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breckenridge

flood plain information 1975

leonard rice consulting water engineers, inc.

COLORADO WATER CONSERVATION BOARD

TOWN OF BRECKENRIDGE

SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

BRECKENRIDGE, COLORADO

PART I - BLUE RIVER

PART II - FRENCH, ILLINOIS, LEHMAN, AND SAWMILL GULCHES

1975

Leonard Rice Consulting Water Engineers, Inc.

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PART I - BLUE RIVER

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PREFACE

The purpose of this report is to present information on the flood hazards along the Blue River in the vicinity of Breckenridge, Colorado. In general, the study area comprises the flood plain of the Blue River only through the town of Breckenridge. Peak discharges on the Blue River between Goose Pasture Tarn and Dillon Reservoir are also tabulated. Records indicate that two damaging floods have occurred in recent years. Both of these floods were in 1965. Since then, Goose Pasture Tarn, a multi-purpose reservoir involving recreation and municipal water, has provided a high degree of incidental flood protection to the area downstream, but flood damage out of the reservoir and from the tributaries of the Blue River may still occur.

Studies made for this report show that floods larger than those in the past could occur in the future in the study area. This report contains information on past floods and maps, profiles and cross sections that indicate the approximate extent and depth of inundation from large floods that can reasonably be expected to occur in the future. For the purpose of this report these floods have been designated as the Intermediate Regional and the Standard Project Floods.

This report was prepared by Leonard Rice Consulting Water Engineers, Inc., of Denver, Colorado at the request of the town of Breckenridge and in cooperation with the Colorado Water Conservation Board. Funds for the study also came from Summit County. It is intended that the report be used by the town of Breckenridge, Summit County and other concerned entities in such a way that flood hazard and future flood damages are minimized. The report provides a basis for further study and planning for optimum use and development of flood-prone areas through zoning and subdivision regulations, construction of flood control projects, or by a combination of these or other approaches to reduce the flood hazards and

flood damage. Information contained in this report will also be useful in programs dealing with ecological and environmental aspects of the study area and its land use role as part of the surroundings.

The town of Breckenridge will make the information in this report available to interested parties and individuals. Copies of the report and information on its use are available from that agency. Leonard Rice Consulting Water Engineers, Inc., on request, will provide technical assistance to federal, state and local agencies in the interpretation and use of data presented herein and will provide other available flood data related thereto.

BACKGROUND INFORMATION

BLUE RIVER AND TRIBUTARIES

Breckenridge is located in the upper drainage basin of the Colorado River. The principal tributary flowing through the town is the Blue River. Minor tributaries discharging into the Blue River in the vicinity of Breckenridge include Lehman, Illinois, Sawmill and French Gulches. The location of Breckenridge and its relationship to the streams is shown in Plate 2.

The major basin in the Breckenridge area is defined at the point where the Blue River enters Dillon Reservoir. A United States Geological Survey continuous recording stream gage is located approximately 1.5 miles above the reservoir. The drainage area above this gage is 119 square miles and has a mean elevation of 9700 feet above mean sea level. The drainage area above the town of Breckenridge is approximately 55 square miles and has a mean elevation of 10,500 feet above mean sea level.

A major hydrologic feature on the Blue River is the Goose Pasture Tarn. The reservoir, commonly referred to as the "Tarn", is located approximately 2 miles above Breckenridge, and has a drainage area of approximately 43.5 square miles. Many other smaller lakes, both natural and man-made, are in the basin.

Breckenridge is surrounded on three sides by mountain ranges. All the tributaries or sub-basins to the Blue River in the Breckenridge area have their headwaters on the mountain divides. On the west side of the Blue River is the Tenmile Range with peak elevations ranging from 12,850 to 14,282 feet. above mean sea level. The Continental Divide forms the southern and eastern boundaries of the basin. Peak elevations along this portion of the basin range from 12,245 to 13,684 feet above mean sea level. Tributaries to the Blue River with head waters on the mountain divides have the characteristic of steep slopes and rather long and narrow valleys.

Over half of the area in the Blue River basin above Breckenridge is above timberline with vegetation limited to alpine tundra. The remaining is land is predominantly covered by spruce, fir, pine, aspen, willows, sage and grassland.

Above the town, all the tributary basins draining into the Blue River from the Tenmile Range on the west have been glaciated, whereas the tributaries draining into the Blue River from the east have not. As a result of the different geologic origins, the tributaries on either side of the Blue River have different hydrologic properties. Sub-basins that have been glaciated have soils developed on glacial material. These soils are generally coarse textured and may vary from a very stony or rocky clay to a very coarse textured gravel with boulders and cobble. Infiltration rates and losses for this type of parent material can be high. In the non-glaciated basins east of the Blue River, the soils have been developed on very hard dense igneous and metamorphic rocks. Infiltration rates and losses through soils or debris developed on the igneous rocks may be relatively low. The valley of the Blue River also has been glaciated and land located within a half mile to one mile on either side of the river is covered by glacial material. Consequently, infiltration rates and losses are exceptionally high.

Below the town, the drainage basins on either side of the Blue River differ markedly from those above the town. Geologic conditions are different in that the parent materials for soils are sedimentary rocks or alluvial fans. Hydrologic properties of soils developed on these materials can be different than those developed on parent materials located above the town of Breckenridge. Infiltration rates and losses through the soils developed on sedimentary rocks may be relatively low whereas infiltration rates and losses through soils developed in the alluvial fans may be moderate to high. However, local variations of infiltration rates and losses may vary considerably within each major area.

Drainage areas for the major tributaries to the Blue River in the Breckenridge vicinity are shown in Table 1.

Table 1

DRAINAGE AREAS

Blue River above gage	119.0 sq.mi.
Blue River above Tarn	43.5 sq.mi.
Lehman and Carter Gulch	3.0 sq.mi.
Illinois Gulch	3.5 sq.mi.
Sawmill Gulch	2.5 sq.mi.
French Gulch	11.0 sq.mi.
North Barton Gulch	4.6 sq.mi.
Swan River	38.5 sq.mi.

Most of the drainage areas are uniform in size except for the Swan River which contains 30% of the area above the U.S. Geological Survey gage. Approximately 80% of the drainage basin above Breckenridge is controlled by the Goose Pasture Tarn.

The climate of the Breckenridge area is cool with an average yearly temperature of about 35°F. Annual precipitation averages 18 inches with approximately half of the precipitation occurring as snowfall. Snow depth variations recorded at a snow course station on Hoosier Pass reveal that snow depths can range from the 18 inches in February of 1944 and 1945 to over 66 inches recorded in April of 1952 and 1965. Snow depths also vary considerably with elevation. The average April 1 snow depth recorded at Hoosier Pass is approximately 47 inches, whereas the average snow depth recorded in Frisco, a station much lower in the basin, for April 1 is 28.7 inches.

DEVELOPMENT IN THE FLOOD PLAIN

The natural flood plain of the Blue River in the Breckenridge area has largely been obliterated by construction within the town. The initial encroachment on the flood plain in

Breckenridge was accomplished early in the 1900's when dredge mining was first active. The tailings left from the dredge operation are still in existence today and may be seen immediately north of the town. Construction within the past few years has further encroached into the Blue River channel reducing the area available for safe passage of a major flood. The mine tailings which once formed a very uneven and rough surface have been leveled off to allow development. The channel bed of the Blue River has been considerably modified from its natural condition. Present uses adjacent to the Blue River include commercial, residential, recreational and related uses. There are virtually no light industrial uses within the city limits.

Development in the study area can be expected to continue. The town is the county seat for Summit County and serves as a winter recreation and ski area. The town presently has a summer population between 650-800 persons. During the winter it increases to over 2500, not including the skiers who are in the town for only one day. There is an extensive winter resort economy which provides employment for the permanent population. The town is also trying to develop more summer activities.

FLOOD SITUATION

HYDROLOGIC DATA

Basic data stations that record information on precipitation, snow depth and stream flow are available in the Breckenridge area. The locations of these stations are shown on Plate 2. The precipitation gage located at Breckenridge is a daily station with records from 1947. The precipitation gage located at Dillon is an hourly recorder with records dating back to 1907.

Snow course stations are maintained by the U.S. Department of Agriculture, Soil Conservation Service. The stations measure the snow depth and water content at intervals during the year. There are three such stations in the Breckenridge area with snow depths and water content information extending back 39 years.

The U.S. Geological Survey maintains several continuously recording stream gages in the immediate area. The station of primary interest to the Breckenridge study is located downstream of the town and has been in existence since 1957. Another U.S. Geological Survey gage was located further downstream and was in existence from 1911 to 1960; however, the construction of the Dillon Reservoir required that a new gage be established at its present location in 1957. From the combined history of the two gages, there are 64 years of stream flow records on the Blue River.

FLOOD FLOWS

High water resulting from snowmelt is the most prevalent type of flood flow occurring in the Blue River basin. Snowmelt generally begins the first of April and the peak runoff in the Blue River occurs in mid-June. Snowmelt then decreases and the flow of the river recedes the latter part of June and throughout July.

Rains occur throughout the summer season. Rain prior to mid-June does not increase the stream flow appreciably. During this early period before peak snowmelt runoff there is actually some reduction in the stream flow during periods of precipitation. After the peak runoff has occurred and snowmelt begins to decrease, rains tend to increase runoff. The rains which occur in July and August have the greatest potential for causing major flooding. Table 2 summarizes the peak flows at the Blue River gage above Dillon for flows over 1000 cfs.

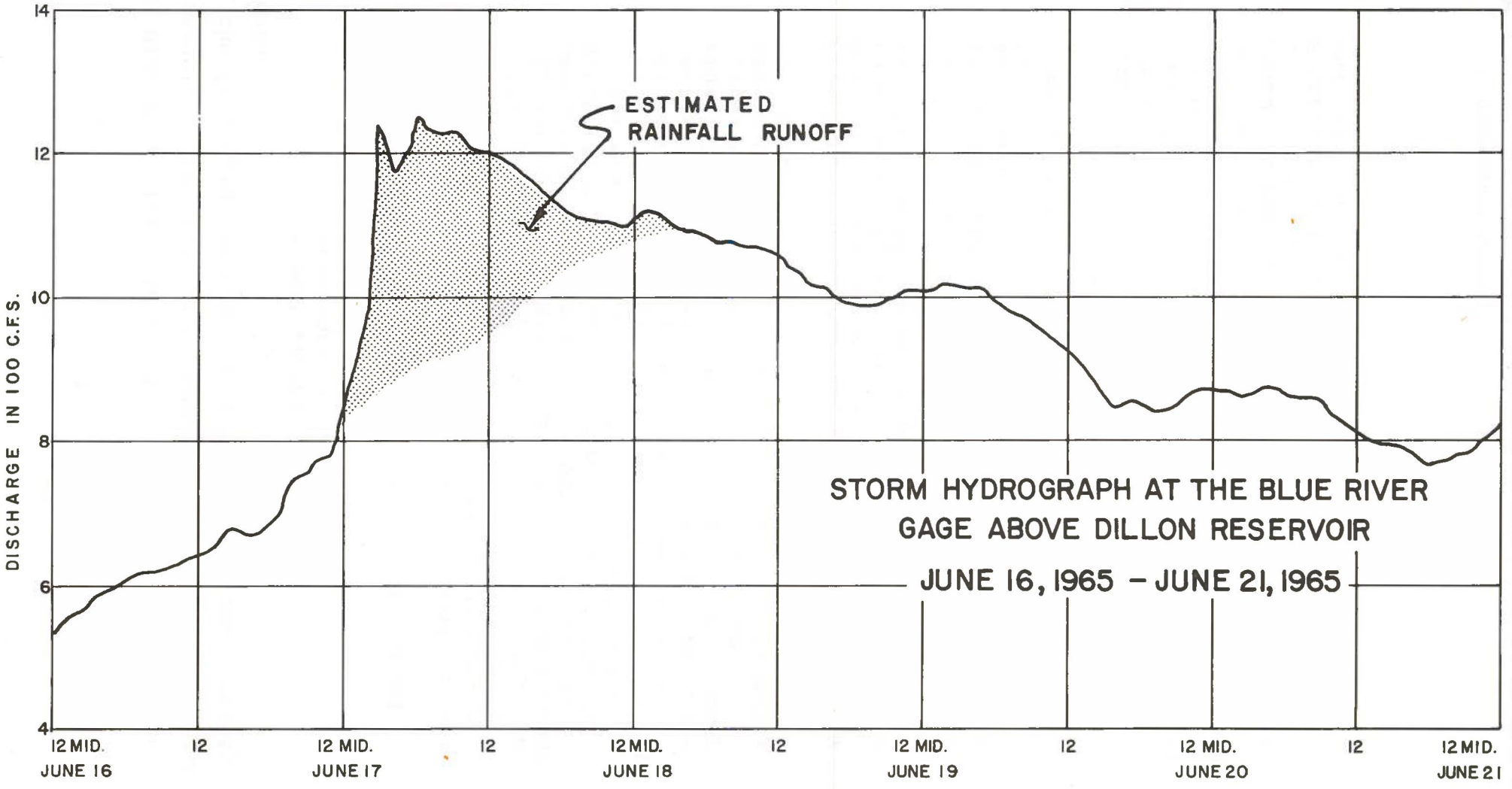
Table 2

FLOOD PEAK STAGES AND DISCHARGES
BLUE RIVER[1]

Date	Discharge (cfs)	Stage (ft.)
June 27, 1912	1,020	3.9
June 2, 1914	1,180	4.35
June 10, 1921	1,100	4.15
June 17, 1923	1,000	3.4
June 14, 1924	1,180	3.6
June 7, 1926	1,080	3.44
May 30, 1928	1,030	3.22
June 17, 1965	1,250	5.38[2]

1. *Peak discharges in excess of 1000 cfs from U.S. Geological Survey Water Supply Papers.*
2. *Gage relocated upstream in 1957 and tributary drainage area reduced from 129 sq.mi. to 119 sq.mi.*

The peak discharge recorded by the U.S. Geological Survey on the Blue River near Dillon for the 64 years of record was 1250 cfs and occurred on June 17, 1965. The flow was a combination of snowmelt and a high intensity thunderstorm or cloudburst of small areal distribution centered in a tributary basin above the town. Plate 1 shows the hydrograph of



STORM HYDROGRAPH AT THE BLUE RIVER
GAGE ABOVE DILLON RESERVOIR

JUNE 16, 1965 – JUNE 21, 1965

1965

PLATE 1

the Blue River for this event at the gage above Dillon Reservoir. The storm and subsequent flooding is described in the following newspaper account by the Summit County Journal:

Summit County Journal
Breckenridge, Colorado
Friday, June 25, 1965

ANGRY FLOOD WATERS TORE AT SUMMIT DURING STORM

Low-lying, tumbling, rolling, black clouds crowded out the mountains on the east, while from overhead came ominous, threatening rolls of thunder. Suddenly the pent-up fury of the angry gods in the sky was unleased, and nature went on a mad rampage, demonstrating her relentless power. Water disgorged from the skies in torrents, while the sun in the west, peeping through an opening in the clouds, threw a magnificent rainbow across the sky and sheets of rain turned into silver streaks, earthward bound. Rivulets were born on the hillsides, little streams grew to be miniature, muddy torrents, and the rivers receiving them soon became crashing, rolling, overflowing instruments of destruction.

From June 1 until June 16, Summit County had only one day without heavy rain. On the 16th the threatening skies literally split wide open. The rain fell in sheets which windshield wipers couldn't handle, water couldn't run down hillsides as fast as it poured from the skies, rivers raged and overran their banks and deep puddles of muddy water appeared in every depression and low spot. Late in the afternoon, the rain settled down to a steady, pounding downpour.

The first indication that there was real trouble came with a call for help from Quandary Lodge, approximately eight miles south of Breckenridge, about 9 p.m. Culverts at Quandary (normally carrying only a small trickle of water) couldn't handle the accumulated runoff from the rain, and the roads were washing out. A large stream of water ran beside Highway 9 toward Breckenridge, undermining the side of the road until it reached the Joe Schneider stables, where it ran through the stables, and back into the Blue River.

The Blue, coursing badly through the town of Breckenridge, could actually be seen steadily rising in its banks. Culverts under the road at Watson and Lincoln had become completely submerged with water. Barricades were erected at the Watson crossing to close the road to traffic, and by 11 p.m. the water was running over the top of the road. Councilmen and Marshal Pastorious sloshed around through the mud, despaired at the persistent downpour of rain, but concluded that the culvert at the Lincoln crossing seemed to be handling the water fairly well at the time.

The morning of the 17th dawned clear and bright, to reveal where the Watson crossing had been, only a gaping hole. The road going to the Valley Brook cemetery, one-half mile north of Breckenridge, had also disappeared into a gulley 20 feet across. The culvert which had carried water under the road in French Gulch, just east of the Breckenridge dump, was gone, leaving a yawning abyss about 30 feet deep. A long stretch of the Boreas Pass Road was washed out.

As noon approached, clouds started drifting in and breaking up, and more rain fell. The river again started rising, and backing up to flood the Lincoln crossing. The Breckenridge water crew (usually working and fighting to keep water flowing around town) fought far into the night to hold back the water and save the street crossing, working until the day's crest had passed. The sun shone warm on Friday, melting snow in the high country, once more swelling the torrential river. At nightfall, water was again lapping over the top and running across Lincoln. The county road crew, working against time and nature, swiftly put in an additional culvert on the west side of the fill to divert part of the incoming flow around the culvert, and back into the Blue.

Saturday it appeared that the immediate danger might be past when debris floating down the river choked the mouth of the culvert. Water backed up over the road. . . . . (original illegible) . . . . . used to unplug the culvert. Once more the road was saved.

Sunday afternoon the culvert again became choked with debris and it was necessary to obtain larger equipment to remove the obstacle from the mouth of the culvert. Robert Graham Excavating Company was called, and Bob Graham, owner of the company,

brought his backhoe to the scene. In order to get close enough to work, Bob moved his equipment down into the bed of a small stream entering the Blue from the west side. He managed to remove the debris, but the suction and pull of the water was so strong that the bucket was pulled up against the mouth of the culvert and an axle snapped on the backhoe. With the help of the B. L. I. backhoe, Bob managed to get the bucket of his machine pulled up and away from the mouth of the culvert. Due to the crippled condition of Graham's equipment, and the under-current and suction of the river, it was impossible to remove the machine with the help of the B. L. I. backhoe and the county road maintainer.

Lincoln leads to the Peak 8 ski area, and is the last existing link at this time with the town reservoir, Valley Brook cemetery and many summer homes on the west side of the Blue River.

At the time of this writing (Monday afternoon), it appears that Lincoln is safe.

It was feared for a time that the water main leading from the town reservoir to Breckenridge might be swept away at the point where it crosses the Blue, but fast work on the part of the town water crew, diverted the force of the waters from the viaduct.

Holes and depressions in the rock piles filled with water. At one point, near Mid City, the water overrunning the old dredge holes, ate a new course, and plunged down to Highway 9 at Braddock Flats. From there it ran north beside the highway in a muddy, roaring torrent for nearly a mile, until it reached the four-mile bridge and poured into the Blue. For a time there was some doubt as to whether the four-mile bridge would be able to withstand the current pressing and washing against it. The north approach to the bridge appeared to be considerably weakened by water which washed new channels under the roadbed, but fortunately the bridge and the road both proved their stability, even under such severe conditions.

The action of the waters was strange indeed. It flooded the Boreas Pass road, left it, and then again covered the road farther west. The total was about . . . . . (original illegible) . . . . but almost buckled under the pounding of the debris and angry waters. The Dillon dam evidently

> held the waters from doing any damage in the area below there. The angry waters extended clear down to Grand Junction.
>
> The bridge on the Whatley road caved in to a degree, but fast effort on the part of the highway crew saved it, and kept one more route of communication open.
>
> Only a constant vigil on the part of the many concientious men made the saving of this great street possible. The town water crew, town marshal, councilmen, county commissioners, and sheriff's department put in many long hard hours, serving above and beyond the call of duty, but with a love for their "high country" and its welfare, uppermost in their hearts.

Flooding within the town of Breckenridge was a function primarily of backwater from culverts and bridges that were plugged with debris. Consequently, flooding was most extensive around each of the major crossings and localized in the stretches between the crossings. The runoff approached the 100-year recurrence storm.

On July 23 of the same year the Blue River left its banks for a second time. The flood was attributed to a storm of high intensity centered over a small tributary above the town. Because of the time of year, rainfall runoff was the predominant cause of flooding. Prior to the storm the flow in the Blue River was 400 cfs and was generally decreasing.

FACTORS AFFECTING FLOODING

Flooding is a natural function of a river and its tributaries. In the process of flooding, vegetation, debris and other natural obstructions impede flood flows and cause backwater conditions that increase flood heights. The debris is washed downstream and collected on bridges and culverts creating a damming effect. As flood flows increase the accumulated debris may break loose and a wall of water and debris surges downstream until another obstruction is encountered.

Man-made features constructed within the flood plain or immediately adjacent to the channel bed obstruct flood flows and create flooding dangers greater than what would have occurred naturally. Man-made obstructions in the flood plain and channel bed consist of irrigation diversion structures, bridges, culverts, buildings, and pipe crossings. Most of these obstructions are present in the Breckenridge area. All the channel crossings, which consist of bridges, culverts and pipelines, if not properly engineered will collect debris and create backwater conditions which cause water levels to rise to the extent that more land is inundated by flood waters. Also, erosion problems will arise when the natural flow of the river is obstructed and narrowly confined. The strength capability of the bridges and culverts can sometimes be exceeded and the crossing destroyed, creating further debris and headwater flowing in the channel and flood plain.

Other obstructions in the flood plain, such as commercial and residential buildings, also create additional flood hazards. Structures in the flood plain restrict flood flows and reduce the carrying capacity of the natural flood plain. Consequently, backwater effects occur which result in increased velocities of flow at and below release points.

GOOSE PASTURE TARN

A major feature in the Breckenridge area that contributes to a reduction in flood damage is the Goose Pasture Tarn. The reservoir is located immediately upstream of the town of Breckenridge and has a drainage area of approximately 43.5 square miles. The storage capacity of the reservoir is nearly 1000 acre-feet with a spillway design capacity of 5,000 cfs. Through the process of storing and gradually releasing flood waters from the tributaries, the reservoir plays an important role in reducing the peak discharge of rainfall-runoff in the Blue River prior to its entering the town of Breckenridge. The value of the reservoir for

reducing peak flows due to snowmelt is marginal due to the broad rather than sharp peak runoff hydrograph which is characteristic of a short duration, high intensity summer thunderstorm. For example, had the dam been in place during the storm of June 1965, as shown on the hydrograph on Plate 1, the peak flow would only have been reduced to 1180 cfs from 1250 cfs and flooding would still have occurred.

OTHER FLOOD DAMAGE REDUCTION MEASURES

Reservoirs, lakes and ponds in the Blue River Basin above the town of Breckenridge provide only incidental flood protection. This storage and trans-mountain diversions near Hoosier Pass has served to reduce peak flows in the study area.

Breckenridge is eligible for flood insurance as provided by the National Flood Insurance Program. The town has been advised by the Federal Insurance Administration that special flood hazard areas exist. The program requires the town to adopt and enforce land use control measures that will guide future development of land in the flood-prone areas to avoid or reduce flood damage.

Although the town has had a flood plain ordinance since 1971, it has not been adequate or effective in controlling development in the flood plain. A new ordinance is under preparation which more closely follows published state guidelines.

FIGURE 1 - Upper Blue River Basin.

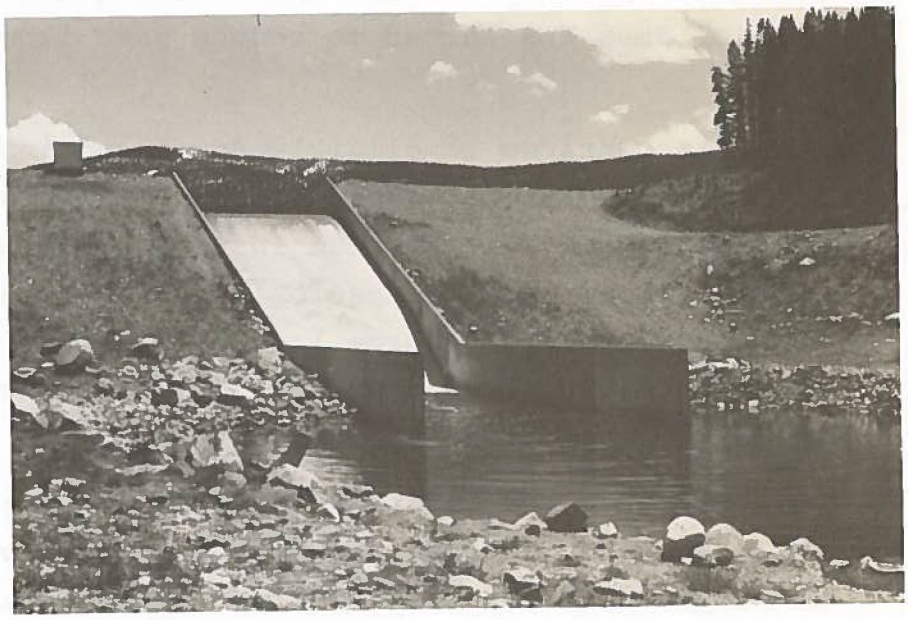


FIGURE 2 - Goose Pasture Tarn spillway

FIGURE 3 - Broken Lance Road downstream crossing of Blue River

FIGURE 4 - Four Seasons Pond spillway and pedestrian bridge

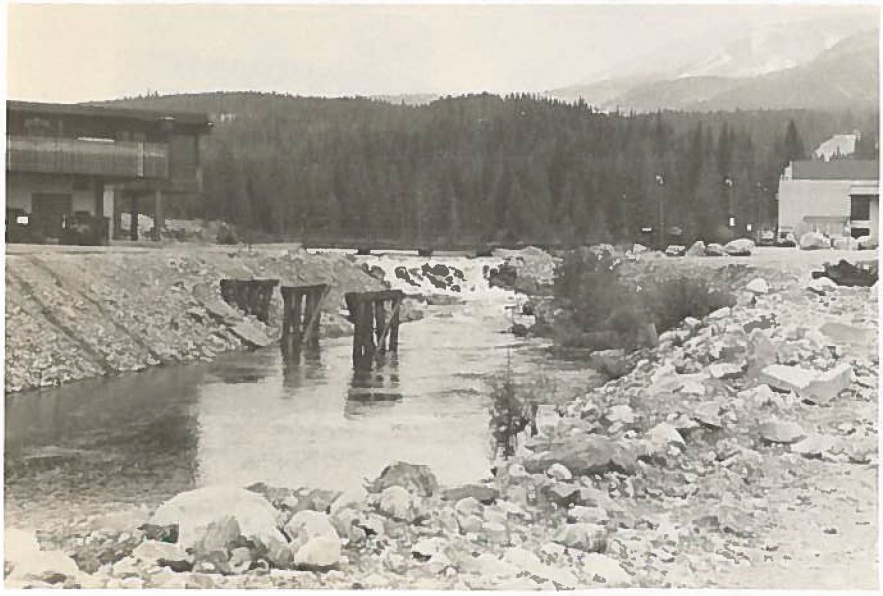


FIGURE 5 - Blue River below Four Seasons Pond dam

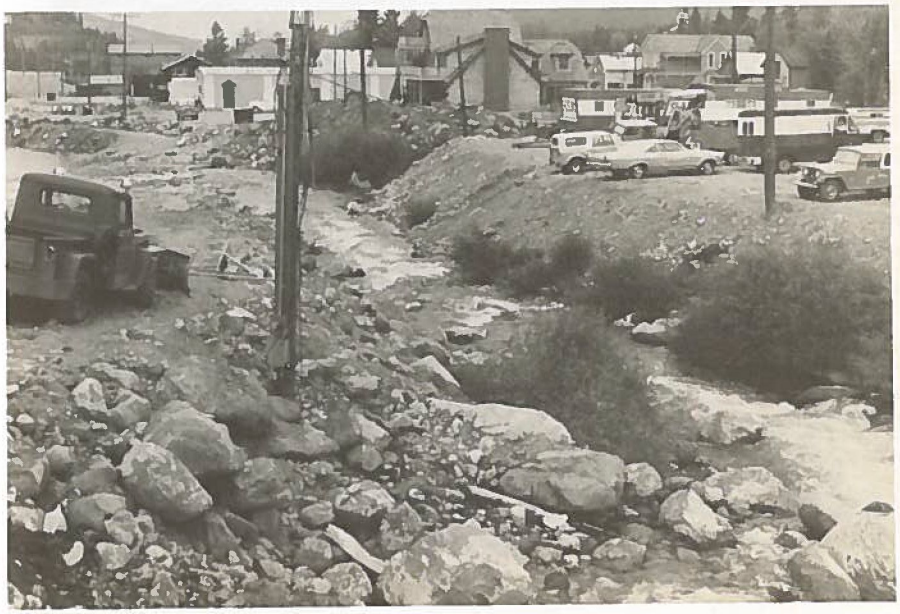


FIGURE 6 - Blue River below Village Road

FIGURE 7 - Pedestrian bridge between Village Road and Lincoln Avenue

FIGURE 8 - Blue River downstream of Lincoln Avenue

FIGURE 9 - Watson Road crossing Blue River

FUTURE FLOODS

Floods of the same magnitude as those that have occurred in the past can recur in the future, and even larger floods are possible. The discussion of future floods in this report is limited to those designated as the Intermediate Regional and Standard Project Floods. The Standard Project Flood would be larger and occur less frequently than the Intermediate Regional Flood. The Standard Project Flood is a rare event, but could reasonably be expected to occur in the future. In addition to determining the Intermediate Regional Flood and the Standard Project Flood, the 10 and 25-year recurrence floods have also been identified at various design points along the Blue River into Dillon Reservoir. Floods larger than the Standard Project Flood are also possible, but the probability of their occurrence becomes increasingly remote.

Determination of the runoff for these floods was based on hydrologic computation, which included analysis of available records of past floods and consideration of pertinent meteorologic and physiographic conditions. Snowmelt floods on the river and cloudburst floods in the tributary basins create the more severe flood conditions in the study area.

FREQUENCY OF FLOODING

The Intermediate Regional Flood is one that could occur about once in 100 years on the average, although it has a one percent probability of being equalled or exceeded during any one year. The runoff from a Standard Project Flood is that generated by a severe combination of meteorological conditions reasonably characteristic of the hydrologic region excluding extremely rare combinations. It is difficult to assign a frequency to the recurrence of a storm of such magnitude but for purposes of this study can be regarded as having recurrence of about once in 500 years.

As mentioned previously, storm-producing events in the Blue River basin can come from either a snowmelt condition or a cloudburst or thunderstorm in the basin. Both conditions were investigated and the type of activity producing the highest runoff for the recurrence interval being investigated was chosen as the design runoff for that interval.

The peak discharge from the snowmelt condition occurs primarily in mid-June and was determined by preparing flow frequency curves from past streamflow records. Consideration was given to climatic conditions as they relate to snowmelt and to the runoff characteristics of the basin. Flooding derived from cloudbursts or thunderstorms occurs primarily after the middle of June and usually during July or August. Due to the lack of available precipitation data in the basin, it was not possible to evaluate major thunderstorm events that had occurred in the past. Because of the lack of data, synthetic storms were derived from statistical analysis of rainfall data presented in Technical Paper 40 of the U.S. Department of Commerce, Weather Service. It was found that the runoff generated from the snowmelt gave higher peak discharges for the frequent runoff events, such as the 10-year, whereas the runoff from a cloudburst type storm gave higher peak discharges for the Intermediate Regional and Standard Project Floods. Peak flows for the four recurrence interval floods are shown in Table 3 for selected locations along the Blue River:

Table 3

PEAK DISCHARGES (cfs)

	10	25	IRF	SPF
Out of Tarn	450	800	900	1200
Below Lehman Gulch	500	800	900	1300
Below Illinois Gulch	500	800	900	1400
Below Sawmill Gulch	550	800	900	1400
Below French Gulch	700	850	1200	1900
Below North Barton Gulch	750	850	1200	1950
Below Swan River	1050	1150	1250	2400

HAZARDS OF LARGE FLOODS

The amount and extent of damage caused by any flood depends on the topography of the area flooded, depth and duration of flooding, velocity of flow, and developments in the flood plain. The occurrence of an Intermediate Regional or Standard Project Flood on streams in the study area at the present time would result in inundation of land adjacent to the river, damage to residences, roads, streets, bridges and culverts, public utilities, and interruption of traffic. Flood waters flowing at high velocity and carrying floating debris create conditions hazardous to persons and vehicles attempting to cross flooded areas. High velocity flows through Breckenridge can erode stream banks thereby threatening the foundations of buildings and bridge abutments and creating hazard to curious spectators and occupants of structures. Cold nights during the early part of the runoff season cause streets subject to shallow flooding to become glazed ice. Sewage, garbage and other organic materials carried or deposited by flood waters create hazards to health. Serious problems could result in providing emergency medical, fire and law enforcement services to areas isolated by floods.

FLOODED AREAS AND FLOOD DAMAGES

The areas along the Blue River through the town of Breckenridge that would be inundated by the Intermediate Regional and Standard Project Floods are shown on Plates 4 through 10. Plate 3 is an index map showing the relative location of the plates within the town of Breckenridge.

During floods, debris collecting on bridges or culverts decreases the flow carrying capacity and causes greater water depths upstream of the structures than would have occurred without them. The maps and illustrations reflect consideration of the channel as it exists today and show the backwater effects with the crossings assumed completely plugged with debris. With few exceptions the primary cause of flooding outside of the banks is caused by debris accumulation plugging the crossing structure. Between the Village Road and Lincoln Ave. crossings flood flows leave the banks on the east side of the channel due to inadequate channel capacity. In addition to the crossing structures, the Four Seasons Pond dam also causes localized flooding. Due to the steepness of the channels in the upper or southern portion of the reach, flood flows would normally be contained within the channel banks with the exception of these obstructions.

At the Four Seasons Pond both the Intermediate Regional and Standard Project Floods are forced out of the banks of the channel and localized flooding occurs. Flood waters of both events, however, are generally contained in the area west of Highway 9.

Between the Village Road and Lincoln Ave. crossings the channel of the Blue River on the east side is not adequate to pass either the Intermediate Regional or Standard Project Floods. The water will leave the bank near the existing pedestrian bridge crossing between these two roads. Once

the water is out of the channel, a wide band of flooding through the town, paralleling the river, will occur. The flooding compounded by the Lincoln and Watson road crossings which, if plugged with debris, also will contribute to water leaving the channel. Several residences and commercial buildings will be affected by the flood waters. Most of the flood waters return to the channel below Watson Road and above French Gulch.

Damage during the Standard Project Flood would be more extensive than during the Intermediate Regional Flood due to the wider floodplain, greater depth of flooding, higher velocity of flow, and longer duration of flooding. Plates 11 through 16 show water surface profiles of both the Intermediate Regional and Standard Project Floods. The depth of flow in the channel can be estimated from these illustrations as well as from the reference points in Table 4. These elevations refer to the water level in the Blue River channel which may differ from elevations in the town once the water has left the river channel. Sheet flooding within the town would generally not exceed a 2 foot depth. Typical cross-sections of the flood plain at selected locations are shown on Plate 17.

In addition to the potential flood hazard from the Blue River there also exists a flood hazard from the tributaries within the town, such as Lehman and Illinois Gulches. The damages caused by a flood from the tributaries can equal or exceed the damages caused by a flood on the Blue River.

OBSTRUCTIONS

Bridges and culverts form obstructions to flood flows in the study area. Table 5 summarizes pertinent data on these obstructions. As may be seen from Plates 4 through 10, the effect of obstructions is to raise the water surface elevation upstream. Bridges are susceptible to structural

Table 4

FLOOD PLAIN REFERENCE DATA

Reference Point Number	Distance in feet	Approx. Streambed Elev.	IRF Elev. MSL	SPF Elev. MSL	Remarks
1	117,820	9446	9455.5	9456.0	Cemetery Road
2	118,330	9450	9456.2	9457.0	
3	118,620	9454	9456.8	9457.5	Cross Section 1-1
4	119,220	9465	9467.2	9468.0	
5	119,670	9475	9479.3	9480.7	
6	119,960	9478	9481.7	9483.7	
7	120,440	9488	9490.3	9491.6	
8	120,910	9495	9498.4	9499.6	
9	121,280	9501	9504.9	9505.6	
10	121,660	9507	9510.5	9511.3	
11	122,020	9512	9515.6	9516.3	
12	122,430	9522	9528.0	9528.6	Cross Section 2-2
13	122,720	9531	9534.5	9535.1	
14	122,960	9538	9541.9	9542.1	
15	123,040	9541	9553.9	9554.7	Watson Road
16	123,140	9545	9554.1	9555.0	
17	123,550	9552	9555.0	9556.1	
18	123,820	9558	9561.7	9562.4	
19	123,910	9560	9572.0	9572.5	Lincoln Avenue
20	124,020	9564	9572.1	9573.0	
21	124,520	9575	9580.3	9581.2	Cross Section 3-3
22	124,870	9582	9586.0	9586.7	
23	125,110	9583	9588.1	9589.2	
24	125,440	9583	9588.7	9589.9	
25	125,620	9584	9589.0	9590.5	
26	125,860	9601	9613.1	9613.5	Village Road
27	126,260	9612	9615.8	9616.5	4 Seasons Pond Dam
28	126,980	9615	9620.0	9620.2	
29	127,430	9625	9629.3	9629.5	Cross Section 4-4
30	127,850	9632	9634.2	9635.2	
31	128,090	9638	9652.5	9653.0	Broken Lance Road D/S
32	128,280	9643	9653.0	9653.7	
33	128,760	9656	9659.0	9659.8	
34	129,120	9661	9662.7	9664.5	
35	129,210	9662	9668.9	9669.6	Broken Lance Road U/S
36	129,380	9664	9669.2	9669.9	Limit of Study

Table 5

BRIDGE AND CULVERTS

Structure	Type	Elevation above mean sea level: Invert	Top of Clearance	Roadway	Intermediate Project Flood	Standard Project Flood
Cemetery Road	3-Iron Pipe Culverts 52" Dia.	9446.1	9450.8	9454.9	9455.5	9456.0
Watson Road	1-CMP Culvert 6' Dia.	9540.9	9546.9	9551.6	9553.9	9554.7
Lincoln Avenue	3-Iron Pipe Culverts 54" Dia.	9560.4	9566.8	9569.5	9572.0	9572.5
Village Road	2-CMP Culverts 8' Dia.	9601.0	9609.3	9612.0	9613.1	9613.5
Broken Lance Road (downstream)	2-RCP Culverts 6' Dia.	9638.3	9644.4	9651.6	9652.5	9653.0
Broken Lance Road (upstream)	Bridge	9662.0	9669.2	9671.0	9668.9	9669.6

damage from the force of floodwater and floating debris. The culverts are more likely to be plugged by debris. It is very probable that once these structures are overtopped by the rapidly moving floodwaters, erosion and washout will occur.

Two new crossings on the Blue River are proposed by the town; one between Lincoln Ave. and Village Road and the other downstream from Watson Road. The two crossings were assumed capable of passing both the Intermediate Regional and Standard Project Floods. These crossingswere in the planning stage and no engineering designs were available at the time of this report.

URBANIZATION

Urbanization without regard to proper drainage design can cause a considerable increase in flood flows. Urbanization within and immediately adjacent to the flat valley floor of both the Blue River and the tributary gulches has the greatest affect on increasing runoff. The increase in runoff will be greatest if the development has a considerable amount of impervious ground cover, such as parking lots, sidewalks and roofs. Proper land use control and city planning can prevent this from occurring. Development can continue in an orderly and planned manner with due regard to the drainage function such that increased peak flows do not add appreciably to the damage potential. Keeping the amount of impervious ground cover to a minimum, detaining the water at its source, and proper design of streets, culverts and other drainage facilities are key elements in preventing increased flood damages due to urbanization.

SUMMARY

This report has identified the probable flooding limits of an Intermediate Regional Flood and Standard Project Flood. As mentioned previously, floods of greater magnitude could

occur and flooding beyond the extent of the limits shown in the report could also occur due to other factors, such as tributary flow and additional developments within the flood plain. The study has indicated that the capacity of the channel of the Blue River through the town of Breckenridge is generally satisfactory. In these few areas where flood flows exceed channel capacity, enlargement of the channel bank would alleviate the problem. The replacement of some key crossing structures with crossings that will pass both the Intermediate Regional and Standard Project Floods would eliminate much of the damage from flooding within the town. Protection of the river channel through the town is of prime importance. There should be no developments or other action which further restricts or constrains the Blue River Channel. Tributary streams can also cause flooding and the same precautions should be taken with them as with the Blue River.

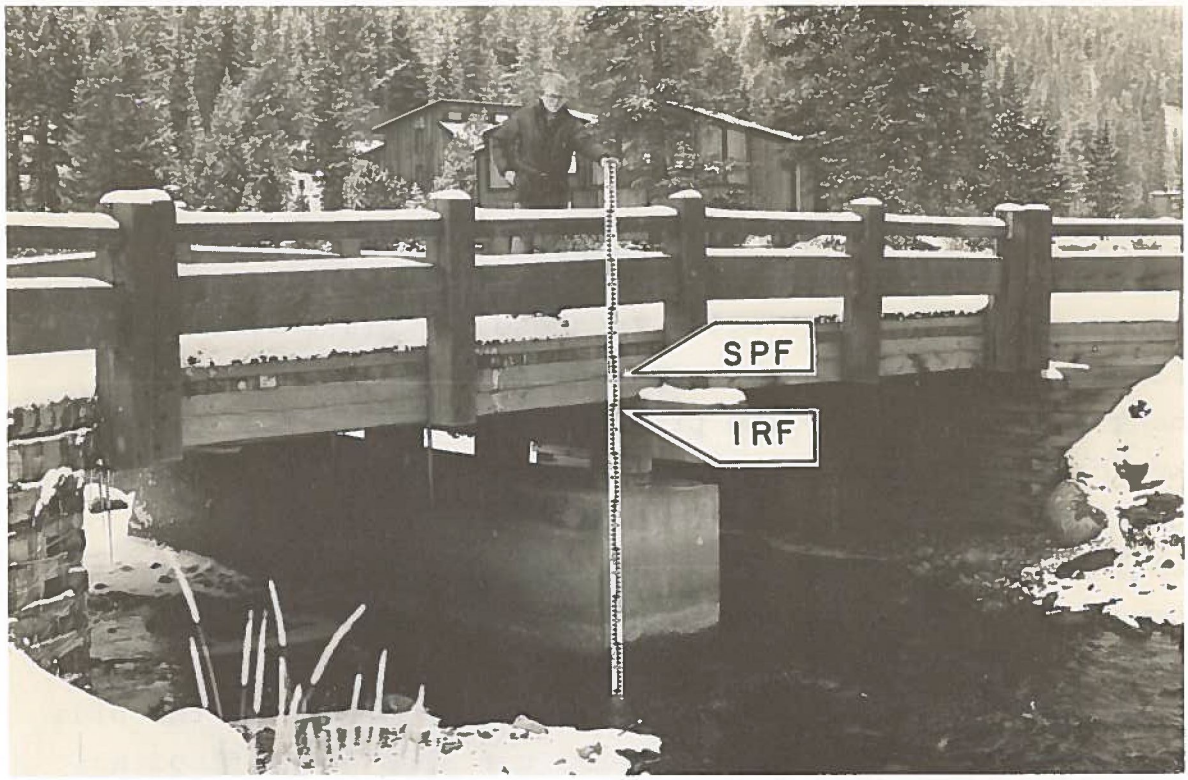


FIGURE 10 - Blue River Flood Heights At Broken Lance Road (Upstream)

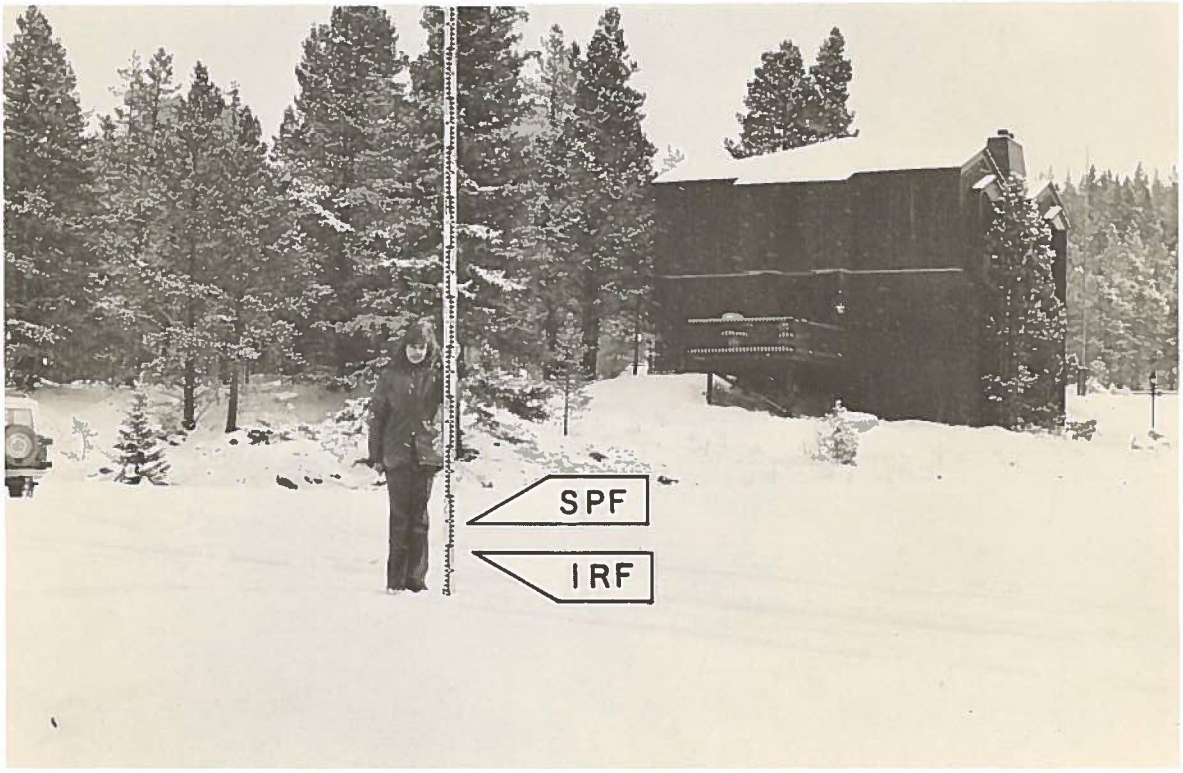


FIGURE 11 - Blue River Flood Heights at Broken Lance Road (Downstream)

FIGURE 12 - Blue River Flood Heights near Four Seasons Pond

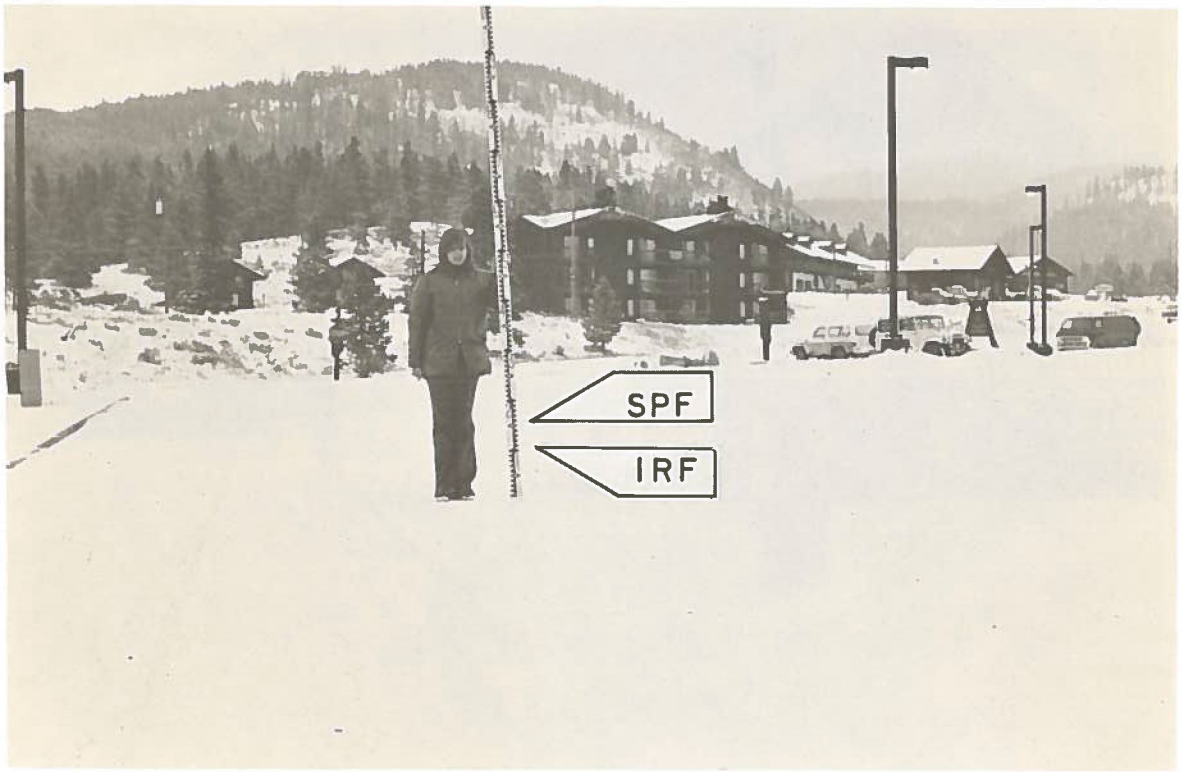


FIGURE 13 - Blue River Flood Heights at Village Road

FIGURE 14 - Blue River Flood Heights at Lincoln Avenue

FIGURE 15 - Blue River Flood Heights at Watson Road

GLOSSARY

Backwater Effect. The rise in surface elevation of flowing water upstream from and as a result of an obstruction to flow.

Cloudburst. A sudden and extremely heavy downpour of rain that is small in areal extent; of short duration; and may be accompanied by lightning, thunder, and strong gusts of wind.

Flood. An overflow of water onto lands used or usable by man and not normally covered by water. Floods have two essential characteristics: the temporary inundation of land; and the land is inundated by overflow from a river, stream lake or ocean. Normally a "flood" is considered as any temporary rise in streamflow or stage, (but not the ponding of surface water), that results in significant adverse effects in the vicinity. Adverse effects may include damage from overflow and land areas, temporary backwater effects in sewers and local drainage channels, and creation of unsanitary conditions or other unfavorable situations from deposition of materials coincident with increased streamflow.

Flood Peak. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest, the maximum stage or elevation reached by the flood flow.

Flood Plain. The relatively flat area or lowlands adjoining a river, stream, watercourse, ocean, or lake, which have been or may be covered by flood water.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Floodway. The channel of the stream and that portion of the flood plain which is used to carry flood flows.

Intermediate Regional Flood. A flood having an average frequency of occurrence on the order of once in 100 years although it has a statistical one percent chance of being equalled or exceeded during any one year.

Sheet Flow. Broad, shallow overland flood flows varying from a few inches in depth to two feet.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations.

LEGEND

- U.S.G.S. Stream Gage
- U.S. Weather Bureau Station
- U.S.D.A. Snow Course Station
- Basin Boundary
- Reservoir or Lake

2 0 2 4

SCALE OF MILES

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

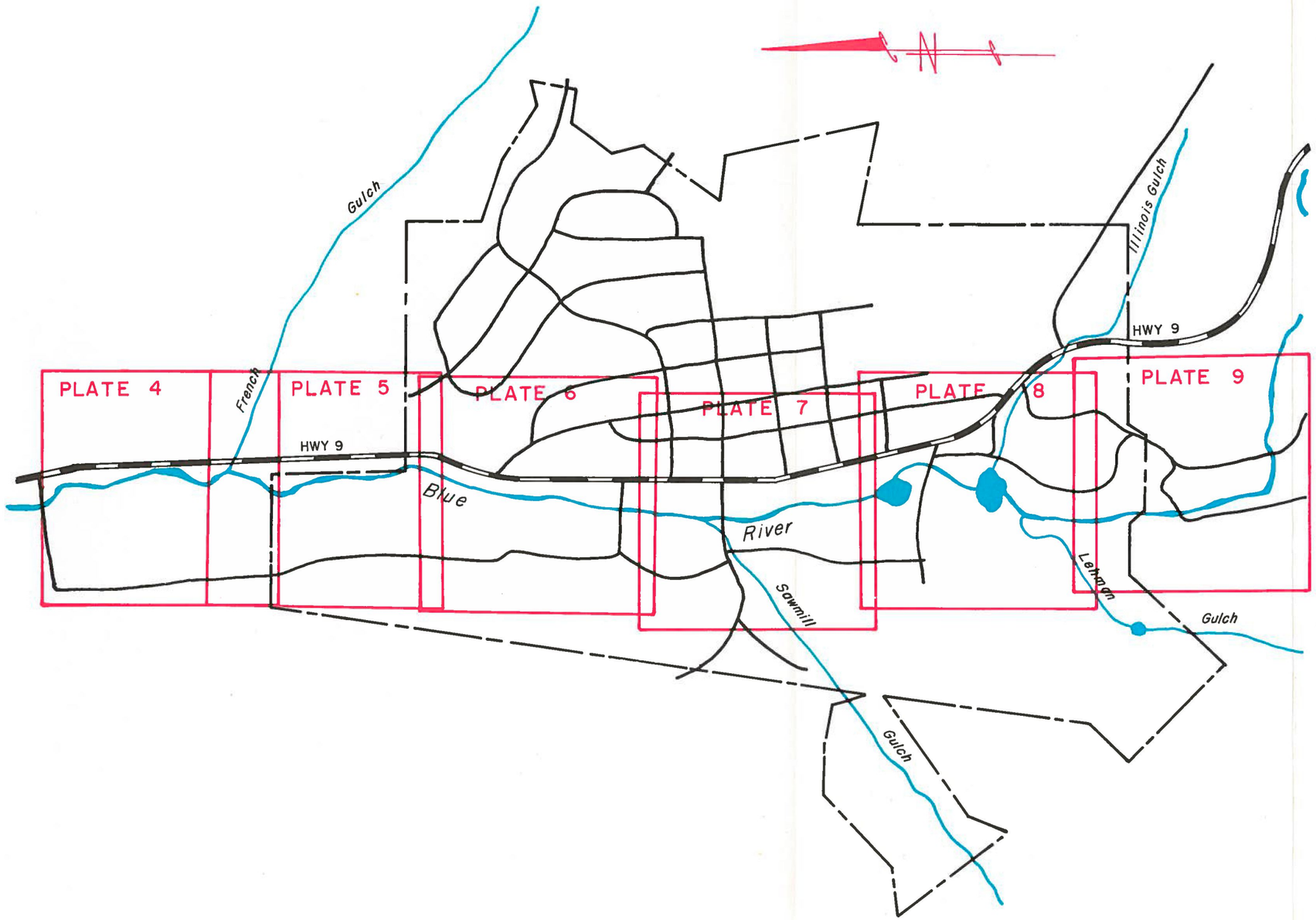
BRECKENRIDGE, COLORADO

BASIN MAP

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 2



COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

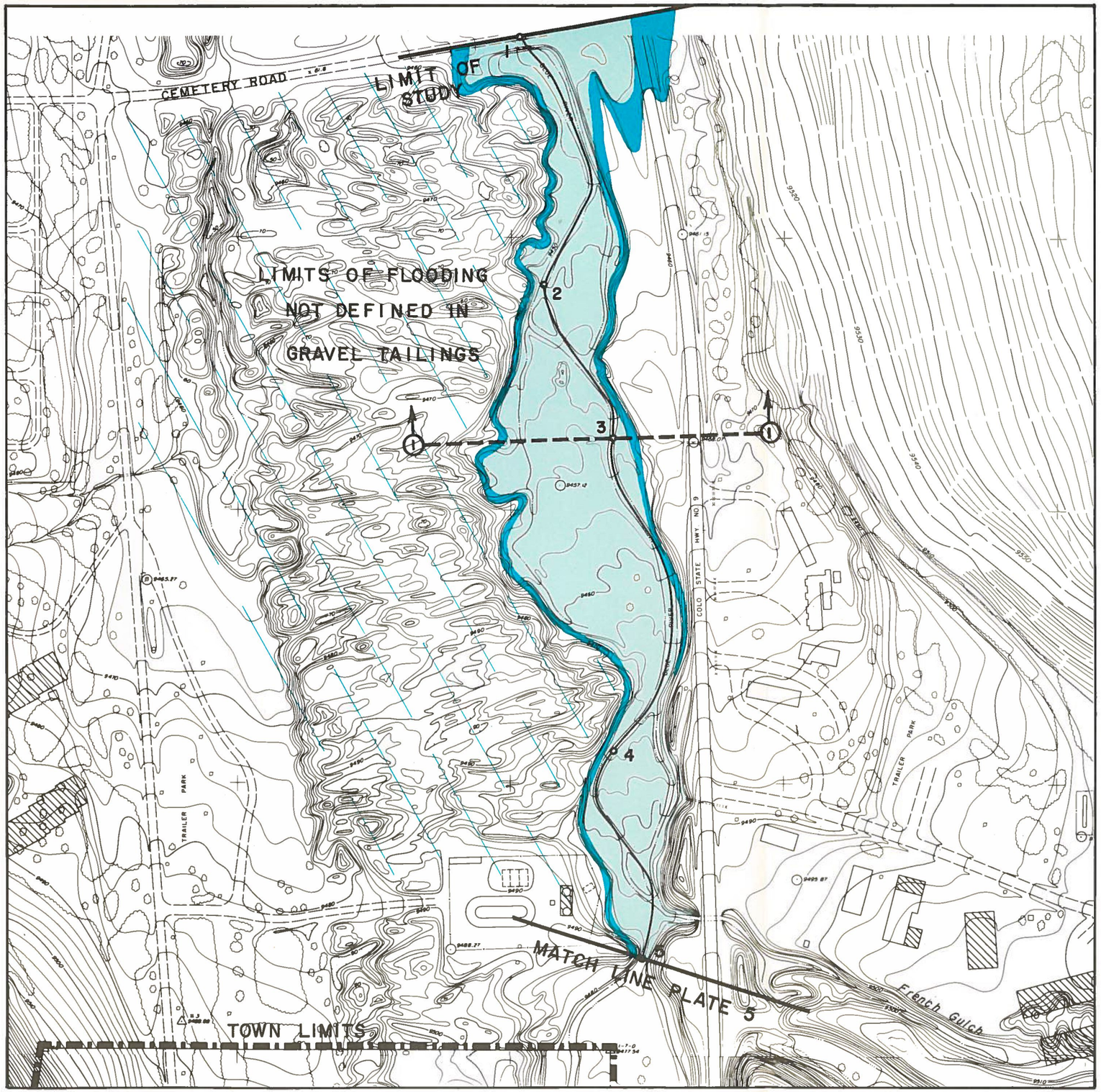
BRECKENRIDGE, COLORADO

INDEX MAP

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 3



LEGEND

INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD

SHEET FLOW

CHANNEL AND VALLEY CROSS SECTION

28 REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plate 11. For Cross Sections see Plate 17.

200 0 200 400

SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

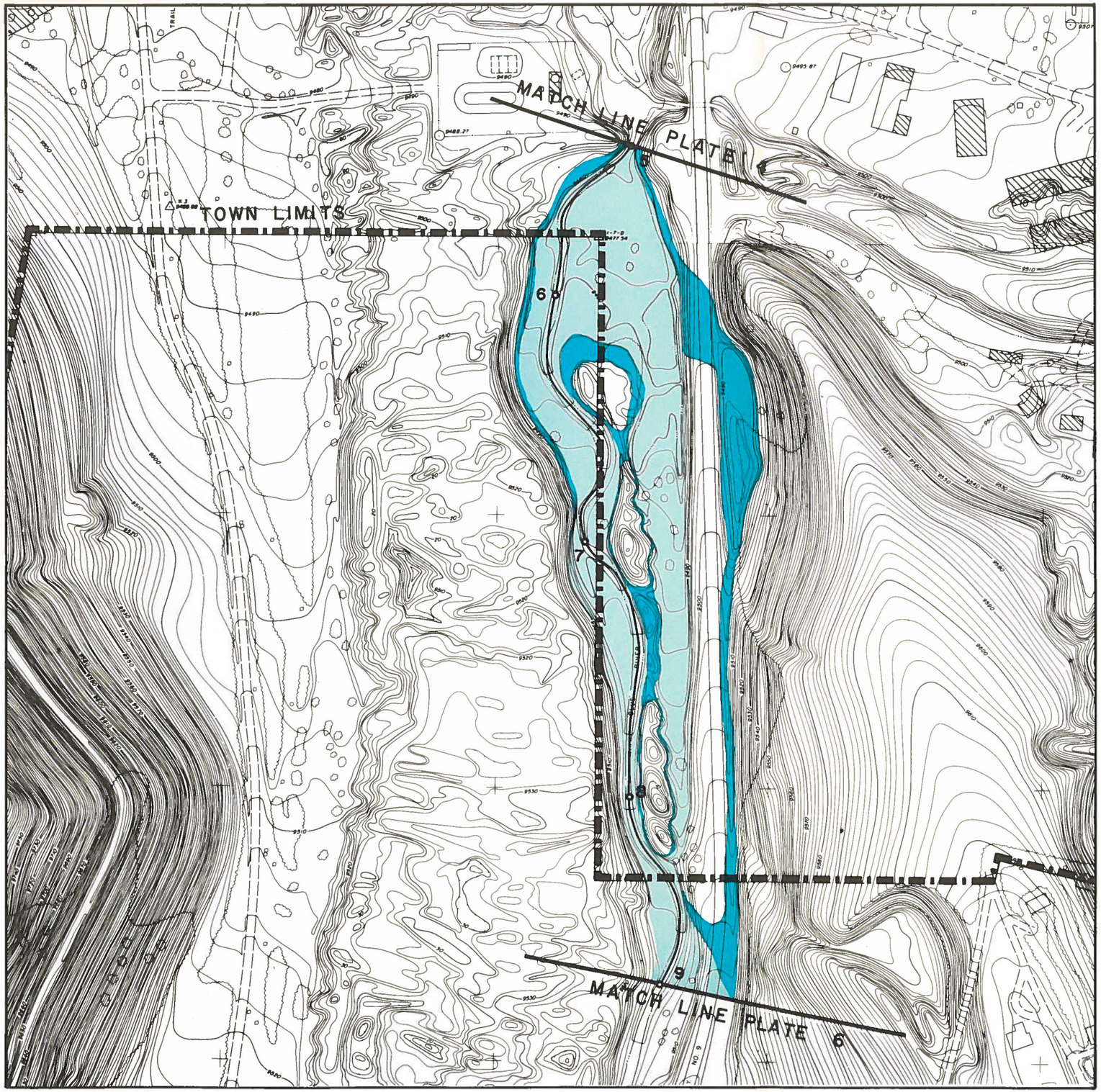
BRECKENRIDGE, COLORADO

FLOODED AREAS

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 4



LEGEND

INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD

SHEET FLOW

3 CHANNEL AND VALLEY CROSS SECTION

28 REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plate 12. For Cross Sections see Plate 17.

200 0 200 400

SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

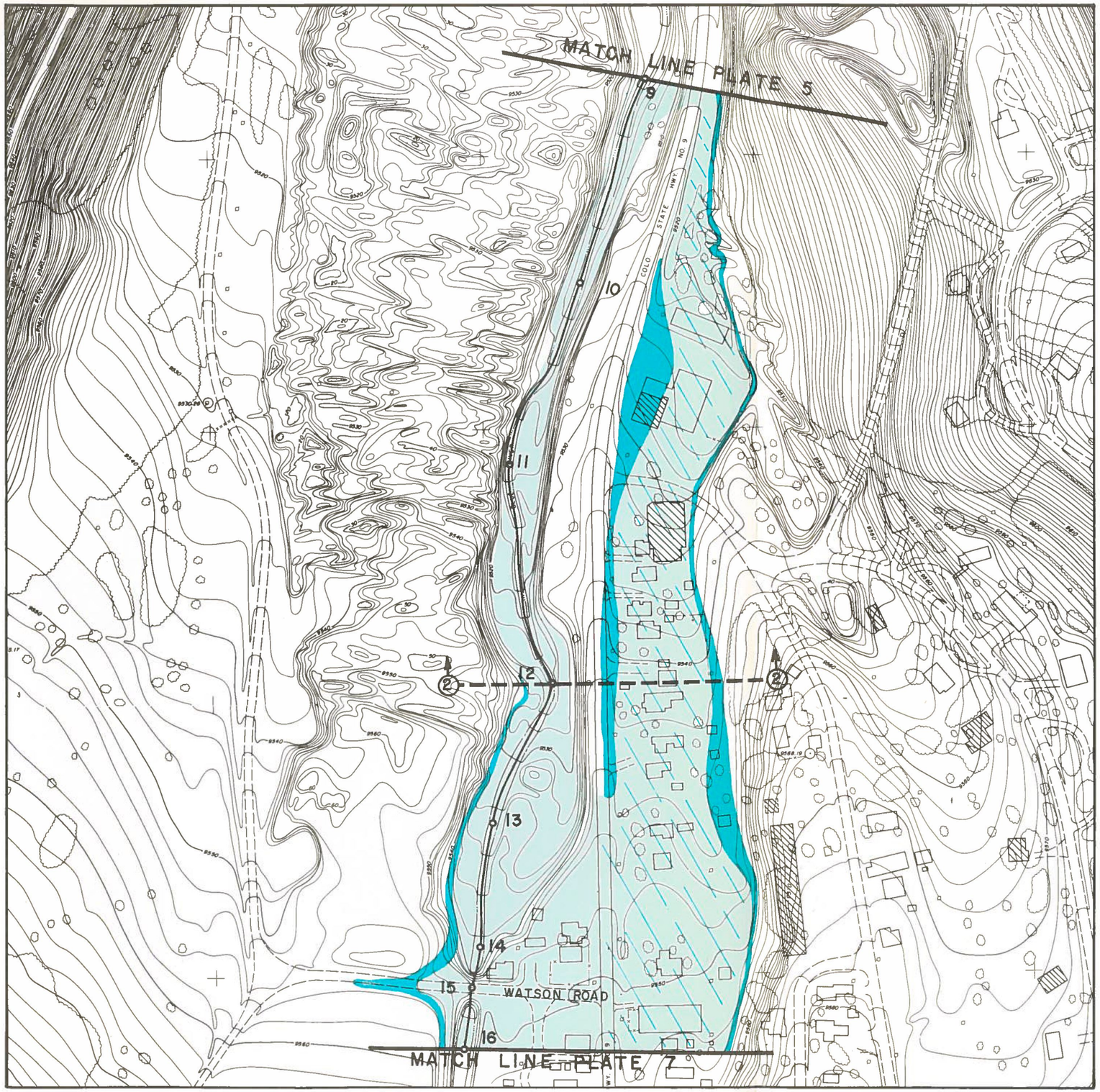
BRECKENRIDGE, COLORADO

FLOODED AREAS

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 5



LEGEND

INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD

SHEET FLOW

3 CHANNEL AND VALLEY CROSS SECTION

28 REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plate 13. For Cross Sections see Plate 17.

200 0 200 400

SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

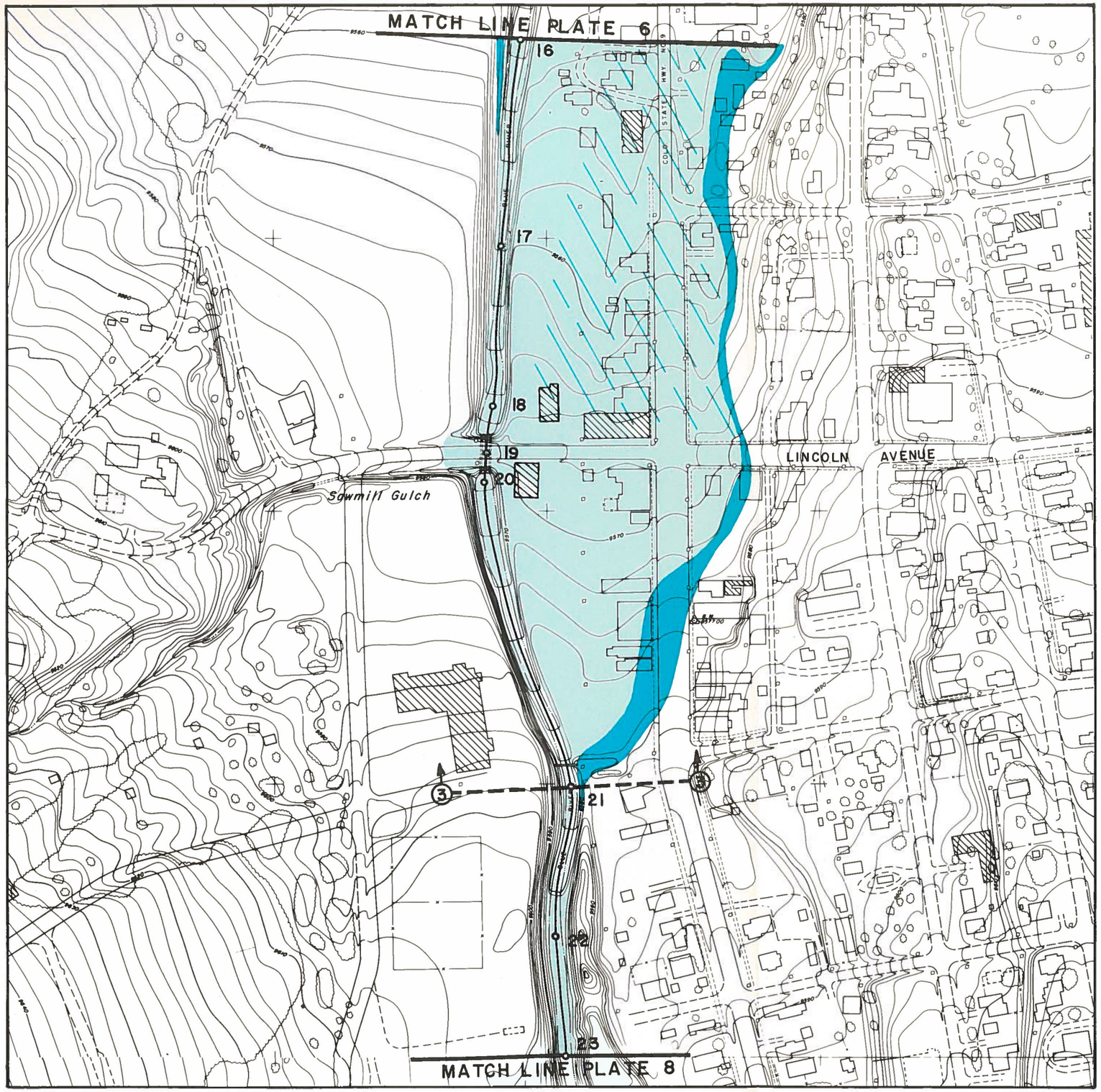
BRECKENRIDGE, COLORADO

FLOODED AREAS

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 6



LEGEND

- INTERMEDIATE REGIONAL FLOOD
- STANDARD PROJECT FLOOD
- SHEET FLOW
- CHANNEL AND VALLEY CROSS SECTION
- 28 REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plate 14. For Cross Sections see Plate 17.

200 0 200 400

SCALE OF FEET

CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD

TOWN OF BRECKENRIDGE, SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION BLUE RIVER

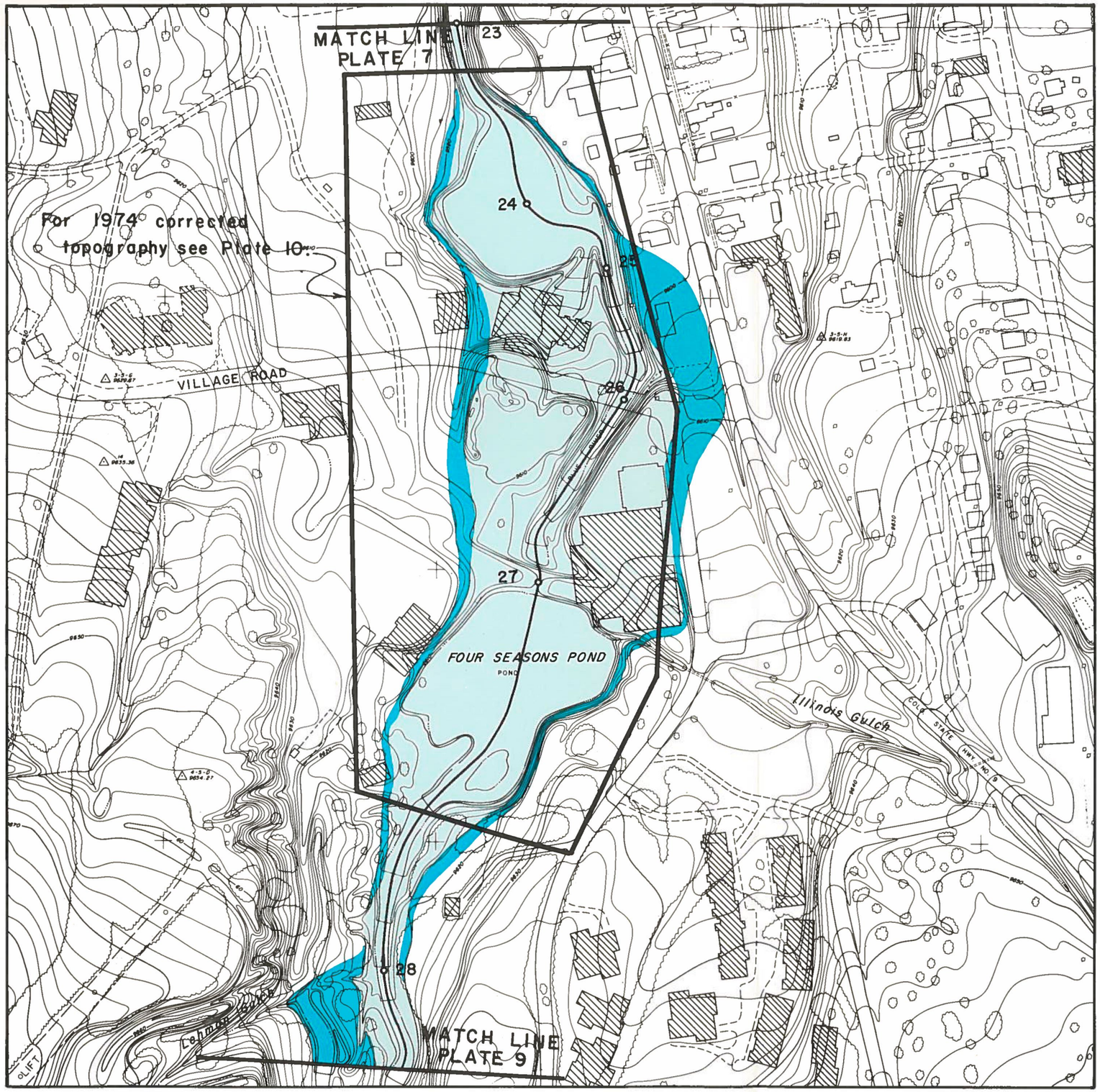
BRECKENRIDGE, COLORADO

FLOODED AREAS

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 7



LEGEND

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

SHEET FLOW

CHANNEL AND VALLEY CROSS SECTION

REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plate 15. For Cross Sections see Plate 17.

200 0 200 400

SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

BRECKENRIDGE, COLORADO

FLOODED AREAS

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 8

LEGEND

INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD

SHEET FLOW

CHANNEL AND VALLEY CROSS SECTION

28 REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plate 16. For Cross Sections see Plate 17.

200 0 200 400

SCALE OF FEET

CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD

TOWN OF BRECKENRIDGE, SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION BLUE RIVER

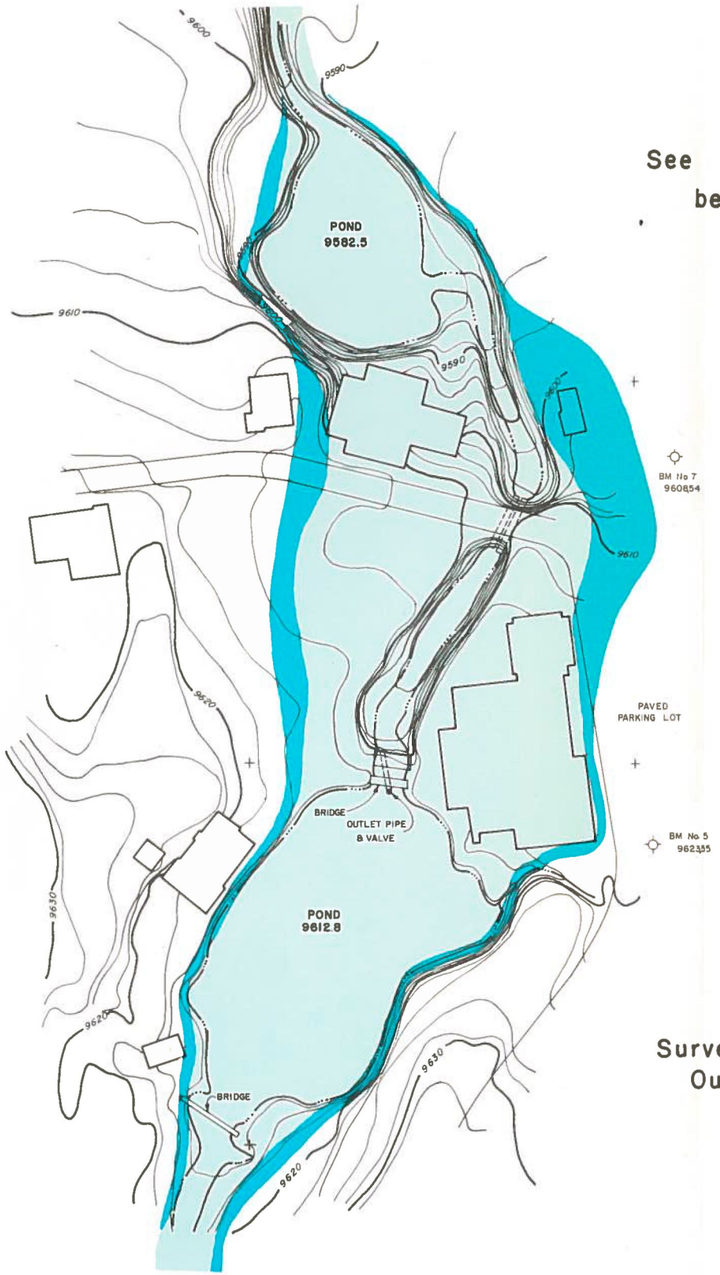
BRECKENRIDGE, COLORADO

FLOODED AREAS

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 9



See Plate 8 for topography beyond limits of this map.

Surveyed by Owens Surveying Outfit in August, 1974.

LEGEND

INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD

SHEET FLOW

3 CHANNEL AND VALLEY CROSS SECTION

28 REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plate 15. For Cross Sections see Plate 17.

200 0 200 400

SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

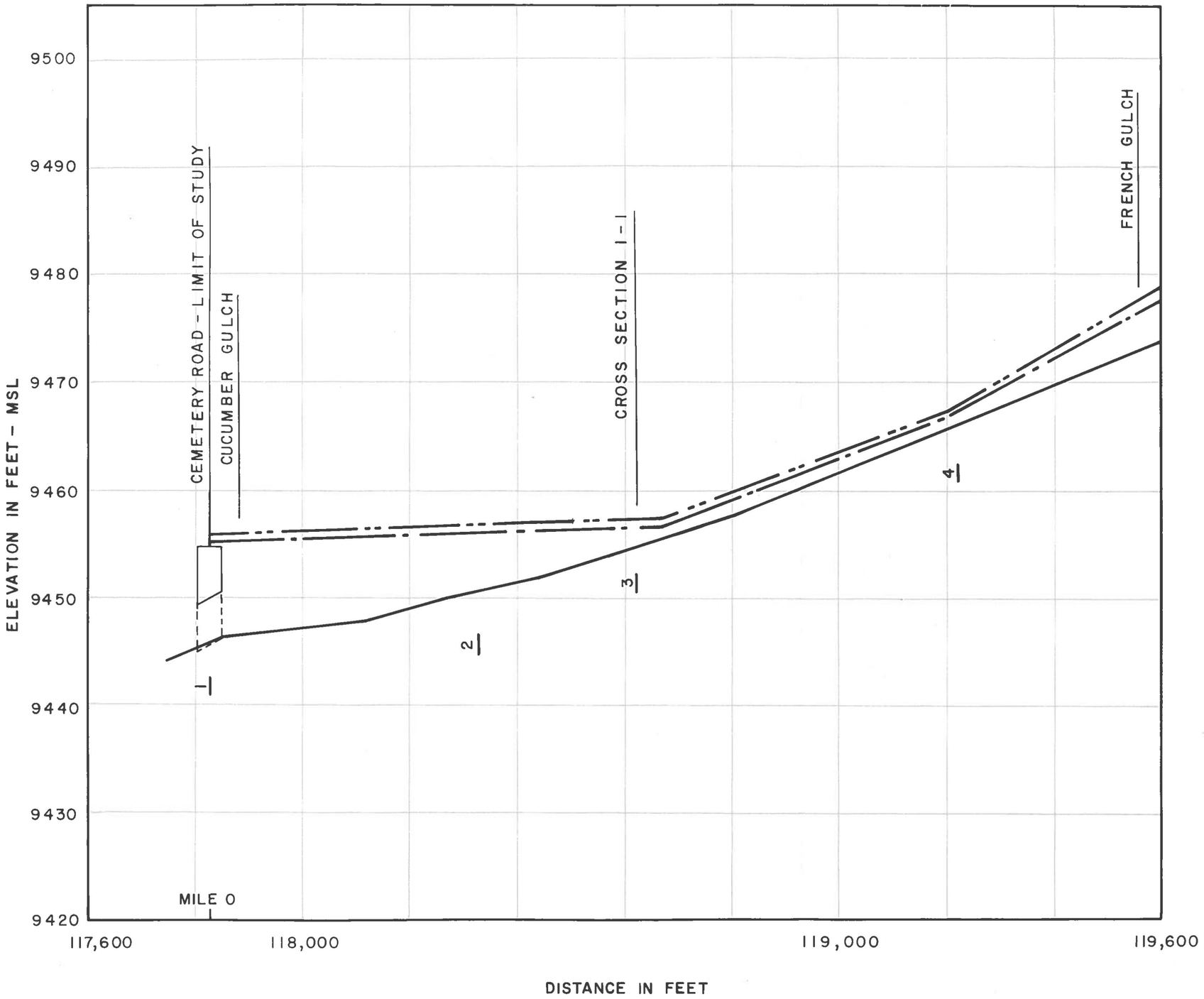
BRECKENRIDGE, COLORADO

FLOODED AREAS

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 10



LEGEND

Standard Project Flood

Intermediate Regional Flood

Low Water

3 Reference Point

NOTES:

See Table 4 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD

TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

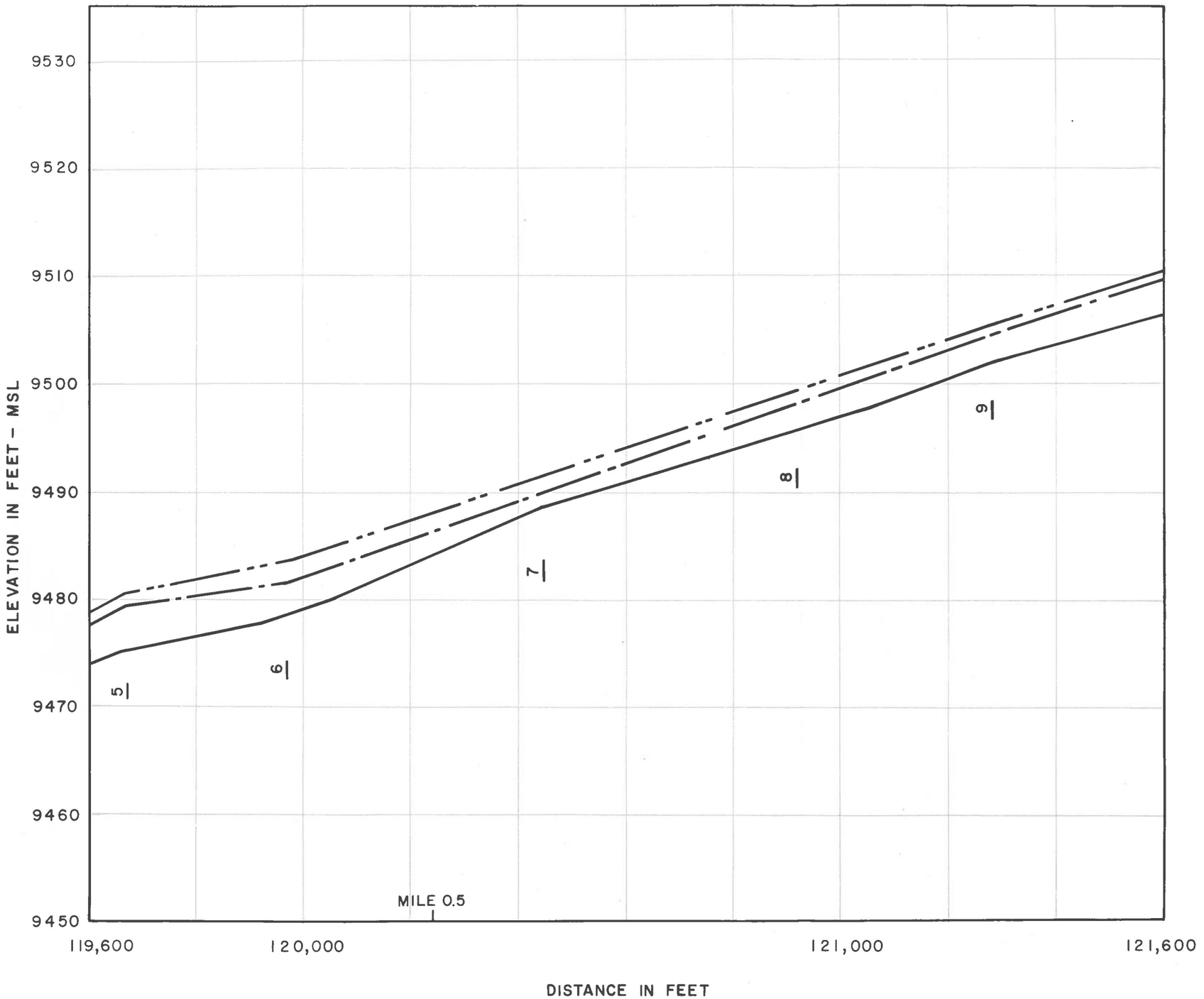
FLOOD PLAIN INFORMATION
BLUE RIVER

BRECKENRIDGE, COLORADO

WATER PROFILES

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.



LEGEND

——— Standard Project Flood

— - — Intermediate Regional Flood

——— Low Water

∞ Reference Point

NOTES:

See Table 4 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

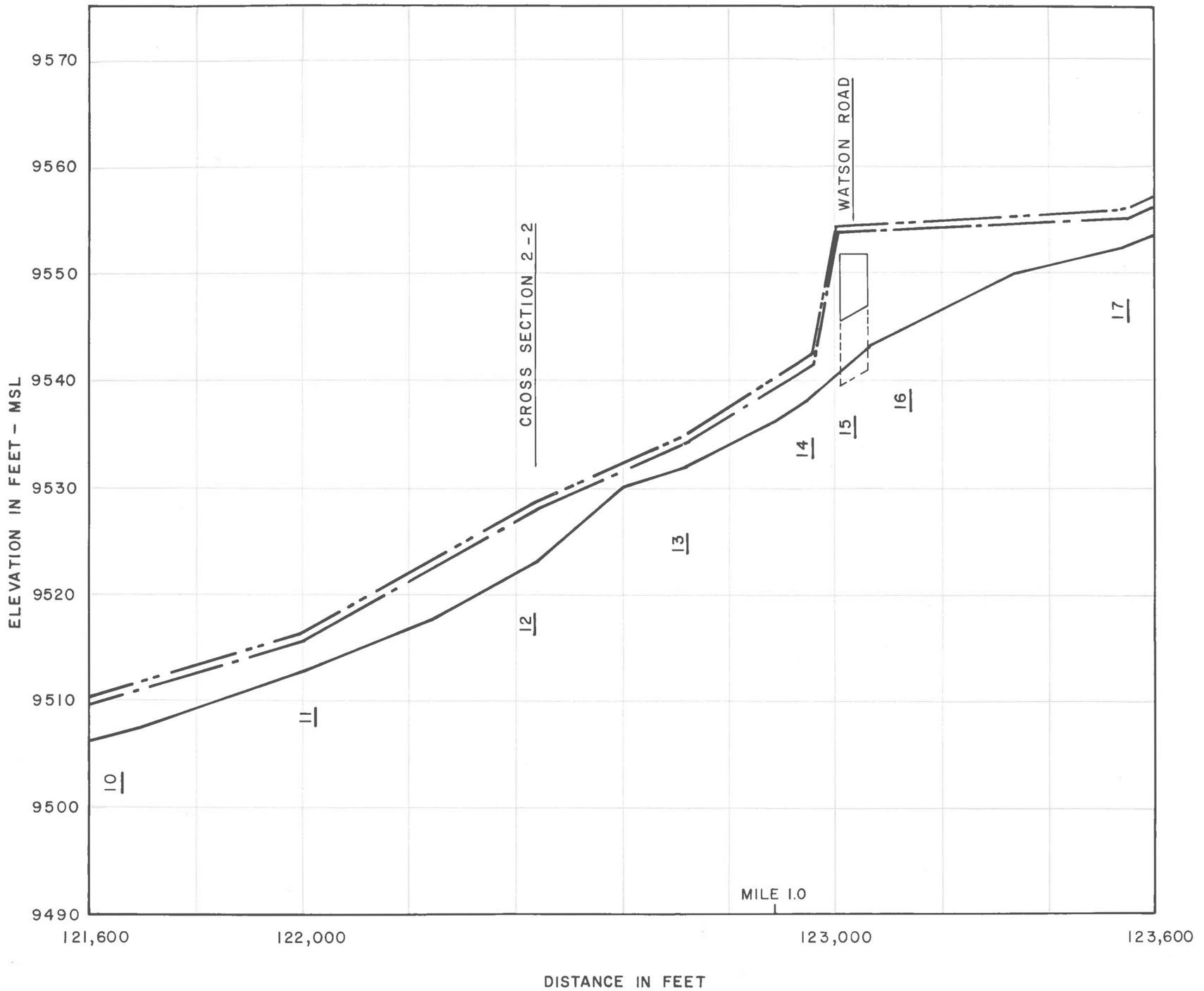
BRECKENRIDGE, COLORADO

WATER PROFILES

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 12



LEGEND

- Standard Project Flood
- Intermediate Regional Flood
- Low Water
- 14 Reference Point

NOTES:

See Table 4 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

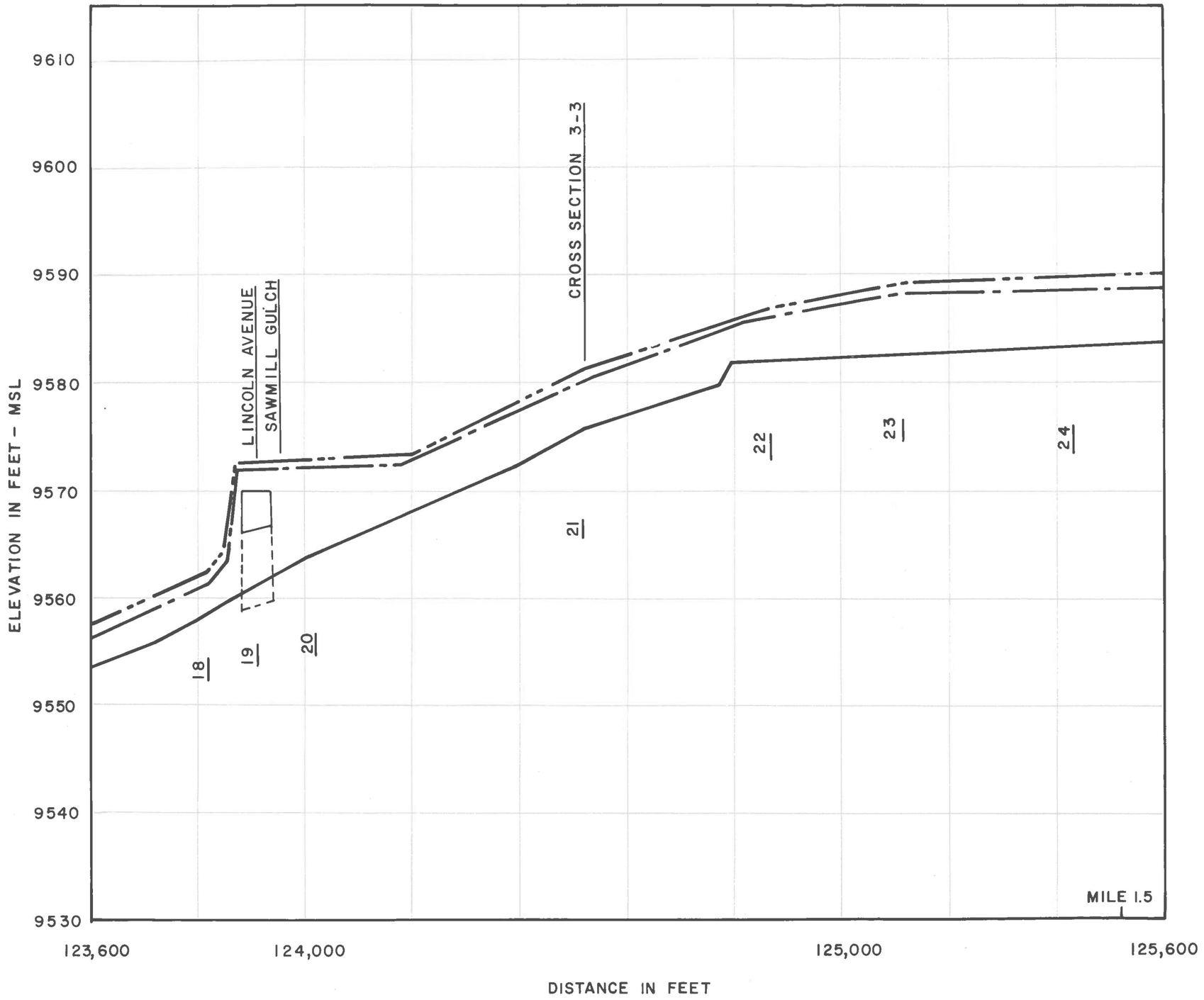
BRECKENRIDGE, COLORADO

WATER PROFILES

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 13



LEGEND

——— Standard Project Flood

— - — Intermediate Regional Flood

——— Low Water

22 Reference Point

NOTES:

See Table 4 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD

TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

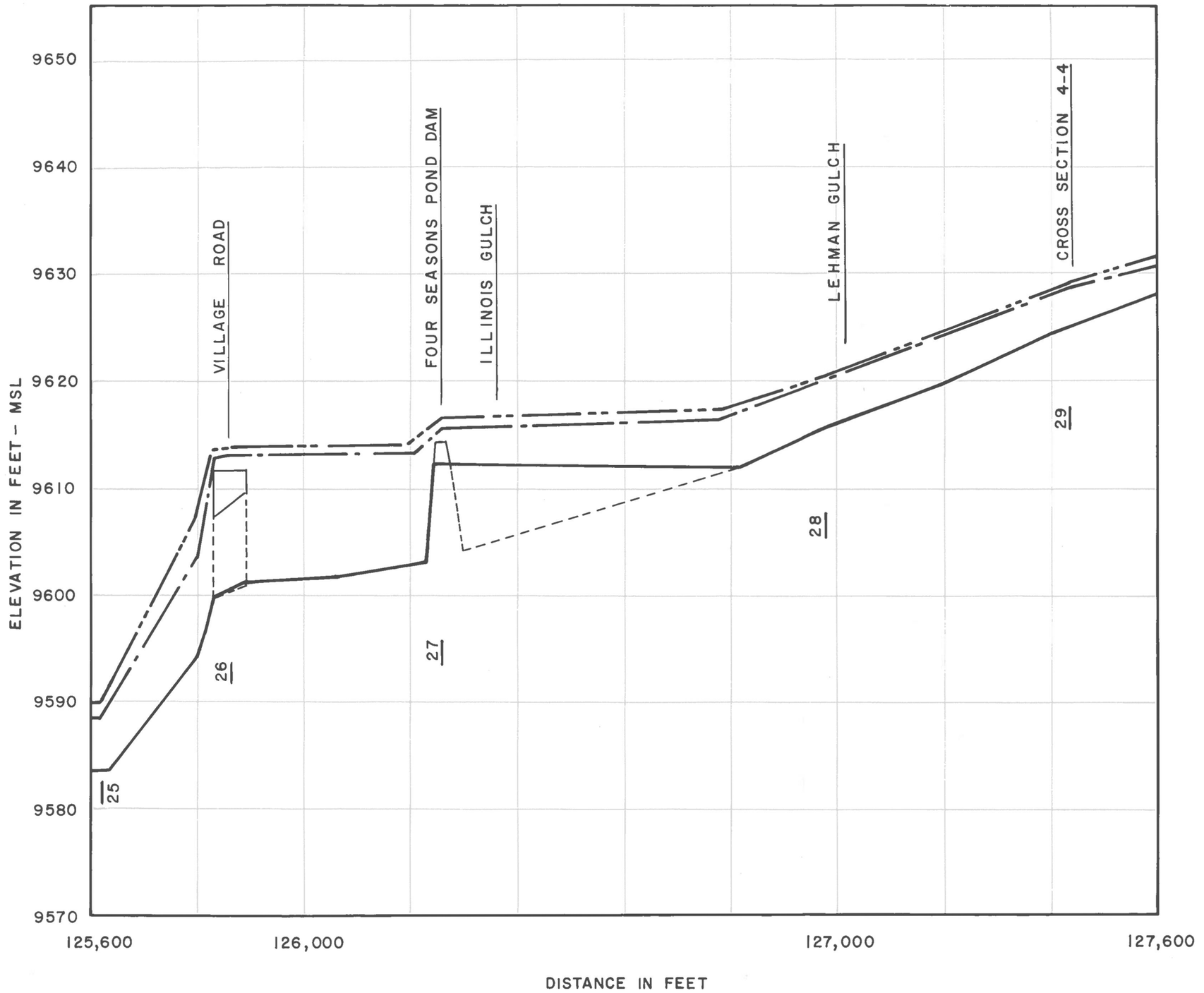
BRECKENRIDGE, COLORADO

WATER PROFILES

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 14



LEGEND

- Standard Project Flood
- Intermediate Regional Flood
- Low Water
- 28 Reference Point

NOTES:

See Table 4 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

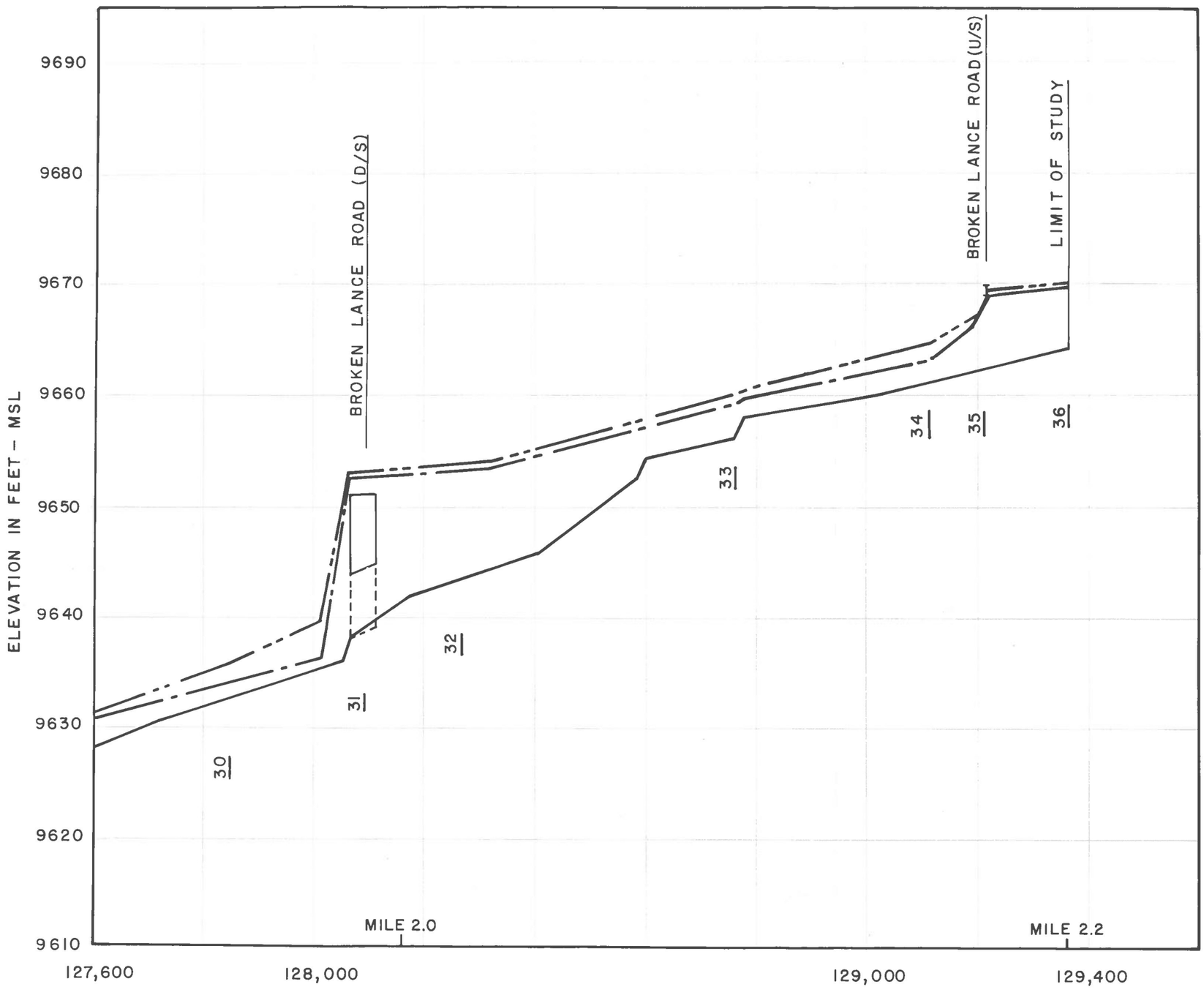
BRECKENRIDGE, COLORADO

WATER PROFILES

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 15



LEGEND

- Standard Project Flood
- Intermediate Regional Flood
- Low Water
- 33 Reference Point

NOTES:

See Table 4 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
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FLOOD PLAIN INFORMATION
BLUE RIVER

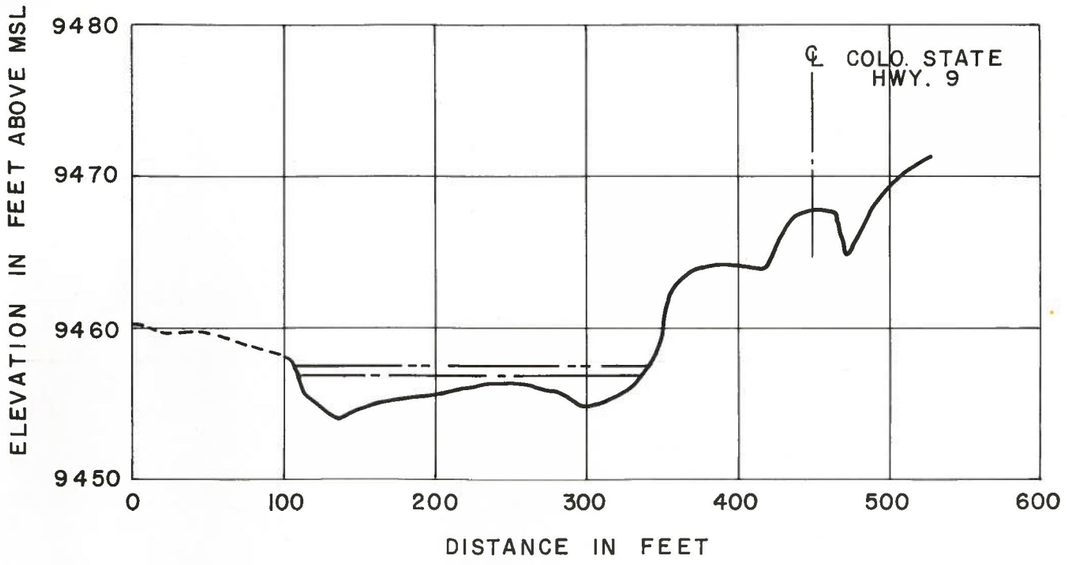
BRECKENRIDGE, COLORADO

WATER PROFILES

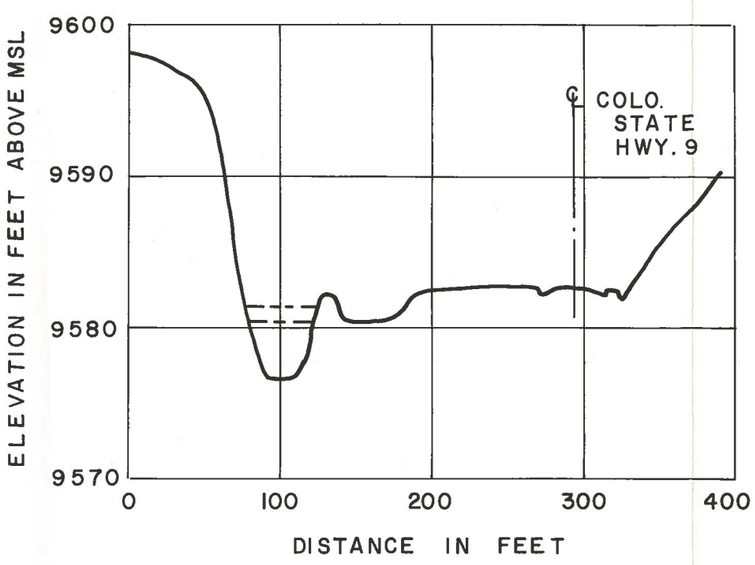
NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc

PLATE 16



CROSS SECTION 1-1



CROSS SECTION 3-3

LEGEND

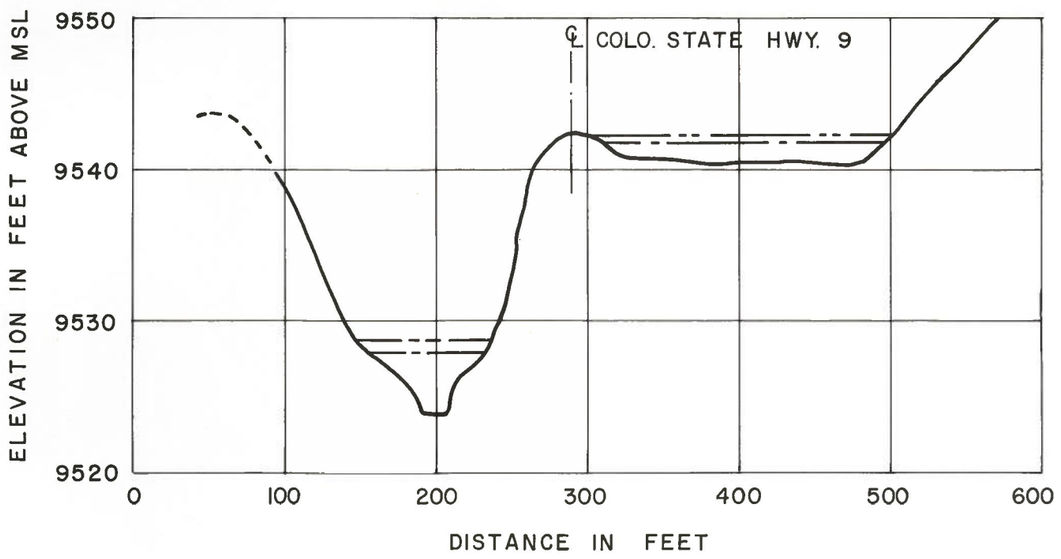
STANDARD PROJECT FLOOD

INTERMEDIATE REGIONAL FLOOD

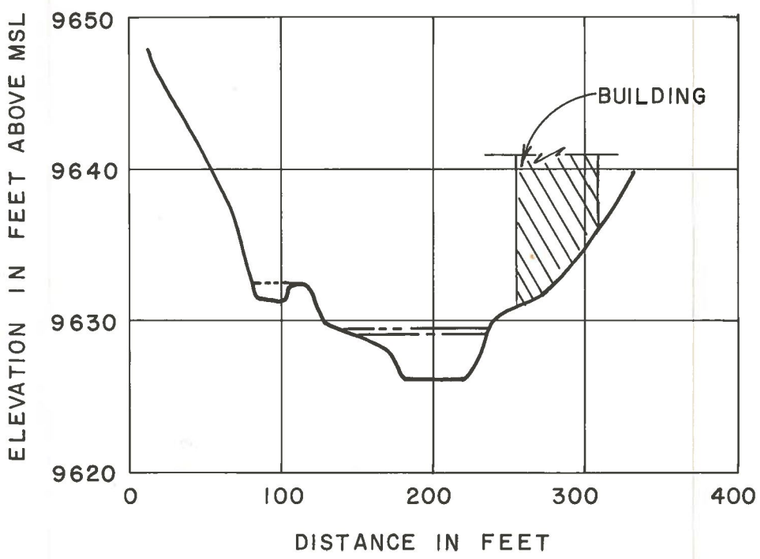
GROUND LINE

NOTES

Cross sections are viewed in direction of flow.



CROSS SECTION 2-2



CROSS SECTION 4-4

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

BRECKENRIDGE, COLORADO

CROSS SECTIONS

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 17

PART II - FRENCH, ILLINOIS, LEHMAN AND SAWMILL GULCHES

TABLE OF CONTENTS

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PREFACE

This is the second of a two-part report describing flood hazards in the vicinity of Breckenridge, Colorado. Part I identifies flood conditions along the Blue River; Part II describes flood hazards for the major tributaries in or adjacent to the town. These tributaries include French, Illinois, Lehman and Sawmill Gulches. The study reach is a lower portion of each gulch within the area where development is expected to occur.

BACKGROUND INFORMATION

A general description of the Blue River basin and its tributaries. including climatic and geologic information, is contained in Part I.

Illinois, Lehman and Sawmill Gulches flow into the Blue River within the town limits of Breckenridge; French Gulch is located immediately north of the existing town boundaries but portions thereof might be considered for future annexations. Development in the flood plain of the tributaries has begun in recent years. The popularity of the ski area located on the west side of Breckenridge accounts primarily for the increased development pressures. A discussion of the features of each basin follows:

French Gulch

French Gulch is an east bank tributary of the Blue River located immediately north of the town of Breckenridge. The French Gulch basin encompasses an area of approximately 11 square miles extending to the Continental Divide. A major flood occurred in French Gulch in 1965 but no substantial damage was reported, primarily because of the lack of development in the basin. In the past five years, however, the lower gulch has been channelized and a housing development has been constructed on both sides of the channel. Channel drops have been provided to control the slope and a small dam has been constructed at the upper end of the development. The study reach is approximately 0.5 miles from the dam downstream to the Blue River.

Illinois Gulch

Illinois Gulch is also an east bank tributary located near the south end of the town. The basin encompasses an area of approximately 3.5 square miles between the French Gulch basin

and Indiana Creek basin. A principal feature of this basin is the Boreas Pass Road from Breckenridge over the Continental Divide to the east slope. East of Highway 9 the channel is in its natural condition while on the west it has been relocated and channelized to allow development of the area. An existing culvert under Columbine Road near the lower end has been improperly installed and the flow is partially blocked. There is no past history of flood damage occurring in this gulch since development in its flood plain has been relatively recent. The study reach extends from the Four Seasons Pond on the Blue River a distance of 0.8 miles upstream to where the Boreas Pass Road crosses the stream channel.

Lehman Gulch

Lehman Gulch, including Carter Gulch, is a west bank tributary extending to the ridge of the Tenmile Range. The basin encompasses an area of 3 square miles. Portions of this basin are in and adjacent to the National Forest and development has not occurred, nor is expected to occur, near the channel. The study reach extends from the confluence with the Blue River, a distance of approximately 0.3 miles upstream.

Sawmill Gulch

Sawmill Gulch is also a west bank tributary of the Blue River, located north of Lehman Gulch. The basin extends to the ridge of the Tenmile Range, encompassing an area of 2½ miles. Like Lehman Gulch, it is narrow and long. The study reach extends from the Blue River a distance of 0.6 miles upstream. Development is occurring within the Sawmill Gulch basin. Also, there are a number of ski runs in and through the Sawmill Gulch basin. Condominium development has occurred immediately adjacent to the stream channel and some relocation of the natural channel has occurred. It is possible that development in this basin will continue on both private and public lands. Breckenridge has a small water storage reservoir

in Sawmill Gulch above the study reach. This reservoir is not on the main stream channel and provides no flood control benefit.

FLOOD SITUATION

HYDROLOGIC DATA

The location of basic data stations which record information on precipitation, snow depth and streamflow in the Breckenridge area is shown on Plate 2, Part I. There are no stream gages or other recording devices located on any of the tributaries in the Breckenridge area.

FACTORS AFFECTING FLOODING

As discussed in Part I, flooding is a natural function of a river and its tributaries. Debris and other natural obstructions impede flood flows and may cause backwater conditions that increase flood heights. Debris is washed downstream, collected on bridges and culverts and creates a damming effect. As the flows increase, this debris may break loose creating a wall of water and debris surging downstream until another obstruction is encountered.

Like the Blue River flood plain, man-made obstructions are present in the flood plain of the tributaries, although not to the same extent. Development is just occurring in many of the flood plains of the tributaries.

Crossing structures over the streams are a factor affecting flooding in many of the tributaries. In French Gulch, should the spillway at the pond near the upper end of the study reach become plugged, flood waters would be forced down the street rather than the channel and considerable damage could occur. Culverts under Highway 9 on French Gulch and Illinois Gulch are adequate in size and have kept clear of debris during a flooding event and will safely pass the Intermediate Regional Flood. Small culverts in the upper reaches of Illinois and Sawmill Gulches can easily become plugged with debris, forcing flood water to temporarily leave the channel and follow the roadways. These structures would very likely wash out in time and the flood waters would return to their historic channel.

FIGURE 16 (Right)- Drop Inlet Spillway at Pond on French Gulch

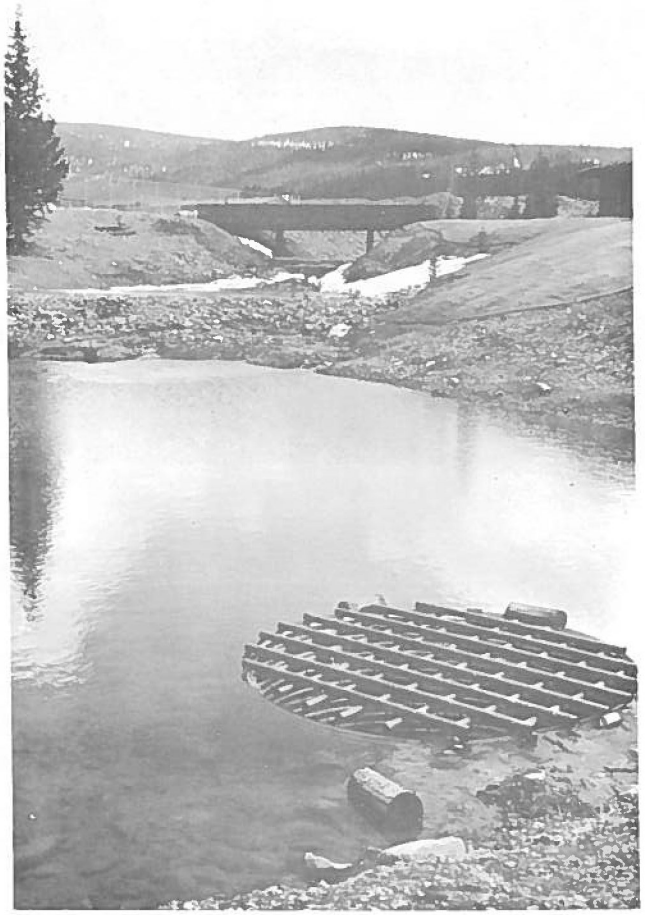


FIGURE 17 (Below) - French Gulch Channel

FIGURE 18 - Illinois Gulch Channel below Columbine Road

FIGURE 19 - Lehman Gulch near Blue River

FIGURE 20 - Condominiums adjacent to Sawmill Gulch

FUTURE FLOODS

The same general discussion on future floods in Part I for the Blue River also applies to the tributaries. The primary difference is that peak discharge from the snowmelt condition on the tributaries may occur earlier in May or June than the mid-June peak discharge which occurs on the Blue River. For the tributaries, however, it was found that the runoff generated from a major thunderstorm event gave higher peak discharges for the storm events studied. The synthetic storm was derived from statiscal analysis of rainfall data presented in Technical Paper 40 of the U.S. Department of Commerce, Weather Service, and the storm was assumed centered over the tributary under investigation with precipitation covering the entire basin. The peak flow was determined for each tributary immediately upstream of its confluence with the Blue River. Flows for the four recurrence interval floods are shown in Table 6:

Table 6

TRIBUTARIES' PEAK DISCHARGES (cfs)

Gulch	10	25	IRF	SPF
French	280	375	708	880
Illinois	132	165	330	520
Lehman	201	245	578	750
Sawmill	45	51	117	179

HAZARDS OF LARGE FLOODS

A general discussion of the hazards of large floods is contained in Part I and is applicable also to the tributaries. The extremely steep slope on the tributaries, however, results in flood waters flowing at even higher velocities than those in the Blue River, resulting in an increased damage potential.

FLOODED AREAS AND FLOOD DAMAGES

The areas along the tributaries of the Blue River that would be inundated by the Intermediate Regional and Standard Project Floods occurring in the tributary streams are shown on Plates 20 through 26. Plate 19 is an index map showing the relative location of the plates. Maps and illustrations reflect consideration of the channel as it exists today.

The hydraulic analysis of the flood situation along the tributaries had to consider crossings being plugged as well as the possibility of free flow of water through them, assuming the crossings were either washed out or kept free from debris. The flood hazard area immediately below crossing structures was based upon the assumption of washout for the smaller structures or free passage of the flood flows through the structures. The flood hazard area above the crossing structures assumed blockage of the structures with backwater effect taken into consideration. Those areas where water might be diverted from the historic channel into an area which normally would not have been flooded have been indicated although the extent of such flooding has not been determined. This flooding generally would be shallow sheet flow although, particularly when following a roadway, the water has a potential for relatively high velocities.

Plates 27 through 40 show water surface profiles for both the Intermediate Regional and Standard Project Floods. The depth of flow in the channel can be estimated from these illustrations as well as the reference points in Table 7. Table 8 summarizes the pertinent data on crossing structures.

It should be noted that in some cases a discrepancy was found between actual surveyed cross-sections utilized in the study and map elevations. In the hydraulic analysis at least two surveyed cross-sections were made on each tributary. Between the surveyed cross-sections measured cross-sections were taken from the 2 foot interval contour mapping provided

Table 7

FLOOD PLAIN REFERENCE DATA
FOR TRIBUTARIES

Reference Point Number	Distance in Feet	Approx. Streambed Elevation	IRF Elev. MSL	SPF Elev. MSL	Remarks
French Gulch					
1	130	9487.3	9490.7	9491.2	
2	790	9496.7	9497.9	9498.1	Cross Section 1-1
3	1440	9514.2	9517.6	9517.9	
4	1940	9527.7	9531.1	9531.6	
5	2290	9539.0	9541.8	9542.0	
6	2580	9562.6	9565.8	9567.0	Magnum Bonum U/S
Illinois Gulch					
1	180	9617.7	9622.9	9623.2	Columbine Rd.
2	430	9625.4	9627.5	9627.5	
3	770	9642.4	9647.1	9647.5	Broken Lance Rd.
4	1090	9647.6	9652.1	9652.5	
5	1270	9656.5	9669.6	9669.8	Highway 9
6	1840	9668.7	9670.4	9670.9	
7	2470	9685.4	9686.7	9687.0	
8	3480	9715.0	9718.0	9718.6	
9	3870	9732.4	9733.0	9733.1	Cross Section 2-2
10	4020	9734.3	9743.2	9743.6	Boreas Pass Rd.
Lehman Gulch					
1	140	9621.0	9624.7	9625.1	
2	280	9636.5	9641.5	9642.3	
3	440	9647.2	9650.6	9650.9	Cross Section 3-3
4	770	9669.6	9674.5	9675.0	
5	1060	9690.3	9693.0	9693.0	
Sawmill Gulch					
1	240	9576.4	9577.7	9577.9	
2	250	9576.9	9581.1	9581.4	Park Avenue
3	830	9595.0	9597.0	9597.4	
4	1610	9650.1	9650.8	9651.0	Cross Section 4-4
5	2100	9679.1	9680.0	9680.3	
6	2350	9695.1	9697.0	9697.2	
7	2840	9727.6	9729.5	9729.7	
8	3410	9768.0	9771.0	9771.3	

Table 8

TRIBUTARY CROSSING DATA

Structure	Type	Elevation Above Mean Sea Level				
		Invert	Top of Clearance	Roadway	Intermediate Project Flood	Standard Project Flood
French Gulch						
Highway 9	1-Concrete Box Culvert 10' Square	9480.0	9489.2	9492.3	9490.8	9490.3
Magnum Bonum (downstream)	1-CMP Culvert 9' Dia.	9503.9	9511.4	9521.5	9505.6	9506.0
Magnum Bonum (upstream)	1-CMP Culvert/Spillway 9' Dia.	9577.1(1)	-	9580.2	9580.5	9580.8
Illinois Gulch						
Columbine Rd.	1-CMP Culvert 5' Dia.	9617.8	9620.6	9621.9	9622.9	9623.2
Broken Lance Rd.	1-CMP Culvert 6' Dia.	9641.5	9643.3	9646.6	9647.1	9647.5
Highway 9	1-CMP Culvert 6' Dia.	9654.2	9660.5	9668.5	9669.6	9669.8
Boreas Pass	1-CMP Culvert Dia.	9733.7	9740.0	9742.7	9743.2	9743.6
Sawmill Gulch						
Park Avenue	1-CMP Culvert 36" Dia.	9575.4	9578.4	9581.0	9581.1	9581.4
Unnamed Crossing	1-CMP Culvert 36" Dia.	9579.7	9582.4	9583.6	9583.7	9584.0
Ski Hill Rd.	3-CMP Culverts 36" Dia.	9709.5	9712.3	9713.9	9512.3	9512.3

(1) Spillway crest elevation

by the town. For comparative purposes, measured cross-sections were also taken at the location of survey cross-sections. Where a discrepancy existed between the elevations on the field and map cross-sections, the elevation data as obtained from the field cross-section were used; however, the flood plains delineated on Plates 20 through 26 are shown at the relative depth determined. In other words, if a depth of four feet of water was determined in the hydraulic analysis utilizing surveyed cross-section data the resulting elevation has been given as the actual flood elevation. In the plan, however, the depth of four feet was superimposed on the map elevations to show a relative depth of flooding. Thus, at a given location, there may be a slight discrepancy between an elevation picked off the plan from Plates 20 through 26 and the elevation given in the profile and Table 7.

A brief description of the flooding which is expected to occur in each of the tributaries follows:

French Gulch

Except for the possibility of plugging of the spillway located at the pond near the upper end of the study reach, flooding would be contained within the channel. The spillway has adequate capacity to safely pass the Intermediate Regional Flood with only a slight possibility of overtopping the structure causing sheet flow to pass down the street adjacent to it. The channel below the dam also has adequate capacity and is provided with drops to control the velocities and erosion potential. Blockage at the spillway, however, will cause major flooding down the street. A 72" diameter CMP culvert upstream of Highway 9 has adequate capacity to pass the flood flows. No blockage of this structure was assumed because of the adequate channel capacity above it. The 60" diameter CMP culvert at Highway 9 also has adequate capacity but could become blocked from debris carried by flow down the street through the development adjacent to the channel. If the culvert

is blocked water would be diverted northward causing street flow along Highway 9.

Illinois Gulch

East of Highway 9 Illinois Gulch is primarily undeveloped. Should flooding occur, even with the Highway 9 culvert completely blocked, there would be very little damage. Flood flows passing over the road generally would be contained in the borrow pit area adjacent to the highway and would eventually find their way back into the Blue River channel. Shallow flooding may occur, but the damage potential would be considered light to moderate. A small culvert under the Boreas Pass Road would also tend to divert water down the road and the water would eventually find its way back into the main stream channel. Due to the relatively small size of this culvert, washout is very likely. West of Highway 9 the flood could easily get out of the channel, particularly at the Four Seasons Pond area, and shallow flooding could cause moderate to heavy damage. The two crossing structures in this area were considered plugged. The lower culvert was not properly installed and is presently obstructing flow in the channel. This culvert should be replaced.

Lehman Gulch

The flood channel of Lehman Gulch is confined within the gulch and there is no development which would be affected by flooding within the tributary. Flooding in Lehman Gulch, however, could cause some damage at the Four Seasons Pond after the flood waters have combined with the Blue River flows.

Sawmill Gulch

The culverts along Sawmill Gulch are very small and were considered to plug and be completely washed out during a major flooding event. The culvert near the upper end of the study reach would cause flood waters to be diverted southward away

from the channel should it become plugged. The condominiums constructed adjacent to the Sawmill Gulch channel are within the flood hazard areas and could be expected to sustain some damage. Channelization of the Sawmill channel has occurred and the historic channel has been largely obliterated. Within the area of Lincoln and Park Avenues, shown on Plate 26, development should not be allowed until adequate measures are taken to improve channelization to adequately convey the Intermediate Regional Flood runoff to the Blue River.

URBANIZATION

Urbanization has recently commenced in the flood plains of the tributaries. While some development has already occurred within the flood plain causing obstructions to flood flows with potential flood damages, many of the tributary flood plains are relatively free. Proper land use controls can prevent further encroachment into the flood plain areas. Additionally, adequate internal drainage design can ensure that flood peaks are not appreciably increased due to future urbanization.

SUMMARY

This portion of the Flood Plain Report for the town of Breckenridge was prepared to discuss the specific flooding potential of the tributaries in and around the town. The study illustrates that potential damage within the tributary basins is of considerable importance, as is the damage potential in the main Blue River channel. Development in the flood plain area should proceed in accordance with proper land use controls as established by local and state standards.

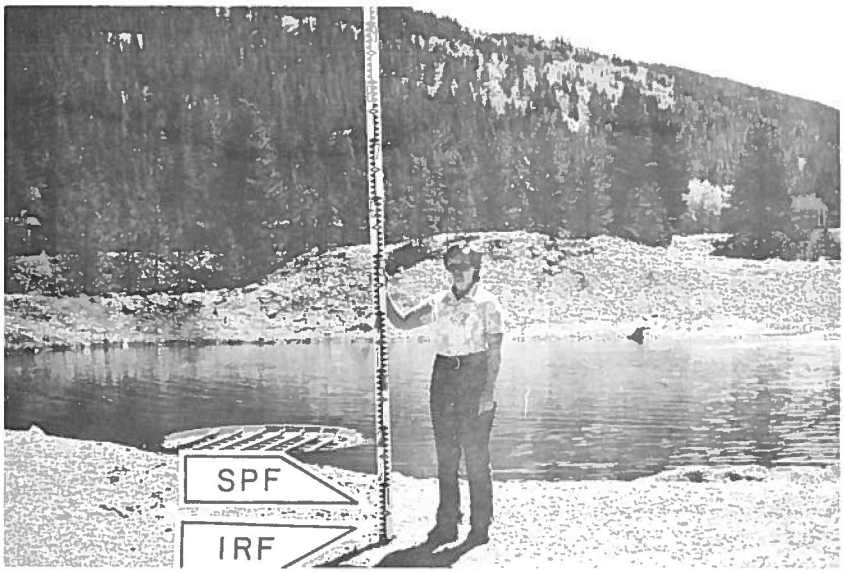
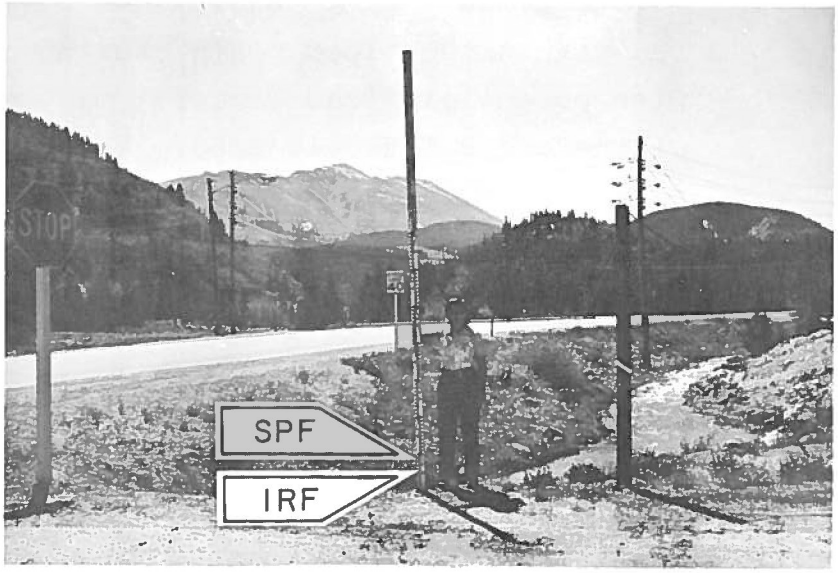


FIGURE 21 - Flood Heights at Pond on French Gulch

FIGURE 22 - Illinois Gulch Flood Heights near Highway 9



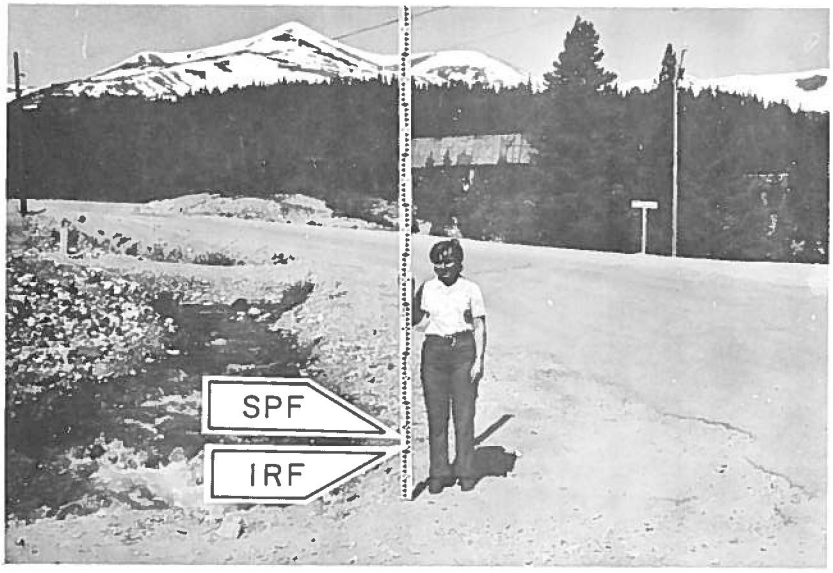


FIGURE 23 - Flood Heights on Sawmill Gulch near Lincoln Avenue and Park Avenue

LEGEND

- U.S.G.S. Stream Gage
- U.S. Weather Bureau Station
- U.S.D.A. Snow Course Station
- Basin Boundary
- Reservoir or Lake

2 0 2 4

SCALE OF MILES

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN AND SAWMILL GULCHES

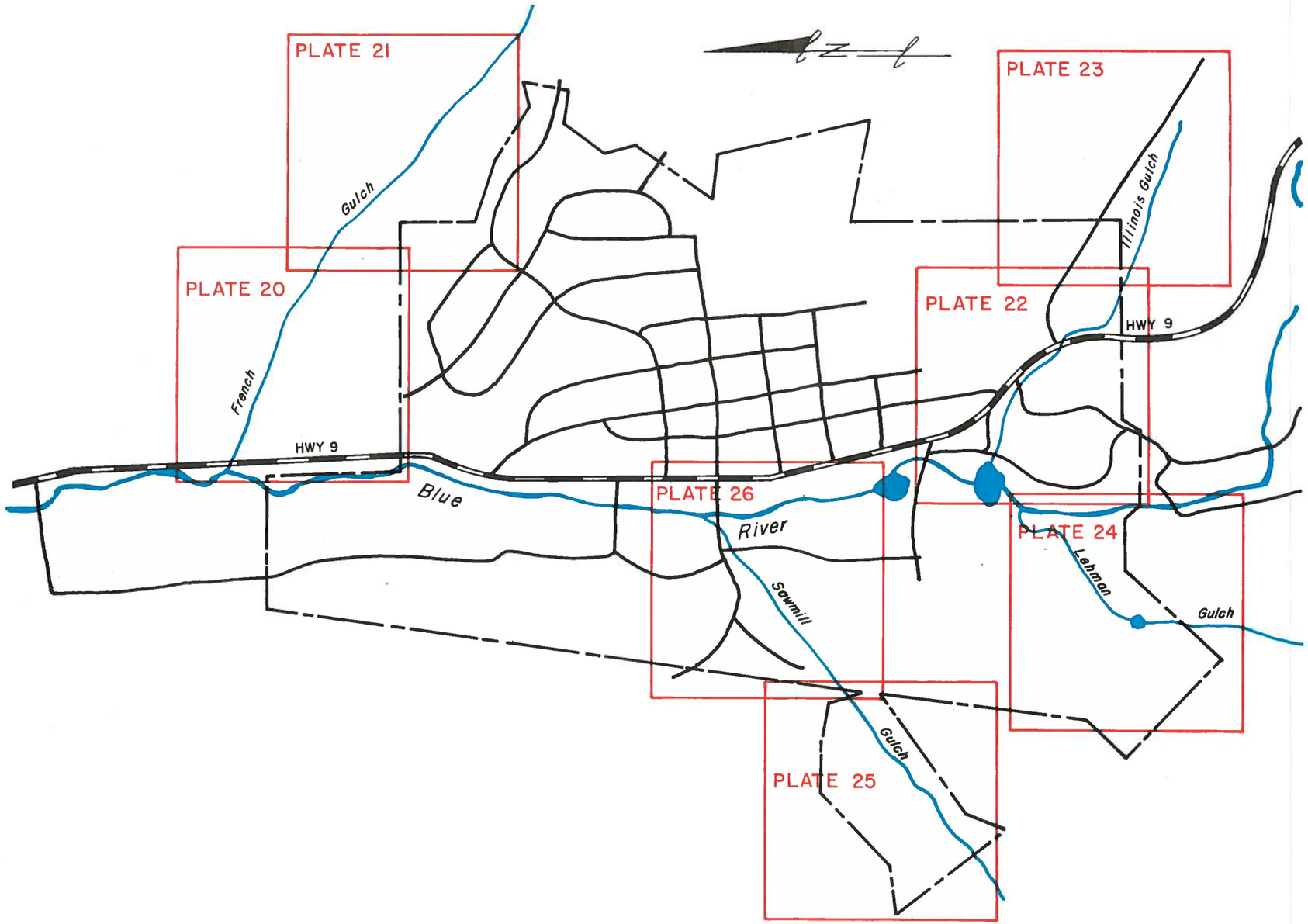
BRECKENRIDGE, COLORADO

BASIN MAP

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 18



COLORADO WATER CONSERVATION BOARD

TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

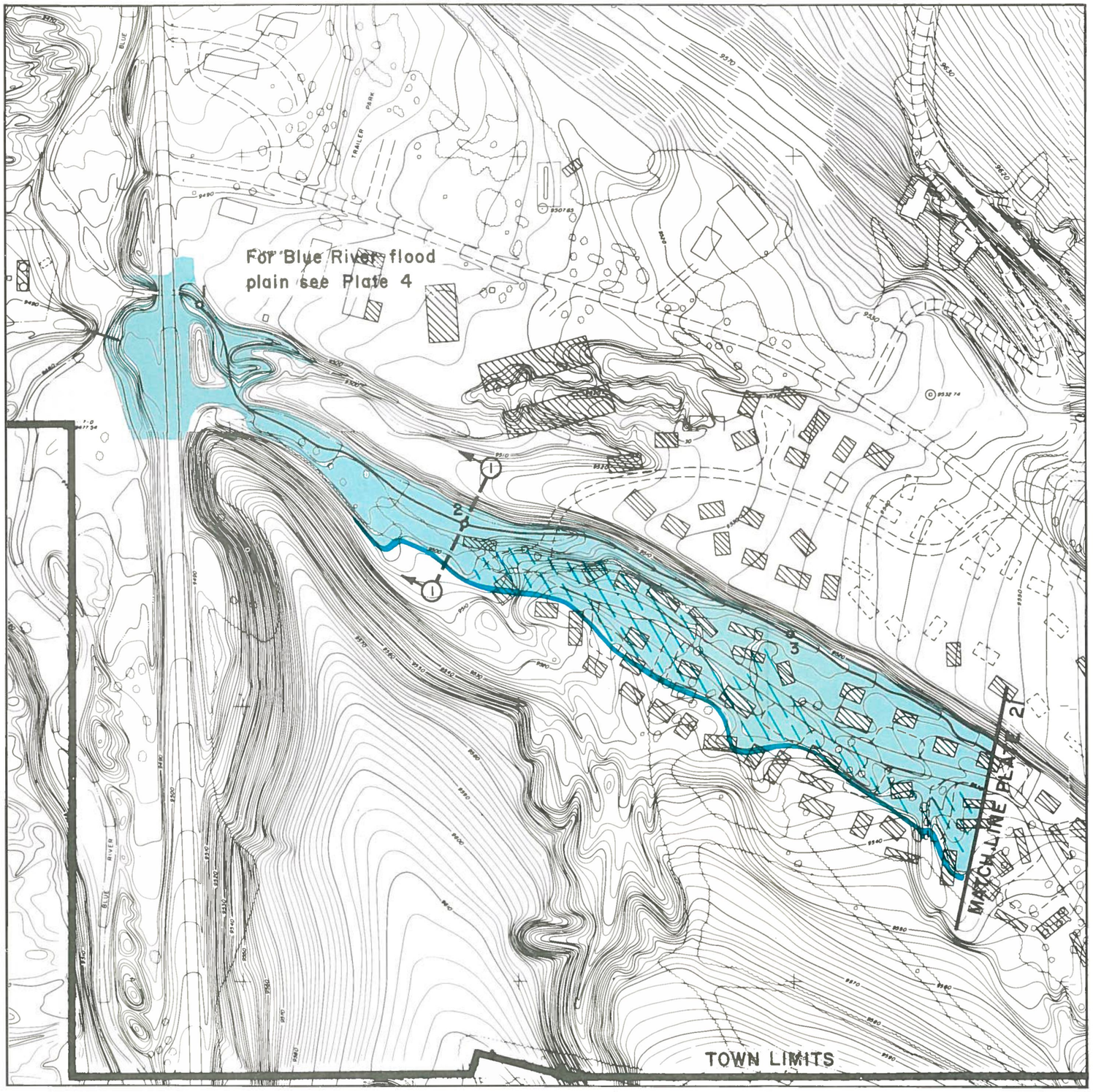
BRECKENRIDGE, COLORADO

INDEX MAP

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 19



LEGEND

INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD

SHEET FLOW

CHANNEL AND VALLEY CROSS SECTION

REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plates 27 & 28.
For Cross Sections see Plate 41.

200 0 200 400
SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

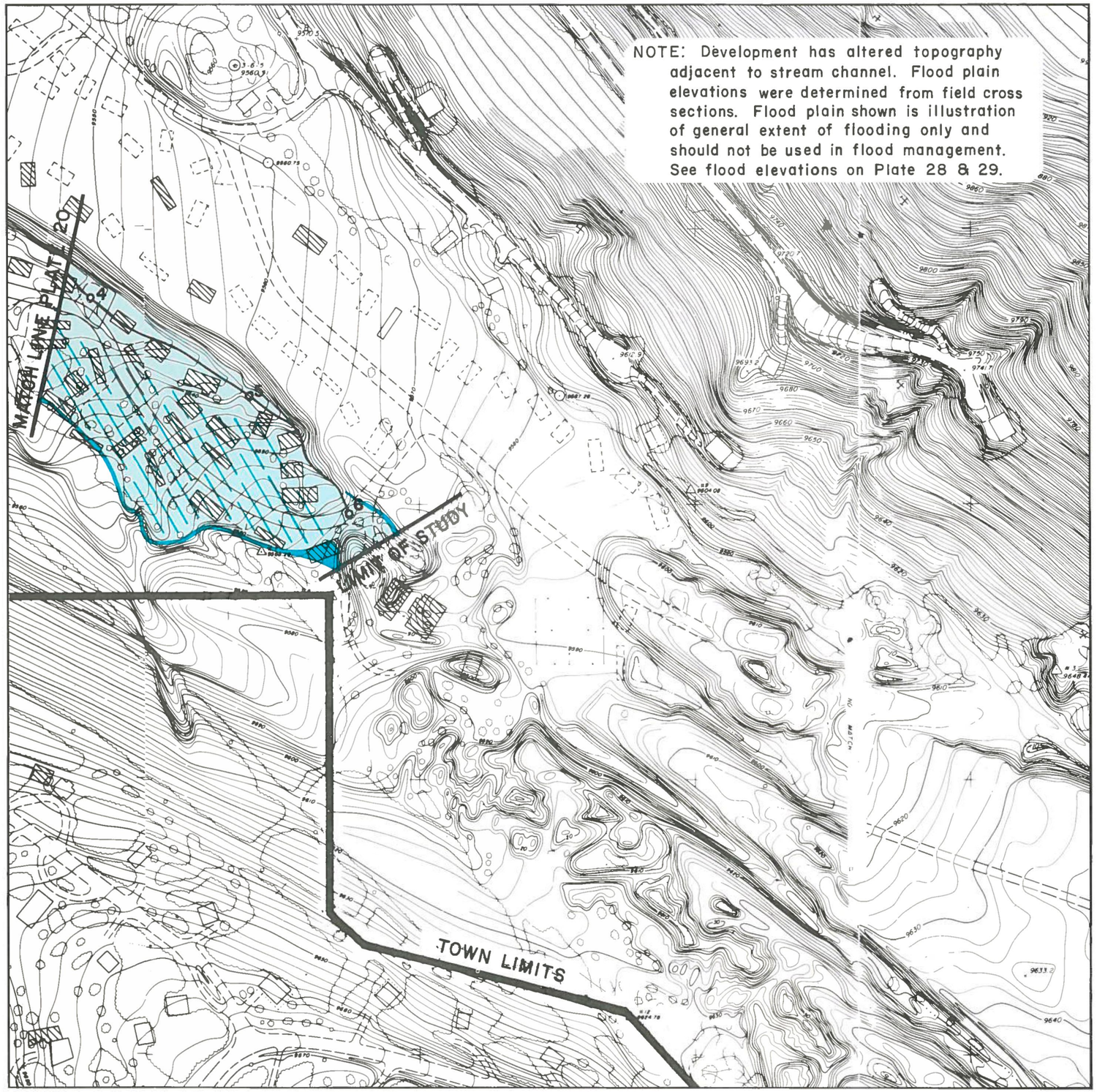
FLOODED AREAS

FRENCH GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 20



LEGEND

- INTERMEDIATE REGIONAL FLOOD
- STANDARD PROJECT FLOOD
- SHEET FLOW
- 3 — CHANNEL AND VALLEY CROSS SECTION
- 2 — REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plates 28 & 29.
For Cross Sections see Plate 41.

200 0 200 400
SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

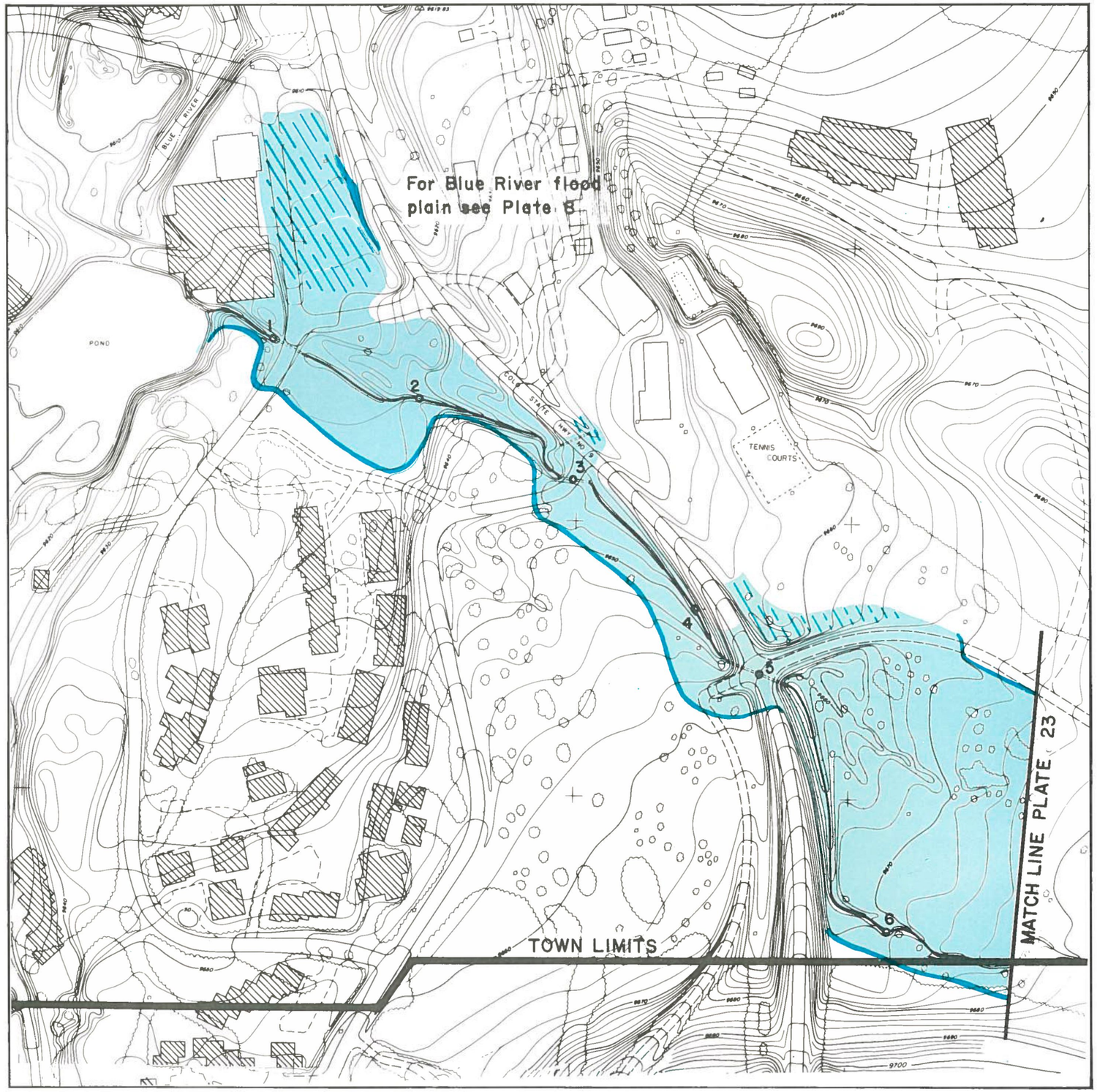
FLOODED AREAS

FRENCH GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 21



LEGEND

- INTERMEDIATE REGIONAL FLOOD
- STANDARD PROJECT FLOOD
- SHEET FLOW
- CHANNEL AND VALLEY CROSS SECTION (3)
- REFERENCE POINT (2)

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plates 30 & 31.
For Cross Sections see Plate 41.

200 0 200 400
SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

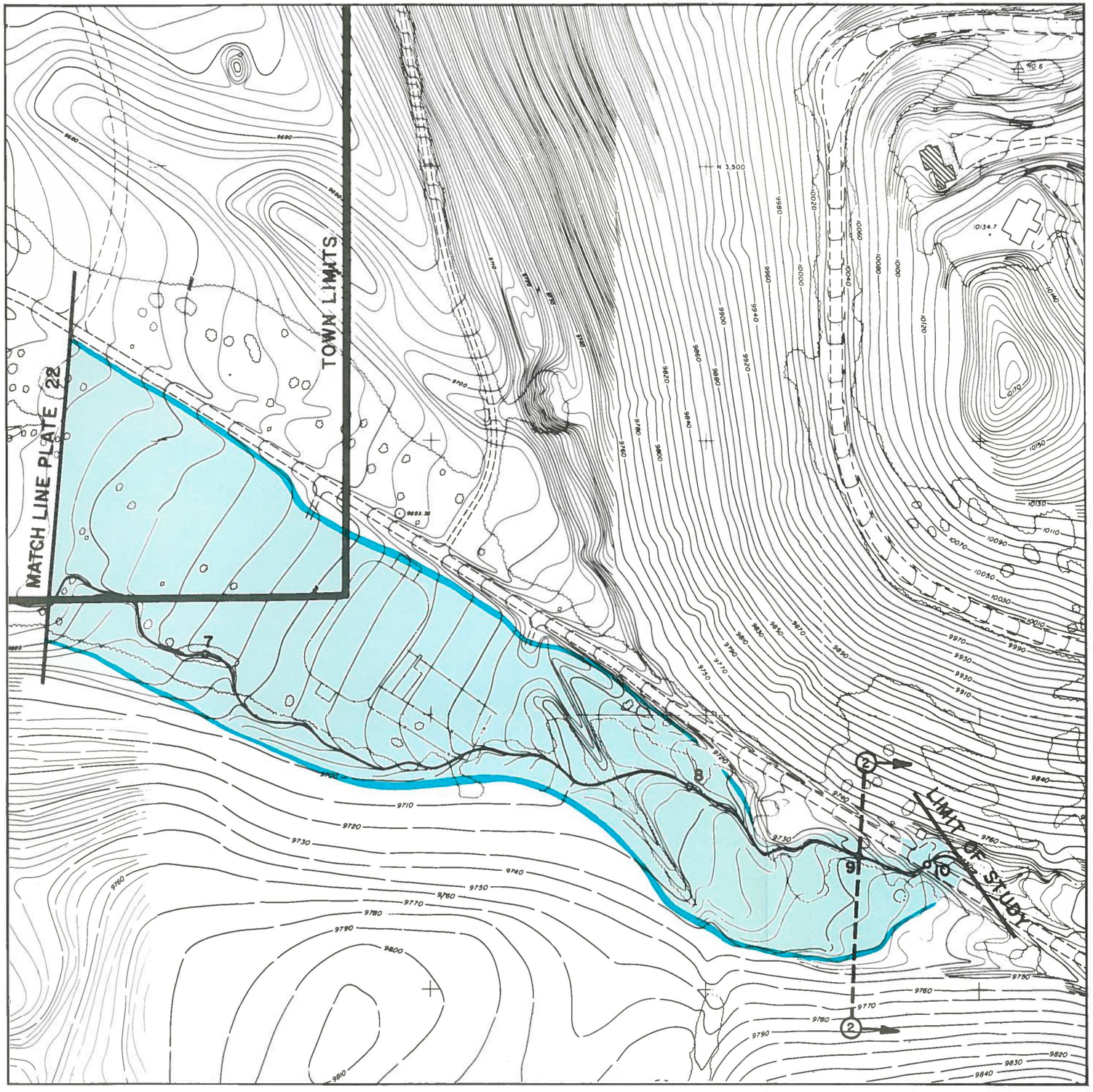
FLOODED AREAS

ILLINOIS GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 22



LEGEND

- INTERMEDIATE REGIONAL FLOOD
- STANDARD PROJECT FLOOD
- SHEET FLOW
- CHANNEL AND VALLEY CROSS SECTION
- REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plates 32,33 & 34.
For Cross Sections see Plate 41.

200 0 200 400
SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

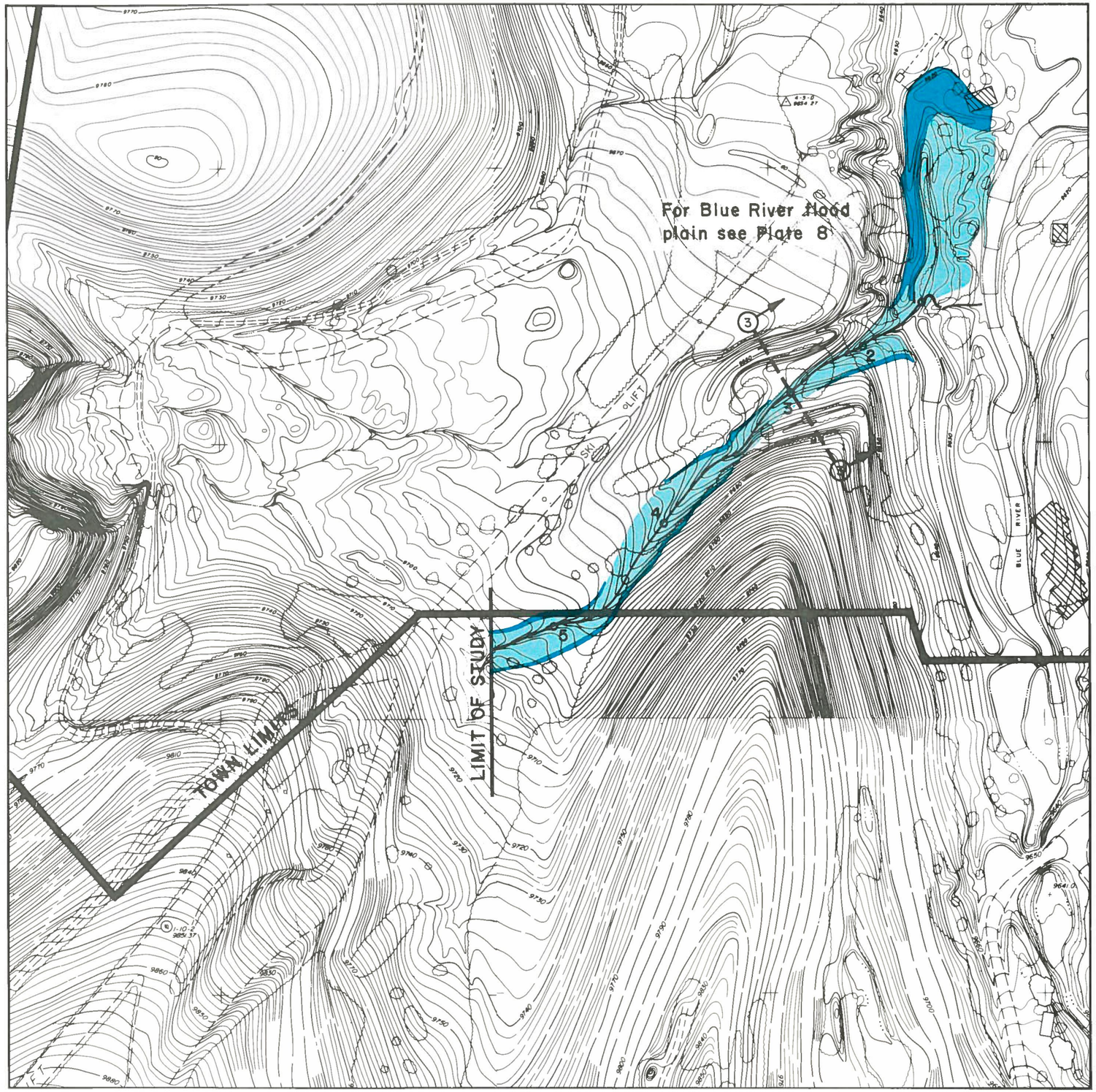
FLOODED AREAS

ILLINOIS GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 23



LEGEND

INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD

SHEET FLOW

CHANNEL AND VALLEY CROSS SECTION

REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plates 35 & 36.
For Cross Sections see Plate 41.

200 0 200 400
SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

FLOODED AREAS

LEHMAN GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 24

LEGEND

INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD

SHEET FLOW

CHANNEL AND VALLEY CROSS SECTION

REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plates 37 & 38.
For Cross Sections see Plate 41.

200 0 200 400
SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

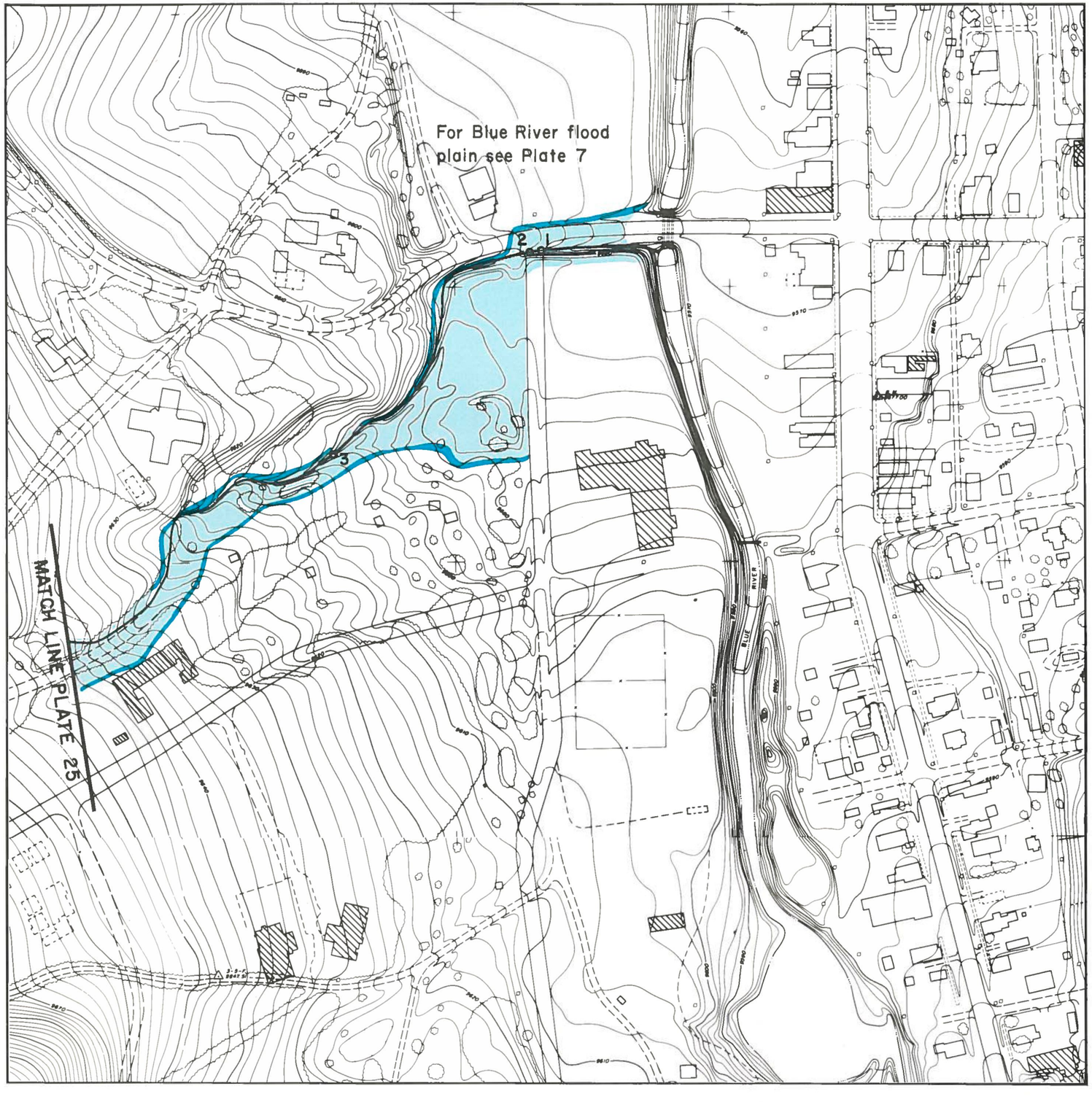
FLOODED AREAS

SAWMILL GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 25



LEGEND

INTERMEDIATE REGIONAL FLOOD
STANDARD PROJECT FLOOD

SHEET FLOW

3 CHANNEL AND VALLEY CROSS SECTION

2 REFERENCE POINT

NOTES

Mapping provided by town of Breckenridge based upon 1971 and 1973 aerial photography.

Limits of flood plain may vary from locations shown because of accuracy of topography.

Areas outside flood plain subject to flooding from local and tributary runoff.

For Profile see Plates 39 & 40.
For Cross Sections see Plate 41.

200 0 200 400
SCALE OF FEET
CONTOUR INTERVAL 2'

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

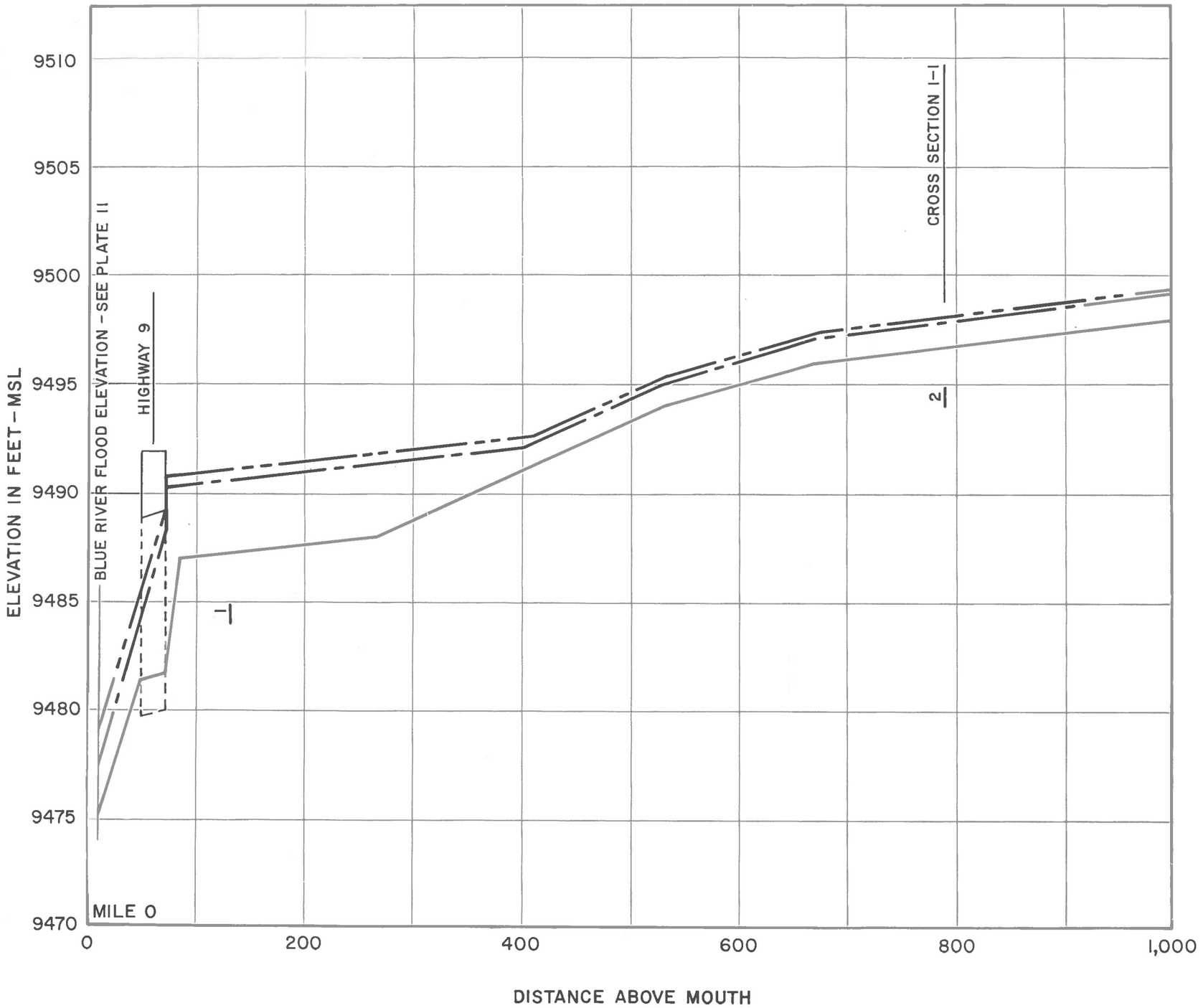
BRECKENRIDGE, COLORADO

FLOODED AREAS
SAWMILL GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 26



LEGEND

- Standard Project Flood
- Intermediate Regional Flood
- Low Water
- 2 Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

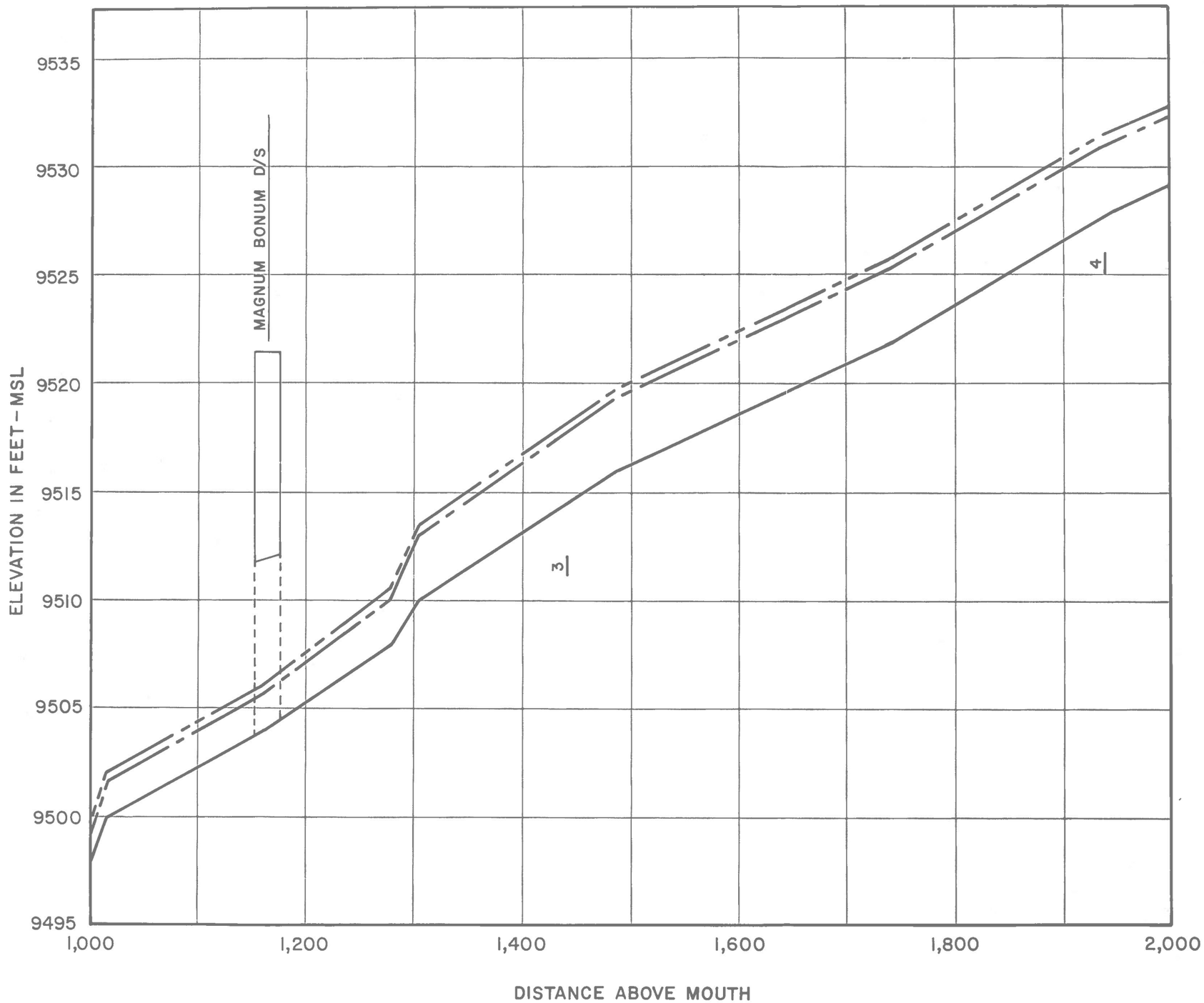
WATER PROFILES

FRENCH GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 27



LEGEND

- Standard Project Flood
- Intermediate Regional Flood
- Low Water
- 2 Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

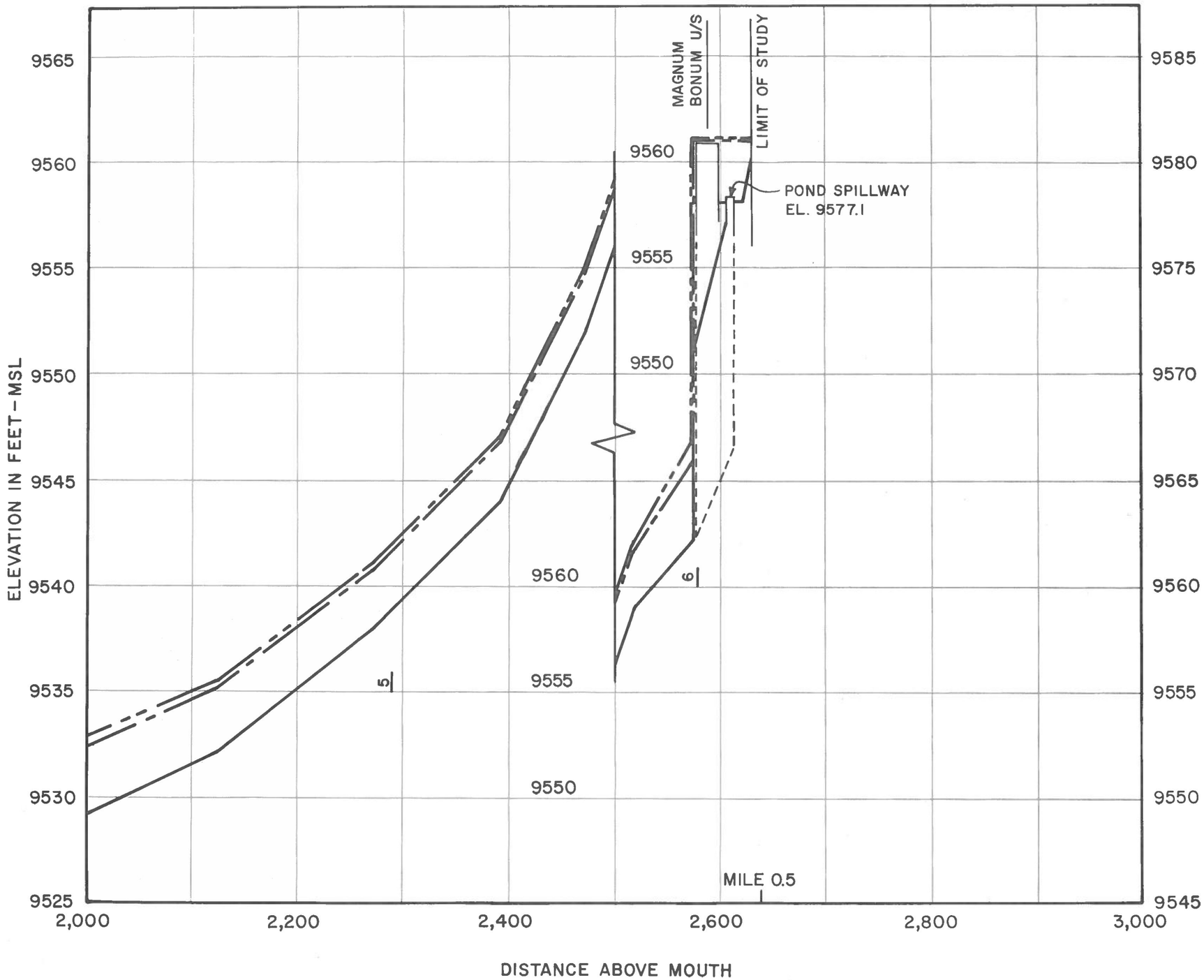
WATER PROFILES

FRENCH GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 28



LEGEND

- Standard Project Flood
- Intermediate Regional Flood
- Low Water
- Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

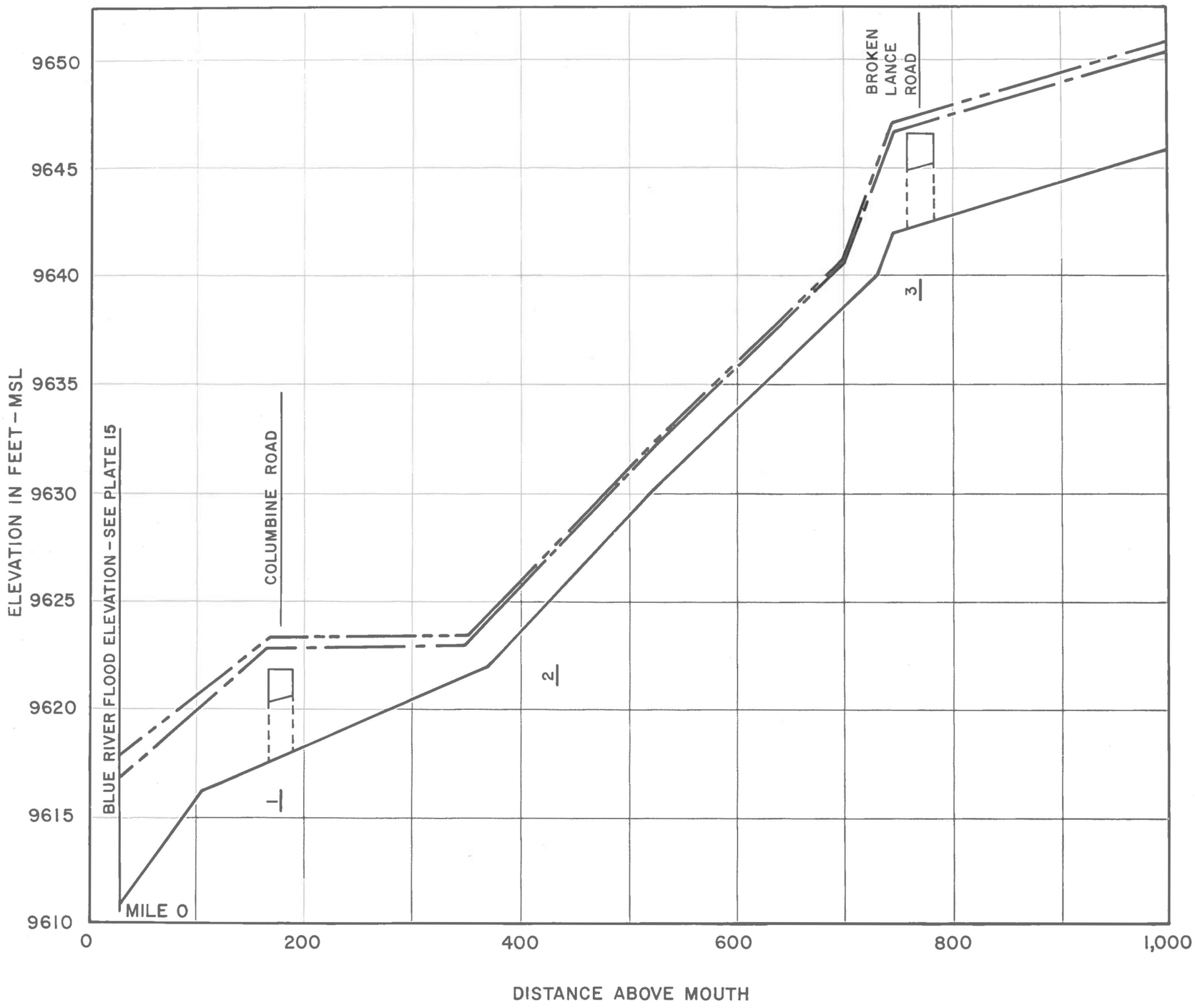
WATER PROFILES

FRENCH GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 29



LEGEND

- Standard Project Flood
- Intermediate Regional Flood
- Low Water
- 2 Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

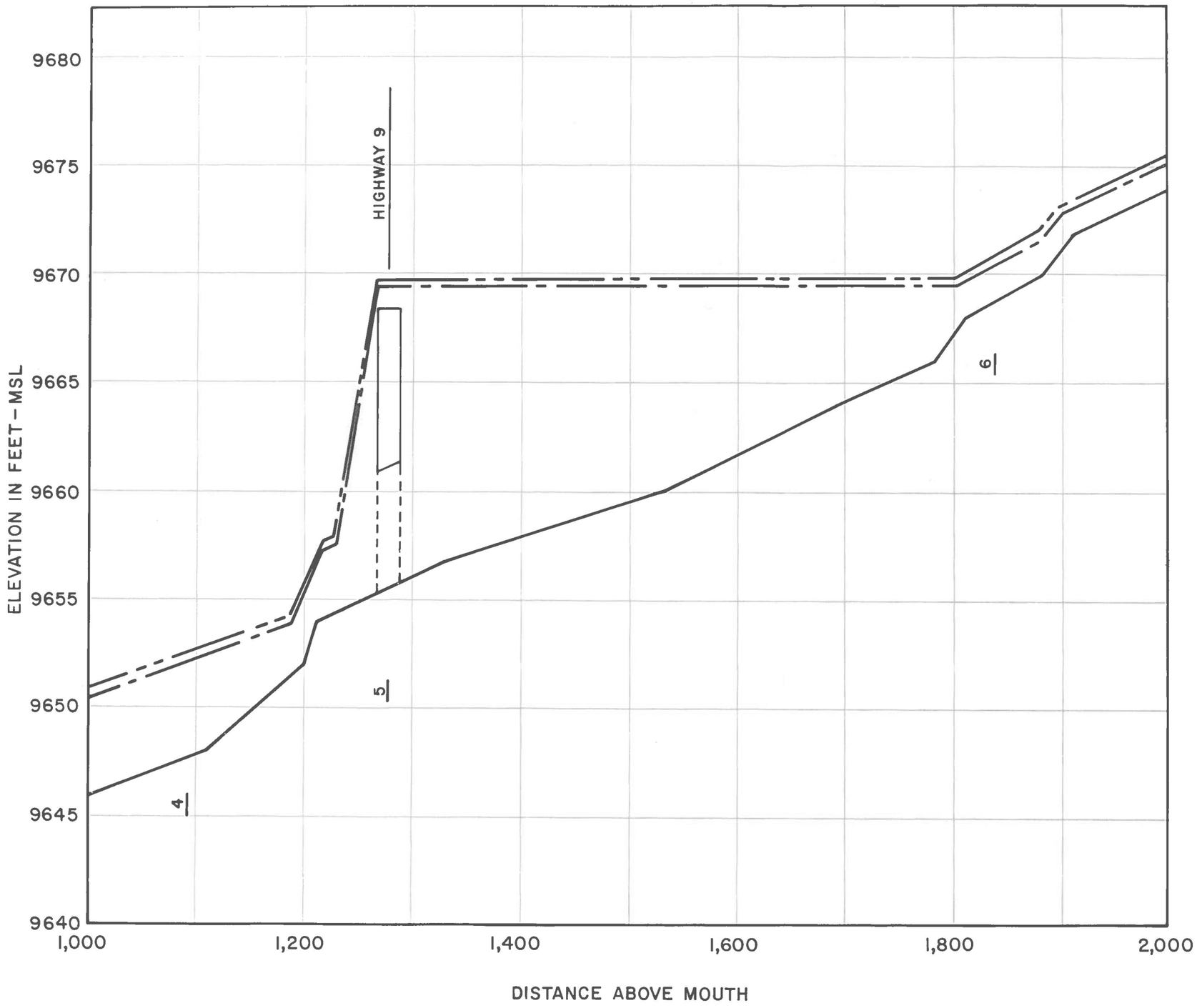
WATER PROFILES

ILLINOIS GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 30



LEGEND

- Standard Project Flood
- Intermediate Regional Flood
- Low Water
- 2 Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

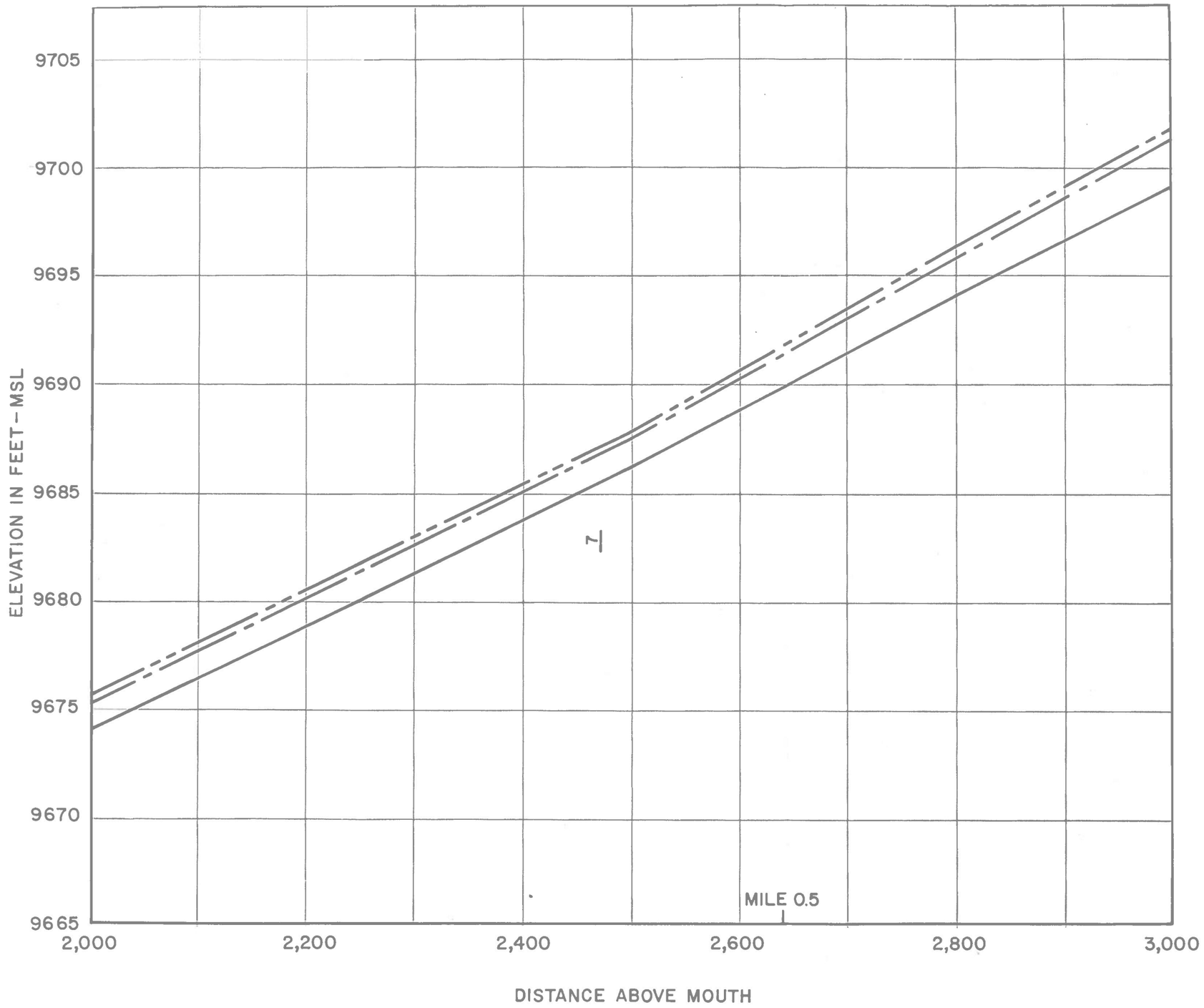
WATER PROFILES

ILLINOIS GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 31



LEGEND

——— Standard Project Flood

— - — Intermediate Regional Flood

——— Low Water

Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD

TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

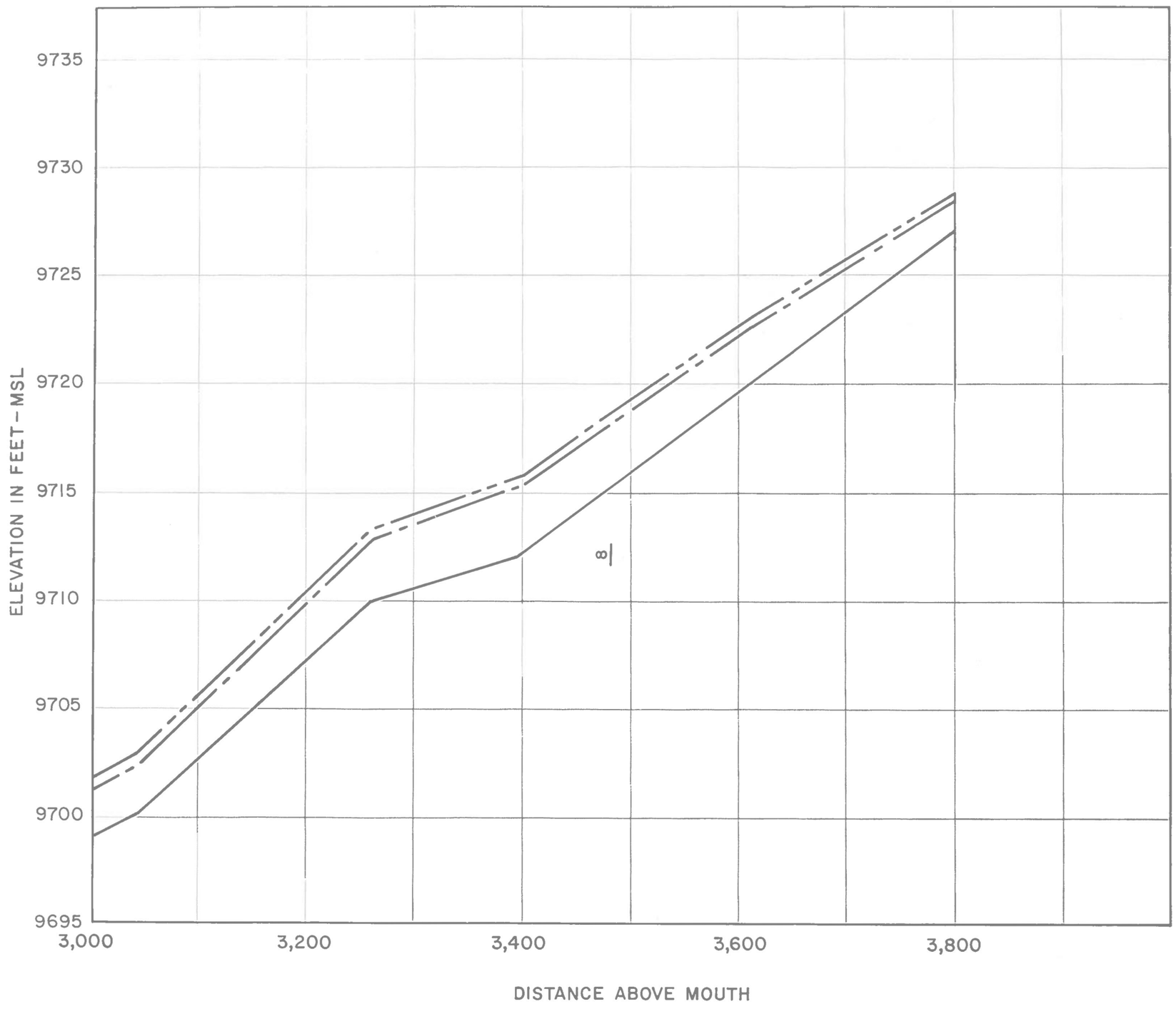
WATER PROFILES

ILLINOIS GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 32



LEGEND

- Standard Project Flood
- Intermediate Regional Flood
- Low Water
- 8 Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

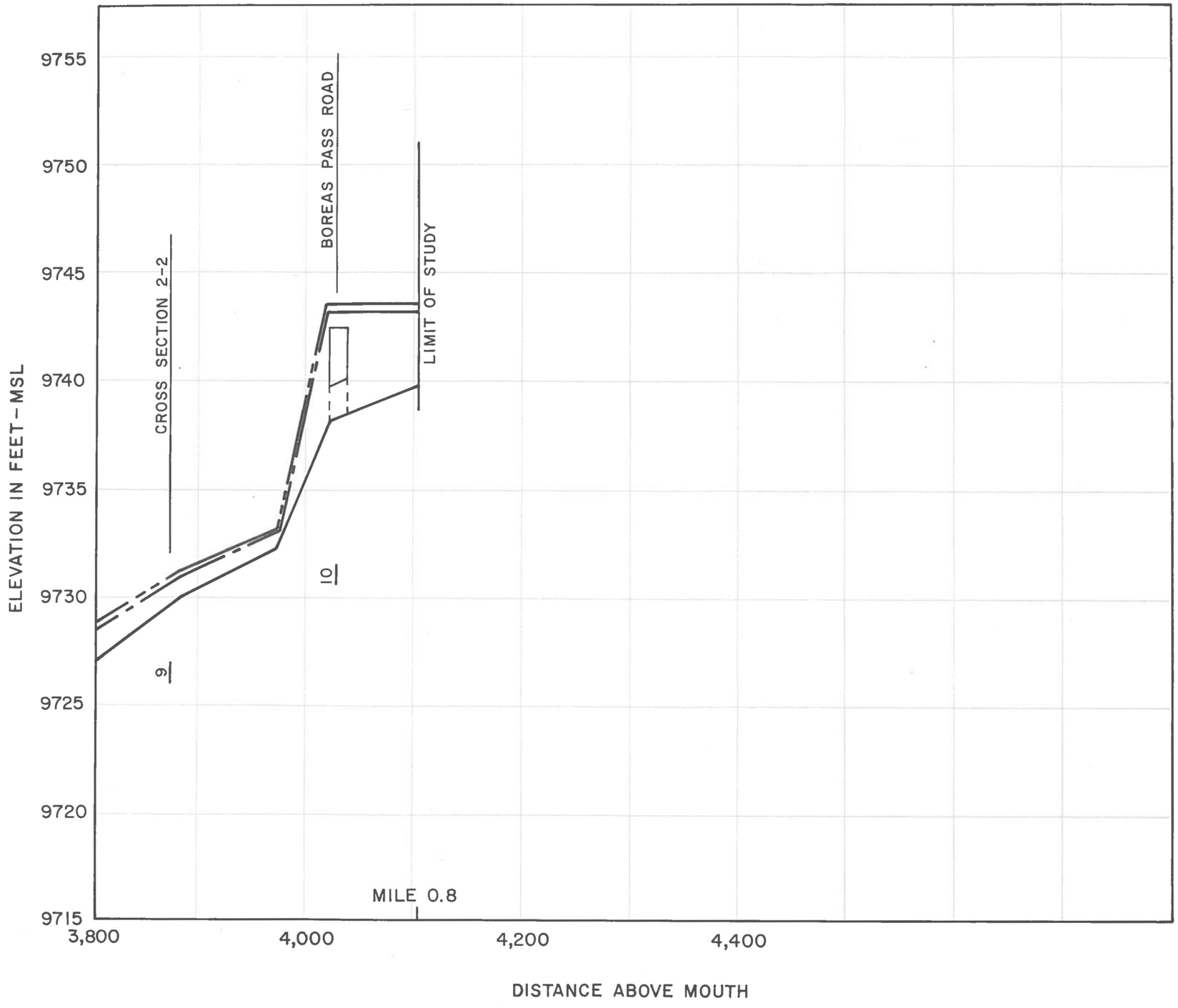
WATER PROFILES

ILLINOIS GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 33



LEGEND

Standard Project Flood

Intermediate Regional Flood

Low Water

2 Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

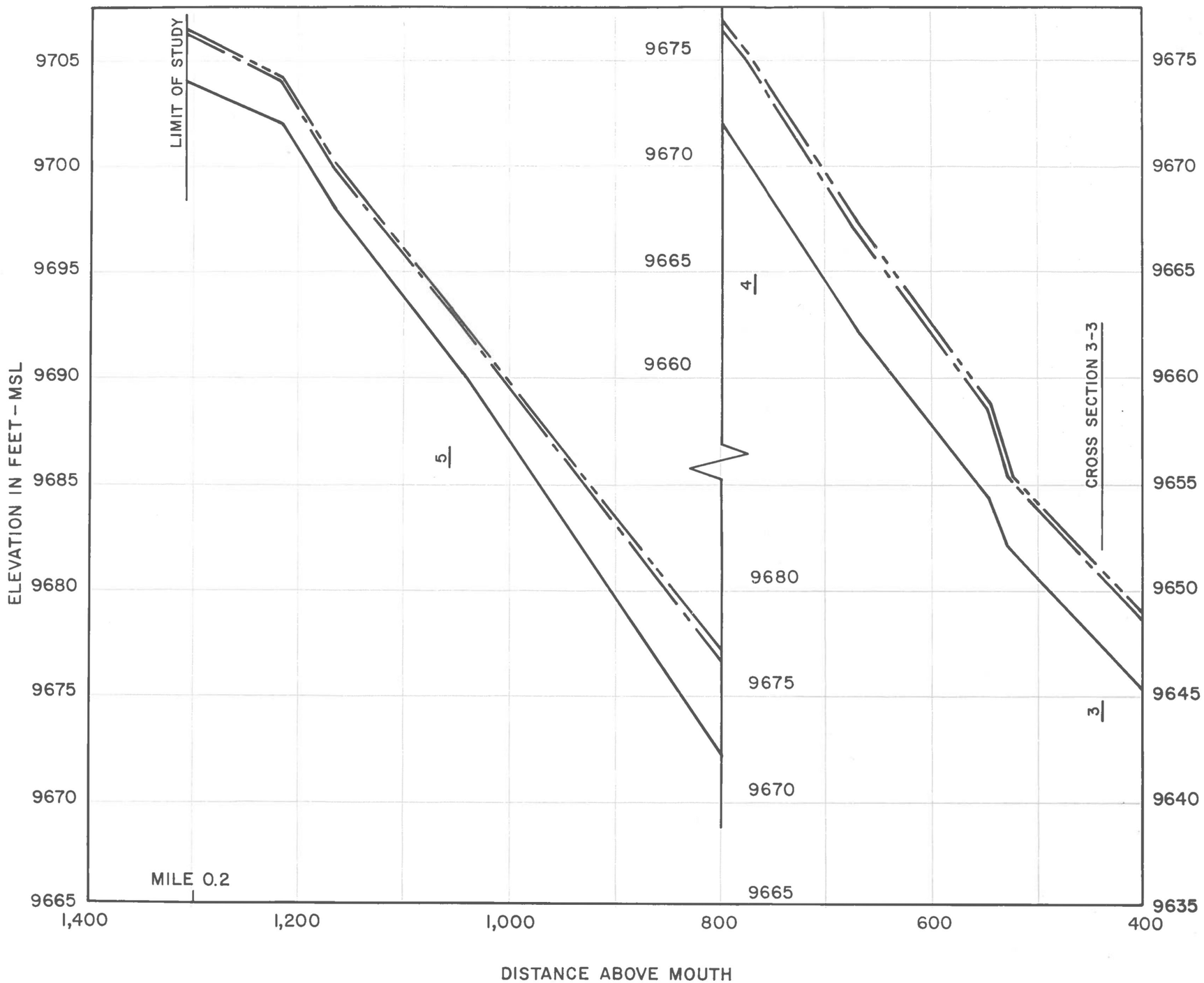
WATER PROFILES

ILLINOIS GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 34



LEGEND

——— Standard Project Flood

— - — Intermediate Regional Flood

——— Low Water

2| Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD

TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

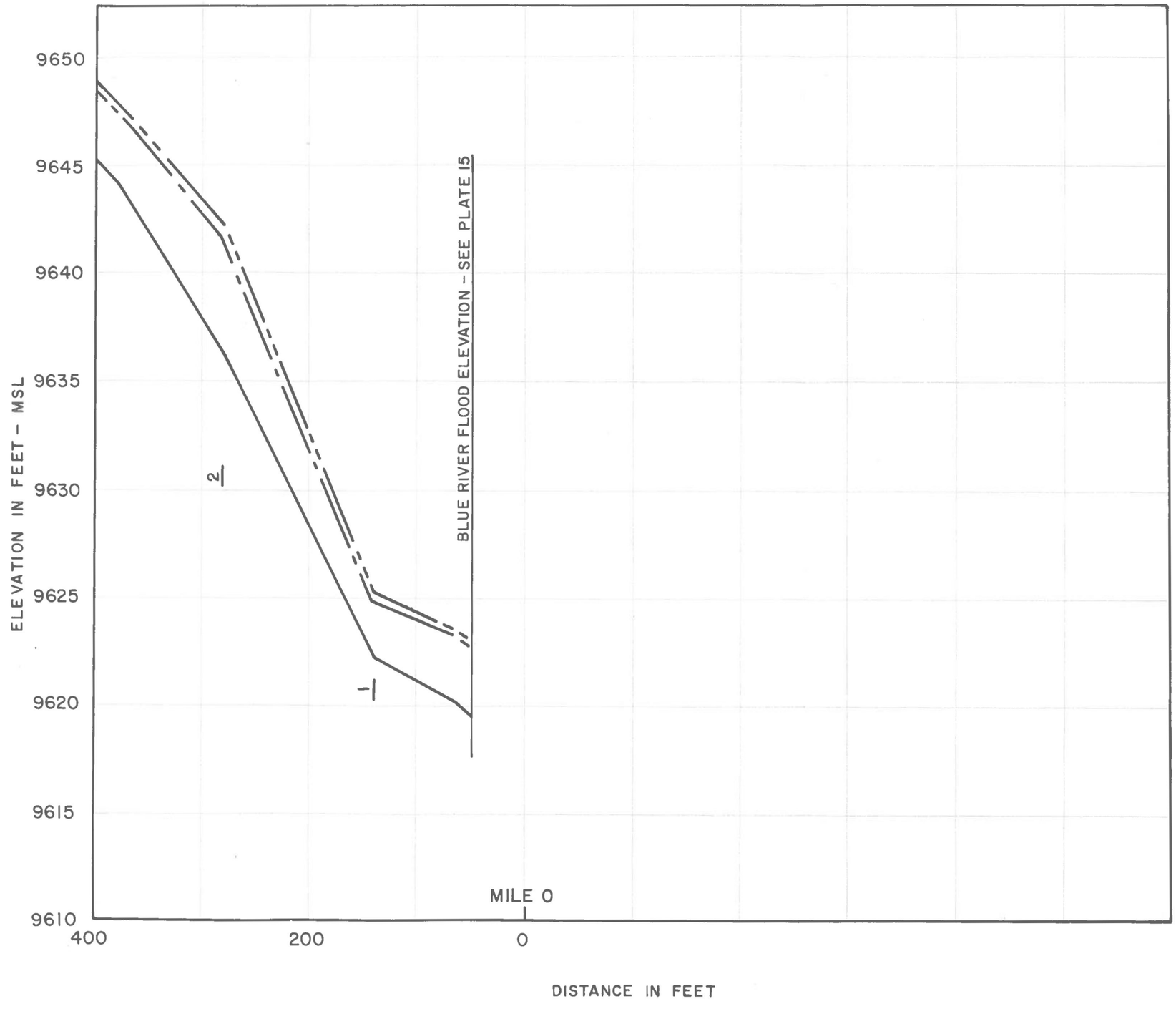
WATER PROFILES

LEHMAN GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 35



LEGEND

——— Standard Project Flood

— - — Intermediate Regional Flood

——— Low Water

| Reference Point

NOTES:

See Table 4 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

BRECKENRIDGE, COLORADO

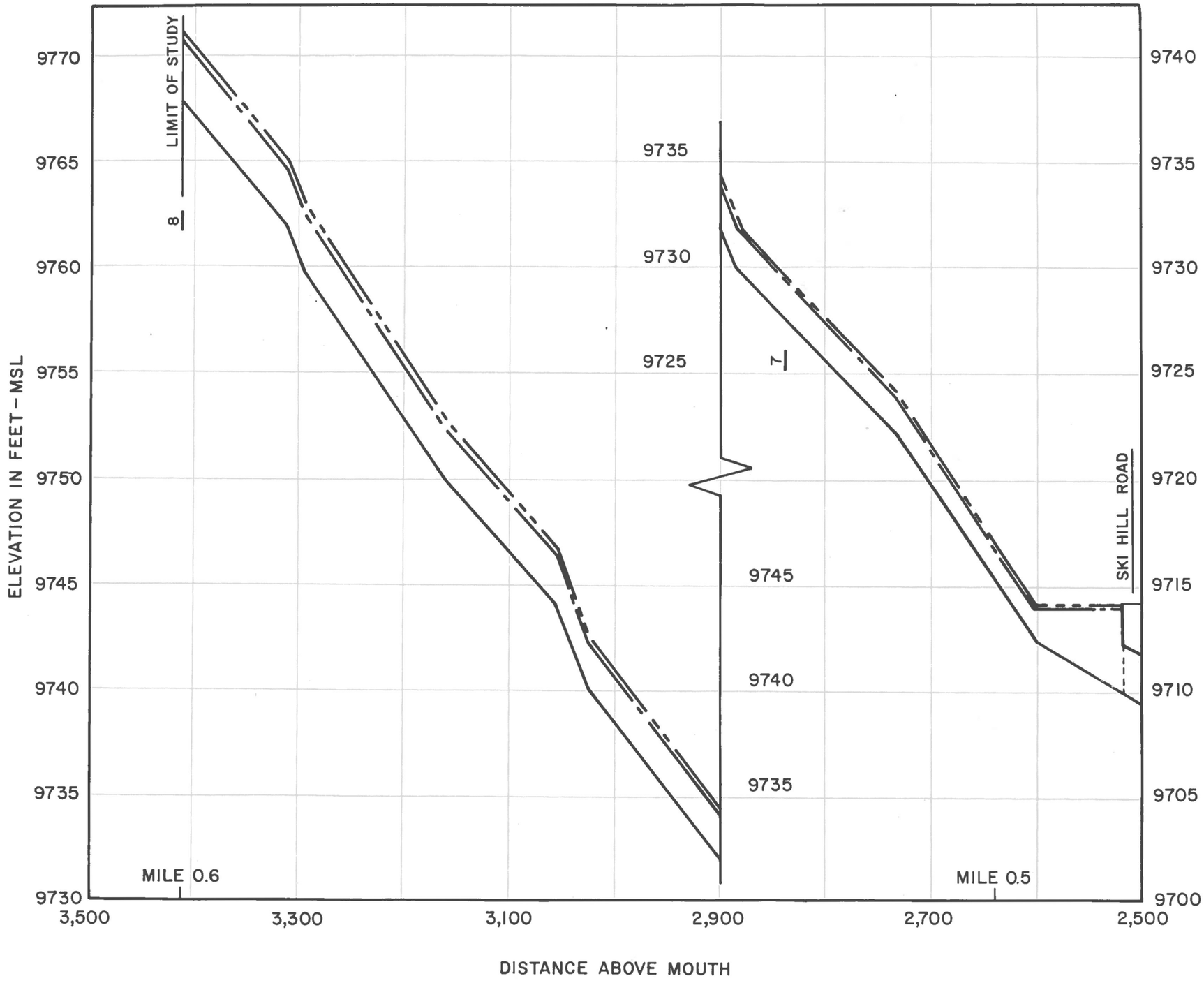
WATER PROFILES

LEHMAN GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 36



LEGEND

- Standard Project Flood
- Intermediate Regional Flood
- Low Water
- 2| Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD

TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

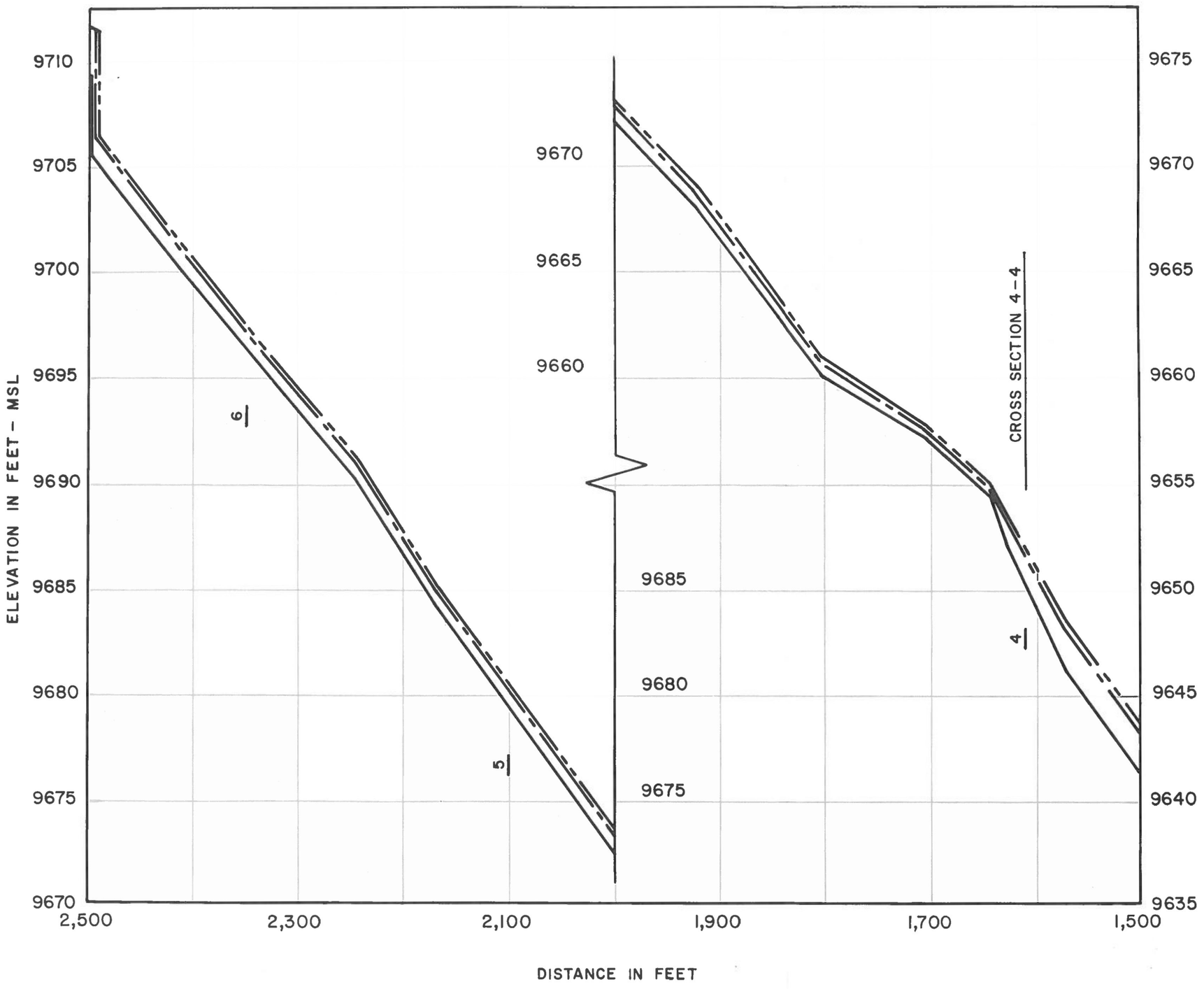
WATER PROFILES

SAWMILL GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 37



LEGEND

——— Standard Project Flood

— - — Intermediate Regional Flood

——— Low Water

| Reference Point

NOTES:

See Table 4 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

BRECKENRIDGE, COLORADO

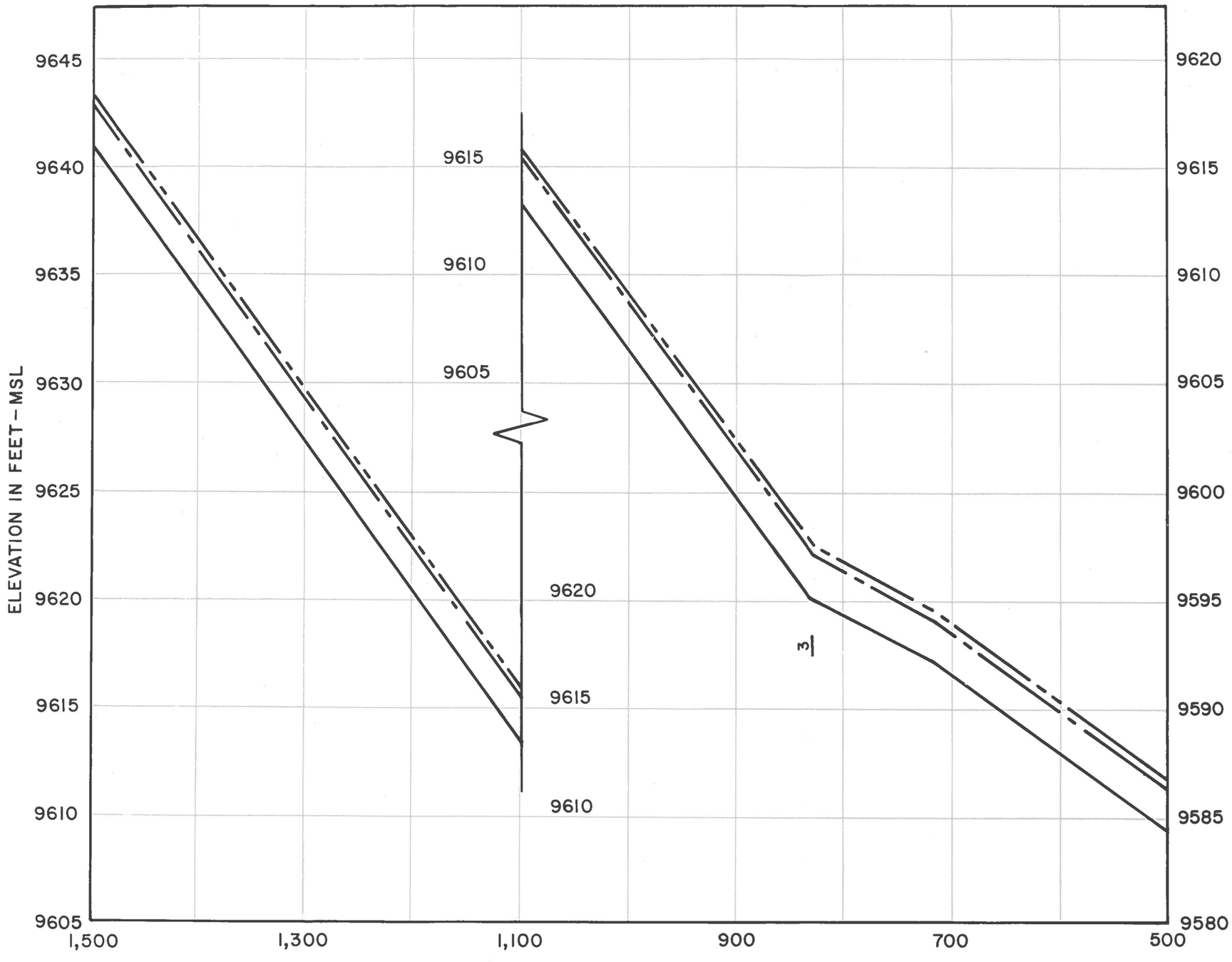
WATER PROFILES

SAWMILL GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 38



LEGEND

— — — Standard Project Flood

— · — Intermediate Regional Flood

——— Low Water

2| Reference Point

NOTES:

See Table 7 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
FRENCH, ILLINOIS, LEHMAN
AND SAWMILL GULCHES

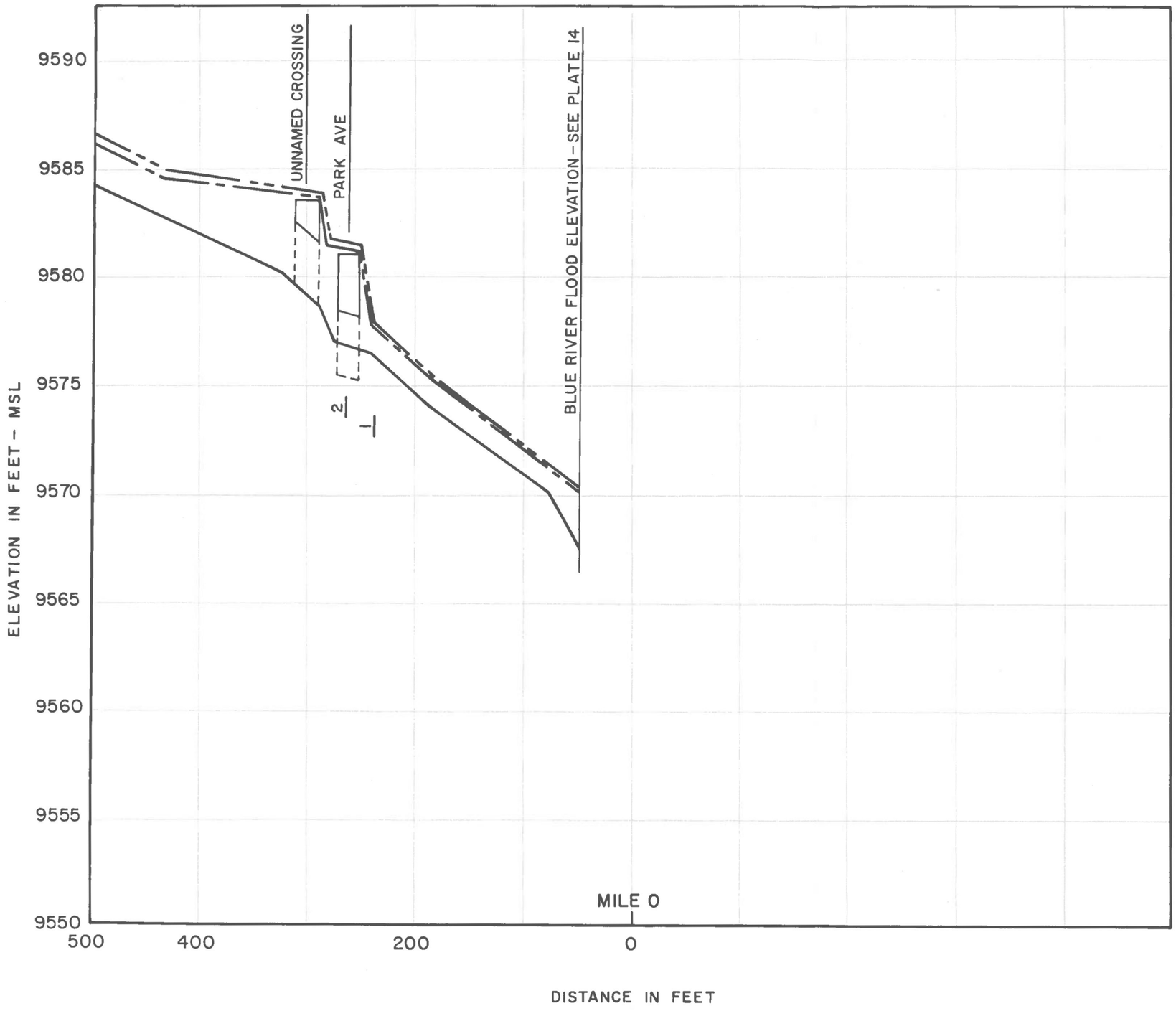
BRECKENRIDGE, COLORADO

WATER PROFILES
SAWMILL GULCH

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 39



LEGEND

Standard Project Flood

Intermediate Regional Flood

Low Water

Reference Point

NOTES:

See Table 4 for flood elevations at reference points.

COLORADO WATER CONSERVATION BOARD

TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION
BLUE RIVER

BRECKENRIDGE, COLORADO

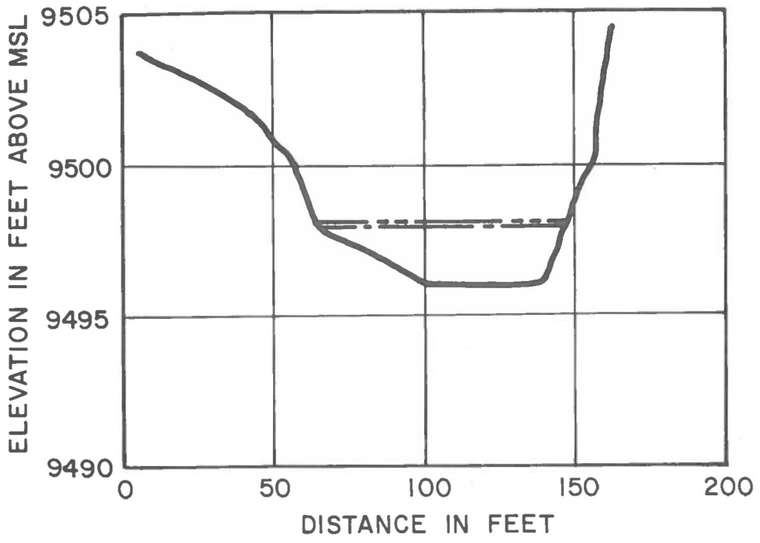
WATER PROFILES

SAWMILL GULCH

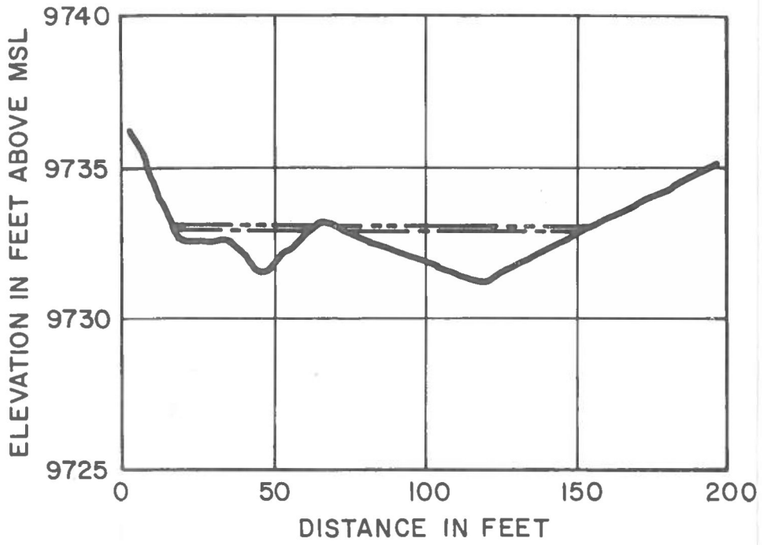
NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 40



CROSS SECTION 1-1
FRENCH GULCH



CROSS SECTION 2-2
ILLINOIS GULCH

LEGEND

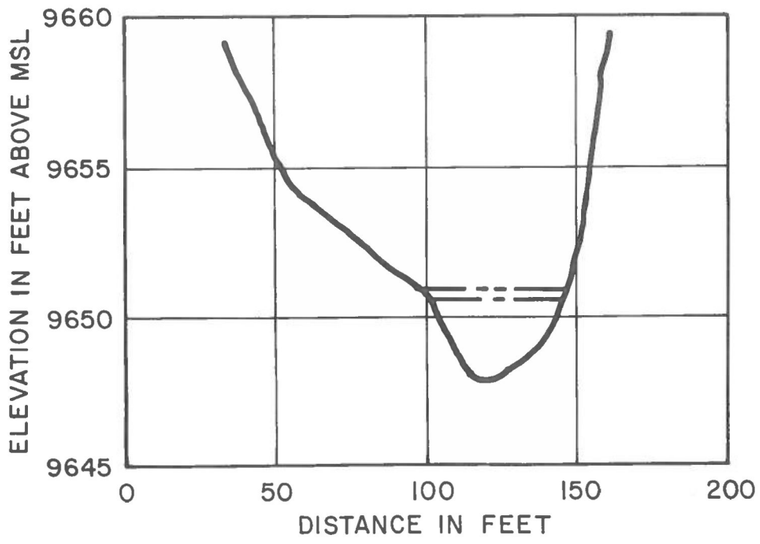
STANDARD PROJECT FLOOD

INTERMEDIATE REGIONAL FLOOD

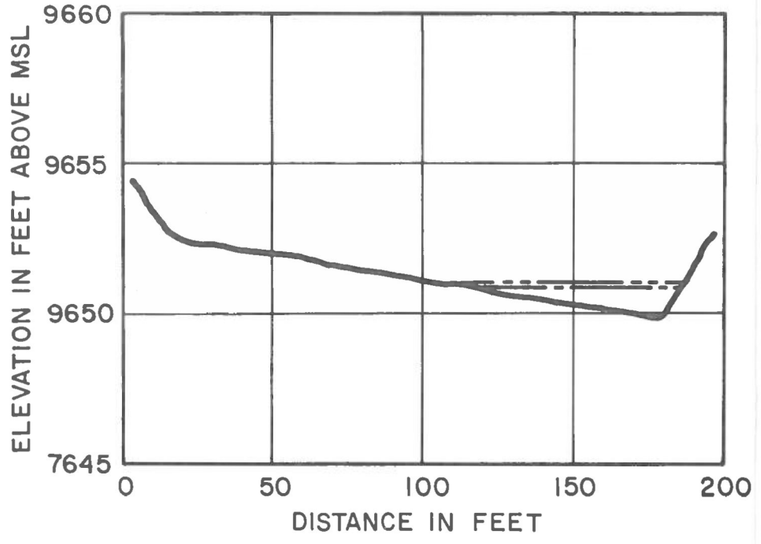
GROUND LINE

NOTES

Cross sections are viewed in direction of flow.



CROSS SECTION 3-3
LEHMAN GULCH



CROSS SECTION 4-4
SAWMILL GULCH

COLORADO WATER CONSERVATION BOARD
TOWN OF BRECKENRIDGE,
SUMMIT COUNTY, COLORADO

FLOOD PLAIN INFORMATION

FRENCH, ILLINOIS, LEHMAN AND SAWMILL GULCHES

BRECKENRIDGE, COLORADO

CROSS SECTIONS

NOVEMBER, 1974

Leonard Rice Consulting Water Engineers, Inc.

PLATE 41