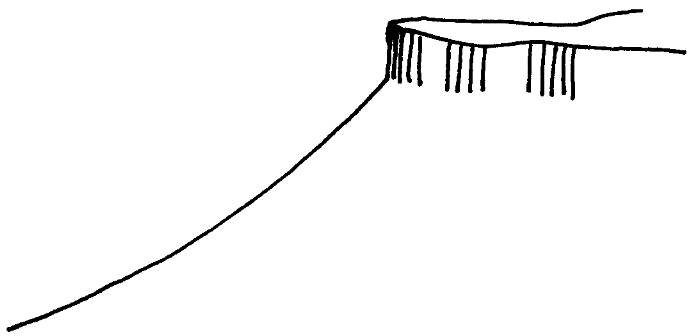

AMERICAN GEOMORPHOLOGICAL

FIELD GROUP

FIELD TRIP GUIDEBOOK

1982 CONFERENCE

PINEDALE, WYOMING

EDITED BY LUNA B. LEOPOLD

GEOLOGIC SETTING

by

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PRE-PLEISTOCENE GEOLOGY

The East Fork rises in the Wind River Mountains, a range extending 190 km in the north-northwestern direction and a width of 58 km. The range rises above an extensive basin the elevation of which is about 2100 m. Gannett Peak, the highest in the range and the highest in Wyoming, is 4207 m.

To the west of the range are nearly horizontal Tertiary sedimentary rocks in the Green River Basin. These are overthrust by Precambrian rocks of the Wind River Mountains along the thrust plane that dips 30^{o} to 35^{o} to the northeast. "The Precambrian core of the uplift consists of magmatites at deeper levels in the center of the range and granitic intrusions and super crustal rocks at higher crustal levels at the southeast end. These rocks constitute some of the oldest Precambrian crust in the United States and are dated at 2.7 b.y. B.P. (Smithson, et al, 1978)."

These investigators (Smithson, et al) ran a traverse of deep seismic-reflection from a position 30 km south of Farson in a northeast direction to a point between Lander and Riverton, a distance of 150 km. The depth to which the reflection data were considered good was 60 km. The sedimentary rocks under the southwest end of the profile range in age from Cambrian through Tertiary. The sedimentary rocks directly under the thrust are deformed by folding and numerous faults. The fault can be traced to a depth of at least 24 km past the deepest possible sedimentary rocks and continues into the Precambrian crystalline rocks of the crust.

GLACIAL SEQUENCE

More important to the present investigation are the results of massive glaciation in the Pleistocene studied first by Blackwelder (1915), later in the southwestern portion of the range by Holmes and Moss (1955), and in the Pinedale area by Richmond (1973). At least four principal glacial periods are identified. The earliest well-preserved combination of fill and outwash terrace, called the Buffalo by Holmes and Moss, presumably related to either the Cedar Ridge or the Sacagawea Ridge glaciations of Richmond. This episode is considered by the former to be pre-Wisconsin. The two main glacial events, Bull Lake and Pinedale, both compound and involving successions of advance and retreat, are marked by massive moraines and widespread outwash plains that have subsequently been trenched leaving extensive dissected terraces along the main river valleys. These are tentively considered to be correlated with the last phases of Wisconsin glaciation. "The longest time interval between stages separates the Buffalo and Bull Lake. The interval between Bull Lake and Pinedale is substantial and greater than the interval between Bull Lake I and Bull Lake II or between any of the oscillations of the Pinedale (Holmes and Moss, p. 651)."

Subsequently there was a minor advance, Temple Lake, indicated by moraines 16 to 30 km upstream of Pinedale moraines and a short distance below cirque headwalls. The outwash train forms a low terrace, Temple Lake - Parker, along some of the valleys. A still younger minor advance is considered contemporaneous with the Little Ice Age of late Holocene time.

Because the main source of sediment carried by the East Fork and other rivers is the suite of terraces within the valleys, the glacial sequence and the associated deposits are important in the present context.

A summary of Pleistocene and Holocene events prepared by Holmes and Moss is shown in Table 1 and their map of glacial deposits in Figure 1. The relation of terraces to glacial events was determined by tracing terraces upstream to the moraine at which each terminates, a method first used by Bryan and Ray (1940). For Boulder Creek the longitudinal and elevation positions of terraces and moraines are shown in Figure 2, in which it can be seen that Pinedale ice destroyed remnants of Bull Lake and higher terraces and that the Main Pinedale terrace abuts and begins at the main Pinedale moraine whereas the Parker-Temple Lake terrace is traced through that moraine. Boulder Creek is immediately north of the East Fork and it may be presumed that the East Fork would have similar profiles.

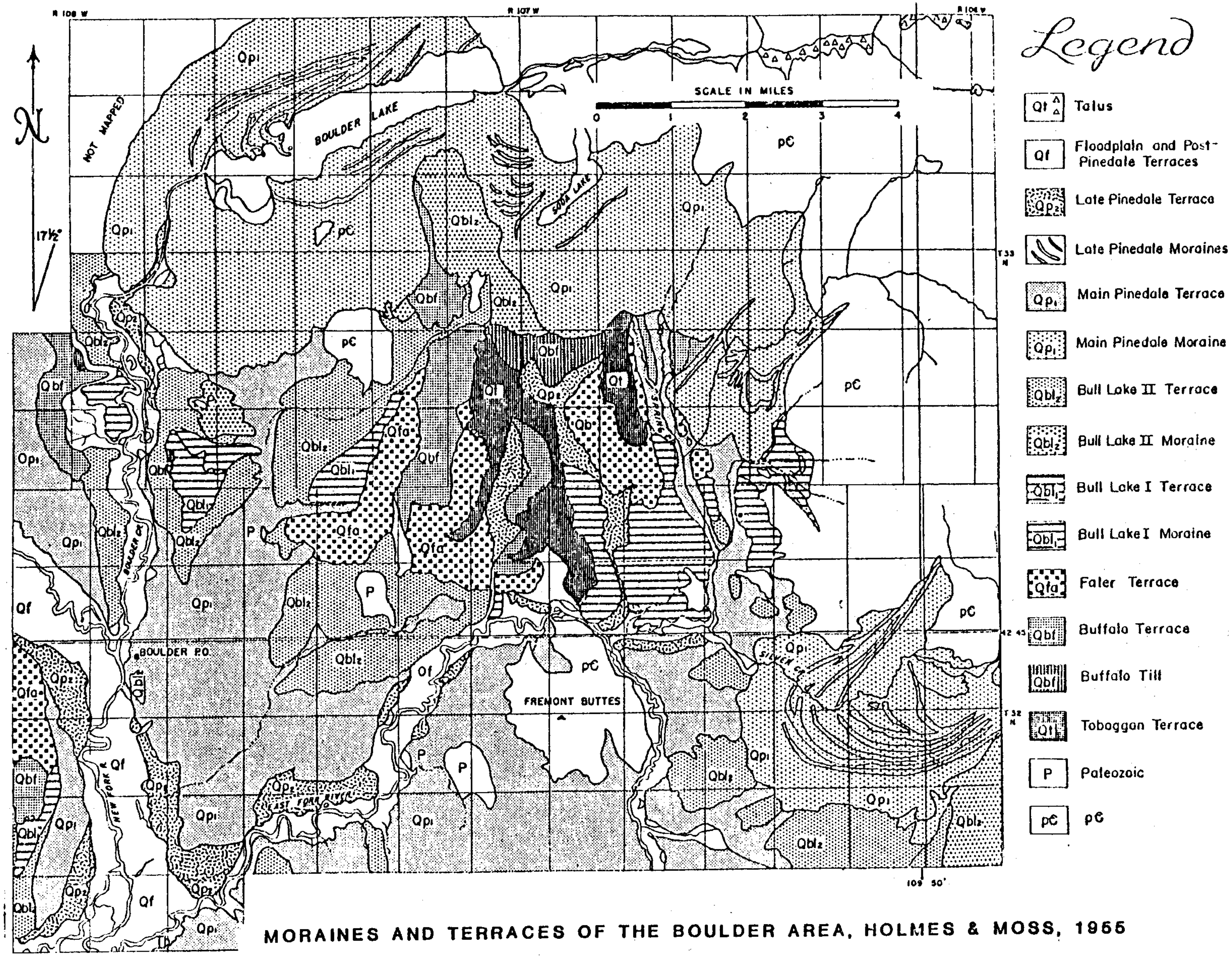
The heights of the various terraces measured by Holmes and Moss are given in Table 2.

GLACIAL OUTWASH TERRACES NEAR THE BEDLOAD TRAP

The detailed mapping of areal extent of different terrace remnants and moraines was carried out by Holmes and Moss up the East Fork to a point 3.2 km (2 miles) south of the Fremont Butte or about 3.7 km north (downstream) of the bedload project, but on the basis of their published map the terrace remnants in the vicinity of the project are identified and shown on Figure 3. The terrace heights shown on Figure 3 closely agree with those measured by Holmes and Moss farther down on the East Fork. However, a considerable length of stream near the project is bordered by a low terrace, 1.5 m above the river. It is not flooded, yet is higher than the flood plain subject to inundation, and is believed to correlate with the Parker-Temple Lake terrace. It is conjectured that Holmes and Moss in listing the flood plain height as 0-5 feet (0-1.9 m) merely lumped the Parker terrace and flood plain together because their mapping, covering 90 square miles, was primarily concerned with the older, more widespread units.

Table 1. Summary of Pleistocene and Holocene Events
(Holmes and Moss, 1955)

Moraine deposition	Terrace deposition	Frost action and mass movement	Eolian action	Vegetation	Early man
Little Ice Age moraines	"Floodplain"	Younger talus; palsen		Chenopods and the composites Grass maximum	
Temple Lake moraines	Parker terrace	Older talus; felsenmeer and polygonboden			Occupation Finley site
Recessional Pinedale moraines	Lower Pinedale terrace	Periglacial frost action likely during glaciation	Widespread eolian action leeward of outwash	Fir	
Main Pinedale moraine	Upper Pinedale terrace				
Bull Lake II moraines	Bull Lake II terrace		Possibly some eolian action in Eden valley		
Bull Lake I moraine	Bull Lake I terrace				
Buffalo till	Faler (?) terrace Buffalo (?) terrace				
	Toboggan Terrace				



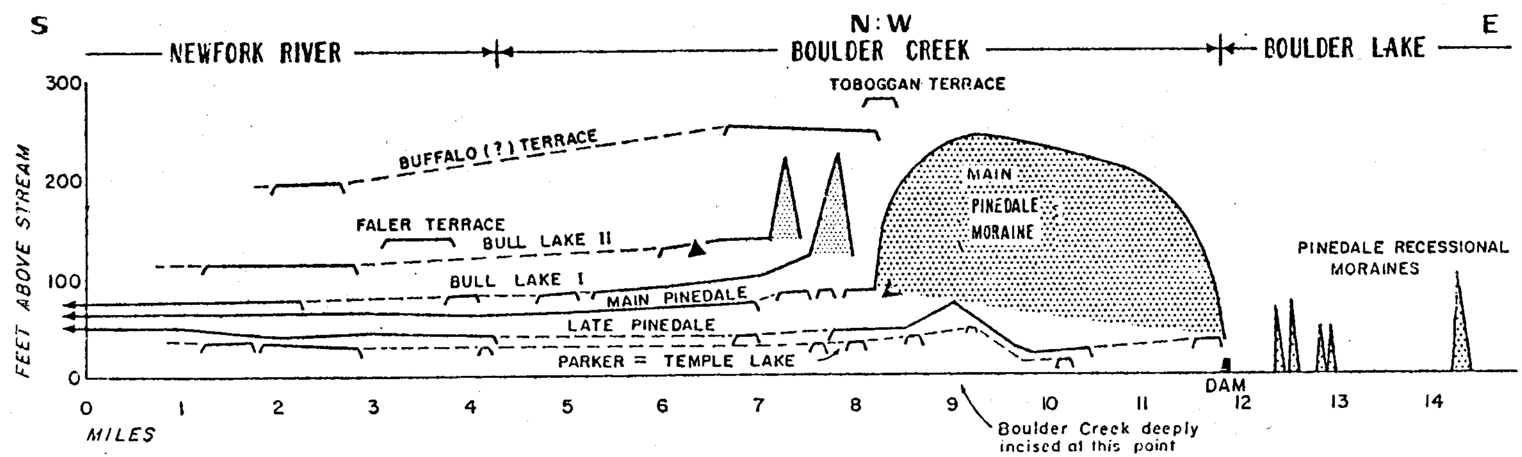
MORAINES AND TERRACES OF THE BOULDER AREA, HOLMES & MOSS, 1955

Figure 1.

Table 2. Heights of terraces above present streambed level, from Holmes and Moss, 1955, in meters (feet in parenthesis)

Stream system	Toboggan	Buffalo	Faler	Bull Lake I	Bull Lake II	Pinedale Main	Pinedale Recessional	Parker (Temple Lake)	Little Ice Age
Boulder Creek New Fork	--	59 (195)	41 (135)	32 (103)	23 (75)	20 (65)	14 (45)	10 (32)	0-1.9 (0-5)
East Fork Main Stream	91 (300)	--	--	26 (85)	18 (60)	10 (33)	6 (20)	--	0-1.9 (0-5)

Notes: The authors published the terrace heights in feet. They did not map terraces as far upstream as the bedload project site and the figures for the East Fork are for the "middle course" of each river, presumed to be downstream of the project.



PROFILE OF TERRACES ALONG BOULDER CREEK AND THE NEW FORK, HOLMES & MOSS, 1955

Figure 2.

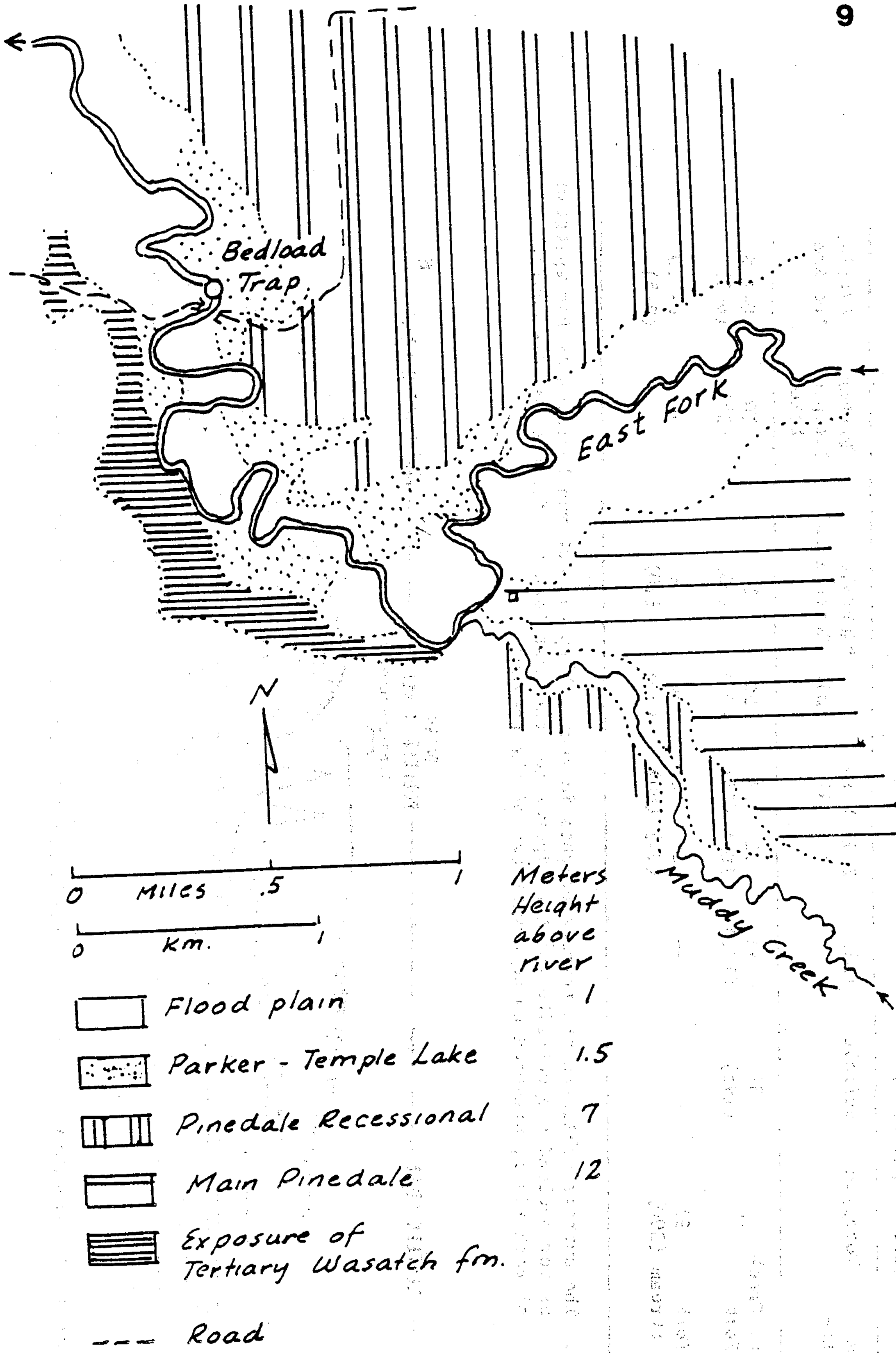

Bedload Trap
East Fork
Muddy Creek
N
0 Miles .5 1
0 km. 1
Meters Height above river
Flood plain 1
Parker - Temple Lake 1.5
Pinedale Recessional 7
Main Pinedale 12
Exposure of Tertiary Wasatch fm.
Road

Figure 3.

Our measurement and those of Andrews (1979) show that even at high flow little bedload is carried by the East Fork immediately above Muddy Creek or where Highway 353 crosses the river 6 km upstream of the project. The explanation can be seen in the glacial geology.

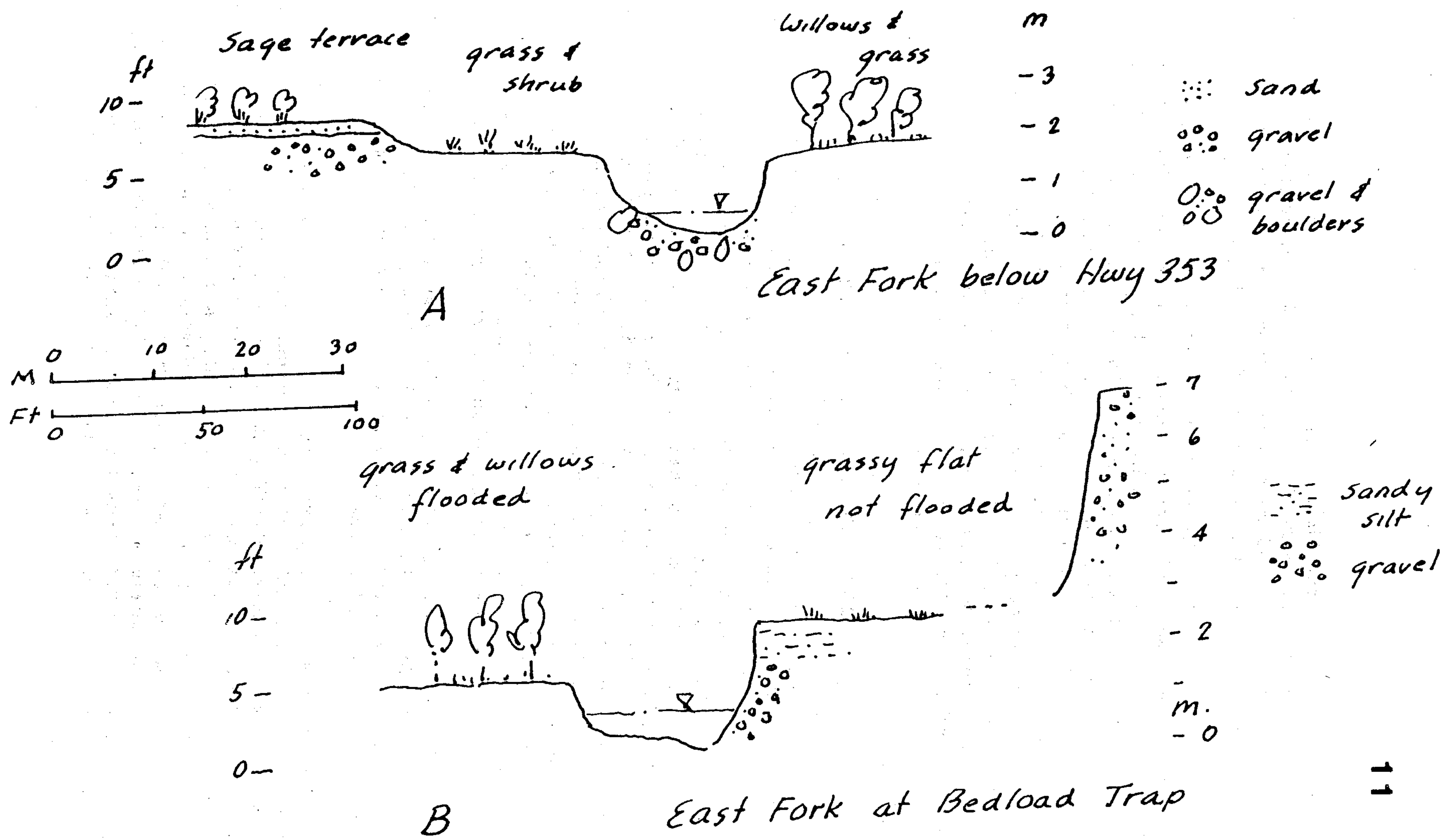
The East Fork rises in the Precambrian rocks just south of Mount Bonneville and flows southward for about 22 km on the high Fremont surface within which soils are thin, bedrock abounds, and rivers carry but little sediment along the bouldery channels. In Township 31 it changes to a westerly course and flows in a canyon cut in the main Pinedale moraine. The till is bouldery and well consolidated and the rate of excavation of material must be very low. It emerges from the moraine on to the unconsolidated and moderately well-sorted debris of the outwash terraces near the bridge of Highway 353. The large rocks available in the moraine are seen in the channel bed for only a short distance downstream of the morainal margin. Thereafter, the streambed is much less steep and is composed of smaller and better sorted material.

CHANNEL CROSS SECTIONS AND TERRACES

A cross section of the channel, associated berms and terraces, and observed bed and bank materials are shown for three locations along the East Fork in Figure 4. Section A is near the Highway 353 bridge just below the moraine. A prominent sage-covered terrace stands 2.8 m above the streambed and a lower grass and willow level at 1.5 m. River bed gradient at this place is .0023 and the bed material has a D_{50} of 90 mm. Section B of Figure 4 is at the bedload project where the river slope is .0007, the D_{50} of bed material is 1.25 mm, and a nearby outwash terrace is at 7 m above river bed elevation. Section C near Fremont Butte, 6.4 valley kilometers downstream of the project, has berms at 1, 2.8 and 4 m above the bed. These levels agree in part with those identified by Holmes and Moss (see Table 2); levels were determined from areal distribution of major mapped terraces, but the details obtained at specific river cross sections add some levels not mapped in the smaller scale areal studies.

In Figure 4D there is added a similar valley cross section of Muddy Creek near its mouth. Some of the terrace levels are locally expressed as straths cut on the Wasatch bedrock presumably by lateral migration of the river against the valley side.

The assignment of a given berm or level to its associated glacial outwash is not self-evident. With the present information it appears safe to assign a terrace remnant standing about 7 m above the East Fork to the Pinedale recessional terrace and that one at 10-12 m to the main Pinedale terrace. The flood plain presently forming and inundated during high flow is the level at 1 to 1.5 m. The most ubiquitous low terrace along the East Fork is that one at 1.5-2.8 m and it probably is related to the minor glaciation called Parker or Temple Lake. This terrace is usually vegetated by sage brush and is not inundated. Considering the fact that little bedload was measured at the base of the moraine near Highway 353 or above the



Sage terrace
grass & shrub
Willows & grass
ft
10 –
5 –
0 –
m
– 3
– 2
– 1
– 0
sand
gravel
gravel & boulders
East Fork below Hwy 353
A
0
10
20
30
M
Ft
0
50
100
grass & willows flooded
grassy flat not flooded
ft
10 –
5 –
0 –
– 7
– 6
– 4
– 2
m.
– 0
sandy silt
gravel
East Fork at Bedload Trap
B

Figure 4

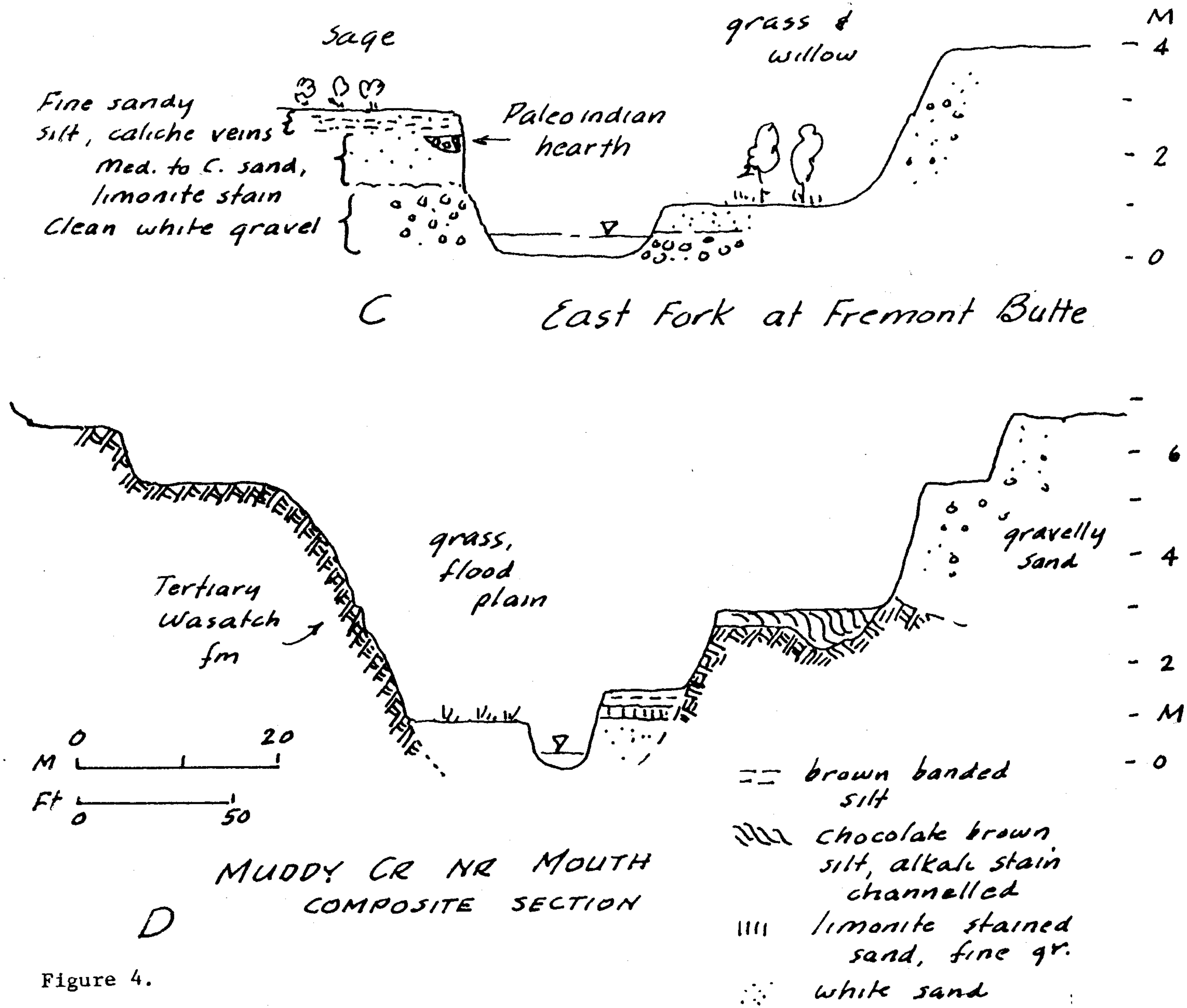

Sage
Fine sandy silt, caliche veins
Med. to C. sand, limonite stain
Clean white gravel
Paleoindian hearth
grass & willow
M
4
2
0
C
East Fork at Fremont Butte
Tertiary Wasatch fm
grass, flood plain
gravelly sand
6
4
2
M
0
M
0
20
Ft
0
50
MUDDY CR NR MOUTH
COMPOSITE SECTION
D
brown banded silt
Chocolate brown silt, alkali stain channelled
limonite stained sand, fine gr.
white sand

Figure 4.

mouth of Muddy Creek it can be postulated from Figure 3 that most of the bedload carried by the river through the study reach is derived from lateral erosion of the unconsolidated sand and gravel of the Parker-Temple Lake terrace, and from the places the river is impinging on the Pinedale recessional terrace. Some also is contributed as small fans emanating from gullies eroded into the steep slopes and walls of the Wasatch bedrock. All of these sources would produce sediment in the sand and gravel range observed in the trapped bedload.

ANCIENT DISSECTED PEDIMENTS

Standing high above the glacial outwash terraces are a series of benches cut on bedrock of the Tertiary Wasatch formation and covered with 1-3 m of rounded river gravel consisting of quartzite and other lithologies resistant to weathering. These benches vary in height from 530 to 20 m above present river levels. Slope processes have carried gravel from these surfaces downhill so that many hillslopes appear to be gravel but are in actuality merely veneered with such material.

These benches generally slope toward the south-southeast but correlation of various remnants is not simple because of the many levels present. So the gradient of the ancient surfaces has not been definitely established, but is close to .0050.

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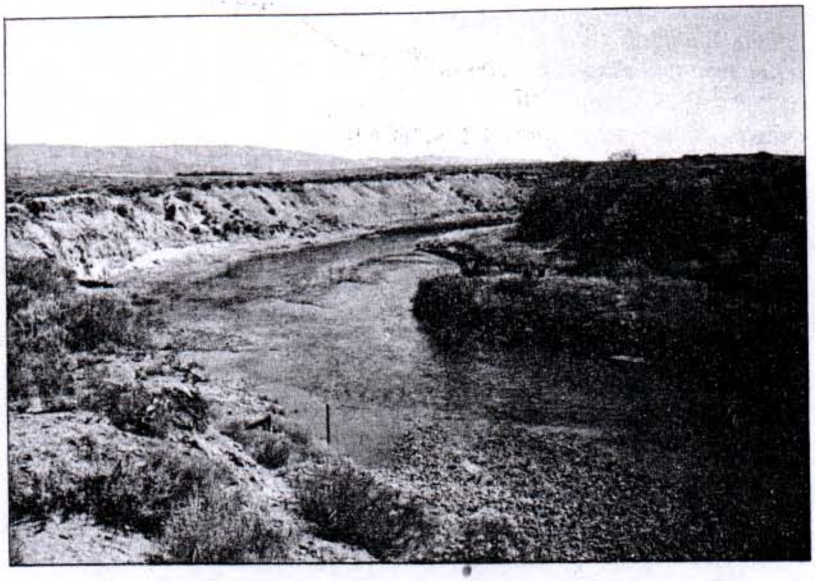
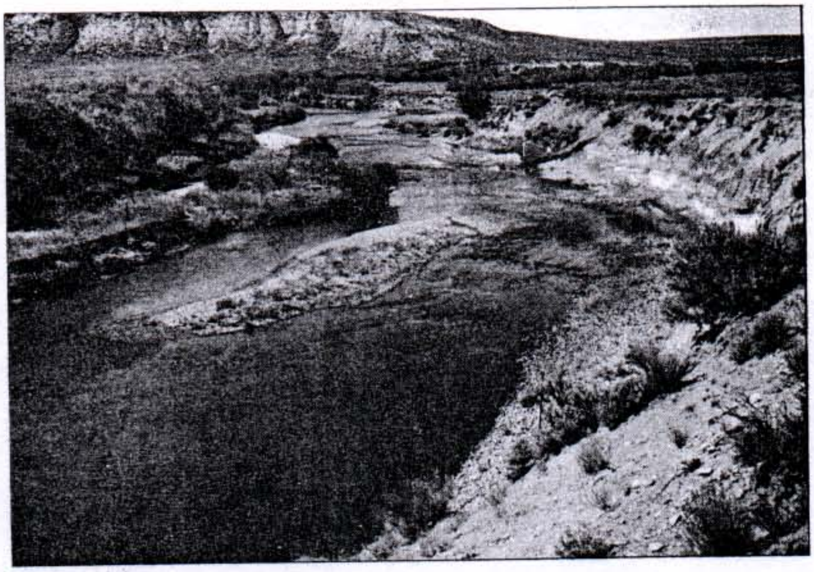
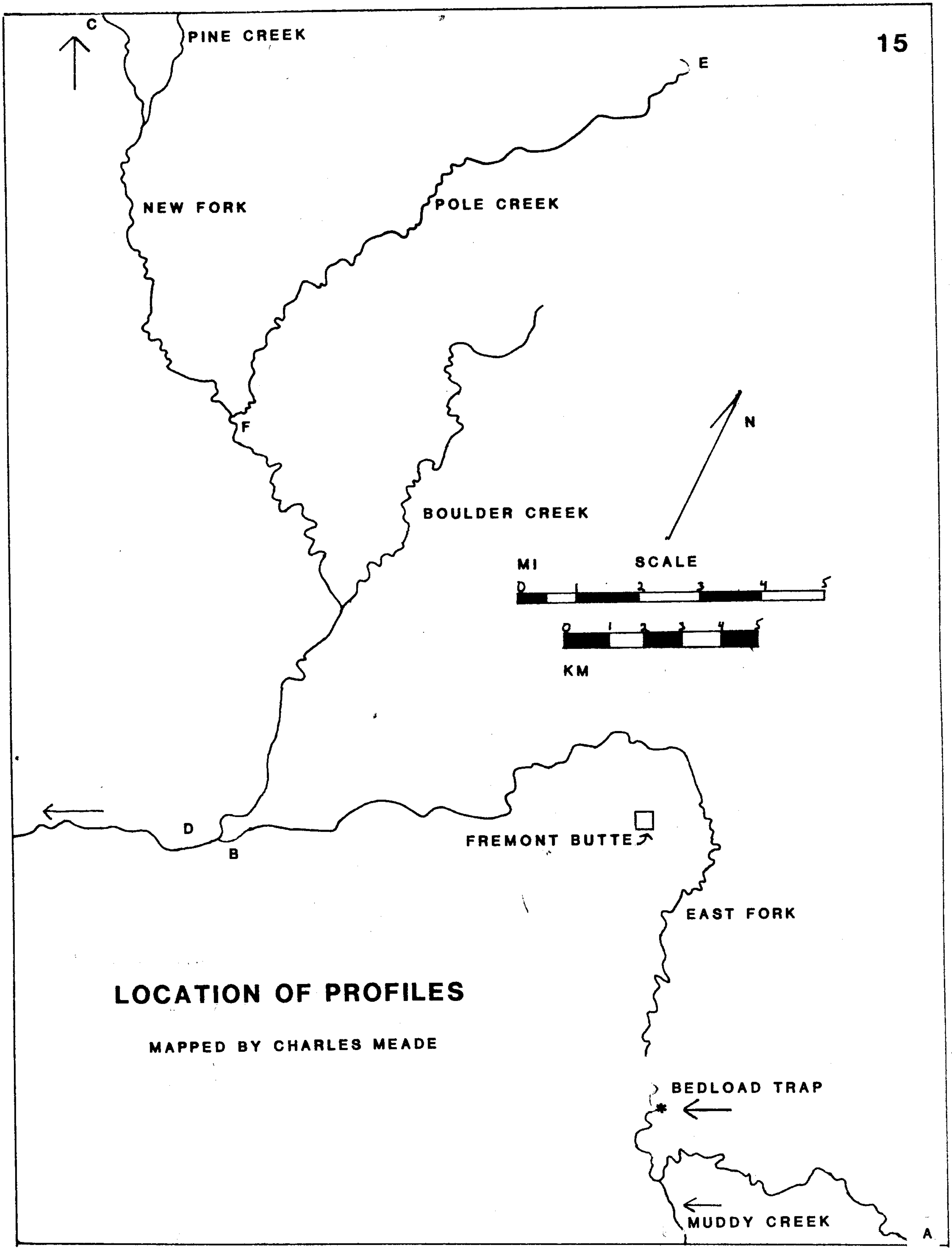


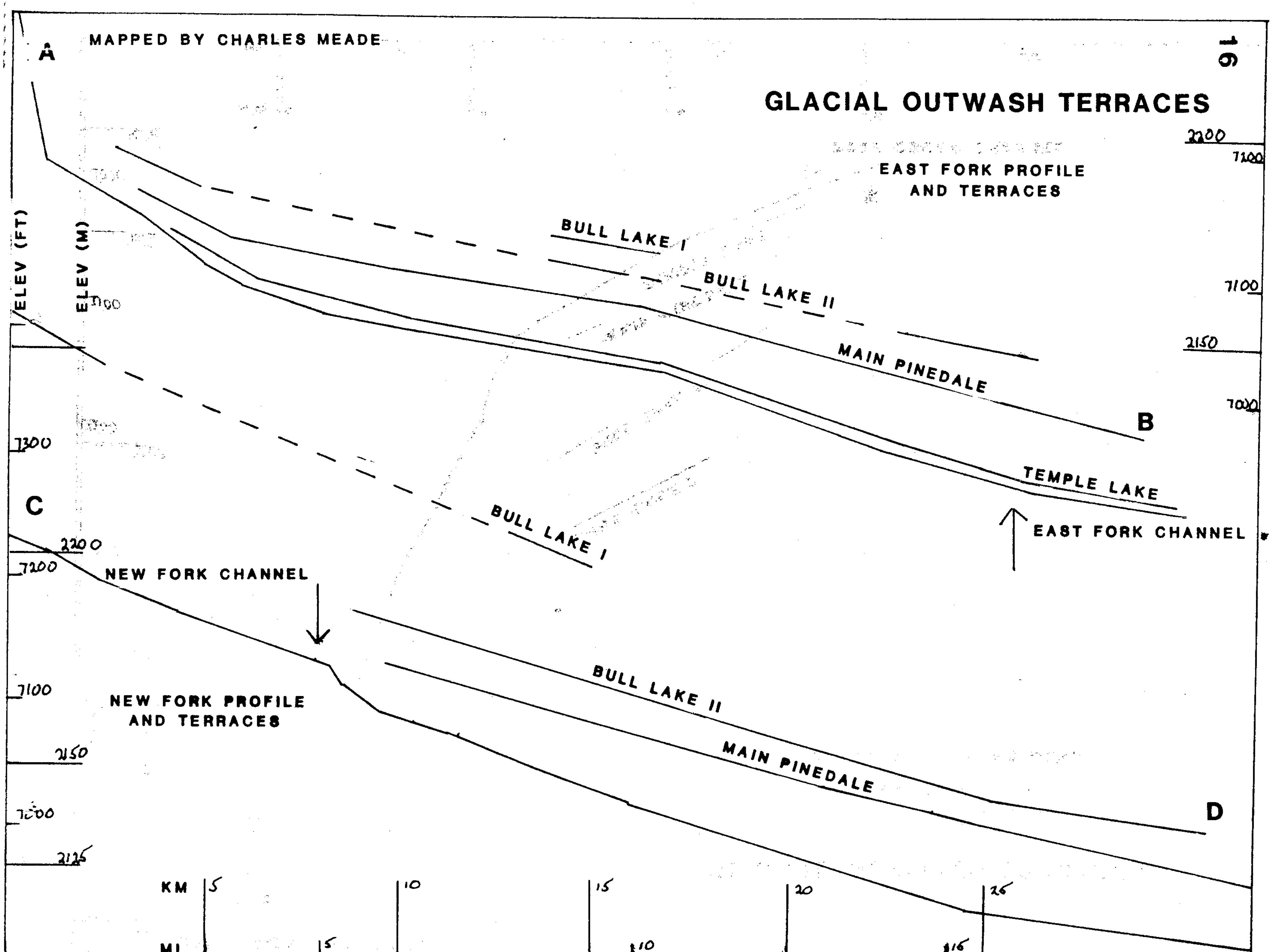


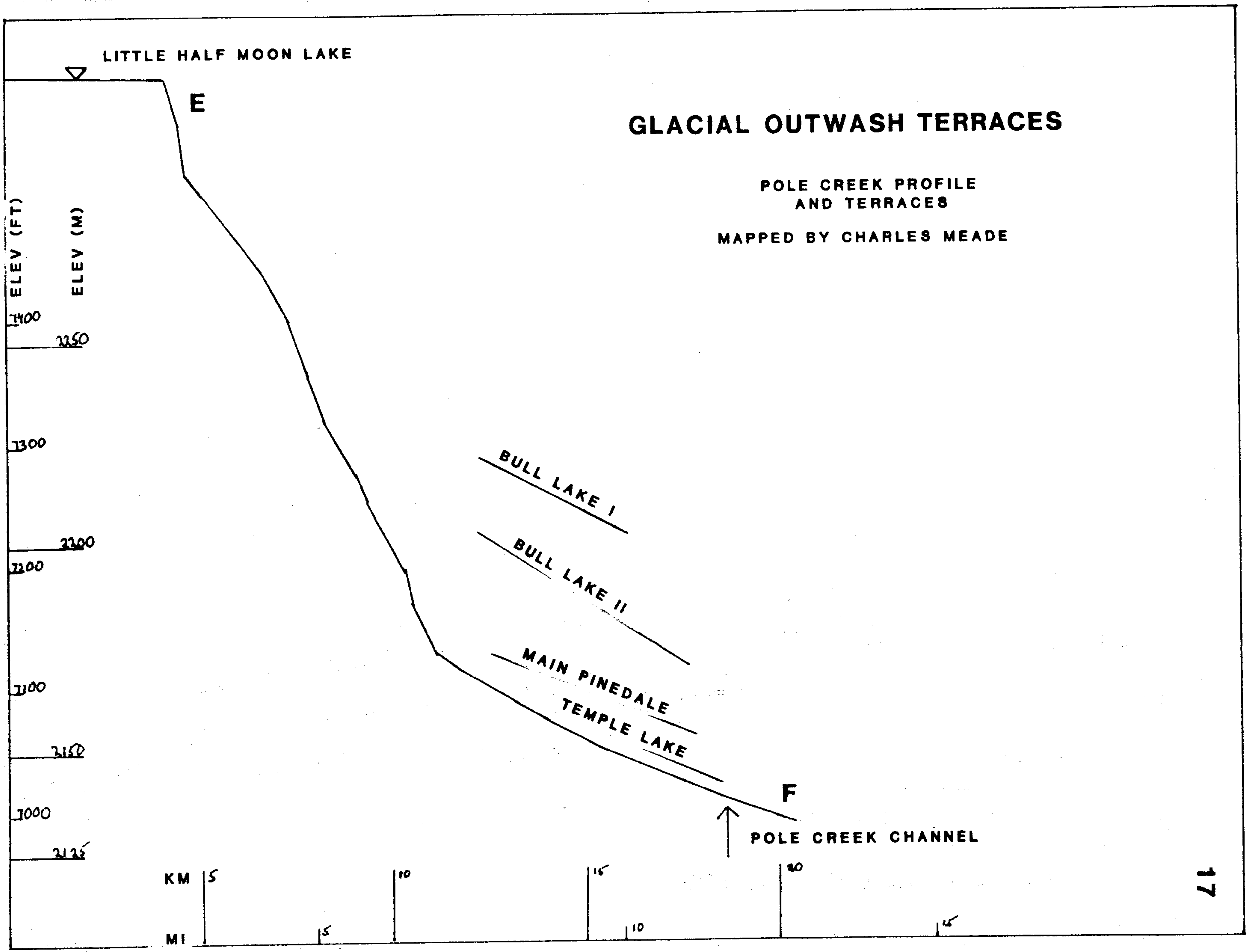
EAST FORK NEAR "GRAVEL GAGE": UPPER, VIEW UPSTREAM, 808 M ABOVE BEDLOAD TRAP: LOWER,VIEW DOWNSTREAM. TERRACE ALONG RIGHT BANK IS PINEDALE RECESSIONAL AT 7 M ABOVE PRESENT RIVER



LOCATION OF PROFILES

MAPPED BY CHARLES MEADE


16
GLACIAL OUTWASH TERRACES
MAPPED BY CHARLES MEADE
A
B
C
D
EAST FORK PROFILE
AND TERRACES
BULL LAKE I
BULL LAKE II
MAIN PINEDALE
TEMPLE LAKE
EAST FORK CHANNEL
NEW FORK CHANNEL
NEW FORK PROFILE
AND TERRACES
BULL LAKE I
BULL LAKE II
MAIN PINEDALE
ELEV (FT)
ELEV (M)
KM
MI
2200
7100
7100
2150
7000
7300
2200
7200
7100
2150
7000
2125
5
10
15
20
25
5
10
15


LITTLE HALF MOON LAKE
E
GLACIAL OUTWASH TERRACES
POLE CREEK PROFILE
AND TERRACES
MAPPED BY CHARLES MEADE
ELEV (FT)
ELEV (M)
7400
2250
7300
2200
7200
7100
2150
7000
2125
BULL LAKE I
BULL LAKE II
MAIN PINEDALE
TEMPLE LAKE
F
POLE CREEK CHANNEL
KM
5
10
15
20
MI
5
10
15