OF
PATHFINDER AND SEMINOE RESERVOIRS
NORTH PLATTE RIVER, WYOMING

By
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and
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Sedimentation Section
Hydrology Branch
Project Planning Division

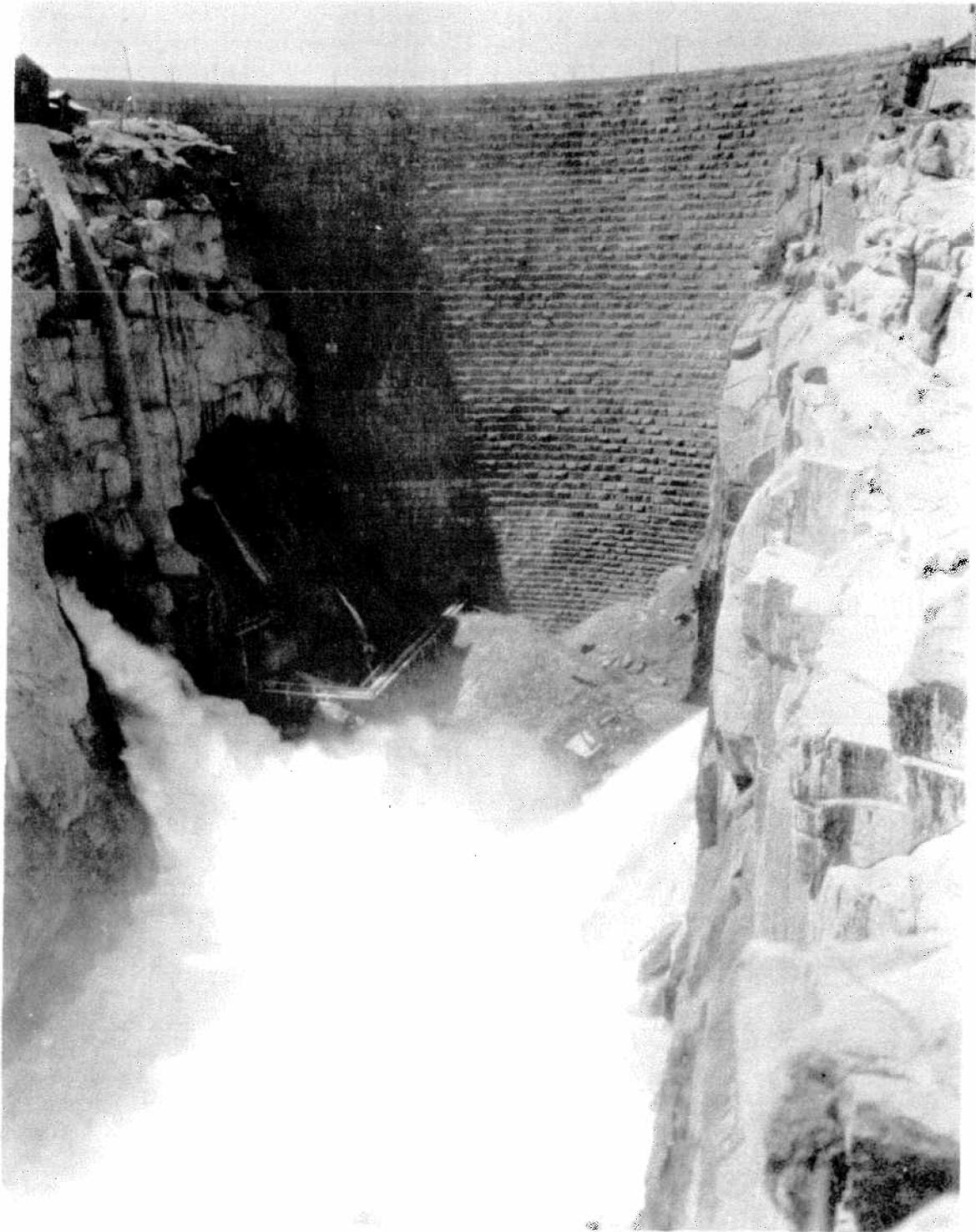
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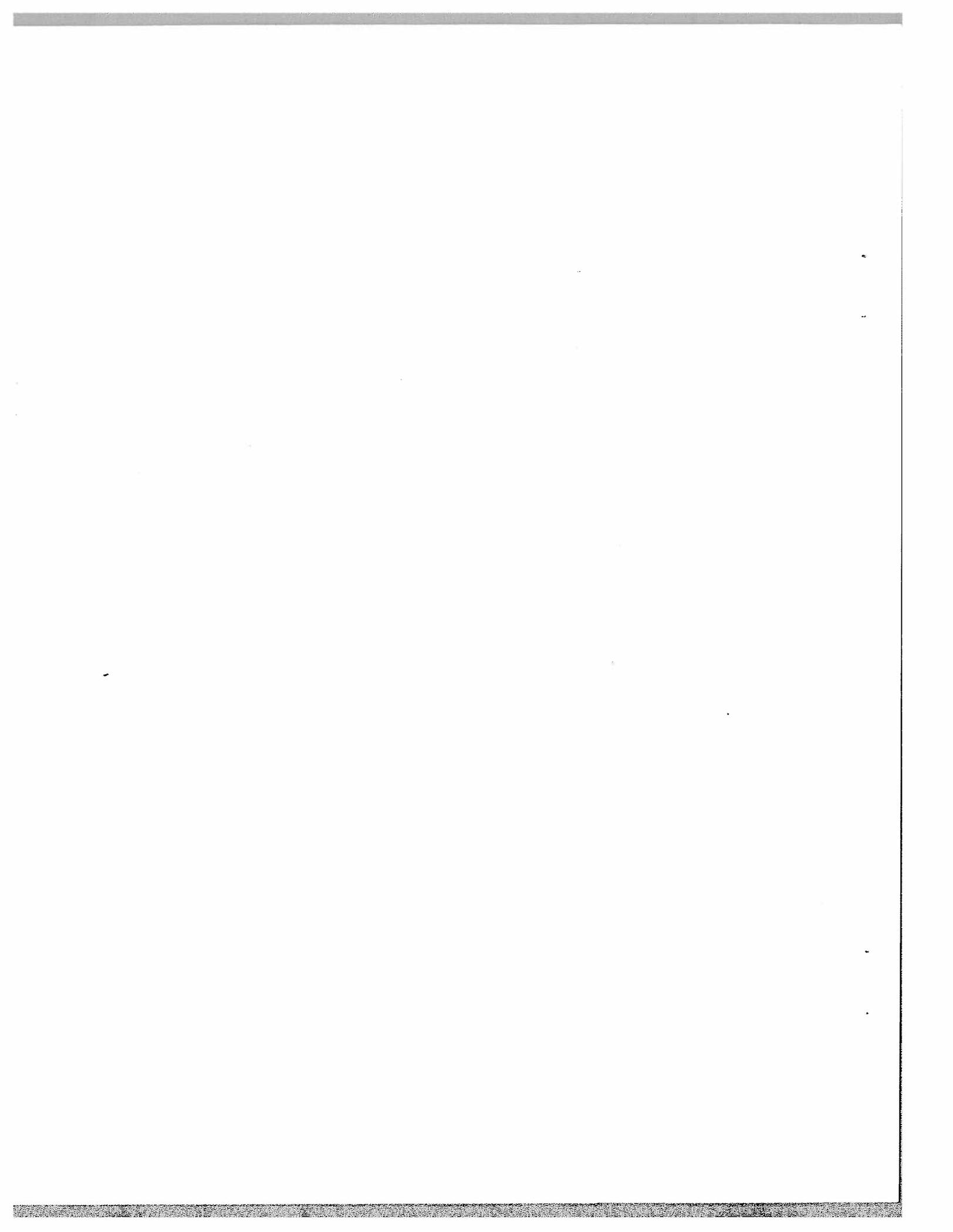
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PATHFINDER DAM



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OF
PATHFINDER AND SEMINOE RESERVOIRS

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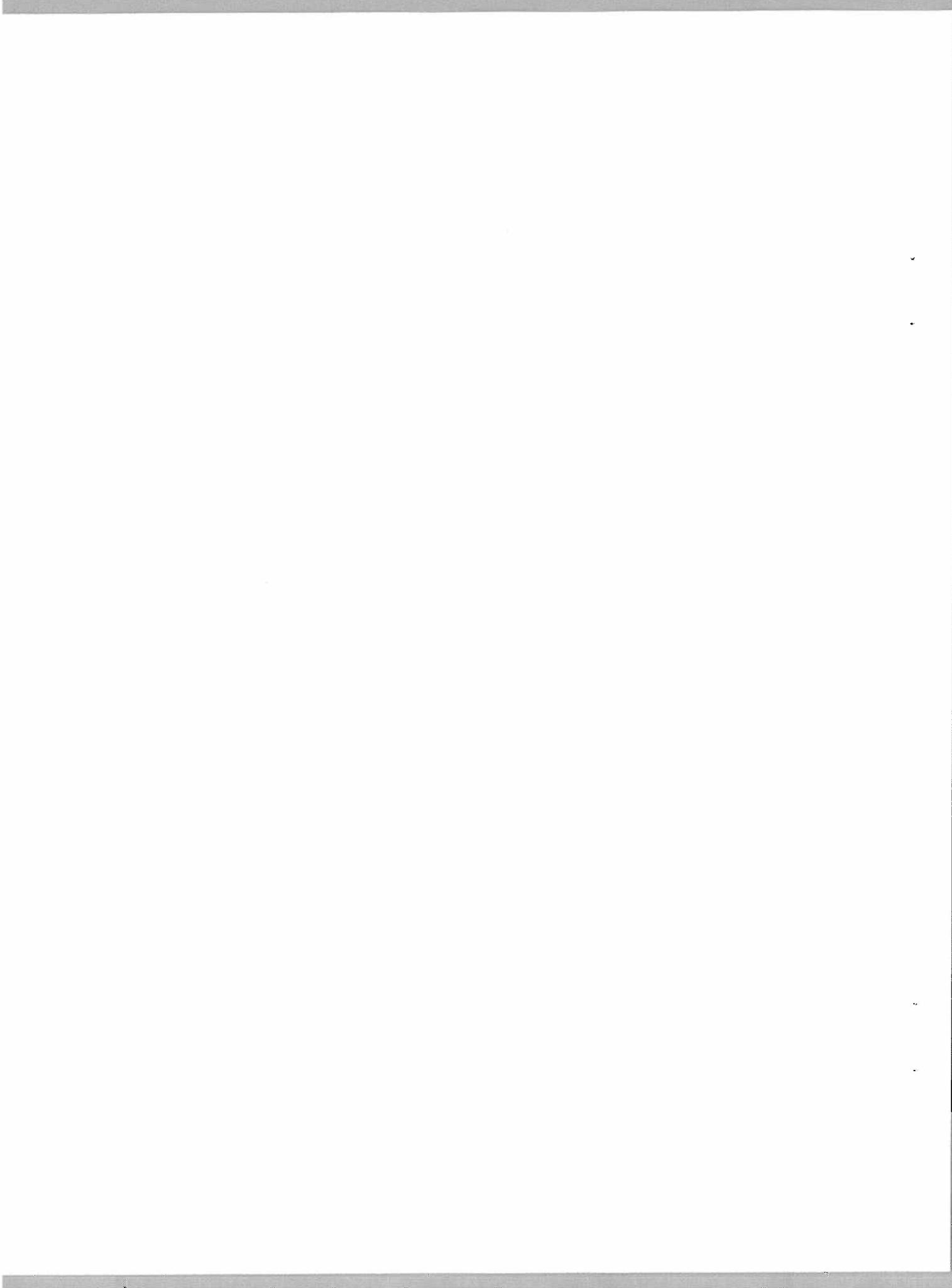
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INTRODUCTION

This report presents the results of an investigation of sedimentation in the Pathfinder and Seminoe Reservoirs on the North Platte River in Wyoming. The investigation was conducted by the Sedimentation Section, Hydrology Branch, Project Planning Division, Bureau of Reclamation, Denver, Colorado, in cooperation with the District Office, Casper, Wyoming, a district of Region 7, Bureau of Reclamation, Denver, Colorado. The investigation was made under the authority of the Reclamation Act of 1902 and amendments thereto. The field work was initiated on March 21, 1950, and was continued intermittently until April 14, 1951.

A copy of the original map of Pathfinder Reservoir made prior to the closure of Pathfinder Dam in 1909, and a copy of the original map of Seminoe Reservoir made prior to the closure of the Seminoe Dam in 1939, were used in analyzing the data obtained during this investigation. In addition to using the above maps the results of the 1931 reconnaissance survey of Pathfinder Reservoir were also used. The reconnaissance survey of 1931 was made by the Corps of Engineers, U.S. Department of the Army, during their, "Silt Investigation in the Missouri River Basin."

ACKNOWLEDGMENTS

Messrs. Dale W. Henry and Joe M. Lara of the Sedimentation Section, Hydrology Branch, Project Planning Division, Denver, Colorado, assisted in the compilation of data and the preparation of charts for this report.

The helpful advice given the writers by the following persons of the Bureau of Reclamation who reviewed this report is also acknowledged:

Mr. I. J. Matthews, District Manager; Mr. Nels P. Nelson, Superintendent, Water and Land; and Mr. Ed H. George, Planning Engineer, Casper Wyoming
Mr. John A. Keimig, Regional Planning Engineer, Region 7, Denver, Colorado
Messrs. H. S. Riesbol and W. M. Borland, Hydrology Branch, Project Planning Division, Denver, Colorado

PURPOSE AND SCOPE

The purpose of this investigation was: (1) to obtain the necessary data for preparing new area capacity tables for Pathfinder and Seminoe Reservoirs, (2) to determine the sediment yield for the drainage areas above Seminoe and Pathfinder Reservoirs, and (3) to obtain information on the sediment disposition in these reservoirs. The analysis of these data should provide information needed for the proper operation of the reservoirs, aid in estimating the useful lives of the reservoirs, and assist in the design of other structures relative to increasing the usefulness of the projects. Information may also be furnished relative to the requirement of upstream measures of control for reducing the rates of sediment contribution.

OWNERSHIP

Both Pathfinder and Seminoe Reservoirs and Dams are owned by the United States Government and are operated by the Bureau of Reclamation, U.S. Department of the Interior.

LOCATION OF DAMS

Pathfinder and Seminoe Dams are located on the North Platte River approximately 47 and 55 miles, respectively, southwest of Casper, Wyoming. Their relative location is shown on Drainage Map, Figure 2, page 8.

LOCATION OF PATHFINDER RESERVOIR

Natrona County, Wyoming

T30N, R85W, Sects. 25, 26, 27, 28, 29, 30, 32, 33, 34, 35, 36

T30N, R84W, Sect. 31

T29N, R84W, Sects. 5, 6, 7, 8, 9, 16, 17, 19, 20, 21, 22, 23,
26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36

Carbon County, Wyoming

T28N, R84W, Sects. 4, 5, 6, 7, 8, 9, 10, 15, 16, 17, 18, 19,
20, 21, 28, 29, 30, 31, 32, 33

T28N, R85W, Sects. 1, 11, 12, 13, 14, 23, 24, 25, 26

T27N, R84W, Sects. 5, 6, 7, 8, 18, 19, 20, 29, 30, 32, 33

T27N, R85W, Sects. 12 and 13

T26N, R84W, Sects. 4, 5, 8, 9

The reservoir map is shown by Figure 4, pages 11 - 16.

LOCATION OF SEMINOE RESERVOIR

Carbon County, Wyoming

T25N, R83W, Sects. 30, 31, 32

T25N, R84W, Sects. 9, 10, 15, 16, 21, 22, 23, 24, 25, 26,
27, 28, 34, 35, 36

T24N, R82W, Sects. 31 and 32

T24N, R83W, Sects. 7, 16, 17, 18, 19, 20, 21, 22, 25, 26,
27, 28, 29, 34, 35, 36

T24N, R84W, Sects. 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13,
14, 15, 16, 17, 18, 19, 20, 22, 23, 24,
25, 26, 27, 28, 33, 35, 36

T24N, R85W, Sects. 13 and 14

T23N, R82W, Sects. 5 and 6

T23N, R83W, Sects. 1, 2, 19, 30

T23N, R84W, Sects. 1, 2, 3, 4, 10, 11, 13, 14, 15, 16, 22, 23,
24, 25, 26, 27, 28, 31, 32, 33, 34, 35

T23N, R85W, Sects. 36

T22N, R84W, Sects. 4, 5, 6,

T22N, R85W, Sects. 1, 2, 3, 10, 11

The reservoir map is shown by Figure 5, pages 17 - 23.

PURPOSE SERVED

Pathfinder Dam was constructed to store irrigation water for the North Platte Project. This project, comprising approximately 236,000 acres of irrigated land, is located more than 170 miles downstream from the dam. The project lands are in Goshen County, Wyoming, and Morill, Sioux, and Scotts Bluff Counties of Nebraska.

Storage water is also supplied to lands under private canals in accordance with the provisions of the Warren Act of February 21, 1911 (36 Stat. 9251). Eight irrigation districts or canal companies, irrigating about 108,000 acres of land have permanent contracts for supplemental water. Eight additional districts or canal companies, irrigating about 35,000 acres of land, have annual or temporary contracts for supplemental water.

Power is also generated with the water released for irrigation purposes.

Seminole Dam was constructed to store water of the North Platte River for use in developing power and for the irrigation of lands in the Kendrick Project. The irrigable area of the project was divided into two units, of which the first unit contains about 22,000 acres of land and the second unit may contain up to 15,000 acres.

DESCRIPTION OF THE DAMS

Pathfinder Dam, illustrated by the Frontispiece, is a masonry, arch-gravity type dam situated in a deep narrow granite canyon. The dam has a structural height of 214 feet, a hydraulic height of 184 feet, the base width is 96.5 feet, and the width at the crest is 10.9 feet.

The crest of the dam is 432 feet long and the elevation of the crest is 5,858.1 feet^{1/} above sea level (USGS datum).

The spillway is a concrete weir, 650 feet long with a capacity of 65,000 cfs. The spillway is located at the north end of the dam. The elevation of the crest of the spillway is 5850.1 feet.

The outlet works consist of two tunnels, one on the north side and the other on the south side of the canyon. The sill of the trashrack for the north tunnel is at elevation 5668.1. The flow through the north tunnel is controlled by two balanced needle valves. The sill of the trashrack for the south side tunnel is at elevation 5719.6. The outlet of the south tunnel is controlled by six balanced Ensign-type valves.

Pathfinder Dike is located about one-fourth miles south of the dam. The dike is earth fill with a concrete core wall. The dike is 1,650 feet long with a structural height of 38 feet and a hydraulic height of 20 feet.

Seminole Dam, illustrated by Figure 1, page 5, is a concrete-arch type dam. This dam is also located in a deep narrow canyon. The dam has the following dimensions in feet:

Structural height 295	Crest width 17
Hydraulic height 195	Crest length 530
Base width 85	

The elevation of the crest of the dam is 6361 feet.

The spillway is an inclined tunnel controlled at the inlet by three fixed-wheel gates. Each gate is 14 x 50 feet. The elevation of the gate sills, which is also the elevation of spillway crest, is 6307 feet. The elevation of the top of the spillway gates is 6357 feet.

DESCRIPTION OF THE LAKES

Pathfinder Reservoir: The 1950 Reservoir Map, Figure 4, Sheets 1 through 6 is shown on pages 11 - 16, inclusive. The lake, beginning at Pathfinder Dam is confined in a narrow deep canyon and is less than 500 feet in width. However, immediately above the dam the lake broadens abruptly to a width of one half mile or more. About one and one-half miles west of the dam the lake is restricted between the base of a mountain and a rock point. Above this restriction the lake opens into a large basin formed by the confluence of Sand Creek, Canyon Creek, and the Sweetwater River with the North Platte River. The basin is approximately 8 miles long in a SSW direction and has a

^{1/} Based on this survey; add 1.9 feet to convert to original Pathfinder Dam Project datum.



(a) Downstream view - Outlet to spillway tunnel left foreground and powerhouse near center of photo.



(b) Upstream view - Crane tower and spillway near right edge of photo, three penstock trash racks near center, and outlet trash rack left of center.

SEMINOE DAM

maximum width of 3 miles. The North Platte River enters this basin approximately midway along the east side, 7-1/2 miles above the dam, through a relatively narrow rugged channel varying in width from 1/4 to 1/2 mile. Four and one-half miles above the entrance to the basin the lake narrows into a canyon section that is approximately 500 feet wide for a distance of about 1-3/4 miles. Continuing upstream the lake gradually widens to a width of approximately 1 mile and stays approximately this wide nearly to the upper end, and then narrows to the head of the back water 10 miles above the narrows or 24 miles above the dam.

The Sweetwater River arm enters the basin from the north through a rugged canyon approximately 1/2 mile wide. Three and one-half miles north of its confluence with the North Platte River the lake narrows to a width of 800 feet and turns sharply to the west. Immediately thereafter it widens to a width of 1 mile for a distance of 3 miles, and then widens again to its maximum width of 1-1/2 miles at the point where Horse Creek enters the reservoir 13.5 miles above the dam. Then the lake narrows gradually to a width of 300 feet at a distance of 18 miles from the dam. The lake again widens slightly before tapering down to reach the spillway crest line 19 miles above the dam.

The south half of the aforementioned basin is in the wide flat valley through which Sand Creek enters the reservoir. The basin has a width of nearly two miles to its upper end, 4 miles above the confluence of Sand Creek and the North Platte River.

At the NE part of the basin between the point that the North Platte enters and leaves the basin is the Canyon Creek arm. This arm is approximately 1 mile wide at its mouth but narrows rapidly to the head of impounded water 3.3 miles above the confluence of Canyon Creek and the North Platte River.

Seminole Reservoir: The 1950 Reservoir Map, Figure 5, Sheets 1 through 7 is shown on pages 17 - 23, inclusive. The main body of the lake above Seminole Dam is on the North Platte River. In addition to the main body of the lake there is one major arm formed by the confluence of the Medicine Bow River with the North Platte River. The other small tributaries of the lake are of minor consequence.

The principal body of the lake at the top of spillway gates, elevation 6357, is approximately 40 miles in length and the Medicine Bow arm is 24 miles in length. The original area of the lake at elevations 6357 and 6340 was 20,045 and 15,280 acres, respectively. The 1950 area of the lake at elevation 6340, the upper limit of this survey is 15,200 acres.

The principal body of the lake extends from the dam in a southerly direction to the head of the backwater. The Medicine Bow arm joins the east side of the lake at a distance of about 8 miles air line or 17.2 river miles upstream from the dam.

Beginning at the dam the lake is confined to a narrow canyon for a distance of about 2 miles. Upstream from this reach the lake abruptly increases in width, from less than 600 feet to one mile or larger. Approximately 4 miles farther upstream or about 6 miles above the dam, the lake is pinched in by another canyon section which extends for about one mile. At this point the lake again widens to a mile or more in width and remains approximately at this larger width for the next 6 miles. The lake, although generally having a narrower width above this point and becoming smaller as the head of backwater is approached, occasionally exceeds a mile in width and averages more than 1/2 mile in width.

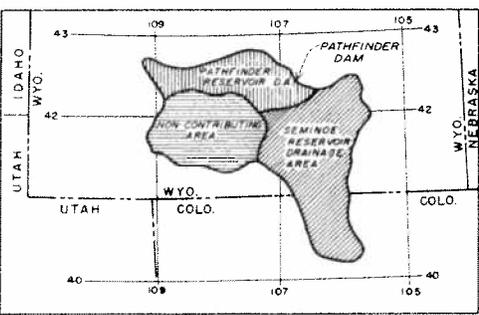
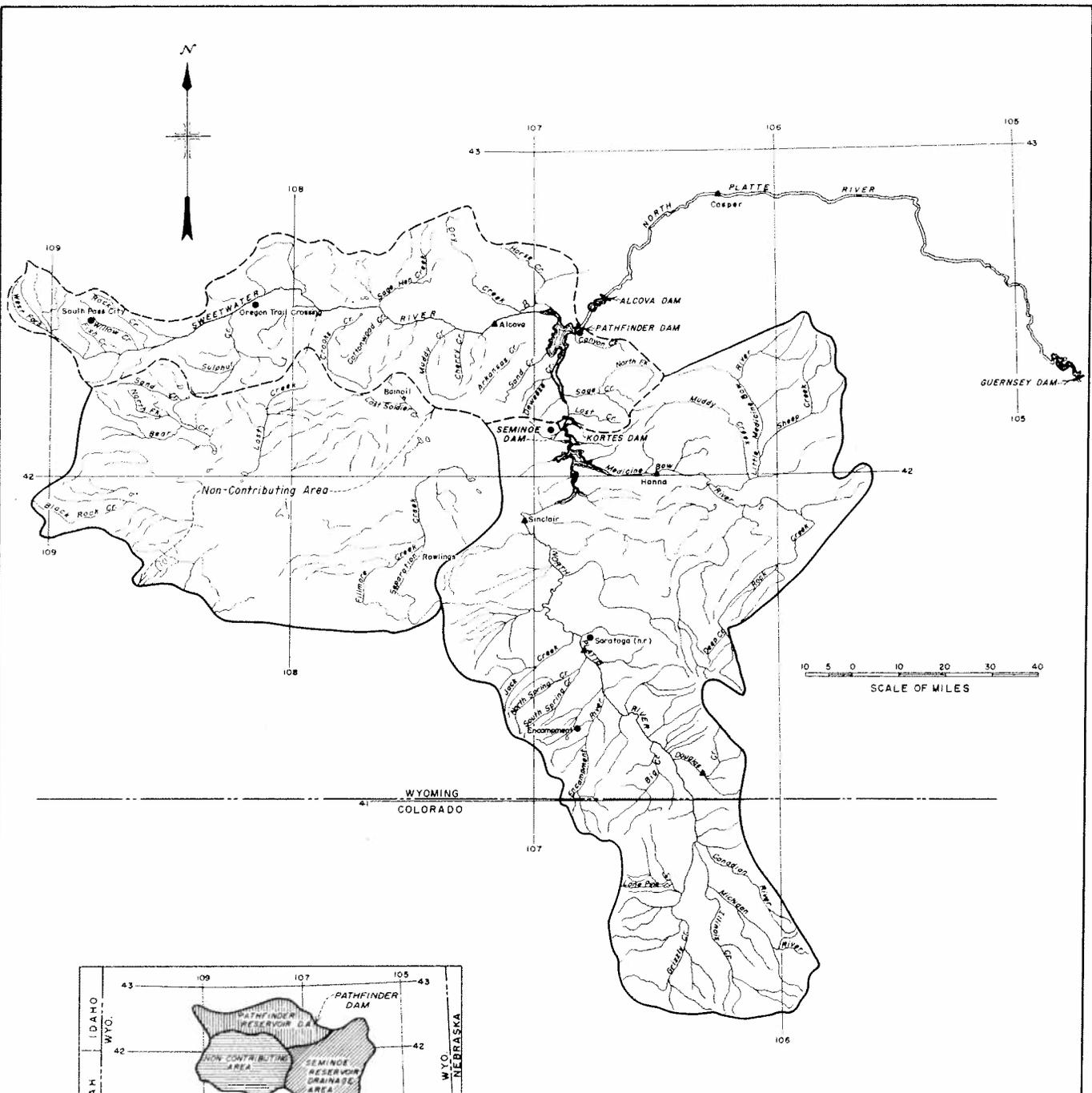
The Medicine Bow arm, approximately 2 miles in width where it joins the North Platte, has a narrow section between 5 and 6 miles above its confluence with the North Platte. Immediately above this narrow section the Medicine Bow arm reaches a width of a mile, then gradually narrows in the upper portions of the arm as the head of backwater is approached.

Description of the Drainage Area

A map of the drainage area is presented by Figure 2, page 8. The headwaters of the North Platte River begin at the Continental Divide in north central Colorado, south of Walden, Colorado. The initial course of the stream, situated between the Medicine Bow Mountains and the Park Range, is in a northwesterly direction, for about 50 miles through Colorado and for 70 miles into Wyoming. At this point about 12 miles northeast of Rawlins, Wyoming, the stream course changes to an easterly direction. It continues east for a few miles until it reaches Seminoe Reservoir. Then its course is in a northerly direction through Seminoe Reservoir and Dam, Kortez Reservoir and Dam, and through Pathfinder Reservoir to Pathfinder Dam.

The major tributaries to the North Platte River in the drainage area are the Medicine Bow River and the Sweetwater River. The Medicine Bow River has a drainage area of approximately 2,310 square miles. It flows in a northwesterly direction and empties into the east side of Seminoe Reservoir. The Sweetwater River has a drainage area of approximately 2,270 square miles at the Geological Survey gaging station which is situated about four miles upstream from the spillway crest line of Pathfinder Reservoir. The Sweetwater River flows in an easterly direction to empty into the west side of Pathfinder Reservoir. Its origin is along the east side of the Continental Divide in the southwestern edge of the Shoshone National Forest, about 20 miles southwest of Lander, Wyoming.

The total drainage area above Pathfinder Dam is approximately 14,600 square miles. The contributing drainage area above Pathfinder Dam including the reservoir area is approximately 10,700 square miles. This latter area may be divided into 3 parts as follows: 7,348 square miles of drainage area above Seminoe Dam; about 2 square miles of drainage area between Seminoe Dam and the stream gaging station



KEY MAP

EXPLANATION

- Drainage Area, Pathfinder Reservoir
- Drainage Area, Seminole Reservoir
- ▲ Discharge Station
- Weather Station

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SEDIMENTATION SECTION

DRAINAGE MAP
PATHFINDER AND SEMINOLE RESERVOIRS

DRAWN..... I. M. S.	SUBMITTED <i>Louis M. Slavy</i>
TRACED..... R. V. S.	RECOMMENDED <i>William H. Corbett</i>
CHECKED..... I. M. S.	APPROVED <i>H. S. Kestel</i>

DENVER, COLORADO, JAN 9, 1953

located 1,000 feet downstream from Kortes Dam; and 3,350 square miles between this gaging station and Pathfinder Dam. The run-off above Seminoe Dam has been controlled by Seminoe Dam since April 3, 1939. However, Kortes Dam, located only 2 miles below Seminoe Dam, did not impound water until September 1950. The recent completion date of Kortes Dam obviates the necessity of considering the effect it would have on the sedimentation in Pathfinder Dam based on this investigation. As the capacity of Kortes Reservoir is only 4,800 acre-feet and because of the small intervening drainage area between Kortes and Seminoe Dams, the future effect that Kortes Dam will have on the sedimentation in Pathfinder Reservoir will be quite small.

Geology - The geology of the North Platte River drainage basin is depicted by Figure 3, ^{1/} page 10. On this map a separation has been made of the area contributing sediment to Pathfinder Reservoir, the noncontributing area, and the total area upstream from Pathfinder Dam.

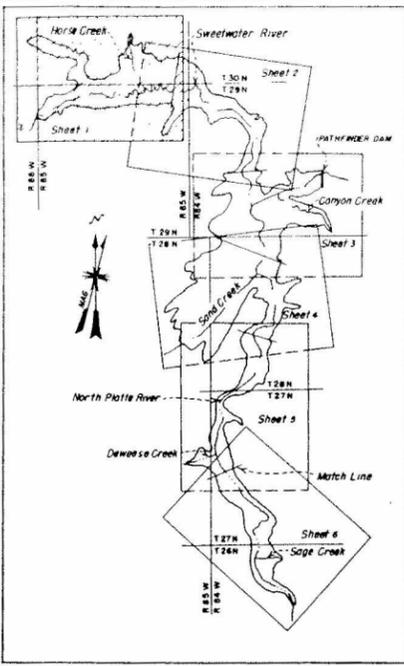
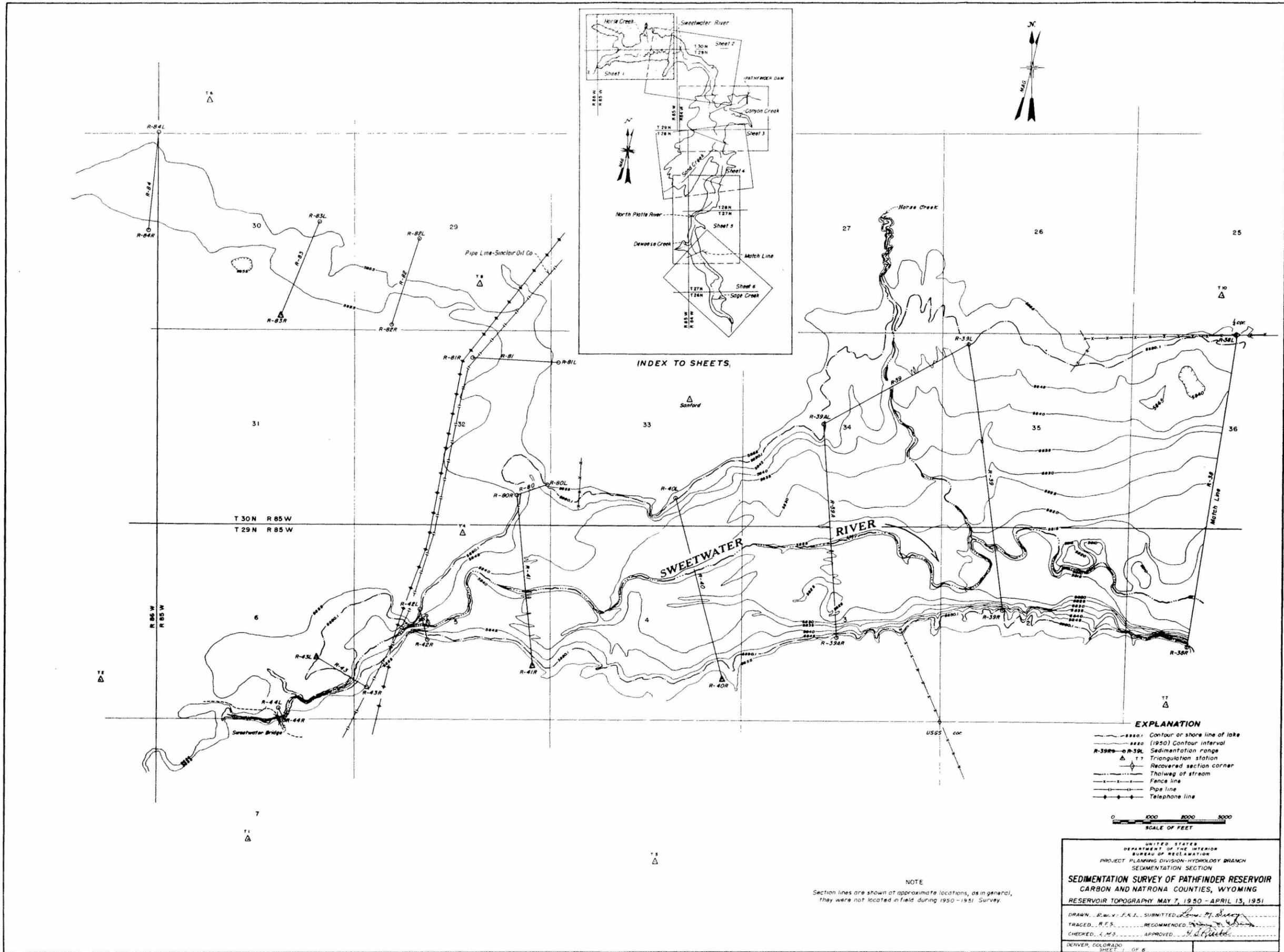
The approximate percentage of the sediment contributing area for Pathfinder Reservoir is divided as follows:

- (a) 25.3 percent from Pre-Cambrian rocks consisting of granite, schist, and gneiss.
- (b) 4.4 percent from the Paleozoic rocks consisting of consolidated sediments, quartzite, limestone, and sandstone.
- (c) 3.9 percent from Mesozoic formations consisting of sediments moderately to loosely consolidated, such as shale, siltstone, sandstone, and some limestone.
- (d) 66.4 percent from formations of Cenozoic age divided as follows: 64.5 percent tertiary sediments, loosely consolidated siltstone, sandstone, and shale; 0.2 percent tertiary lava; and 1.7 percent of Quarternary and Recent river alluvium, terrace material, and sand dunes.

The above percentages vary considerably for the total drainage area above Pathfinder Dam as may be noted on Figure 3. For instance, the alluvium, terrace material, and sand dunes for the total contributing area amount to 5.4 percent. Reservoir deposition of eolian deposits from sand dunes adjacent to Seminoe Reservoir is of particular importance. Later in the report such deposition is discussed in detail.

Topography - The topography of the basin ranges from the rugged mountains along the Continental Divide bordering the western and southern sides of the basin to the rough rolling land interspersed with numerous mountainous areas on the northern and eastern sides of the basin. Elevations throughout the area are high, ranging from 12,000 feet above sea level at the headwaters of the North Platte River to 5,850 feet at Pathfinder Dam.

^{1/} This Figure with certain modifications is based on the geologic map prepared by the Bureau of Reclamation, Casper District, Casper, Wyoming.



- EXPLANATION**
- Contour or shore line of lake
 - Contour interval (1950)
 - Sedimentation range
 - △ Triangulation station
 - △ Recovered section corner
 - Thalweg of stream
 - Fence line
 - Pipe line
 - Telephone line



NOTE
 Section lines are shown at approximate locations, as in general, they were not located in field during 1950-1951 Survey.

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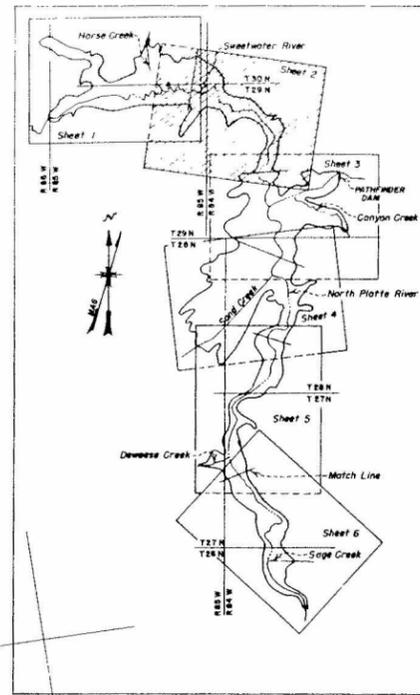
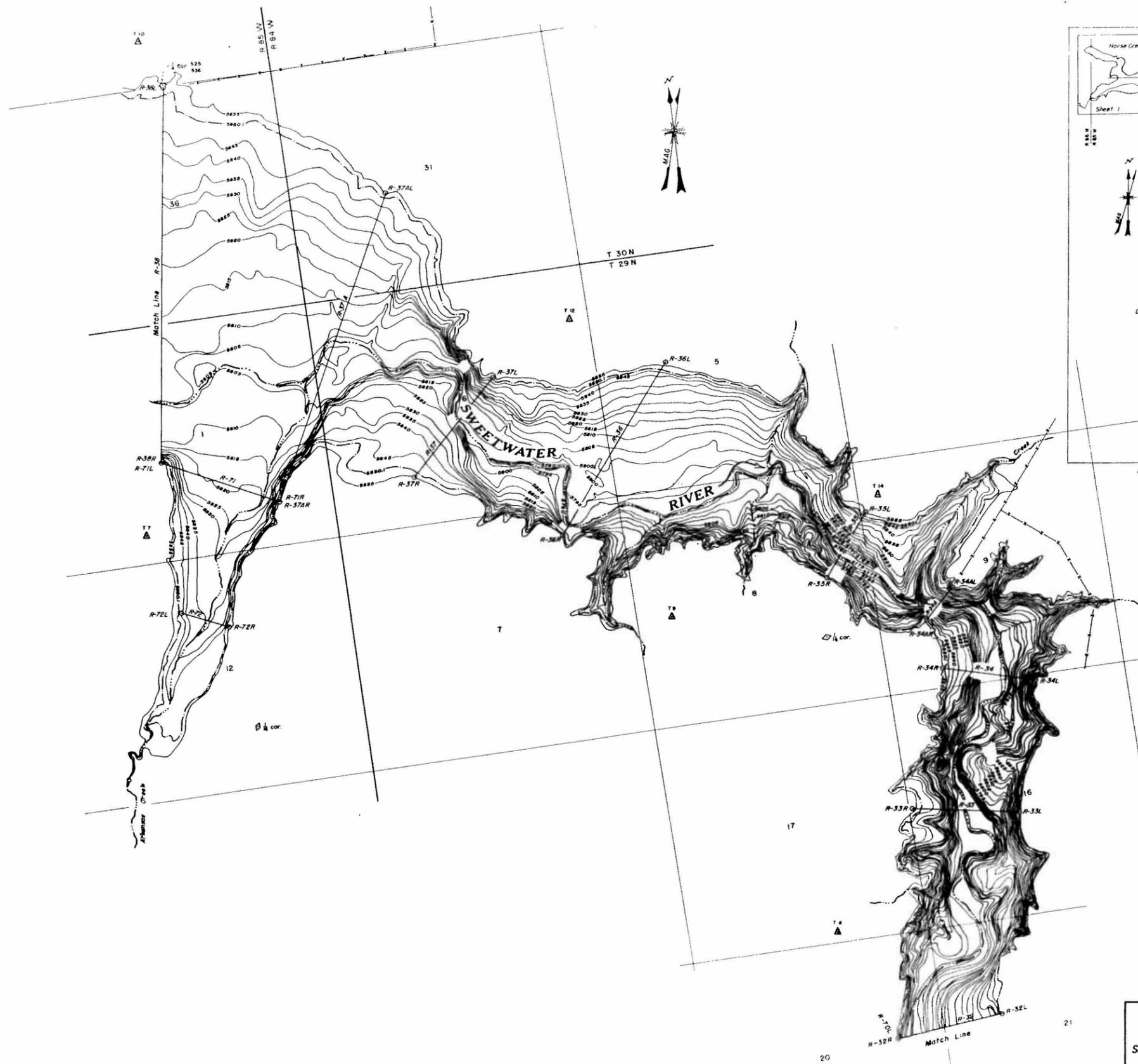
**SEDIMENTATION SURVEY OF PATHFINDER RESERVOIR
 CARBON AND NATRONA COUNTIES, WYOMING**

RESERVOIR TOPOGRAPHY MAY 7, 1950 - APRIL 13, 1951

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 TRACED: R.F.S. RECOMMENDED: *[Signature]*
 CHECKED: C.M.S. APPROVED: *[Signature]*

DENVER, COLORADO
 SHEET 1 OF 6

FIGURE 4, PAGE 11



INDEX TO SHEETS

- EXPLANATION**
- 3600 Contour or shore line of lake
 - 3600 (1950) Contour interval
 - R-37L-R-37L Sedimentation range
 - △ T 11 Triangulation station
 - ◊ Recovered section corner
 - Thalweg of stream
 - Fence line



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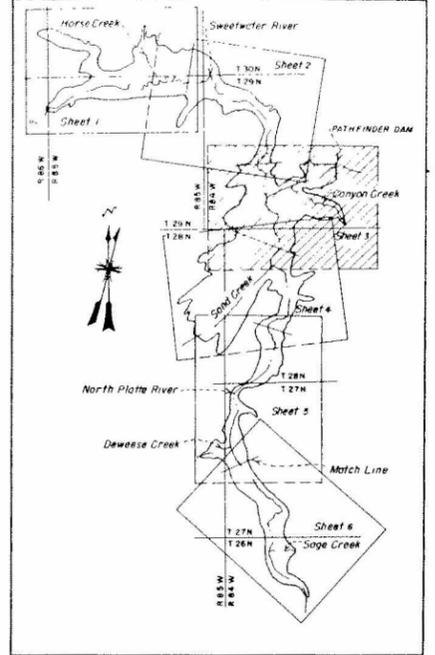
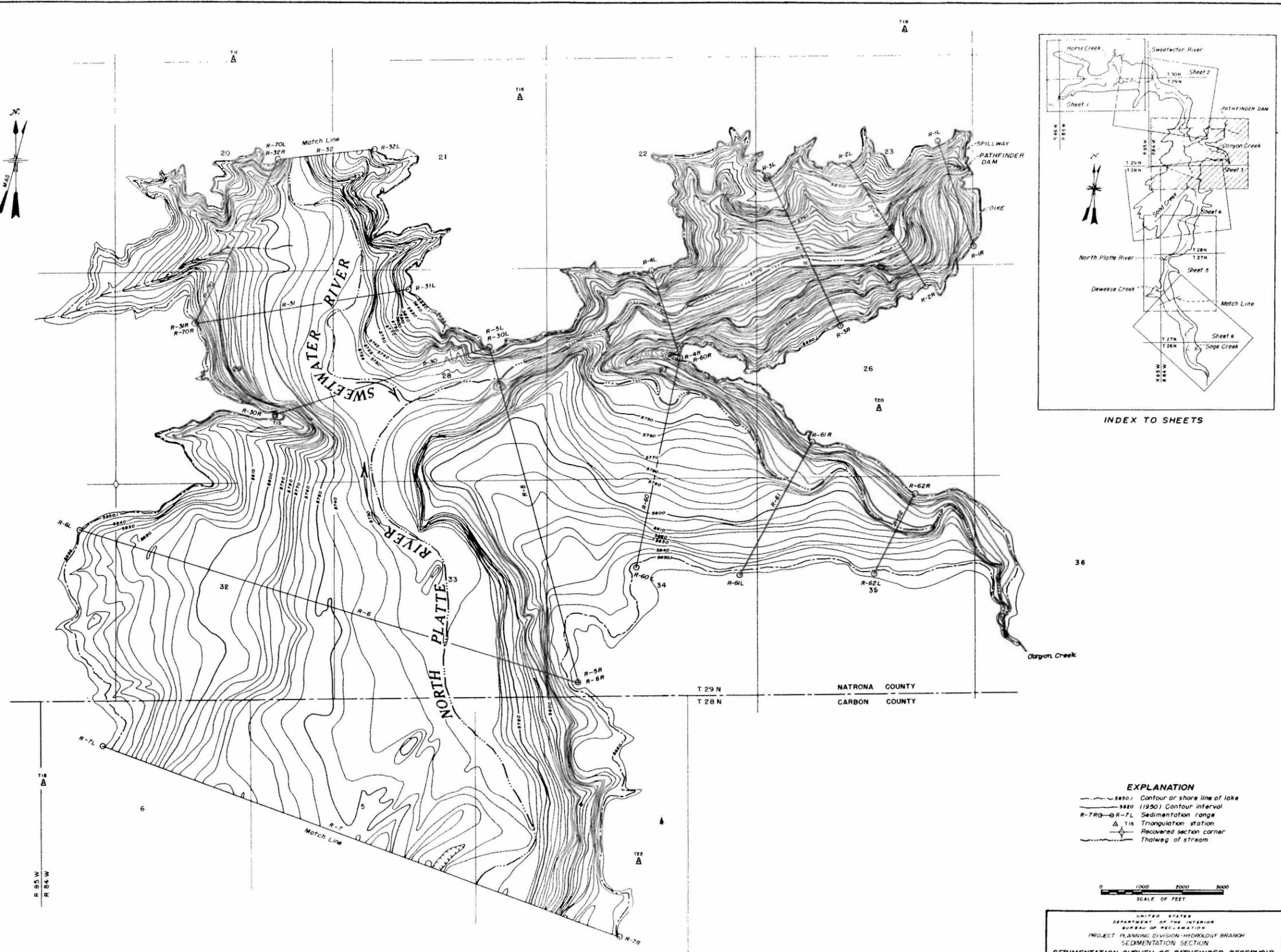
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 SHEET 2 OF 6

NOTE
 Section lines are shown at approximate locations, as in general,
 they were not located in field during 1950-1951 survey

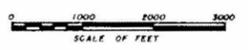
FIGURE 4, PAGE 12



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- EXPLANATION**
- 8850' Contour or shore line of lake
 - 8820' (1950) Contour interval
 - R-70L-R-7L Sedimentation range
 - △ T15 Triangulation station
 - △ T15 Recovered section corner
 - Thalweg of stream



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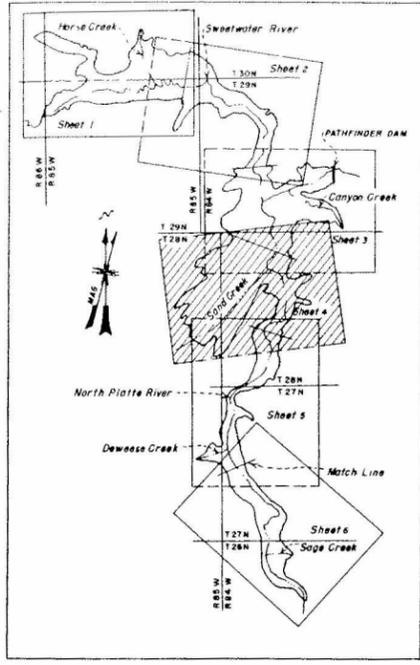
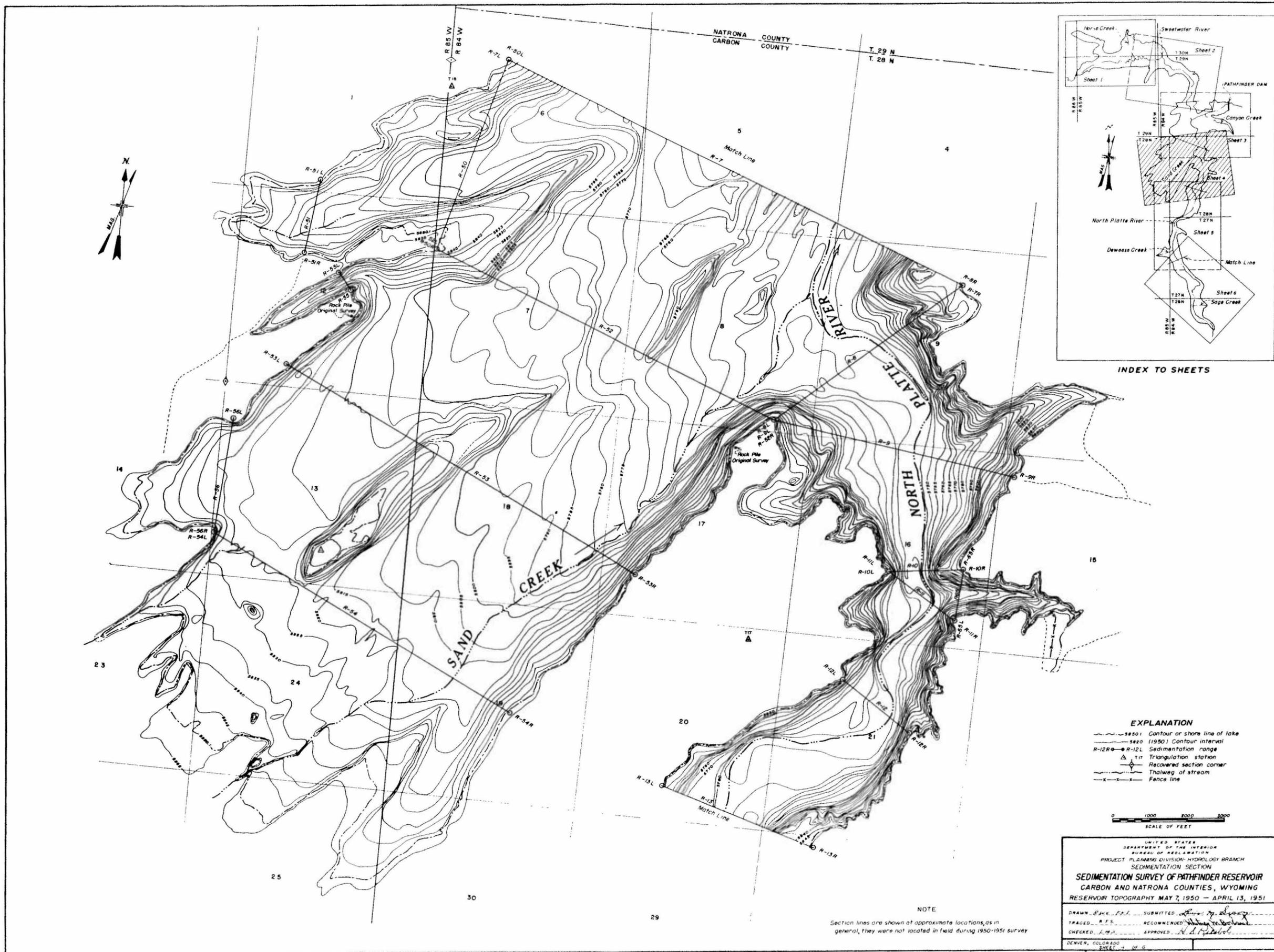
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 TRACED & P.S. RECOMMENDED *[Signature]*
 CHECKED & M.L. APPROVED *[Signature]*

DENVER, COLORADO
 ENGINEER

NOTE
 Section lines are shown at approximate locations, as in general,
 they were not located in field during 1950-1951 survey.

FIGURE 4, PAGE 13



- EXPLANATION**
- 58501 Contour or shore line of lake
 - 5820 (1950) Contour interval
 - R-12R ● R-12L Sedimentation range
 - △ T-17 Triangulation station
 - ◊ Recovered section corner
 - Thalweg of stream
 - - - - - Fence line



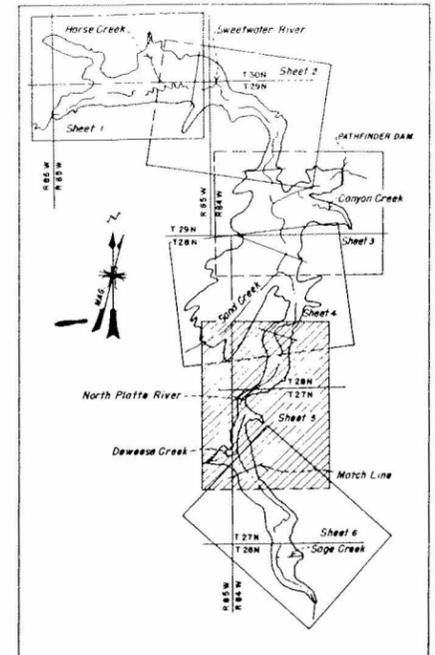
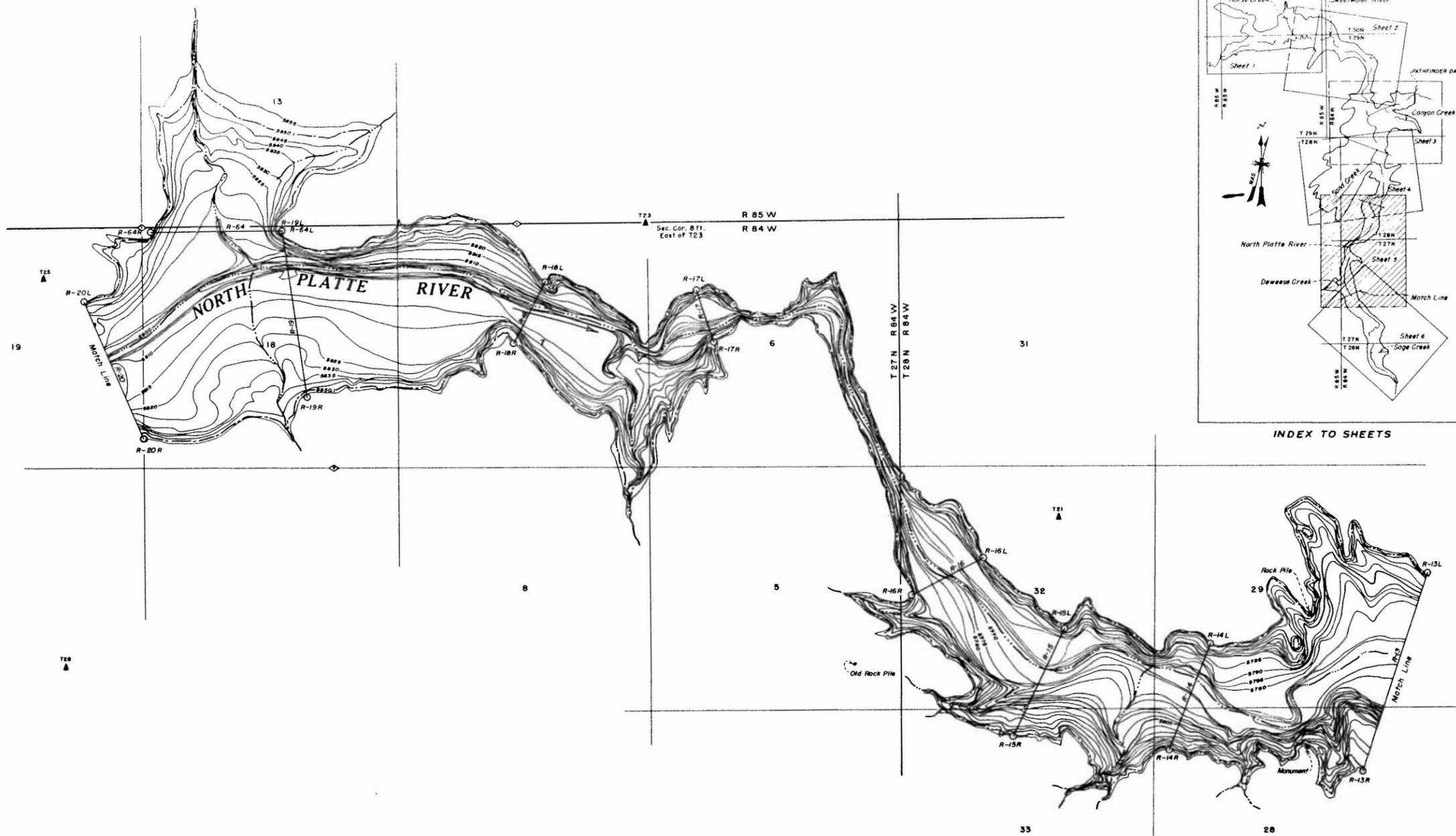
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 RESERVOIR TOPOGRAPHY MAY 7, 1950 — APRIL 13, 1951

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DENVER, COLORADO
 SHEET 4 OF 6

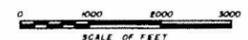
NOTE
 Section lines are shown at approximate locations, as in general, they were not located in field during 1950-1951 survey

FIGURE 4, PAGE 14



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- EXPLANATION**
- 8850: Contour or shore line of lake
 - 8870 (1950) Contour interval
 - R-13R—R-13L Sedimentation range
 - △ T23 Triangulation station
 - ◊ Recovered section corner
 - Thalgog of stream

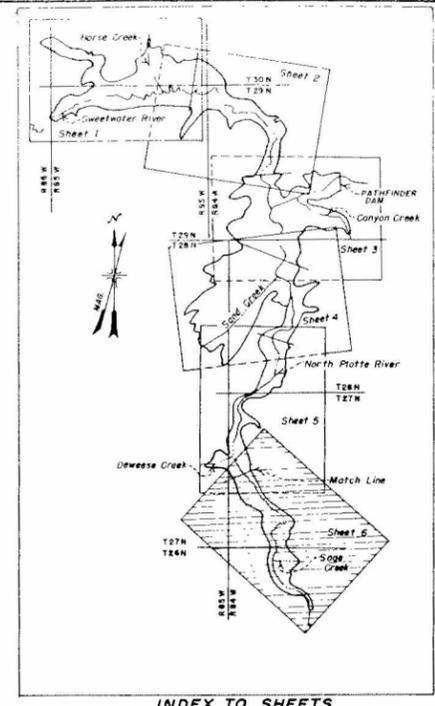
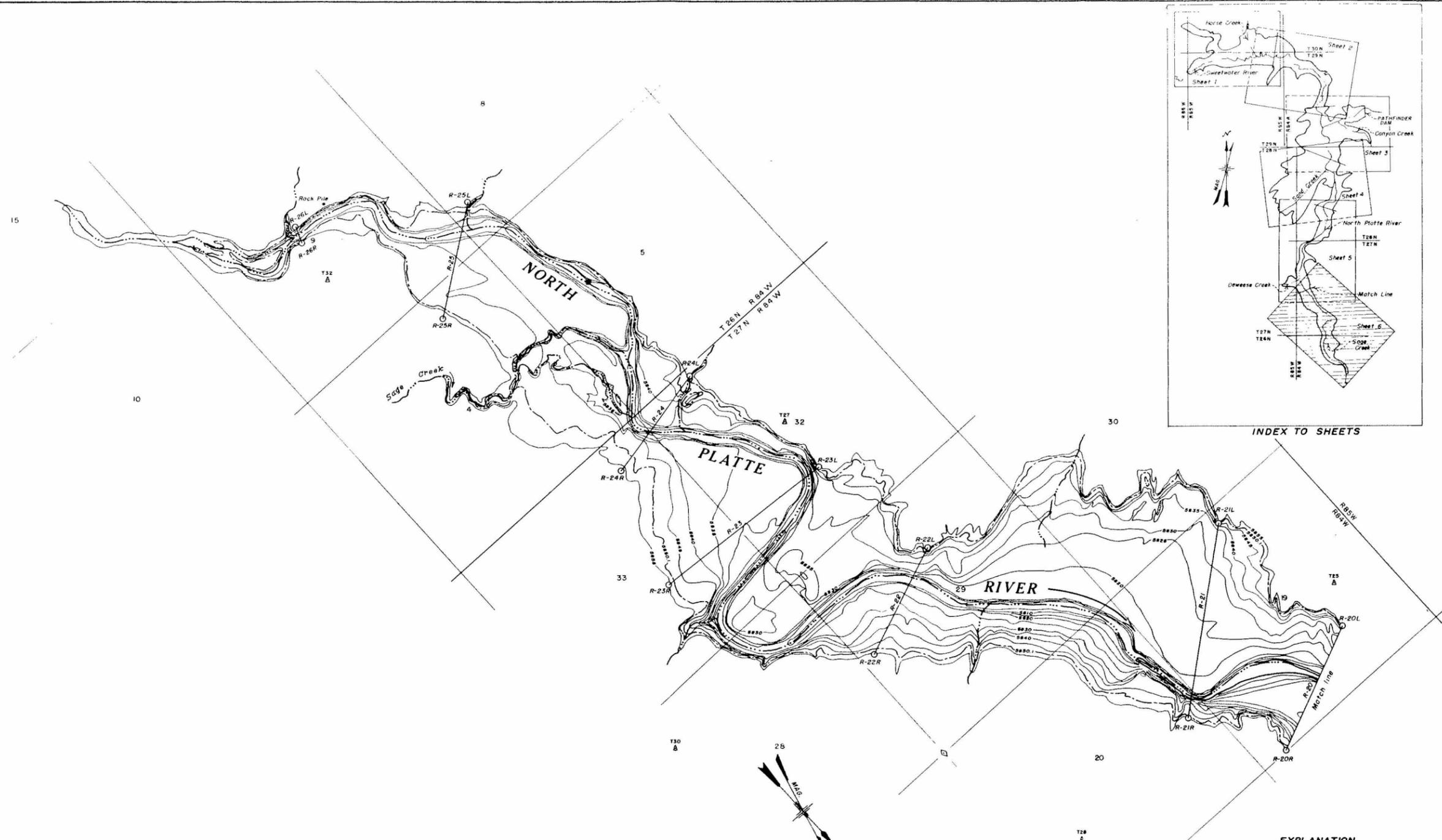


UNITED STATES
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 PROJECT PLANNING DIVISION-HYDROLOGY BRANCH
 SEDIMENTATION SECTION
SEDIMENTATION SURVEY OF PATHFINDER RESERVOIR
 CARBON AND NATRONA COUNTIES, WYOMING
 RESERVOIR TOPOGRAPHY MAY 7, 1950 - APRIL 13, 1951

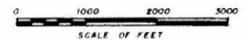
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DENVER, COLORADO
 SHEET 2 OF 5

NOTE
 Section lines are shown at approximate locations, as in general they were not located in field during 1950-1951 survey.



- EXPLANATION**
- 8850.1 Contour or shore line of lake
 - 8840 (1950) Contour interval
 - R-22L Sedimentation range
 - △ T-28 Triangulation station
 - ⊠ Recovered section corner
 - Thalweg of stream



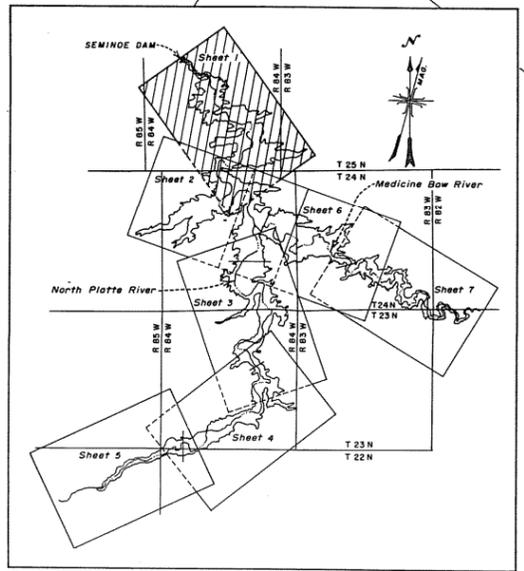
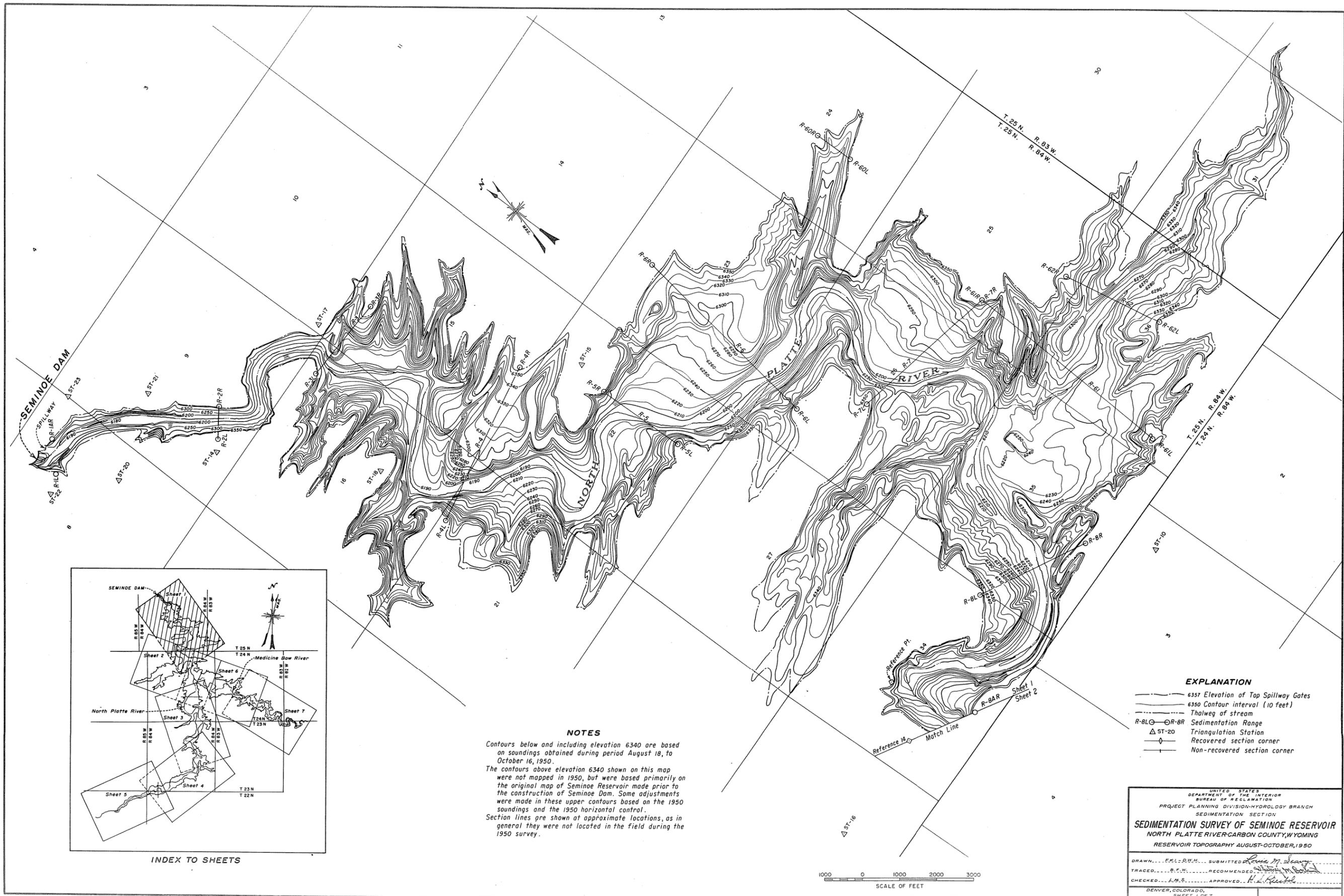
NOTE
 Section lines are shown of approximate locations, as in general, they were not located in field during 1950-1951 survey.

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DENVER, COLORADO
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FIGURE 4, PAGE 16



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NOTES

Contours below and including elevation 6340 are based on soundings obtained during period August 18, to October 16, 1950.

The contours above elevation 6340 shown on this map were not mapped in 1950, but were based primarily on the original map of Seminole Reservoir made prior to the construction of Seminole Dam. Some adjustments were made in these upper contours based on the 1950 soundings and the 1950 horizontal control.

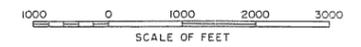
Section lines are shown at approximate locations, as in general they were not located in the field during the 1950 survey.

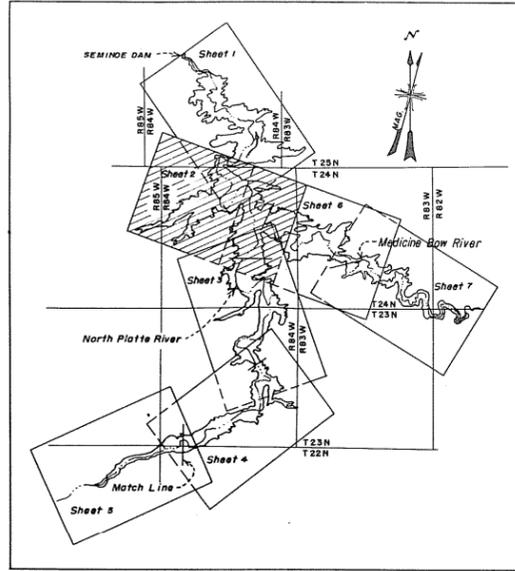
- EXPLANATION**
- 6357 Elevation of Top Spillway Gates
 - 6350 Contour interval (10 feet)
 - Thalweg of stream
 - R-BL O R-BR Sedimentation Range
 - △ ST-20 Triangulation Station
 - ◇ Recovered section corner
 - Non-recovered section corner

UNITED STATES
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SEDIMENTATION SURVEY OF SEMINOLE RESERVOIR
NORTH PLATTE RIVER-CARBON COUNTY, WYOMING
RESERVOIR TOPOGRAPHY AUGUST-OCTOBER, 1950

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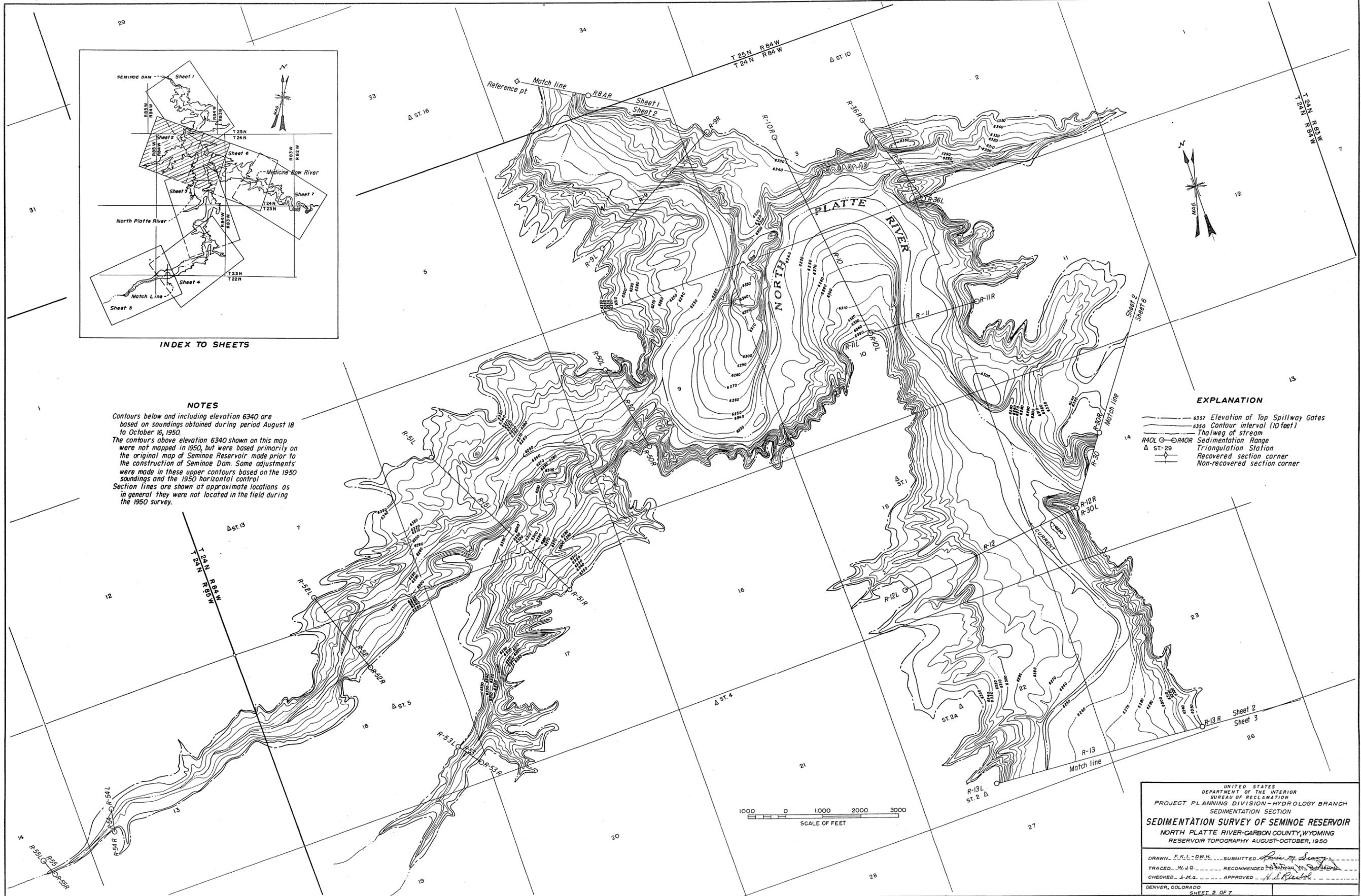


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 Section lines are shown at approximate locations as in general they were not located in the field during the 1950 survey.

EXPLANATION

- 6357 Elevation of Top Spillway Gates
- 6350 Contour interval (10 feet)
- Thalweg of Stream
- R40L G—OR40R Sedimentation Range
- △ ST-29 Triangulation Station
- Recovered section corner
- Non-recovered section corner



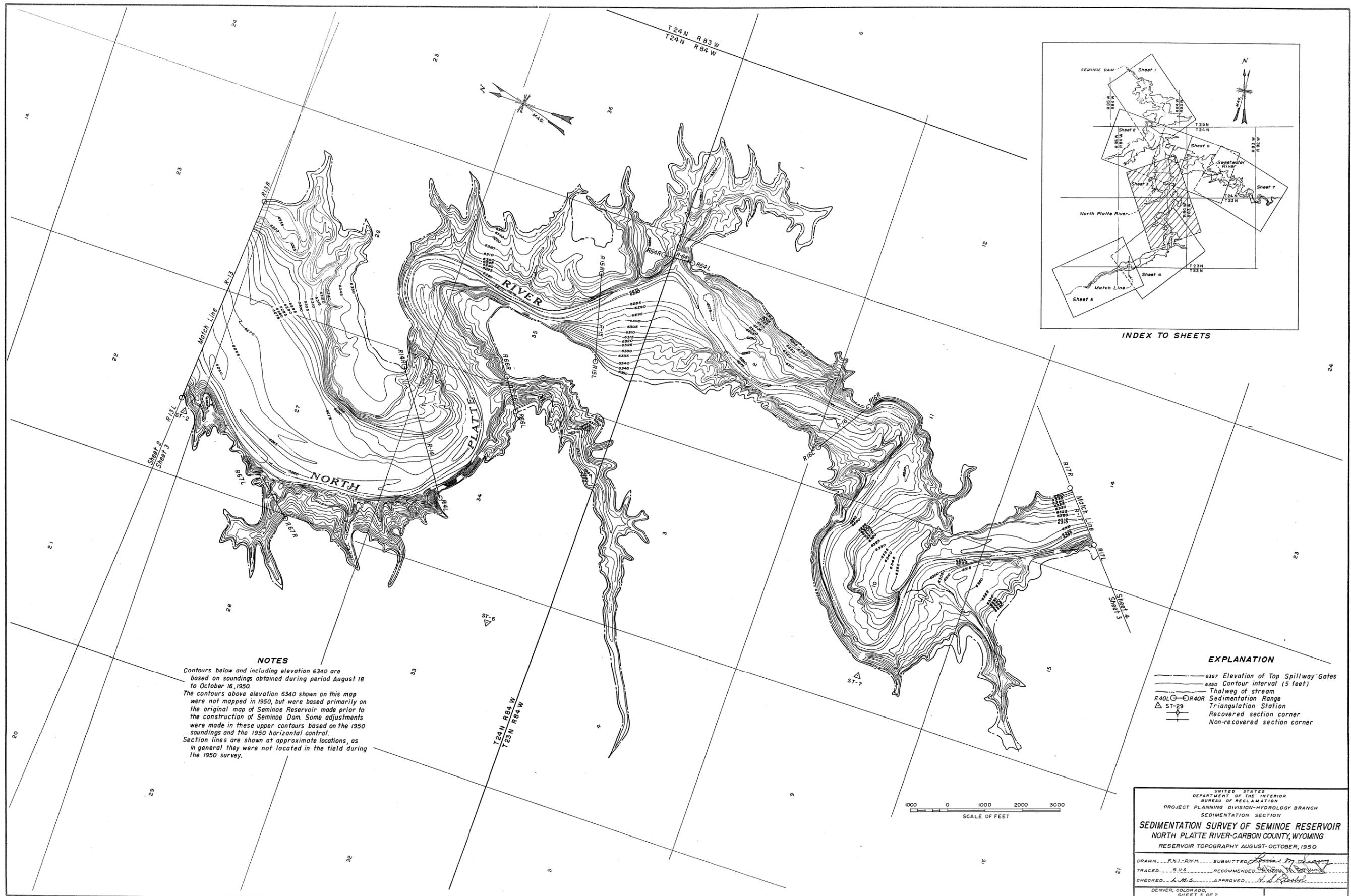
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SEDIMENTATION SURVEY OF SEMINOLE RESERVOIR
 NORTH PLATTE RIVER—GARCON COUNTY, WYOMING
 RESERVOIR TOPOGRAPHY AUGUST—OCTOBER, 1950

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FIGURE 5, PAGE 18



NOTES

Contours below and including elevation 6340 are based on soundings obtained during period August 18 to October 16, 1950.

The contours above elevation 6340 shown on this map were not mapped in 1950, but were based primarily on the original map of Seminoe Reservoir made prior to the construction of Seminoe Dam. Some adjustments were made in these upper contours based on the 1950 soundings and the 1950 horizontal control.

Section lines are shown at approximate locations, as in general they were not located in the field during the 1950 survey.

EXPLANATION

- 6357 Elevation of Top Spillway Gates
- 6350 Contour interval (5 feet)
- Thalweg of stream
- R40C—R40R Sedimentation Range
- △ ST-25 Triangulation Station
- ⊕ Recovered section corner
- ⊖ Non-recovered section corner

SCALE OF FEET
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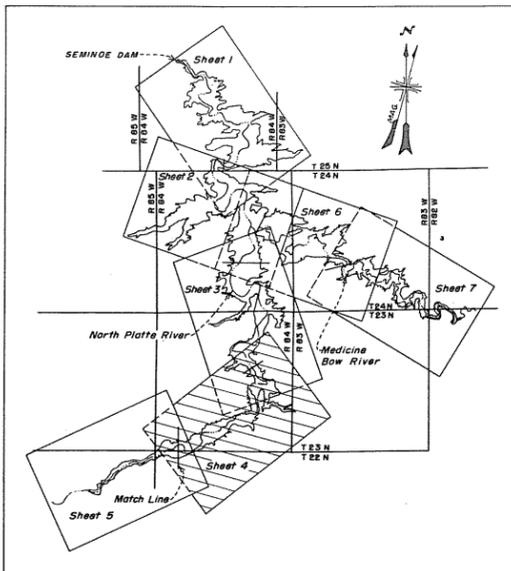
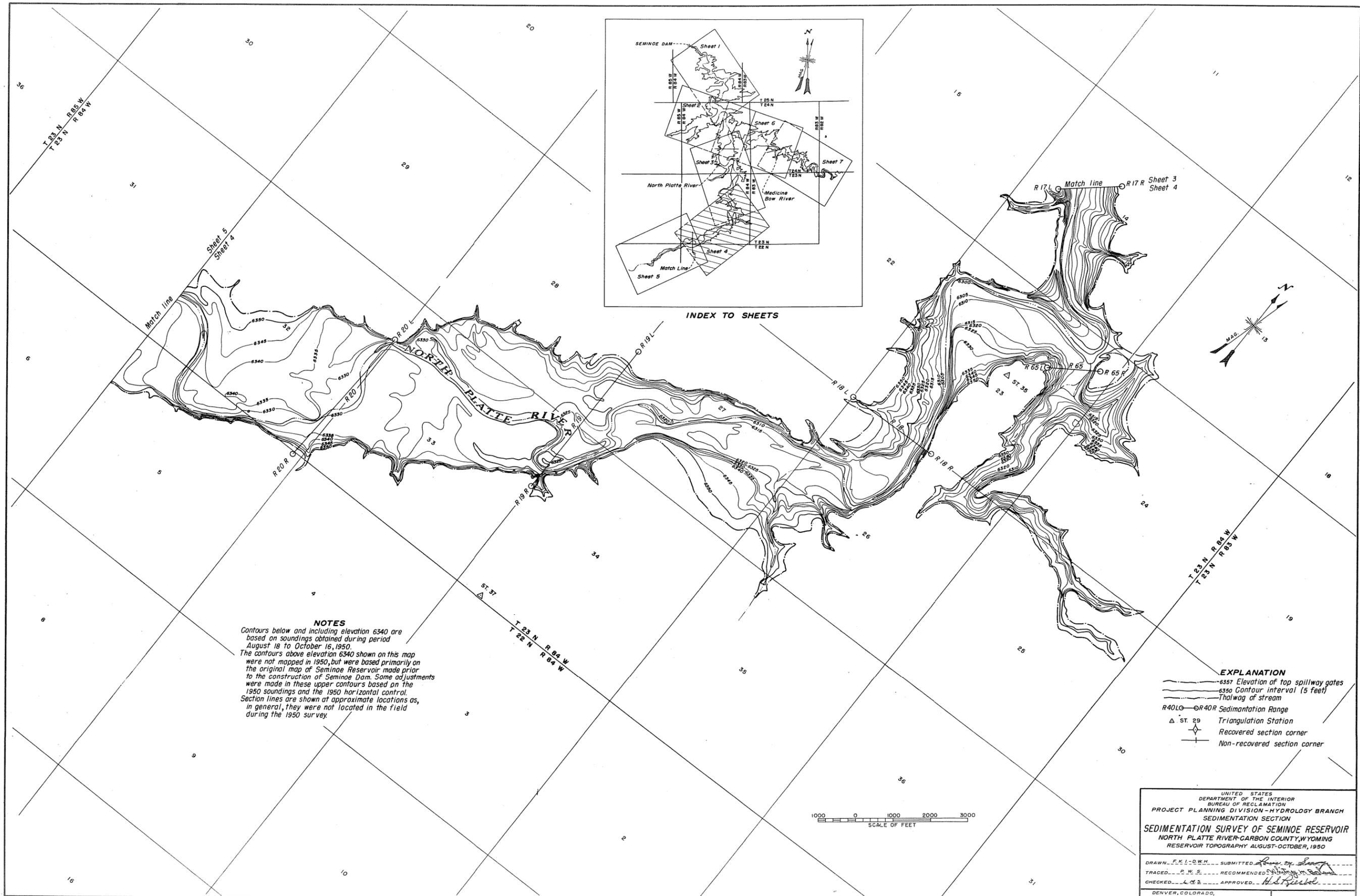
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SEDIMENTATION SECTION

SEDIMENTATION SURVEY OF SEMINOE RESERVOIR
NORTH PLATTE RIVER-CARBON COUNTY, WYOMING
RESERVOIR TOPOGRAPHY AUGUST-OCTOBER, 1950

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FIGURE 5, PAGE 19



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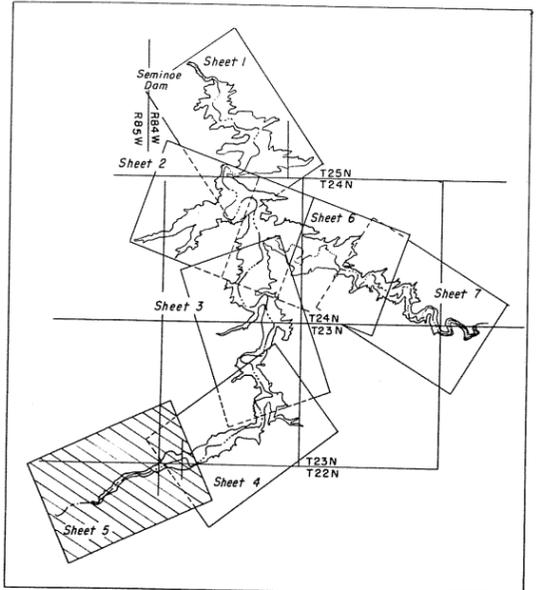
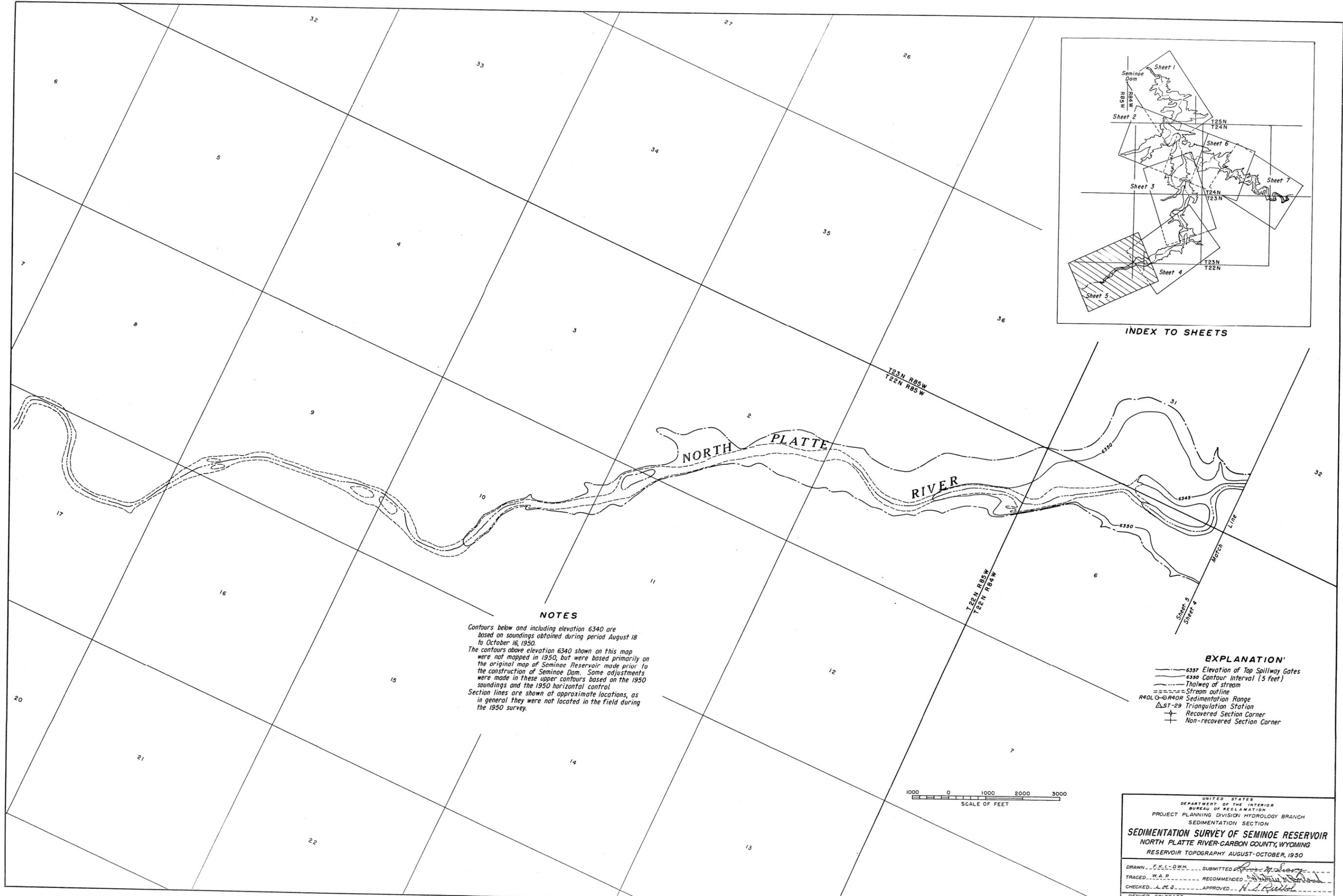
- EXPLANATION**
- 6357 Elevation of top spillway gates
 - 6350 Contour interval (5 feet)
 - Thalweg of stream
 - R40L—R40R Sedimentation Range
 - △ ST. 29 Triangulation Station
 - ◇ Recovered section corner
 - ⊕ Non-recovered section corner

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 NORTH PLATTE RIVER-CARBON COUNTY, WYOMING
 RESERVOIR TOPOGRAPHY AUGUST-OCTOBER, 1950

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 SHEET 4 OF 7

FIGURE 5, PAGE 20



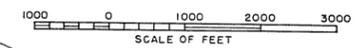
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 Section lines are shown at approximate locations, as in general they were not located in the field during the 1950 survey.

EXPLANATION

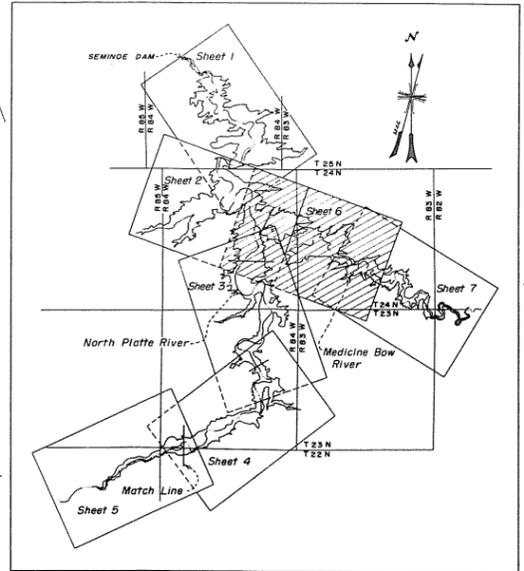
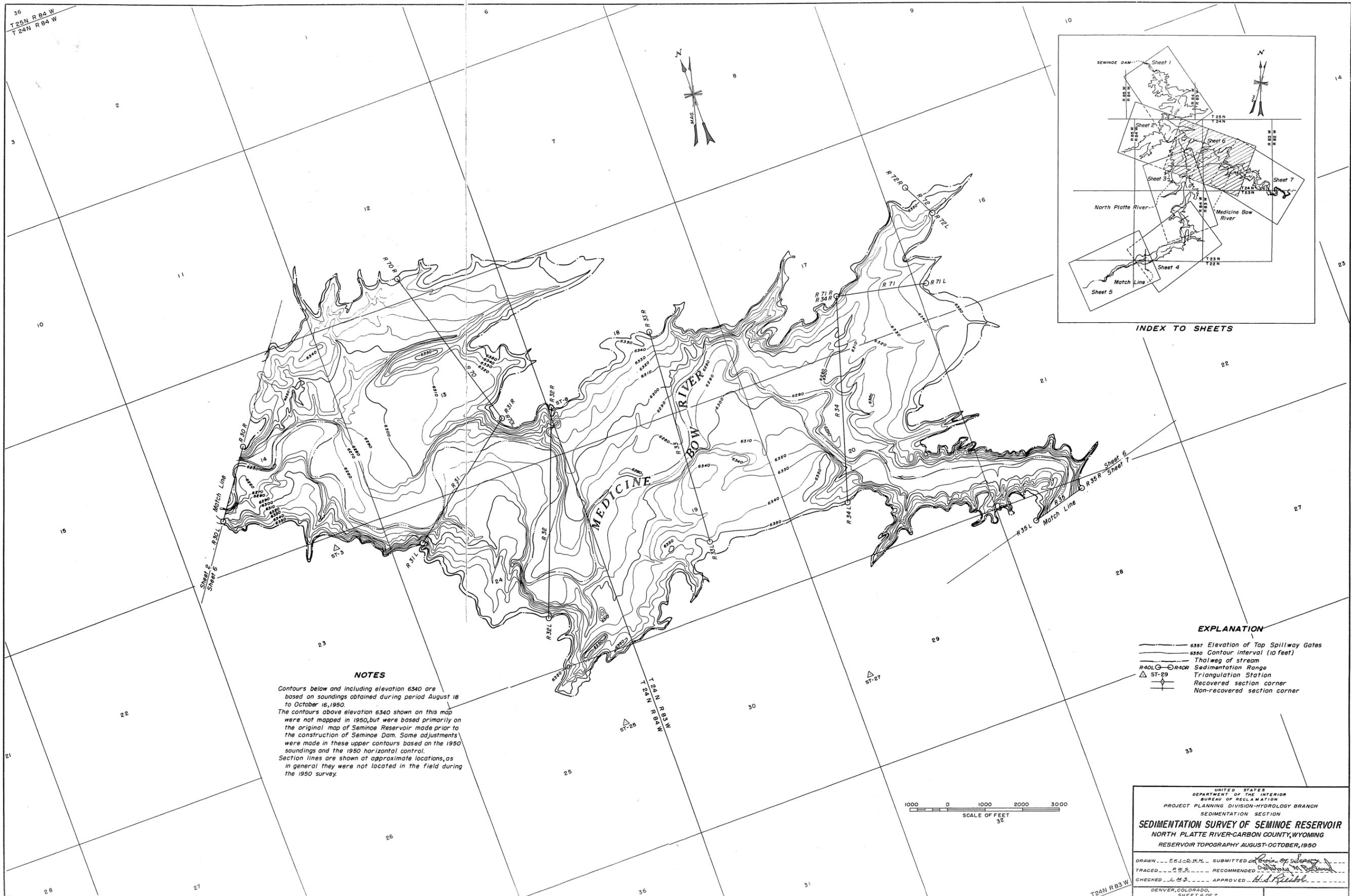
- 6357 Elevation of Top Spillway Gates
- 6350 Contour Interval (5 feet)
- Thalweg of stream
- Stream outline
- R40L-R40R Sedimentation Range
- Triangulation Station
- △ ST-29 Recovered Section Corner
- ⊕ Non-recovered Section Corner



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SEDIMENTATION SURVEY OF SEMINOLE RESERVOIR
 NORTH PLATTE RIVER-CARBON COUNTY, WYOMING
 RESERVOIR TOPOGRAPHY AUGUST-OCTOBER, 1950

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 SHEET 5 OF 7



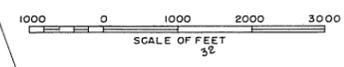
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 Section lines are shown at approximate locations, as in general they were not located in the field during the 1950 survey.

EXPLANATION

- 6357 Elevation of Top Spillway Gates
- 6350 Contour interval (10 feet)
- Thalweg of stream
- R40L ○ R40R Sedimentation Range
- △ ST-29 Triangulation Station
- Recovered section corner
- Non-recovered section corner



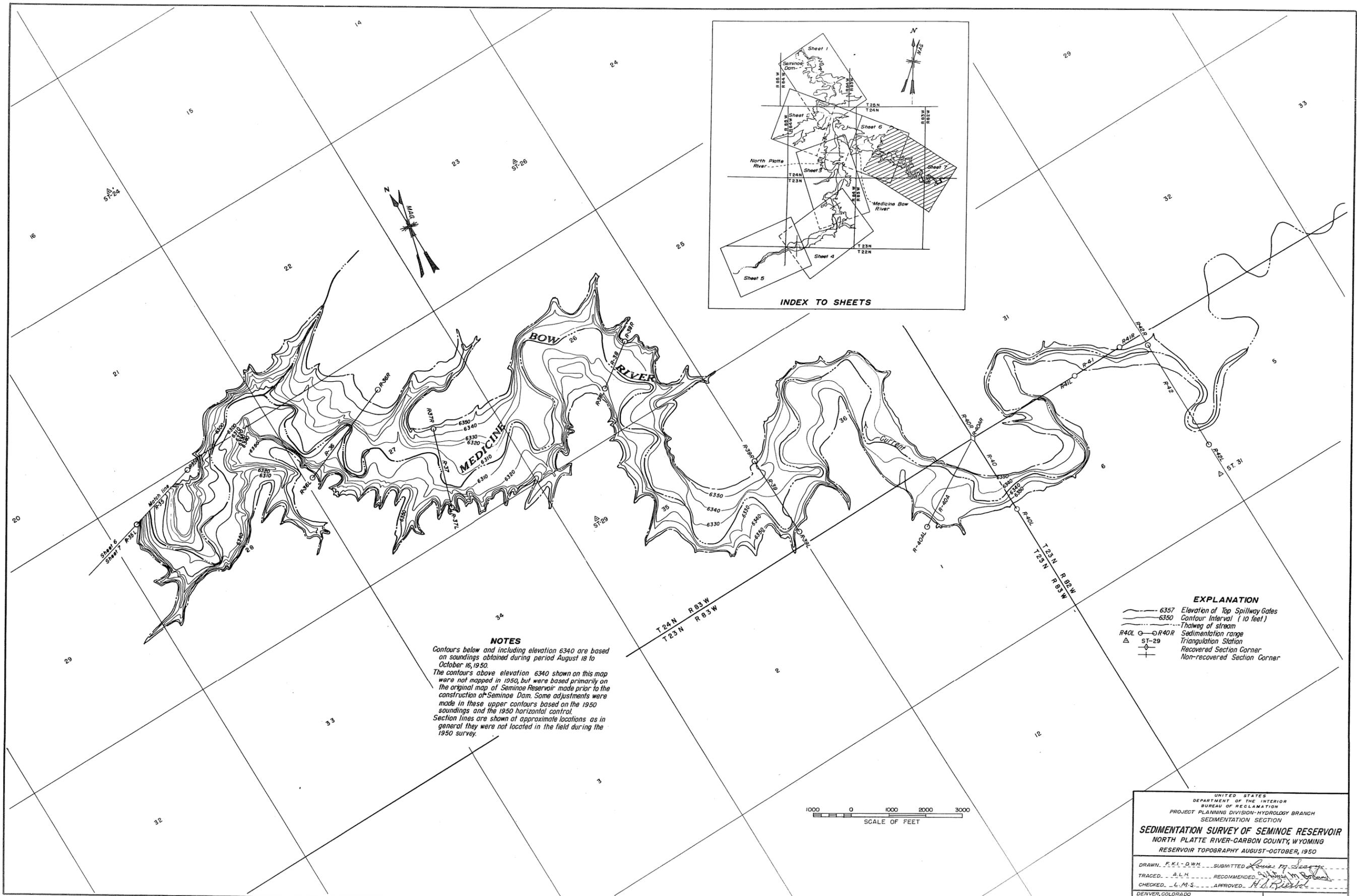
UNITED STATES
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 SEDIMENTATION SECTION

SEDIMENTATION SURVEY OF SEMINOLE RESERVOIR
 NORTH PLATTE RIVER-CARBON COUNTY, WYOMING
 RESERVOIR TOPOGRAPHY AUGUST-OCTOBER, 1950

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 CHECKED — L. M. S. — APPROVED — *[Signature]*

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 SHEET 6 OF 7

FIGURE 5, PAGE 22



NOTES
 Contours below and including elevation 6340 are based on soundings obtained during period August 18 to October 16, 1950.
 The contours above elevation 6340 shown on this map were not mapped in 1950, but were based primarily on the original map of Seminoe Reservoir made prior to the construction of Seminoe Dam. Some adjustments were made in these upper contours based on the 1950 soundings and the 1950 horizontal control.
 Section lines are shown at approximate locations as in general they were not located in the field during the 1950 survey.

- EXPLANATION**
- 6357 Elevation of Top Spillway Gates
 - 6350 Contour Interval (10 feet)
 - Thaweg of stream
 - R40L — R40R Sedimentation range
 - △ ST-29 Triangulation Station
 - ⊕ Recovered Section Corner
 - ⊕ Non-recovered Section Corner



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SEDIMENTATION SURVEY OF SEMINOE RESERVOIR
 NORTH PLATTE RIVER-CARBON COUNTY, WYOMING
 RESERVOIR TOPOGRAPHY AUGUST-OCTOBER, 1950

DRAWN: F.K.L.-A.W.H. SUBMITTED: *Louis M. Seay*
 TRACED: A.L.H. RECOMMENDED: *William M. Brown*
 CHECKED: L.M.S. APPROVED: *H.A. [Signature]*

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 SHEET 7 OF 7

FIGURE 5, PAGE 23

Climate (1)* - The winters in the drainage area are long and severe. The annual frost free period is 100 days or less. The average annual temperature at Pathfinder and Seminoe Dams is approximately 45.5° F and 42.8° F, respectively. The average annual temperature is lower at the higher elevation in the basin. For instance at South Pass City, Wyoming, near the headwaters of the Sweetwater River the average annual temperature is 34.2° F.

Rainfall - The average precipitation over the basin is light. Most of the precipitation falls as snow. The average annual precipitation for six weather stations selected throughout the basin is given below:

<u>STATION</u>	<u>AVG. AN. PRECIP.</u>
Pathfinder Dam	10.2 inches
Saratoga, Wyoming	14.8 inches
Oregon Trail Crossing, Wyoming	9.7 inches
Seminoe Dam	8.2 inches
Encampment, Wyoming	11.1 inches
South Pass City, Wyoming	12.1 inches

Runoff (2) - The amount of inflow and outflow for Pathfinder Reservoir for the period June 1909 (since the beginning of storage) to April 3, 1939, (the beginning of storage in Seminoe Reservoir which is upstream from Pathfinder Reservoir) was 40,299,500 and 38,725,500 acre-feet, respectively. The average annual inflow and outflow for Pathfinder Reservoir during the same period were 1,350,500 and 1,297,800 acre-feet, respectively.

During the period April 3, 1939, through July 1950 (the average date of the survey soundings) the inflow and outflow for Pathfinder Reservoir were 10,366,800 and 9,561,100 acre-feet, respectively. The average annual inflow and outflow for Pathfinder Reservoir for the same period were 921,490 acre-feet and 849,880 acre-feet, respectively.

The average annual amount of water contributed to Pathfinder Reservoir by the Sweetwater River, based on 9 years of record at the Geological Survey gaging station located 5 miles upstream from the high-water line of Pathfinder Reservoir, was 79,400 acre-feet.

The amount of the inflow and outflow for Seminoe Reservoir for the period April 3, 1939, (since the beginning of storage) to September 16, 1950, (the average date of the survey soundings) was 10,382,300 acre-feet and 9,217,100 acre-feet, respectively. The average annual inflow and outflow for Seminoe Reservoir for the same period were 906,800 acre-feet and 805,000 acre-feet, respectively.

*Numbers in parentheses, as (1) above, refer to bibliography references.

During the above period about 15 percent of the inflow into Seminoe Reservoir was contributed by the Medicine Bow arm. Most of the remaining 85 percent of inflow was contributed by the North Platte River.

Land Cover - Land cover in the basin consists principally of range grasses and sagebrush at lower elevations, and sparse to dense stands of pine in the mountains. Large areas, especially along the Sweetwater River, are so arid that vegetation of any kind is sparse.

Land Use - Light precipitation and short growing seasons limit the use of the land. It is principally devoted to grazing. Most of the ranches in the area do have small irrigated meadows to produce hay, but actual cultivation is very limited in extent.

Soils (3) - Approximately 50 percent of the soils of the drainage basin are of the Navajo-Chipeta type. This soil type is associated with the high desert plateaus of semi-arid regions. This soil is developed over sandstones, shales and limestones and has a great variety of color.

The remaining 50 percent of the soils are almost equally divided and consist of the Bingham-Avon, Underwood Babb, Macammom Deschutes, and Helmer-Santa-Benewah types. These soils vary considerably but generally are thin, coarse to stony, or gravelly soils associated with mountainous regions.

History of the Surveys

The survey of Pathfinder and Seminoe Reservoirs was performed by the Sedimentation Section, Hydrology Branch, Denver, Colorado, and the Planning Section of the Casper, Wyoming, District Office of Region 7, both of the Bureau of Reclamation. The field work was carried out at intervals from March 21, 1950, to April 14, 1951.

The field work was performed, under the direction of Frank K. Illk, Engineer, by the following personnel of the Hydrology Branch; Richard W. Vaughan, Assistant Chief of Party, Jack C. Bessee, James F. King, Carl R. Miller, and Edward Lewandowski. The latter 3 men participated during only a part of the survey period. In addition several laborers were furnished by the Casper Office to assist the party. The field parties engaged in the survey furnished by the Casper District Office were under the direction of Donald B. Woltersdorf and John E. Larsen.

The survey work on Pathfinder Reservoir was divided in the following manner. The Casper Office personnel established and triangulated the primary horizontal control net, monumented the range ends, ran level control to all range end monuments and took profiles of the ranges from the range ends to the water surface. The Sedimentation Section field party established the ranges, performed the secondary triangulation to locate the range ends, sounded the reservoir, and mapped the crest contour.

The survey was initiated by extending the existing Geological Survey triangulation systems to cover the reservoir area with a second-order triangulation net comprising 26 stations. This net was plotted on plane table sheets at a scale of 1 inch = 1,000 feet and the range ends were located by plane table triangulation.

Sixty-two sedimentation ranges were established, of these 56 were profiled by obtaining soundings by use of an 808J Fathometer. The other ranges were profiled by use of an engineer level, level rods, and an engineer chain. To improve the underwater detail, approximately 130 miles of additional sounding lines were run between ranges and located by sextant angles from the boat with shore triangulation stations or range ends.

The crest contour (elevation 5850.1) of the lake, the 5855 contour and such lower contours as were exposed at time of survey were mapped on the plane table sheets.

On August 17, 1950, the soundings were completed on Pathfinder Reservoir and for statistical purposes the average date of survey for Pathfinder Reservoir was based on the average date of the survey soundings. This was July 1950.

However, the shore line mapping for Pathfinder Reservoir which was also accomplished by the Sedimentation Section's party was discontinued to obtain soundings at Seminoe Reservoir. This mapping was resumed after soundings were obtained at Seminoe Reservoir but was discontinued because of inclement weather on December 13, 1950. Shore line mapping was resumed again on April 2, 1951, and was completed by the Sedimentation Section's party on April 13, 1951.

The survey field work on Seminoe Reservoir was divided in a different manner from the field work for Pathfinder Reservoir in that only the hydrographic work, consisting of soundings and sediment sampling was scheduled for accomplishment by the Sedimentation Survey Party of the Hydrology Branch. The remainder of the field work, similar to that accomplished on Pathfinder Reservoir, was scheduled to be accomplished by personnel of the Casper, Wyoming, District Office.

Sufficient control for initiating the soundings on Seminoe Reservoir was completed by the District parties by August 17, 1950. On this date the Sedimentation Survey party moved to Seminoe Reservoir and began obtaining reservoir soundings. Sounding of the inundated portion of this reservoir, which includes 47 sediment ranges and 150 miles of random soundings between the sediment ranges, was completed by this party on October 16, 1950.

Because of the work load in the Casper Office and the limited number of personnel to accomplish it, and since the depletion of Seminoe Reservoir because of sediment deposition appeared small based on the soundings made, the completion of Seminoe Reservoir was deferred.

The work deferred consists principally of topographic mapping of the upper 17 feet of reservoir elevation, which would entail levels to the sedimentation range ends, profiles of the portion of ranges above the reservoir stage when the soundings were made (August 17 to October 16, 1950), and the mapping of the shore line of the lake.

Since the soundings for Seminole Reservoir did not extend above elevation 6340 feet, changes in area and capacity of Seminole Reservoir are based on data below this elevation rather than below elevation 6357, the top of the spillway gates. For statistical purposes in computing the average amount of sediment contributed by the drainage area above Seminole Reservoir and deposited below elevation 6340 feet, the averaged date of the resurvey of Seminole Reservoir is September 16, 1950, the mean date for the soundings.

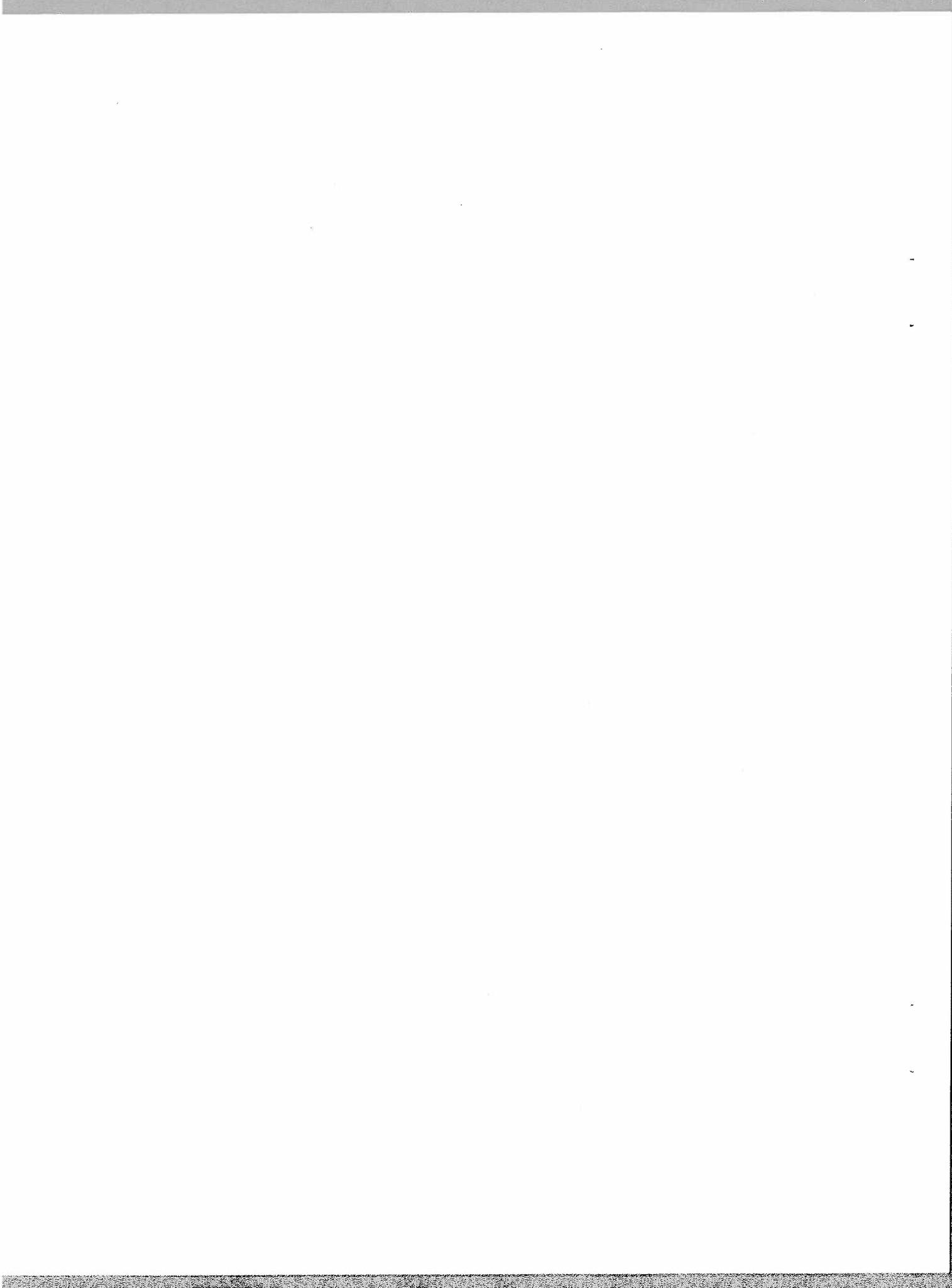
SEDIMENT DISTRIBUTION, PATHFINDER RESERVOIR

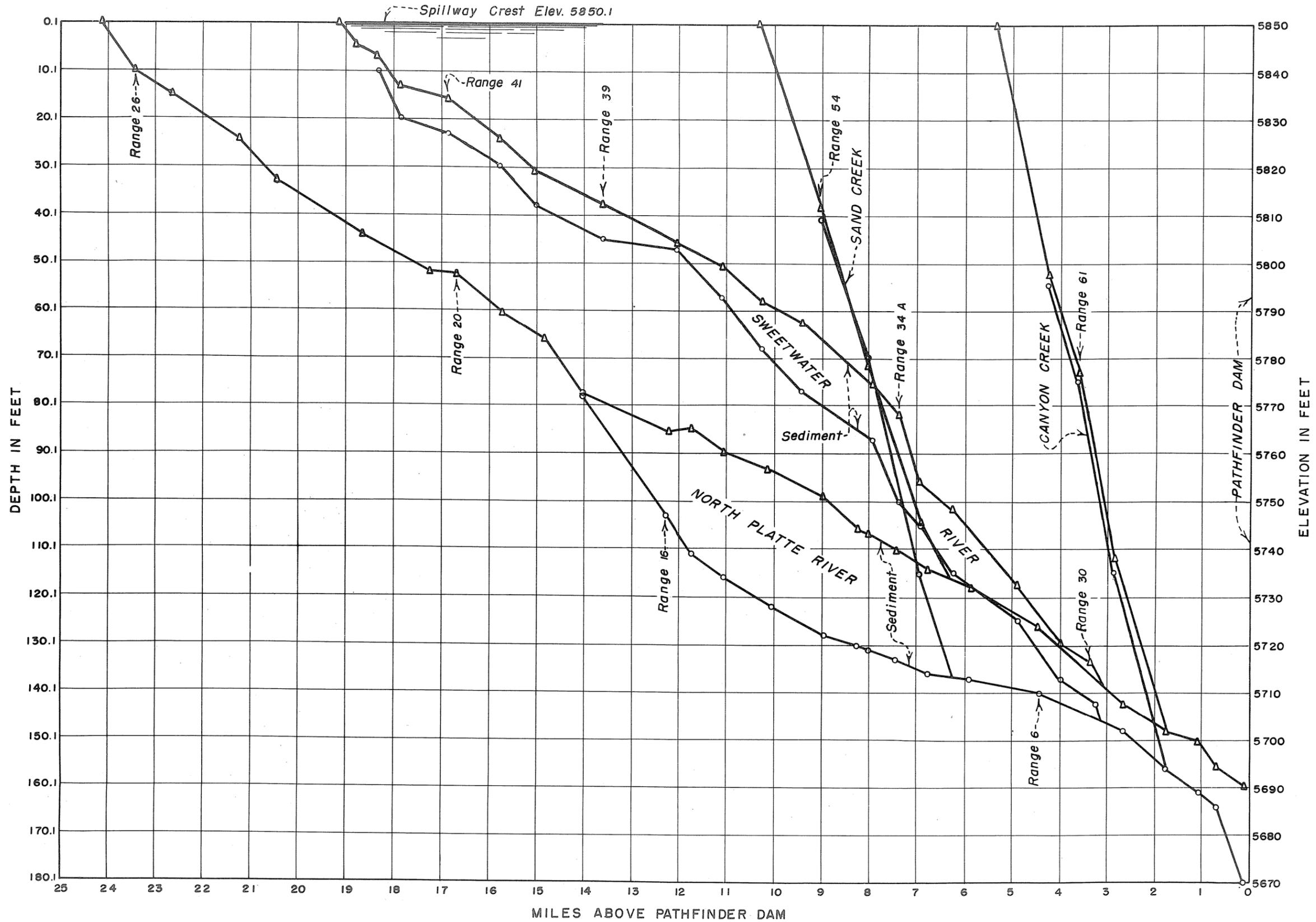
Longitudinal distribution. The variation of the thickness of the sediment in Pathfinder Reservoir is presented graphically by Figure 6, page 29, which shows the original and the 1950 longitudinal profiles of the thalweg of the main arm and principal tributaries of the lake. The original profile does not extend to crest elevation on this graph as in several instances the contour closures on the stream bed were not shown on the original map. Such contours were broken at the edge of the stream banks. The depth of sediment near the dam is approximately 20 feet and on the North Platte River arm nine miles upstream from the dam the maximum depth of sediment is almost 30 feet. The maximum depth of sediment on the Sweetwater River arm is approximately 15 feet, at a distance of 9-1/2 miles upstream from the dam.

Lateral distribution. The lateral distribution of the sediment in Pathfinder Reservoir is depicted by Figure 7, page 30. Cross sections of the North Platte River arm 4.3 and 10.7 miles upstream from the dam and a cross section of the Sweetwater River arm 7.2 miles upstream from the dam are shown. The original and the 1931 profiles were drawn by the Corps of Engineers during their 1931 "Silt Investigation" of Pathfinder Reservoir. Data for constructing the 1950 profiles were obtained from the contour map based on our 1950 survey of the reservoir. It is apparent that some of the variations between the original, the 1931, and the 1950 profiles are caused by the errors derived from the determination of the exact location of the cross sections on the different maps. The locations of these cross sections are the sites of the 1931 sediment ranges. These ranges were not permanently marked in the field and were of a reconnaissance nature so the mapping accuracy would also account for some of the variation of the profiles for the three surveys. However, the general lateral sediment distribution can be observed by studying these cross sections. The sediment deposits appear to be confined principally to the channel portion of the reservoir. Inadequate data were available from the original and the 1931 surveys to determine the quantity of delta deposits. Field observation did not reveal delta deposits of any consequence.

Sediment disposition curve. A sediment disposition curve for Pathfinder Reservoir is presented by Figure 8, page 31. The standard design curve (4), Type II curve, and Type III are also shown for comparison. The sediment disposition curve for Pathfinder Reservoir indicates scour in the top 10 percent of reservoir depth. It is believed that the irregularities in the Pathfinder Reservoir disposition curve are caused by discrepancies in the original map. Even more irregularities were noted when a disposition curve was plotted from data obtained during the 1931 reconnaissance resurvey.

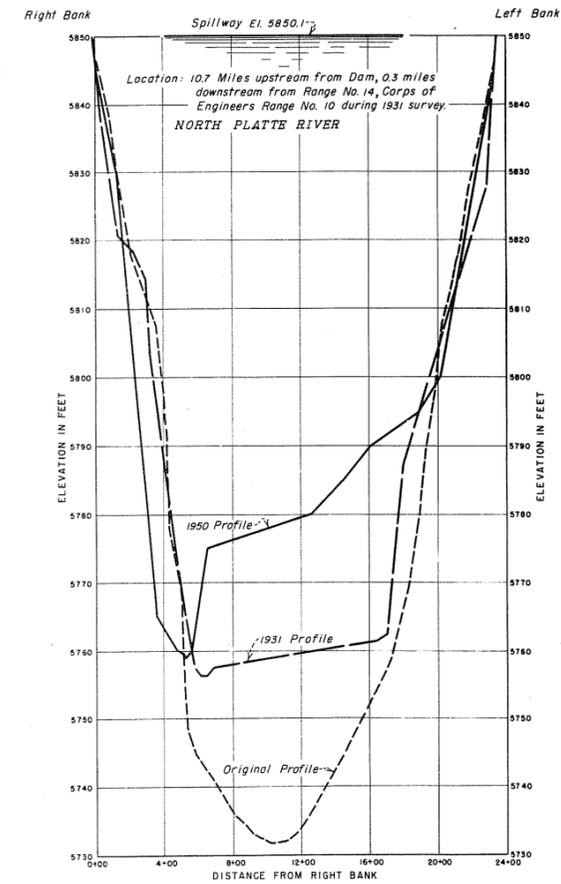
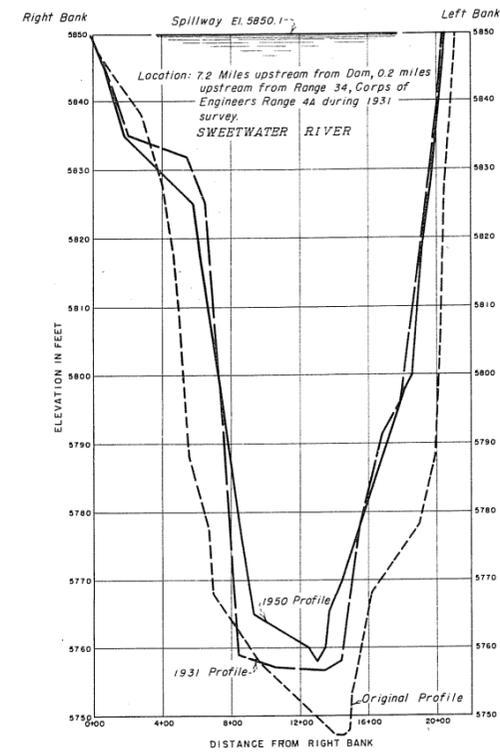
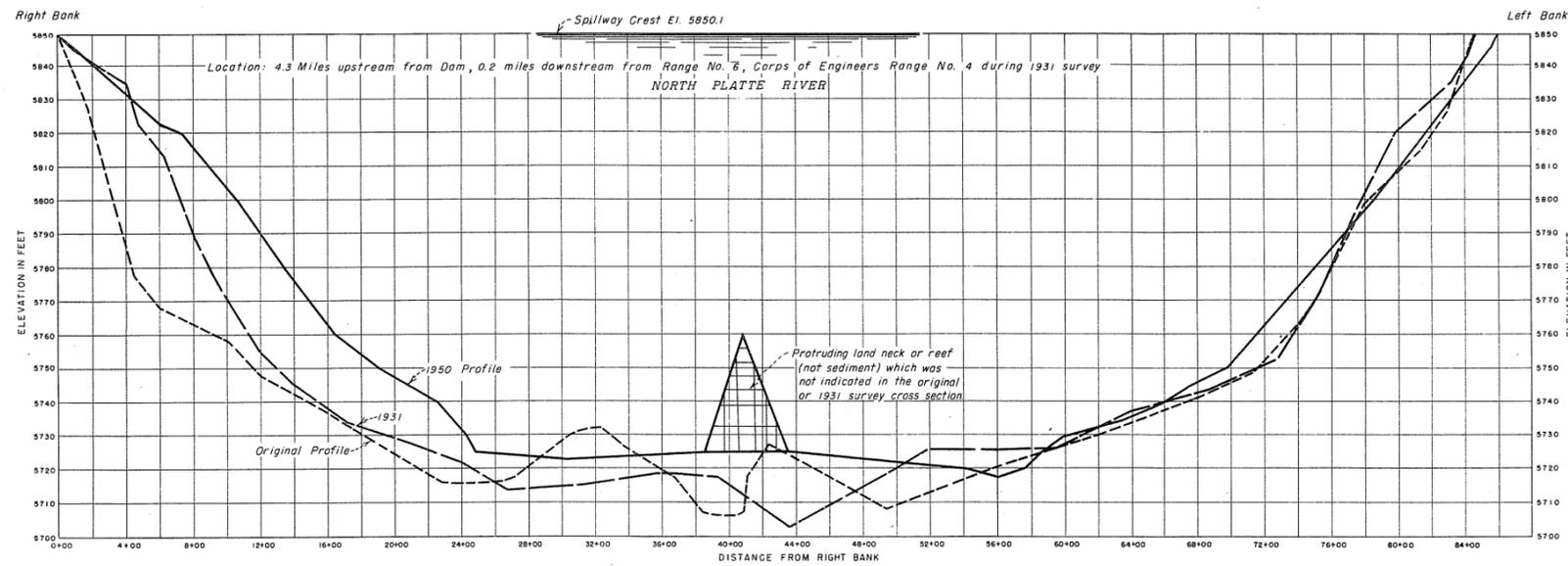
Volume weight and mechanical analysis. During the 1931 "Silt Investigation of Pathfinder Reservoir" three to five samples of the sediment deposited in the reservoir were obtained along 10 sediment ranges in the North Platte River arm and along 5 sediment ranges in the Sweetwater River arm. A mechanical analysis was made of each sample obtained. In this report the samples for each sediment range have been composited. The results are shown on Table 1, page 32. An analysis of the observed densities is also illustrated by a graph, see Figure 9, page 33.





EXPLANATION
 ▲— 1950 Thalweg profile
 ○— Original thalweg profile

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PATHFINDER RESERVOIR
LONGITUDINAL PROFILES
 DRAWN *F. K. I.* SUBMITTED *Louis M. Berry*
 TRACED *N. R. W.* RECOMMENDED *W. H. M. B. J.*
 CHECKED *L. M. S.* APPROVED *H. J. Riebel*

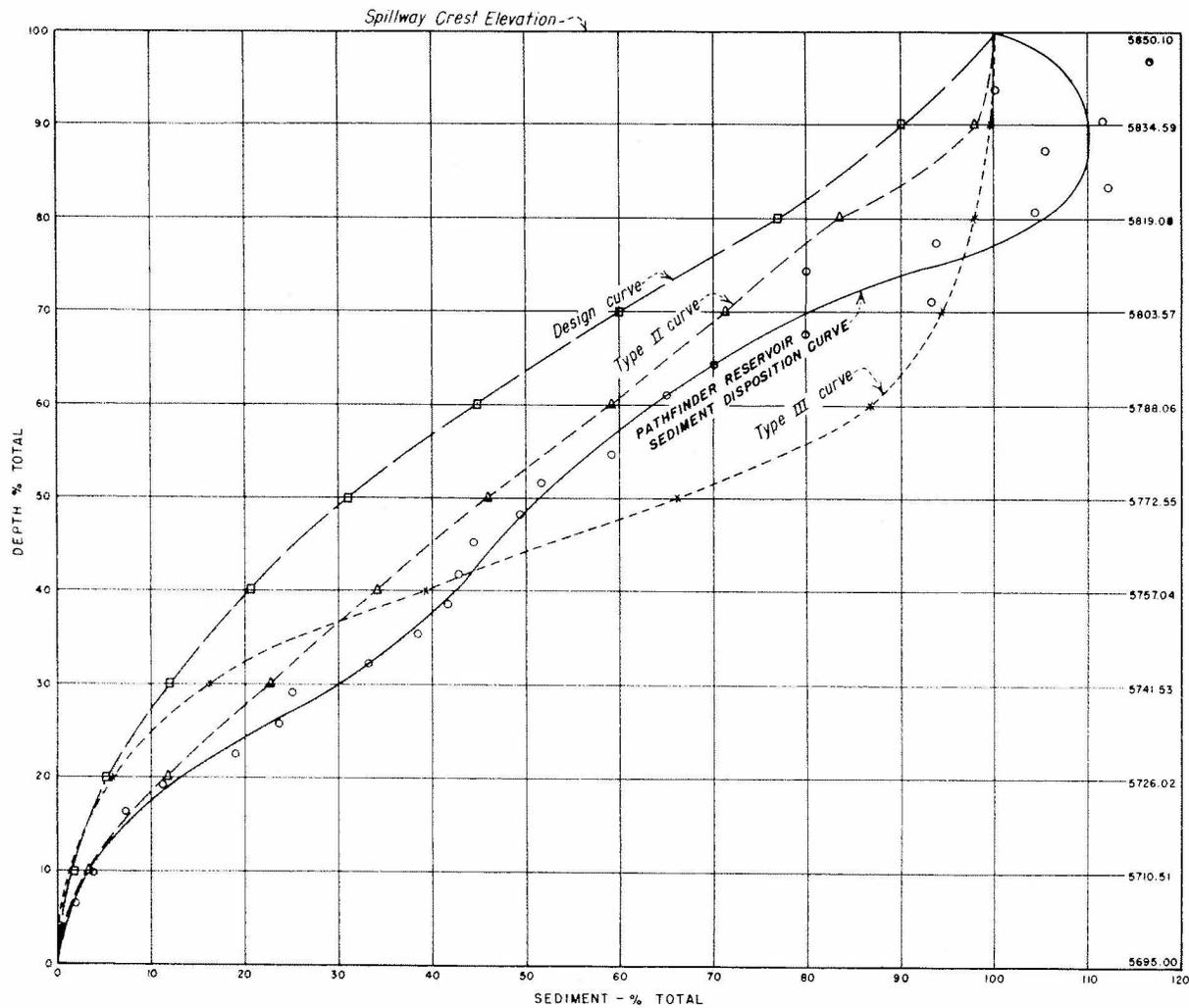


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**PATHFINDER RESERVOIR
 CROSS SECTIONS**

DRAWN: P.R.C. SUBMITTED: [Signature]
 CHECKED: L.P.S. RECOMMENDED: [Signature]
 APPROVED: [Signature]

DENVER, COLORADO, FEBRUARY 6, 1953

FIGURE 7, PAGE 30



- EXPLANATION**
- Pathfinder reservoir curve
 - Design curve *
 - △ Type II curve
 - × Type III curve

NOTES

* The design curve, type II curve and type III curve are shown in "A progress report on the disposition of sediment in the reservoir" by Arthur W Van't Hul, U.S.D.I., Bureau of Reclamation, Project Planning Division, Hydrology Branch, Sedimentation Section, Jan 1950. Elevations refer to Pathfinder Reservoir.

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SEDIMENTATION SECTION

**SEDIMENT DISPOSITION CURVES
PATHFINDER RESERVOIR
AND OTHER TYPES**

DRAWN . . . F.K.J. . . . SUBMITTED BY *John M. Bostrom*

TRACED . . . A.L.M. . . . RECOMMENDED BY *John M. Bostrom*

CHECKED . . . L.M.S. . . . APPROVED *L.M.S.*

DENVER, COLORADO FEB 12, 1953

FIGURE 8, PAGE 31

Table 1

MECHANICAL ANALYSIS OF PATHFINDER RESERVOIR BED SEDIMENT
(Samples Obtained by Corps of Engineers, Department of the Army, 1931)

Composite Sample No and Location	Percent smaller than 1/64 mm	Mean size mm	Percent clay	Percent silt		Percent sand					Percent gravel	
				VF&F	M&C	Very fine	Fine	Medium	Coarse	Very coarse	Granule	Pebble
North Platte River												
1 (R-1)	17.2	0.0911	11.9	05.3	15.2	35.4	15.6	04.3	02.2	02.7	02.4	05.0
2 (R-3)	48.8	.0225	39.0	09.9	04.3	18.7	10.1	10.3	06.1	01.6	00.0	00.0
3 (R-5)	51.6	.0907	39.4	12.3	04.2	09.5	06.5	06.0	21.8	00.3	00.0	00.0
4 (R-7)	26.6	.1301	19.3	07.3	06.8	12.3	23.9	17.0	13.3	00.1	00.0	00.0
5 (R-13)	89.4	.00369	53.7	35.6	02.9	02.3	03.7	01.7	00.1	00.0	00.0	00.0
6 (R-19)	09.7	.0867	05.4	04.4	16.5	34.1	34.9	03.8	00.8	00.1	00.0	00.0
7 (R-21)	33.9	.1481	17.6	16.3	07.1	07.8	19.3	26.9	04.9	00.1	00.0	00.0
8 (R-23)	00.8	.2888	00.3	00.5	02.1	06.7	29.5	49.2	04.3	01.0	01.2	05.2
9 (R-15)	79.5	.00417	48.8	30.7	09.9	07.7	02.6	00.3	00.0	00.0	00.0	00.0
10 (R-17) Sweetwater River	59.8	.01104	33.6	26.2	18.8	17.0	03.7	00.7	00.0	00.0	00.0	00.0
11 (1A)	79.5	.0022	67.8	11.7	02.1	06.4	04.4	04.4	02.1	01.1	00.0	00.0
12 (4A)	68.6	.0051	44.5	24.1	12.3	16.5	01.6	00.6	00.3	00.1	00.0	00.0
13 (8A)	00.6	.1524	00.2	00.4	07.4	28.6	55.9	06.6	00.6	00.2	00.1	00.0
14 (12A)	01.0	.1369	00.5	00.5	12.6	33.3	47.5	04.0	01.1	00.4	00.1	00.0
15 (16A)	00.2	.8557	00.1	00.1	00.2	00.3	05.3	24.4	33.3	21.7	11.6	03.0

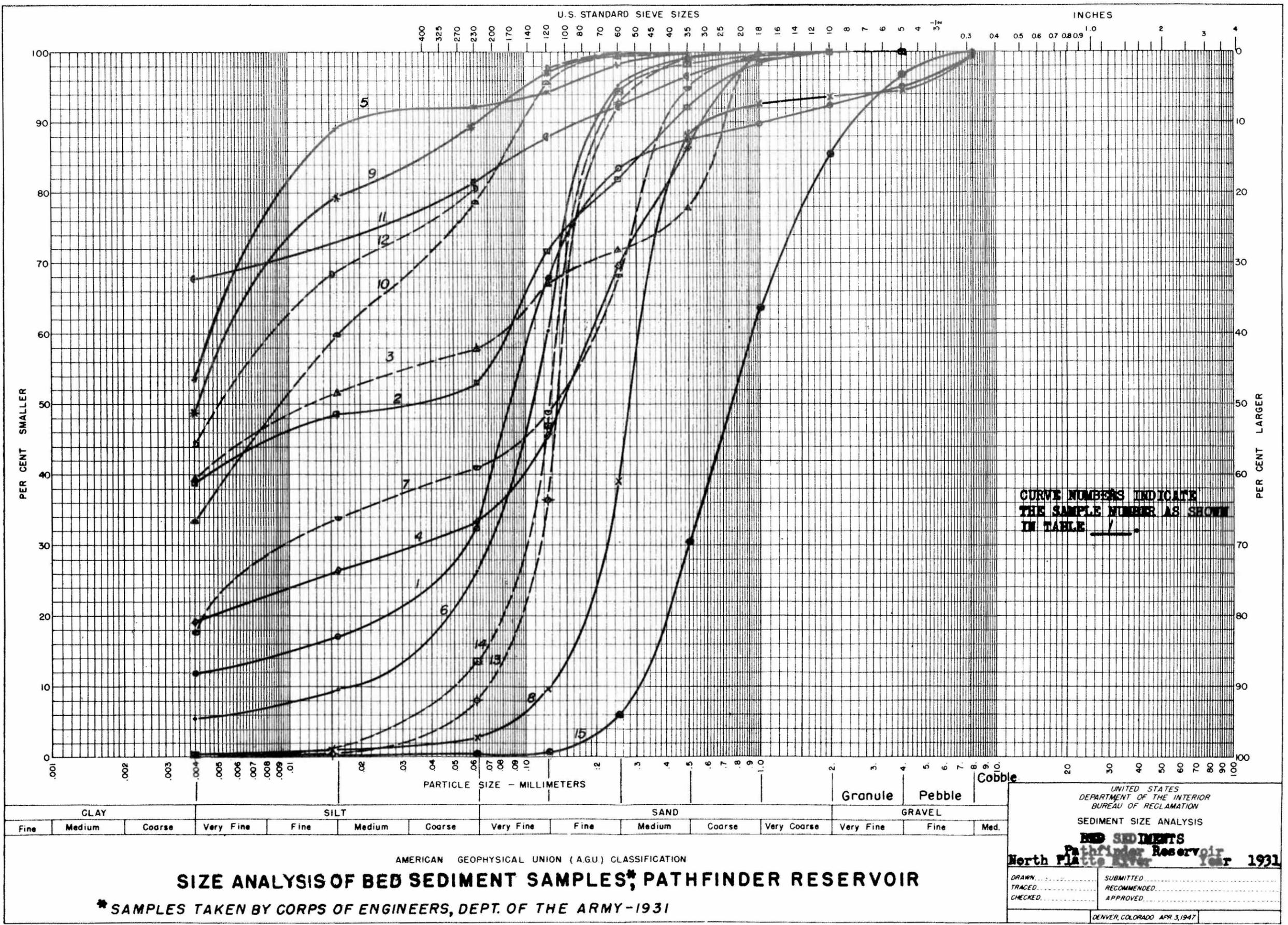


FIGURE 9, PAGE 33

In order to convert the quantity of sediment deposited in Pathfinder Reservoir into volume weight, pounds per cubic foot, the method presented by Lane and Koelzer (5) was used. The first step was the division of the sediment into three fractions, clay, silt, and sand. The small percent of gravel found in a few of the samples was added to the sand fraction. For the 15 composite samples the following percentages were obtained:

Size	North Platte River Arm (10 samples)	Sweetwater River Arm (5 samples)	Mean for Pathfinder Res. (15 samples)
Clay	26.9	22.6	25.5
Silt	23.6	14.3	20.5
Sand	49.5	63.1	54.0

The second step was the selection of the weight for each fraction which is given after one year of consolidation and which varies for reservoirs of different operation conditions.

The third step was the selection of constants, K, to be used in computing the consolidation of each fraction of the sediment over a period of years. These constants are also based on the size of the sediment particles and on reservoir operating conditions.

The density values selected were those given for a reservoir normally having a moderate drawdown. The weights, W₁, in pounds per cubic foot after one year of deposition under this condition are 46, 74, and 93 for clay, silt, and sand, respectively. The consolidation factors, K, for each fraction of the sediment for the operation condition selected were 10.7, 2.7, and 0 for clay, silt, and sand, respectively. The formula used to determine the average weight of the sediment after a period of time was $W = W_1 + 0.4343 K \left[\frac{T}{T-1} (\log_e T) - 1 \right]$ where W = average unit weight of the sediment after T years of deposition. This is a slight modification of the Lane and Koelzer formula that was made by Miller and Moody. (6) The results obtained by use of the modified formula agree closely with the results obtained by use of the original formula which is $W = W_1 + K \log_{10} T$. The degree of accuracy of the modified formula has been checked by comparing computed volume weight of reservoir sediment deposits with the volume weight obtained by laboratory analysis of undisturbed reservoir sediment samples. For sediment where the clay fraction does not exceed 25 percent of the total sample, the variation between the results of the laboratory analysis and the formula is usually within 5 percent.

The volume weight of the sediment for the North Platte River arm, the Sweetwater River arm, and the average volume weight of the sediment for Pathfinder Reservoir by use of the modified formula are given below:

North Platte River Arm

$$\begin{aligned} \text{(Weight after one year) } W_1 &= (46 \times 0.269) + (74 \times 0.236) + (93 \times 0.495) = \\ &75.84 \text{ lbs/ft}^3 \end{aligned}$$

$$\text{(Consolidation factor) } K = (10.7 \times 0.269) + (2.7 \times 0.236) + (0 \times 0.495) = 3.52$$

Then the average weight in 1931 or after 22 years,

$$W = 75.84 + 0.4343 (3.52) \left[\frac{22}{21} (\log_e 22) - 1 \right] = 79.27 \text{ lbs/ft}^3$$

and the average weight in 1950 or after 41 years,

$$W = 75.84 + 0.4343 (3.52) \left[\frac{41}{40} (\log_e 41) - 1 \right] = 80.12 \text{ lbs/ft}^3$$

Sweetwater River Arm

$$\begin{aligned} \text{(Weight after one year) } W_1 &= (46 \times 0.226) + (74 \times 0.143) + (93 \times 0.631) = \\ &79.66 \text{ lbs/ft}^3 \end{aligned}$$

$$\text{(Consolidation factor) } K = (10.7 \times 0.226) + (2.7 \times 0.143) + (0 \times 0.631) = 2.81$$

Then the average weight in 1931,

$$W = 79.66 + 0.4343 (2.81) \left[\frac{22}{21} (\log_e 22) - 1 \right] = 82.39 \text{ lbs/ft}^3$$

and the average weight in 1950,

$$W = 79.66 + 0.4343 (2.81) \left[\frac{41}{40} (\log_e 41) - 1 \right] = 83.08 \text{ lbs/ft}^3$$

Pathfinder Reservoir

$$\begin{aligned} \text{(Weight after one year) } W_1 &= (46 \times 0.255) + (74 \times 0.205) + (93 \times 0.540) = \\ &77.12 \text{ lbs/ft}^3 \end{aligned}$$

$$\text{(Consolidation factor) } K = (10.7 \times 0.255) + (2.7 \times 0.205) + (0 \times 0.540) = 3.28$$

Then the average weight in 1931,

$$W = 77.12 + 0.4343 (3.28) \left[\frac{22}{21} (\log_e 22) - 1 \right] = 80.24 \text{ lbs/ft}^3$$

in 1939,

$$W = 77.12 + 0.4343 (3.28) \left[\frac{30}{29} (\log_e 30) - 1 \right] = 80.66 \text{ lbs/ft}^3$$

and the average weight in 1950,

$$W = 77.12 + 0.4343 (3.28) \left[\frac{41}{40} (\log_e 41) - 1 \right] = 81.08 \text{ lbs/ft}^3$$

Summarizing the above information on the mechanical analysis and volume weight of sediment deposits the following is noted:

The average weight of the sediment in Pathfinder Reservoir in 1950 was approximately 81 pounds per cubic foot and it was composed of 54 percent sand. The average density of the sediment increased about 4 pounds per cubic foot in 41 years.

Explanation of Results in Statistical Summary for Pathfinder Reservoir

Although an accurate detail survey was made of Pathfinder Reservoir in 1950 it has been a difficult task to determine closely the amount and disposition of the sediment deposits in the reservoir. The reason these difficulties were experienced was because of the low degree of accuracy used in making the original map which should be designated as a preliminary survey and because the 1931 survey was of a reconnaissance nature.

The capacity of Pathfinder Reservoir derived from the original map, made in 1903 or six years before storage began, is 1,070,000 acre-feet. A direct comparison between the original map and the map based on the 1950 survey indicates that the capacity of 1,070,000 acre-feet based on the original map is too large and consequently that the resultant sediment volume, 54,000 acre-feet, is also too great. The figures shown on the preceding page, in Table 2, Statistical Summary--Pathfinder Reservoir, are believed to be a closer approximation of the original reservoir capacity and sediment deposition.

These data were obtained as follows:

(a) The map based on the 1950 survey was selected as a base map and the cross sections of the 40 sediment ranges surveyed by the Corps of Engineers in 1931 was compared with equivalent cross sections derived from the original and the 1950 maps.

(b) The original capacity of the reservoir, the capacity of the reservoir in 1931, and the capacity of the reservoir in 1950 were computed by the range method⁽⁷⁾ and by use of the cross sections for the appropriate years.

(c) Since these cross sections were not ideally located to compute the volume by the range method, the results were adjusted by a factor chosen to make the volume computed by the range method, using the 1950 cross sections, agree with the volume computed by the contour method from the 1950 map.

The adjusted reservoir capacities are 1,056,300 acre-feet for 1909; 1,028,700 acre-feet for 1931; and 1,015,900 acre-feet for 1950. Based on these capacities the sediment deposition from 1909 to 1931 is 27,600 acre-feet and the sediment deposition from 1931 to 1950 is 12,800 acre-feet. The total sediment deposition from 1909 to 1950 is 40,400 acre-feet, rather than 54,000 acre-feet which was determined by the use of the original map with no adjustment.

The annual amount of sediment deposition for the period 1909-1931 is approximately 1,250 acre-feet. By extending this annual rate of sediment deposition until 1939, when storage began at Seminole Reservoir upstream from Pathfinder Reservoir, the amount of sediment deposition in Pathfinder Reservoir by 1939 was 37,500 acre-feet or the capacity of Pathfinder Reservoir in 1939 was 1,018,000 acre-feet.

During the period 1939-1950, with Seminoe Reservoir in operation, the annual amount of sediment deposition in Pathfinder Reservoir was $\frac{1,018,800 - 1,015,900}{11} = 263.6$ acre-feet.

The estimated quantity of sediment deposited in Pathfinder Reservoir, based upon the 1931 reconnaissance survey by the Corps of Engineers, was 52,000 acre-feet, or approximately 2,360 acre-feet annually. An analysis of the 1950 survey data indicates that these figures are too large.

Summary for Pathfinder Reservoir

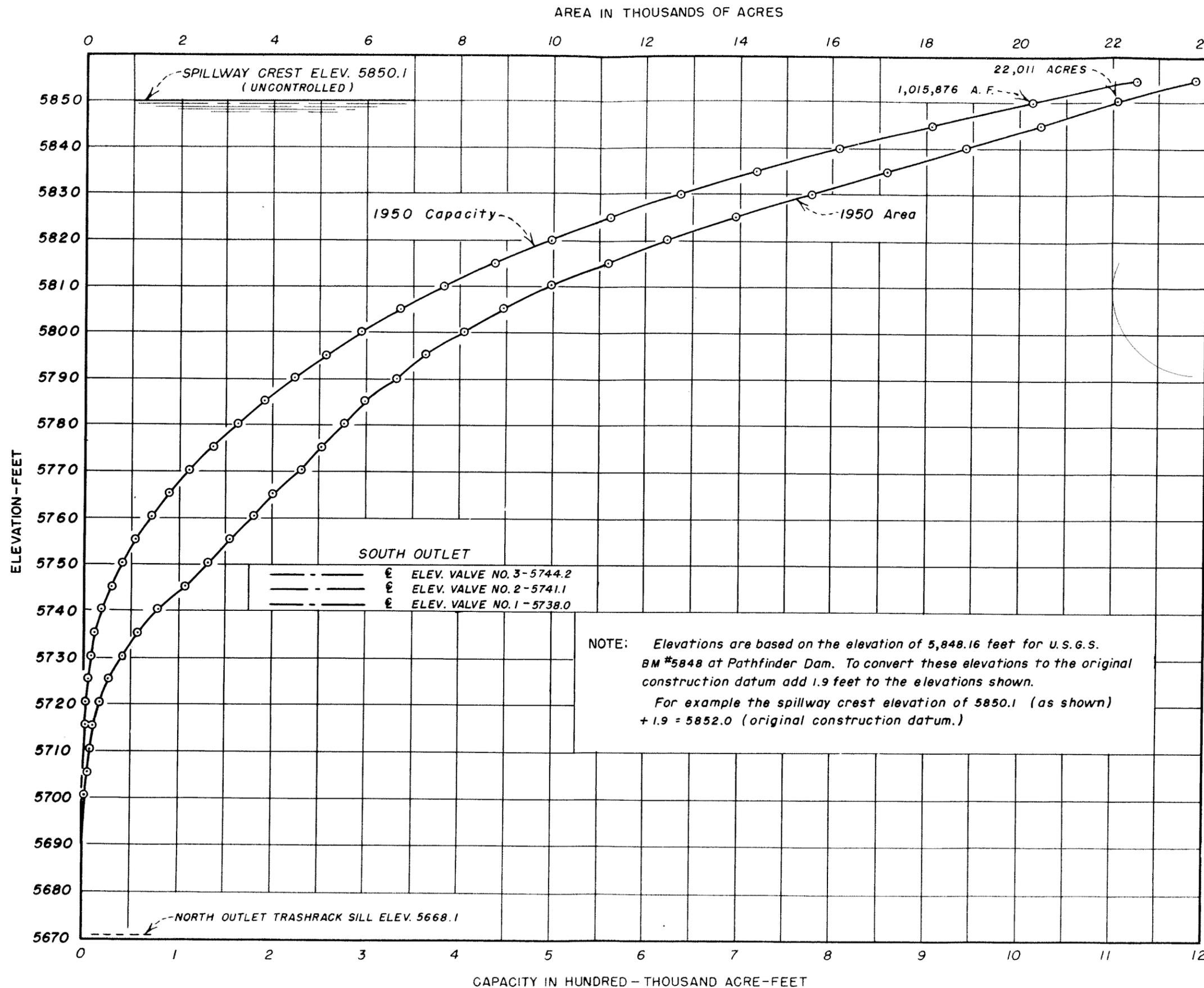
Information obtained during this investigation and the reappraisal of prior surveys indicate that the original capacity of Pathfinder Reservoir was 1,056,300 acre-feet, its capacity in 1939 was 1,018,000 acre-feet and its capacity in 1950 was 1,015,900 acre-feet. An area and capacity table and curves based on the 1950 survey is presented by Figure 10, page 40. The sediment yield from the original drainage area was 0.12 acre-feet per square mile annually and the sediment yield from its present drainage area is 0.08 acre-feet per square mile annually.

The loss of the original reservoir capacity to date of present survey, 1950, or in 41.1 years, is 3.82 percent. Based on the rate of sediment deposition in Pathfinder Reservoir since storage began upstream in Seminoe Reservoir, the future storage loss in Pathfinder Reservoir will be only 1 percent in 40 years.

It is believed that an appreciable percentage of the sediment deposited in Pathfinder Reservoir resulted from wind action. The large areas of eolian deposits adjacent to the shore line show evidence of considerable movement, see Figure 11, page 41. Wave action along stretches of the shore has also moved sediment into the reservoir, see Figure 12, page 42. However, the total amount of sediment that has been deposited in Pathfinder Reservoir is small in comparison with the total storage capacity and since the amount of deposition that has occurred since the construction of Seminoe Dam has been greatly reduced, it follows that sediment deposition from wind action in Pathfinder Reservoir is of minor importance.

SEDIMENT DISTRIBUTION, SEMINOE RESERVOIR

Longitudinal distribution. The variation of the thickness of the sediment for a portion of Seminoe Reservoir is presented graphically by Figure 13, page 43. The 1950 longitudinal profile of the thalweg of the North Platte River arm of the reservoir is shown from the dam extending upstream to the closure of the 6340 contour. The 1950 longitudinal profile of the thalweg of the Medicine Bow River arm is shown from its confluence with the North Platte River also extending upstream to the 6340 contour. Insufficient data were presented for the stream beds of the North Platte River and the Medicine Bow River to completely delineate the original thalweg of these two streams. However,



1950 SURVEY		
*Elevation Feet	Area Acres	Storage Acre-feet
5855	23,839	1,128,178
5850.1	22,011	1,015,876
5845	20,431	907,673
5840	18,835	809,534
5835	17,153	719,598
5830	15,528	637,931
5825	13,902	564,396
5820	12,465	498,512
5815	11,180	439,428
5810	9,938	386,664
5805	8,932	339,513
5800	8,108	296,931
5795	7,291	258,453
5790	6,680	223,538
5785	5,988	191,883
5780	5,513	163,138
5775	5,040	136,765
5770	4,632	112,594
5765	4,027	90,966
5760	3,599	71,912
5755	3,097	55,187
5750	2,621	40,909
5745	2,139	29,030
5740	1,573	19,786
5735	1,120	13,085
5730	818	8,261
5725	497	5,008
5720	351	2,899
5715	169	1,626
5710	123	898
5705	79	395
5700	37	111
5695	7	12
5690	0	**
5685		
5680		
5675		
5670		

**Area and capacity at and below this elevation is negligible based on 1950 survey

NOTE: Elevations are based on the elevation of 5,848.16 feet for U.S.G.S. BM #5848 at Pathfinder Dam. To convert these elevations to the original construction datum add 1.9 feet to the elevations shown. For example the spillway crest elevation of 5850.1 (as shown) + 1.9 = 5852.0 (original construction datum.)

SOUTH OUTLET

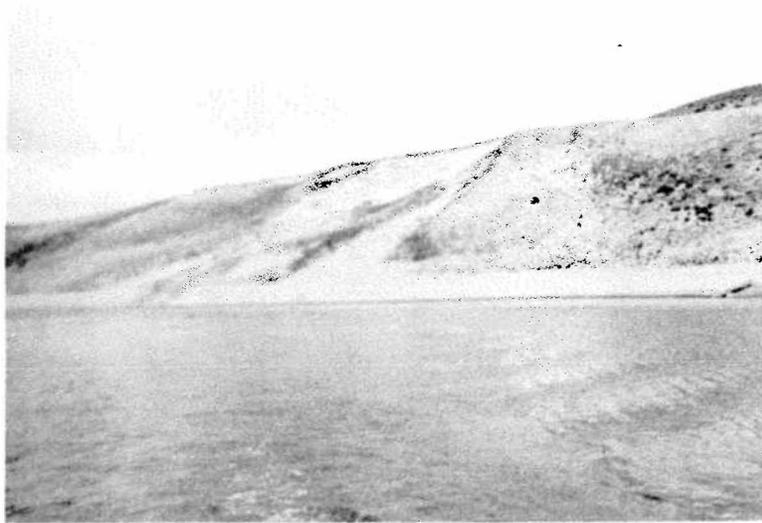
- ELEV. VALVE NO. 3-5744.2
- - - ELEV. VALVE NO. 2-5741.1
- ELEV. VALVE NO. 1-5738.0

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SEDIMENTATION SECTION
AREA AND CAPACITY CURVES
PATHFINDER RESERVOIR
NORTH PLATTE RIVER

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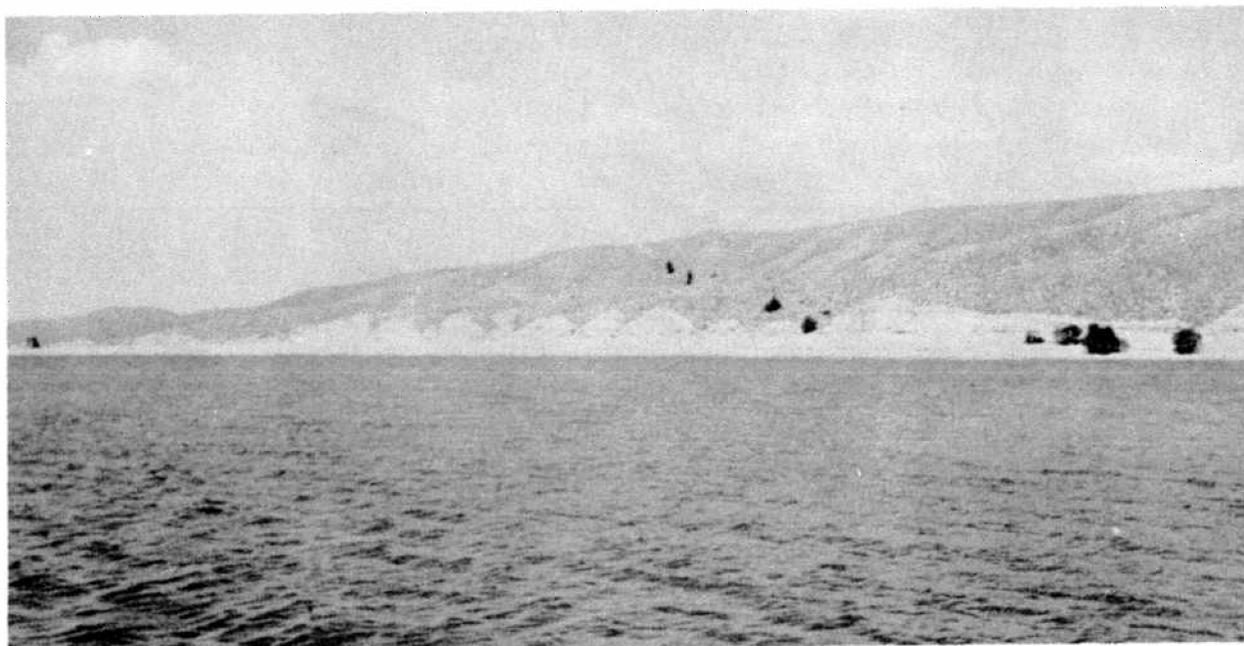
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DENVER, COLO. 4-25-51

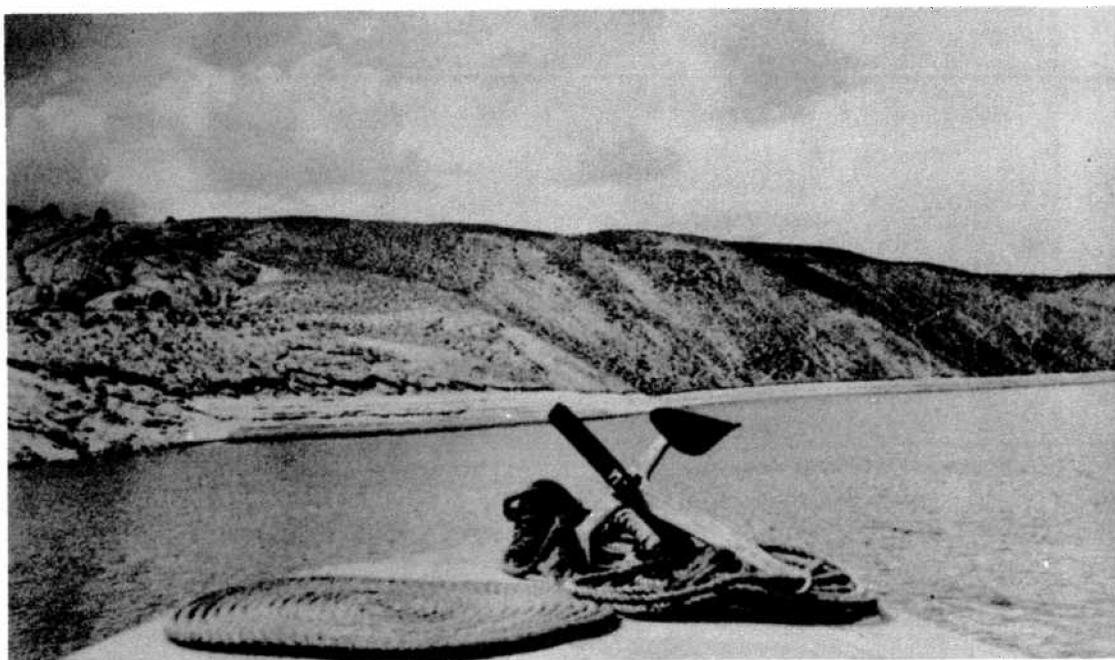


**SAND DUNES
IN NARROWS NORTH PLATTE RIVER ARM
PATHFINDER RESERVOIR**

About 12 miles upstream from Pathfinder Dam.
Sediment is contributed to Reservoir by wind and wave action
upon sand dunes in this vicinity.

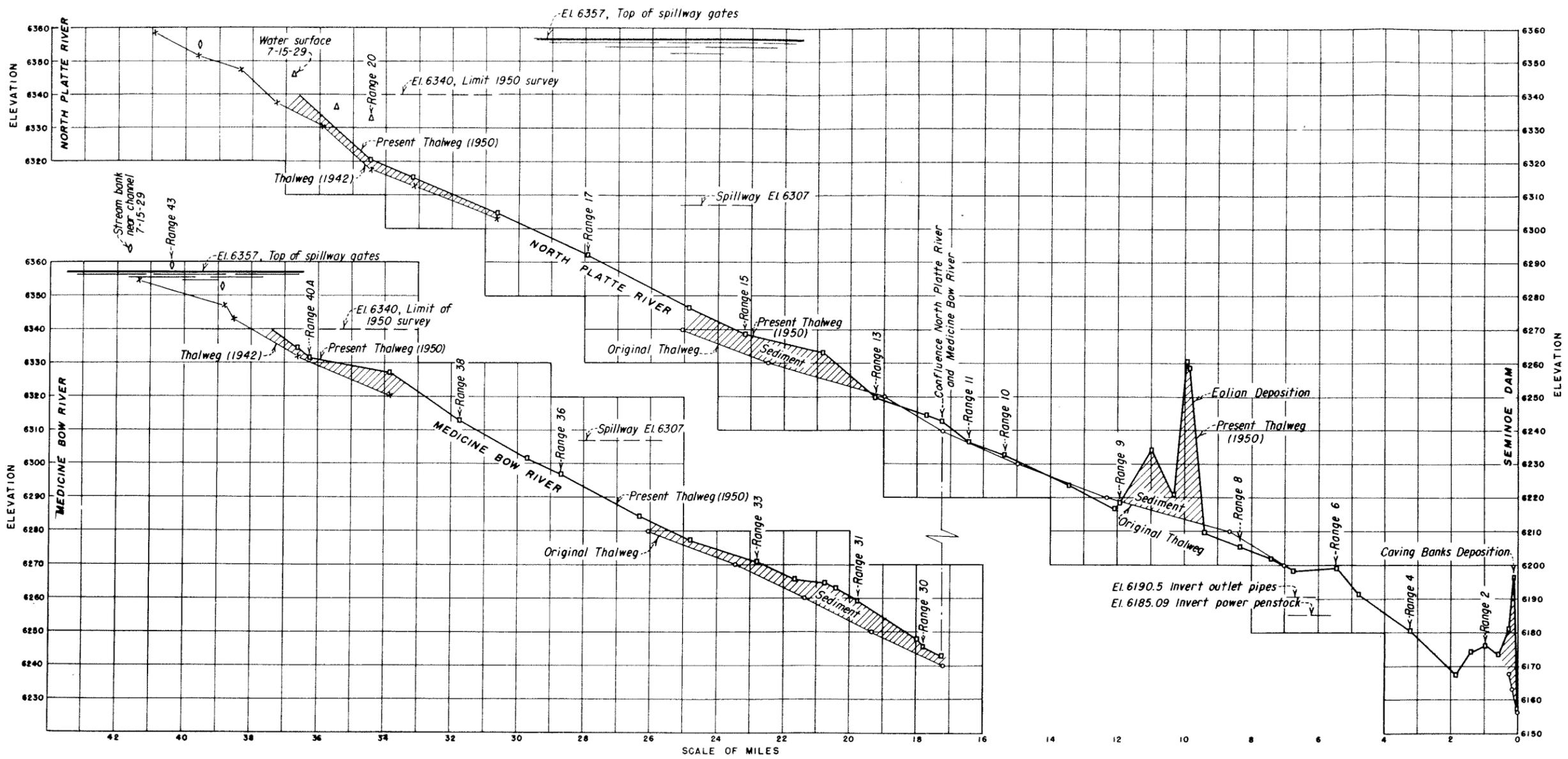


(a) Location is on North Platte River Arm
between Ranges Nos. 11 and 12.



(b) Location is on North Platte River Arm
between Ranges Nos. 17 and 18.

STREAM BANK EROSION
PATHFINDER RESERVOIR



EXPLANATION

- Profile Original Thalweg, based on 1929 survey
- Profile Present Thalweg, based on 1950 survey
- × Profile Thalweg, based on 1942 partial survey
- △ Elevation of water surface, taken from maps based on 1929 survey
- ◇ Elevation of stream bank near channel, taken from maps based on 1929 survey

NOTES

Contour closures in the stream channel were not shown on maps, based on the 1929 survey, above elevation 6270 and 6280 for the North Platte and the Medicine Bow Rivers, respectively. Contour closures on the North Platte River were also omitted for elevations 6170, 6180 and 6190

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SEDIMENTATION SECTION

**LONGITUDINAL PROFILE
NORTH PLATTE AND MEDICINE BOW RIVERS
SEMINOE RESERVOIR**

DRAWN: D.W.H. SUBMITTED: *[Signature]*
 TRACED: W.A.P. RECOMMENDED: *[Signature]*
 CHECKED: L.M.S. APPROVED: *[Signature]*

DENVER, COLORADO JAN. 26, 1953

FIGURE 13, PAGE 43

on the North Platte River arm the depth of the sediment deposits near the dam resulting from bank caving, the depth of eolian deposits between Sediment Ranges Nos. 8 and 9, and the depth of stream-borne deposits between Sediment Ranges Nos. 13 and 16 are shown. The maximum depths of these three types of sediment deposits, measured at the locations described above, were approximately 35, 50, and 8 feet, respectively.

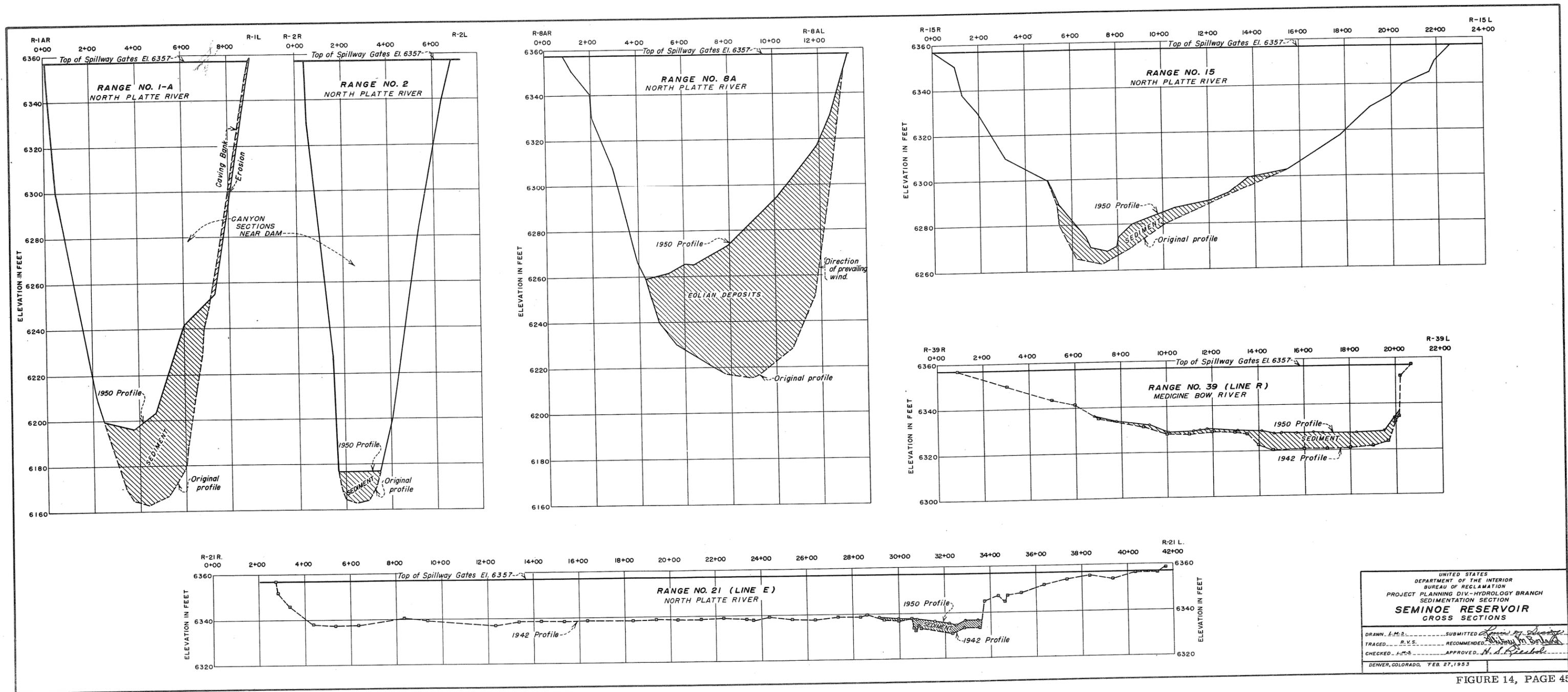
A partial survey of the delta area of Seminole Reservoir was made in 1942 and the longitudinal profiles of the thalweg of both the North Platte River and the Medicine Bow River determined by this survey are also shown on Figure 13. A comparison between the 1950 and the 1942 longitudinal profiles shows several feet of delta deposits in the channel of both streams for this period.

Lateral distribution. The lateral distribution of the sediment in Seminole Reservoir is depicted by Figure 14, page 45. The cross section of Sediment Range No. 1-A shows the sediment deposits resulting from bank erosion. Two views of the shore line in the vicinity of this range where bank slides have occurred are shown on Figure 15, page 46. It will be noted by the crack shown in Figure 15 (a) that an additional amount of bank movement into the reservoir is imminent.

The cross section of Sediment Range No. 8A, Figure 14, illustrates the lateral distribution of eolian deposits between Sediment Ranges Nos. 8 and 9. A distant view of the left bank of the reservoir in the vicinity of Range No. 8A, between Ranges Nos. 8 and 9, is presented by Figure 16 (a), page 47. An idea of the extent of the sand dune in the vicinity of this cross section can be obtained from this figure. The sandy shore line, upstream from Range 8A, and a close-up view of the sand dune shown in Figure No. 16 (a) are depicted by Figure No. 17. Eolian deposits as measured by Sediment Range No. 8A are about 70 feet in depth at Station 10+00. These deposits extend from the left bank out into the lake for a distance of approximately 1,000 feet or to within about 350 feet of the shore line on the right bank of the lakes. The right end of Range 8A in contrast to the left end is on a rocky hog back. It is shown by Figure 18 (a), page 49. On the right bank in this vicinity there are no sand dunes and only wave erosion near the lake surface is noted.

The lateral distribution of sediment in Seminole Reservoir consisting principally of water-borne sediment is also shown on Figure 14 by cross sections of Ranges Nos. 2, 15, 21, and 39. Cross sections of the latter two ranges show sediment deposits in the stream channel for the period 1942 to 1950, for the North Platte River arm and the Medicine Bow River arm, respectively. When cross sections of ranges above elevation 6340 are obtained, additional information pertaining to delta deposits in Seminole Reservoir can be presented.

Sediment disposition curve. A sediment disposition curve for Seminole Reservoir is shown by Figure 19, page 50. Many irregularities in sediment deposition are noted.

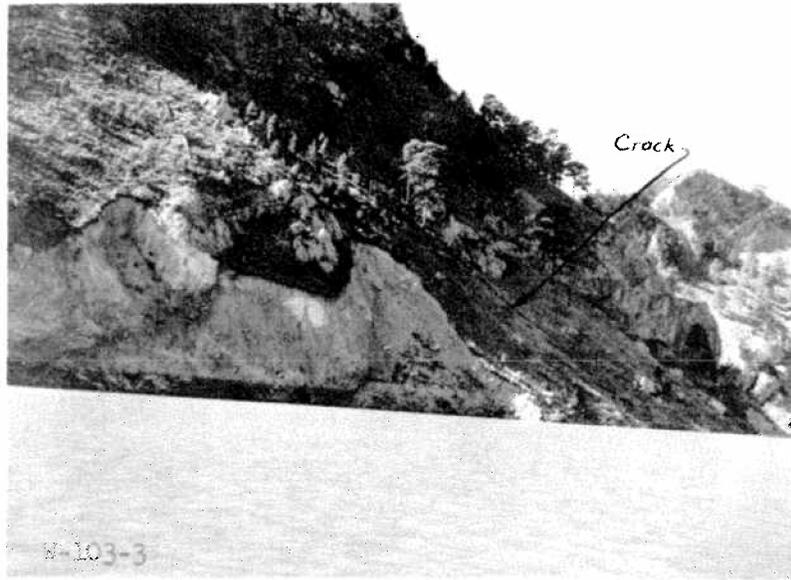


UNITED STATES
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 SEDIMENTATION SECTION
SEMINOE RESERVOIR
 CROSS SECTIONS

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 CHECKED: J.M.S. APPROVED: *[Signature]*

DENVER, COLORADO, FEB. 27, 1953

FIGURE 14, PAGE 45



(a) Scarred bank shows where material has slipped into reservoir. Crack to right of scar shows beginning of new land slide. Location about 200' upstream from Range No. 1.



(b) Land slide left bank of reservoir about 500 feet upstream from Range End R-1-L.

BANK EROSION NEAR SEMINOE DAM



(a) Location - Left side of Reservoir vicinity of Range No. 8-A.



(b) Location is downstream from Range No. 8, adjacent to Road from Sinclair, Wyo. to Seminoe Reservoir.

SAND DUNES SEMINOE RESERVOIR

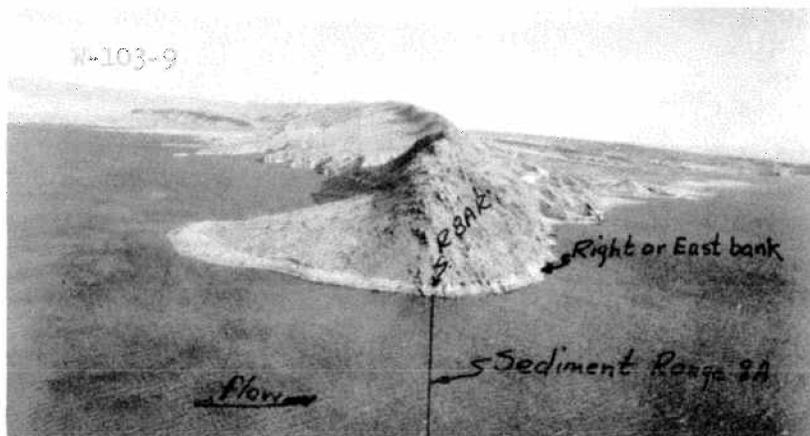


(a) Close-up - Sand Dune shown in Figure 16, Near Range End R-8A L, Seminole Reservoir.



(b) Left shoreline about 1000 feet upstream from Range No. 8 A, Seminole Reservoir

SAND DUNE & SHORELINE
SEMINOLE RESERVOIR



(a) Shoreline opposite Sand Dune, shown by Figure 16A. Note wave erosion and lack of sand.



(b) North Platte River below Dam - View looking downstream. The channel is well armored and confined between narrow Canyon Walls.

SHORELINE SEMINOE RESERVOIR
AND
NORTH PLATTE RIVER DOWNSTREAM
FROM SEMINOE DAM

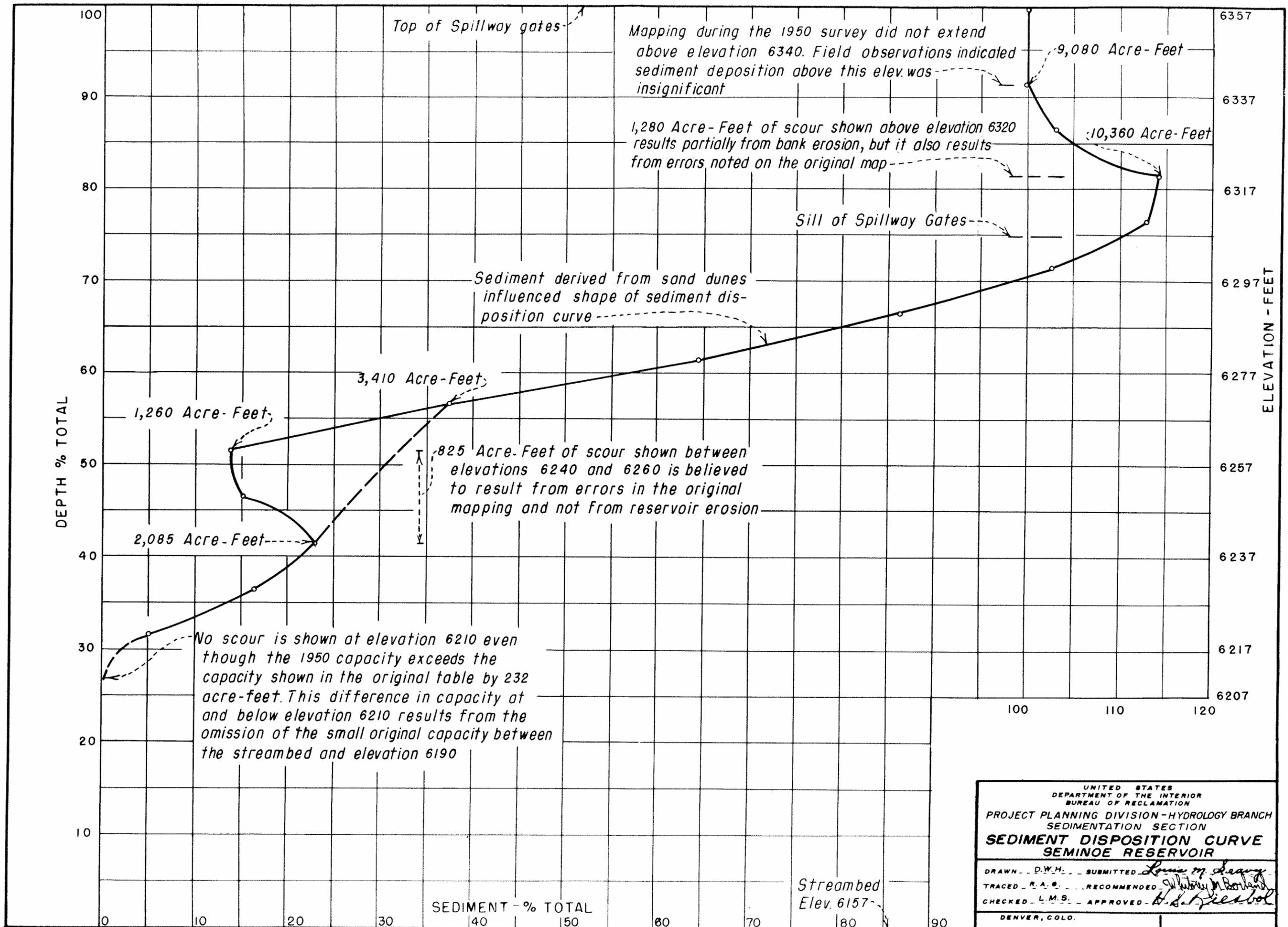


FIGURE 19, PAGE 50

(a) The area and capacity curves and tables, Figure 20, page 52, based on the original and the 1950 survey list 5,600 and 5,830 acre-feet of capacity, respectively, at elevation 6210. A review of the longitudinal profiles and cross sections previously described shows that this indicated scour below elevation 6210 did not occur but results from an error in the original map or failure to map the stream channel.

(b) The 825 acre-feet of scour shown between elevations 6240 and 6260 also results from discrepancies in the original map. A 20-foot vertical section (Figure 14) in the eolian deposition lies in this limit.

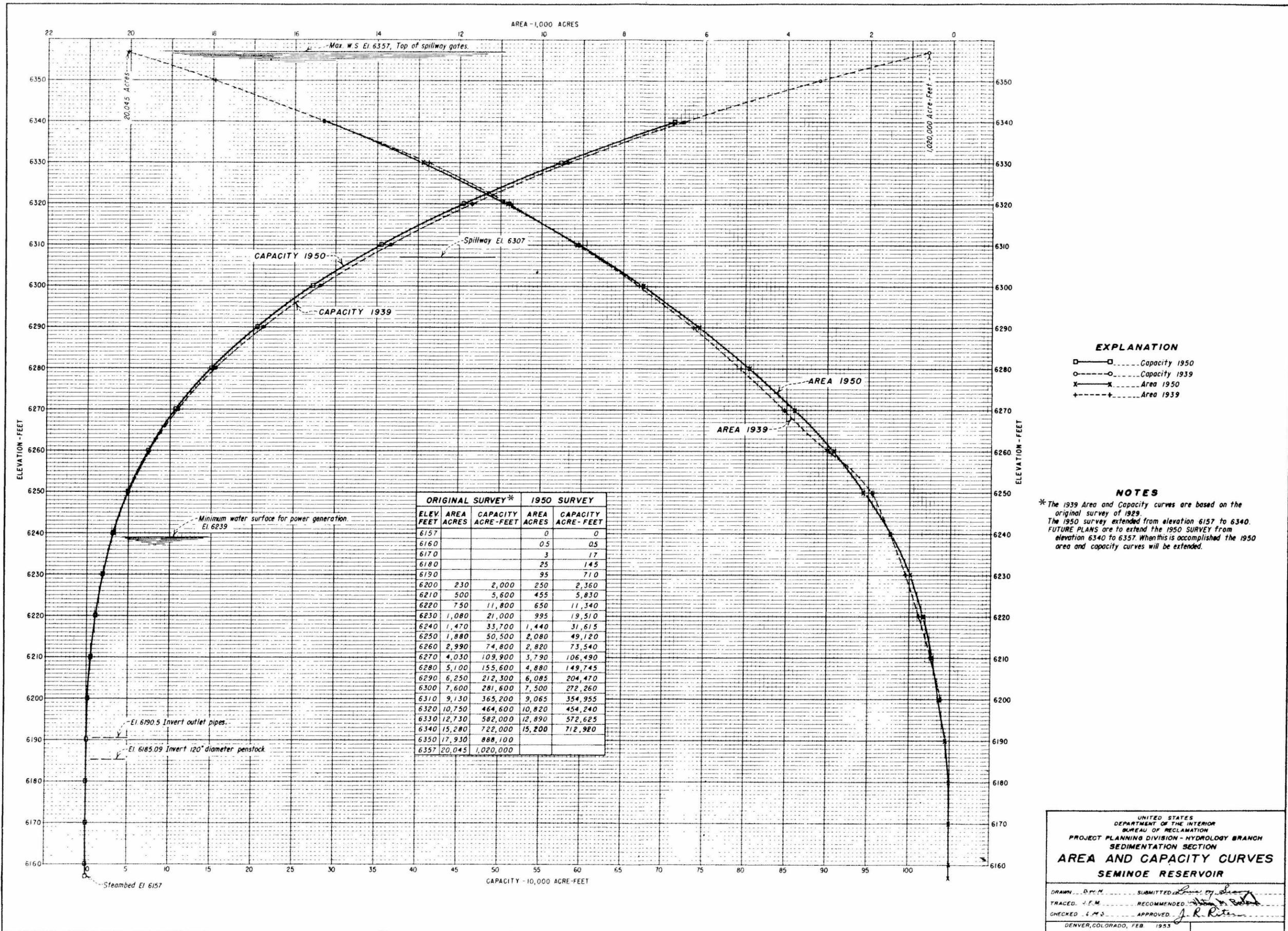
(c) The sediment disposition curve between elevations 6260 and 6310 or between 52 and 77 percent of the depth of the reservoir is fairly uniform. This indicates that there are no serious original mapping errors between these limits or that sufficient uniform sediment deposition has occurred to prevent such errors from being noticeable.

(d) A scour of 1,280 acre-feet is shown between elevations 6320 and 6340. Field observations indicate that wave erosion and bank caving have occurred along the shore line of the lake and that actually some scour has occurred between these limits. It is believed, however, that errors noted in the original map account for the larger portion of this capacity gain which is listed as scour.

A resume of the factors described concerning the sediment disposition curve for Seminole Reservoir indicates that the 9,080 acre-feet of sediment shown is the minimum sediment deposition that occurred. Probably a more realistic figure would be approximately 10,100 acre-feet. This figure would be obtained by adjusting the original map to reflect no scour below 52 percent of the reservoir depth. The operation level of Seminole Reservoir during period 1939-1950 does not indicate that scour below 52 percent of the reservoir depth is reasonable.

Volume weight and mechanical analysis. During the 1950 survey of Seminole Reservoir only three samples of the sediment deposited in the reservoir were obtained. The field locations of the samples were on Sediment Ranges Nos. 36, 37, and 39 of the Medicine Bow River arm. The samples were obtained by use of a small pipe sediment sampler.⁽⁸⁾ The size of each sample obtained was 8 inches in length and 1/2-inch in diameter. The data pertaining to these samples are given in Table No. 3 on the following page.

A graph based on the data from these samples is shown by Figure 21, page 53.



EXPLANATION

□—□ Capacity 1950
 ○—○ Capacity 1939
 ×—× Area 1950
 +—+ Area 1939

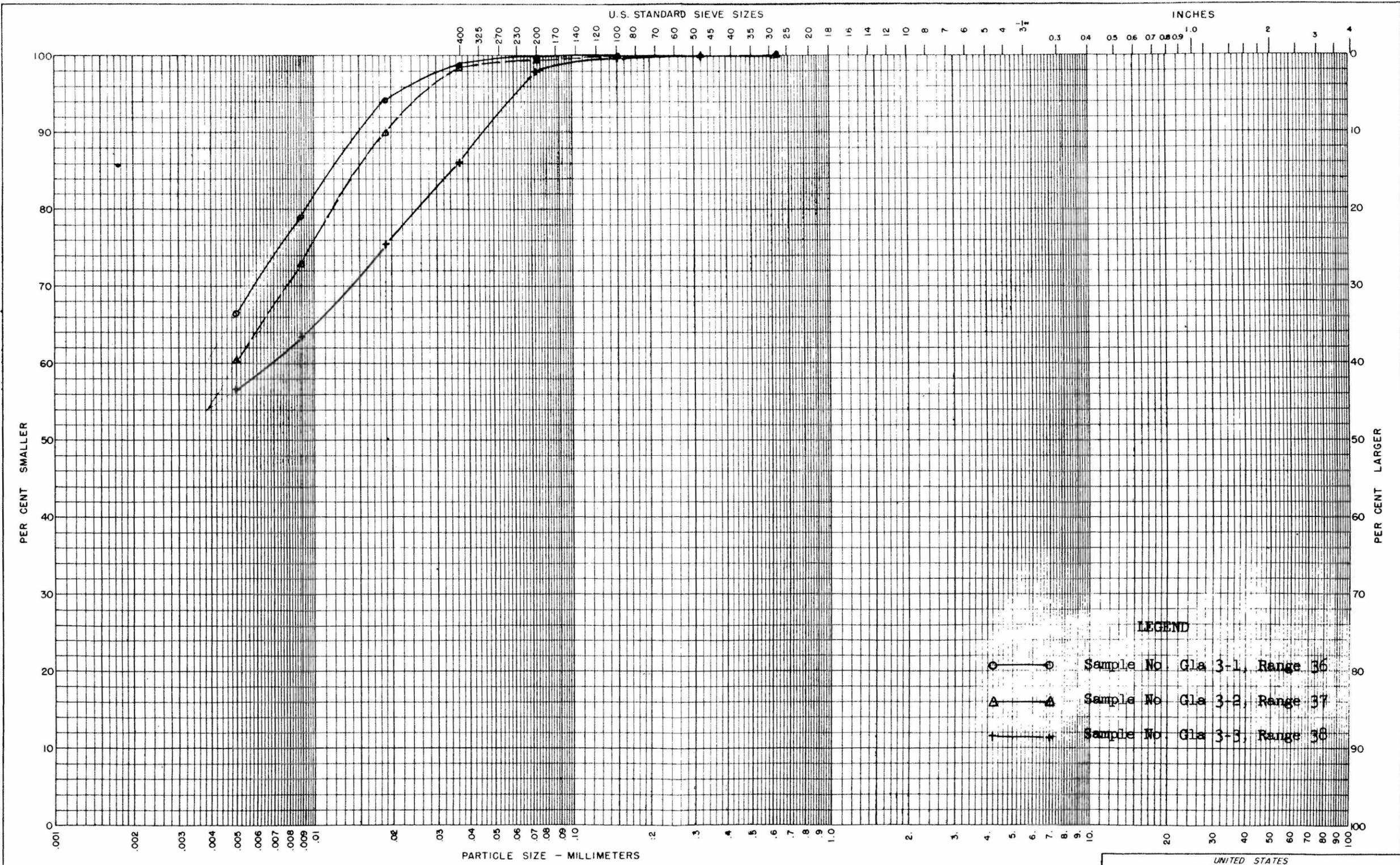
NOTES

*The 1939 Area and Capacity curves are based on the original survey of 1929. The 1950 survey extended from elevation 6157 to 6340. FUTURE PLANS are to extend the 1950 SURVEY from elevation 6340 to 6357. When this is accomplished the 1950 area and capacity curves will be extended.

UNITED STATES
 DEPARTMENT OF THE INTERIOR
 BUREAU OF RECLAMATION
 PROJECT PLANNING DIVISION - HYDROLOGY BRANCH
 SEDIMENTATION SECTION
AREA AND CAPACITY CURVES
SEMINOLE RESERVOIR

DRAWN: D.F.M. SUBMITTED: *[Signature]*
 TRACED: J.F.M. RECOMMENDED: *[Signature]*
 CHECKED: J.M.S. APPROVED: *[Signature]*
 DENVER, COLORADO, FEB. 1953

FIGURE 20, PAGE 52



CLAY			SILT				SAND				GRAVEL			
Fine	Medium	Coarse	Very Fine	Fine	Medium	Coarse	Very Fine	Fine	Medium	Coarse	Very Coarse	Very Fine	Fine	Med.

AMERICAN GEOPHYSICAL UNION (A.G.U.) CLASSIFICATION

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

SEDIMENT SIZE ANALYSIS
BED SEDIMENTS
Seminole Reservoir
Medicine Bow Arm October 1950

DRAWN: J.M.H. SUBMITTED: _____
TRACED: _____ RECOMMENDED: _____
CHECKED: _____ APPROVED: _____

DENVER, COLORADO APR 3, 1947

FIGURE 21, PAGE 53

Table No. 3

SEDIMENT SAMPLE DATA OF SEMINOE RESERVOIR
Medicine Bow River, Wyoming

Sample No	Range No	Date Sampled	Volume weight (lb/cu ft)	Mechanical Analyses								
				Percent of grade sizes mm								
				.295	.147	.074	.037	.019-	.009-	.005-	.0-	
				.589	.295	.147	.074	.037	.019	.009	.005	.0
1	36	Oct 1950	45.6	0.1	0.0	0.2	0.8	4.8	15.1	12.6	66.4	
2	37	Oct 1950	34.8	0.1	0.3	0.2	0.8	8.7	16.9	12.8	60.2	
3	38	Oct 1950	44.8	0.3	0.4	1.4	11.7	10.6	12.0	7.0	56.6	

54

*Average 41.6

*The average percent of clay for the three samples obtained in the Medicine Bow River arm of Seminoe Reservoir is 56.7 percent. The estimated volume weight per cubic foot for the three samples, by use of the modified Lane Koelzer formula and the initial weight for the particle sizes listed by Trask ⁽⁵⁾ clay 13 pounds, silt 76 pounds, and sand 88 pounds, gives an average weight of 45.32.

Since the three samples listed above are not believed to be representative of the average sediment deposits in Seminoe Reservoir, a weight of 65 pounds per cubic foot which is roughly an average between the weight of the samples obtained in Medicine Bow River arm and the weight of the samples obtained in Pathfinder Reservoir, was used to convert the volume of sediment in Seminoe Reservoir from cubic feet to tons.

Table 4

STATISTICAL SUMMARY
SEMINOE RESERVOIR

	Quantity	Unit
Age ^{1/}	11.45	years
Watershed ^{2/}	7,348	sq mi
Reservoir		
Area at top of spillway gates, elev 6357, Original	20,045	acres
Area at elev 6340, Original	15,280	acres
Area at elev 6340, Present	15,200	acres
Original storage capacity, top of spillway gates	1,020,000	ac-ft
Original storage capacity, elev 6340	722,000	ac-ft
Present storage capacity, elev 6340	712,920	ac-ft
Sedimentation^{3/}		
Total sediment	9,080	ac-ft
Accumulation per year average	793	ac-ft
Accumulation per year per 100 sq mi drainage area	10.8	ac-ft
Accumulation per year per acre of drainage area	7.35	cu-ft
Accumulation per year per acre of drainage at 65 pounds per cu ft (estimated)	0.24	tons
Depletion of storage^{4/}		
Loss of original capacity per year	0.08	percent
Loss of original capacity to date of survey	0.89	percent

1/ Based on beginning of storage on April 3, 1939 and the average date of soundings made during this survey, September 16, 1950.

2/ Based on 7,350 square miles listed as the contributing drainage area upstream from the U. S. Geological Survey gaging station 1,000 feet downstream from Kortes Dam. Two square miles deducted for drainage area between Seminoe Dam and gaging station. Does not include non-contributing drainage area outlined on Drainage Map, Figure 2.

3/ Items under "Sedimentation" are based on the sediment measured below elevation 6340 during the 1950 survey.

4/ Items under "Depletion of storage" are based on the original storage capacity at the top of spillway gates. Sediment deposition between the top of the spillway gates and elevation 6340 is believed to be small.

SUMMARY FOR SEMINOE RESERVOIR

The 1950 survey of Seminoe Reservoir extended from the stream bed of the reservoir to elevation 6340 or 17 feet below the top of the spillway gates. A comparison between the original survey and the 1950 survey between these limits indicates a loss of 9,080 acre-feet of storage capacity or a loss of 1.26 percent of the original storage capacity below elevation 6340 in 11.45 years.

Field observations indicate that in general erosion rather than deposition has occurred between elevations 6340, the top limit of the 1950 survey, and elevation 6357, the top of the spillway gates. The net change in the reservoir capacity for this period between these limits is believed to be small. At elevation 6340 the surface area in 1950 is 80 acres less than the area obtained during the original survey. This decrease in area at this elevation results from deposition of material removed from higher elevation by wave action, wind action, and bank caving as well as from stream-transported sediment.

The quantity of eolian deposition in the North Platte River arm of Seminoe Reservoir in the vicinity of Sediment Range No. 8A, about 10 miles upstream from the dam, is approximately 3,100 acre-feet. This is about one-third of the total sediment measured by the 1950 survey. It lies between cross sections selected at a location of 3700 feet upstream and 2900 feet downstream, respectively, from Sediment Range No. 8A and between the contour elevations of 6220 and 6290. It is recommended that the contributing sand dune area at Range 8A be investigated by the Soil and Moisture Branch or appropriate officials of Region 7 relative to evaluating the worth of a treatment program to reduce the future loss of reservoir storage from this sediment source.

A detailed economic study of the monetary loss because of storage depletion resulting from eolian deposits was not made for use in this report. However, for illustrative purposes, if it is assumed that the replacement cost per acre-foot of storage including dam, right-of-way, appropriate power facilities, etc. is \$40 per acre-foot; then the loss in value to the Project represented by the loss of storage capacity in the vicinity of Sediment Range No. 8A in 11.45 years equal $40 \times 3,100 =$ \$124,000, and the annual loss equals \$10,830. If no treatment is given to this sand dune area the potential loss over a period of years is believed to be of sufficient magnitude to warrant further investigations of this area. If a treatment program is recommended and it is successfully executed, consideration should then be given to treatment of the sand dune area shown by Figure 16 (b) to obviate the future necessity of relocating the access road to Seminoe Dam which is threatened by the shifting of this sand dune.

In attempting to evaluate the effect of sediment on Seminoe Reservoir and also Pathfinder Reservoir, a considerable amount of time and expense was involved in making a fair appraisal of the changes which occurred during the periods between the original and present surveys. The present policy of the Bureau of Reclamation and other Federal Agencies is to make an accurate reservoir survey and install permanent

monuments at survey stations, denoting the ends of sediment ranges, prior to the closure of the dam. On reservoirs where this type of survey has been made, the cost and difficulties involved in evaluating the amount and disposition of sediment in the reservoir, the changes in the stream regimen upstream from the reservoir and downstream from the dam, and the preparation of new area and capacity tables are a minimum. In addition, accurate data for use in designing new structures may be obtained.

BIBLIOGRAPHY

- (1) Climatological Data, Wyoming Section, Weather Bureau, United States Department of Commerce.
- (2) Water Supply Papers, Surface Water Supply of the U. S., Part 6, Missouri River Basin, Geological Survey, United States Department of the Interior.
- (3) Soils and Men, Yearbook of Agriculture, 1938, United States Department of Agriculture.
- (4) Van't Hul, Arthur W., A Progress Report on the Disposition of Sediment in Reservoirs, Bureau of Reclamation, January 1950.
- (5) Lane, E. W. and Koelzer, V. A., Density of Sediment Deposited in Reservoirs, Report No. 9, A cooperative study by Federal Agencies, published in November 1943 at St. Paul U. S. Engineer District Sub-Office Hydraulic Laboratory, University of Iowa, Iowa City, Iowa.
- (6) Miller, Carl R., Determination of the Unit Weight of Sediment for use in Sediment Volume Computations, Bureau of Reclamation, February 17, 1953.
- (7) Eakin, H. M., revised by Brown, Carl B., Silting of Reservoirs, Technical Bulletin 524, United States Department of Agriculture, Washington, D. C., United States Government Printing Office, 1939.
- (8) Seavy, Louis M., Sedimentation Survey of Tongue River Reservoir, Bureau of Reclamation, August 1949.

