

## VALUATION SECTION MONTANA 4

### GENERAL LOCATION

Valuation Section Montana 4 covers about 230 miles of main line in Montana between Colorado Junction, near Butte, and the Montana-Idaho State Line, near the east portal of the St. Paul Pass Tunnel.

### EXPLORATIONS

The first reconnoissance west of Butte started November 1st, 1904, when a route was examined from Butte to Anaconda, thence up Warm Springs Creek to Flint Lake, about forty miles. This trip was made by team as good roads existed up to Flint Lake. Operations ceased at this point about November 15th, on account of winter weather, no preparations having been made for carrying on Mountain work during that season.

In May, 1905, the exploration of this route was continued west from Flint Lake; crossing the head waters of Rock Creek and over a spur of the Rocky Mountains, bounding Bitter Root Valley on the east; thence down Ross Fork of the Bitter Root River into Bitter Root Valley; thence up Nez Perces Fork of said river to Nez Perces Pass. An alternate route west from Flint Lake was examined via Skalkaho Pass and Creek of same name to Grants Dale in the Bitter Root Mountains.

These routes were examined carefully and barometric readings taken frequently - an engineer, with an assistant and two men with pack horses and cooking outfit composed the party.

The next important exploration was of Lolo Pass, on which a party started in October, 1905, at Missoula, following up the Bitter Root River to Lolo Creek; thence up this Creek to Lolo Pass; thence north along the divide to the head of the South Fork of Fish Creek; thence down Fish Creek to Rivulet. The lateness of the season and the deep snow, covering all horse feed on the mountains, forced this party back.

In January, 1906, a party composed of an engineer with 3 men made a thorough exploration of the Bitter Root Divide and all important streams flowing easterly to the Bitter Root and Missoula Rivers. The exploration work covered the divide from Lolo Pass on the south to the head of Cedar Creek on the north, an approximate distance, measured along the State boundry line,

of from sixty to sixty-five miles. In connection with this work, notes were taken to locate all streams, side trips made down same, and elevations taken at frequent intervals to determine possible gradients. This work was carried on in 15 to 30 feet of snow.

The examination of the aforementioned routes consumed about 15 months' time between November, 1904, and February, 1906.

The next exploration for a pass through the Bitter Roots was made up the St. Regis River in the summer of 1906, starting near Saltese and following a fork or feeder of said river. Every available prospect was carefully examined in this territory, consuming about three months' time on the part of the engineer and crew, though without the hardships connected with winter work.

In addition to the mountain exploration work previously described, an exploration was made from Butte west in the summer of 1906 along the Deer Lodge, Hellgate, Missoula and St. Regis Rivers to Saltese. This involved no particular difficulties as good roads existed along the entire route and the proximity of the Northern Pacific Railway aided in the work. This exploration was completed in one month.

The country traversed in the Bitter Root Mountains was practically void of trails, and where any existed they had been neglected so that wind falls made travel a slow and tedious process. Pack horses carrying provisions for three to four weeks' supply were used when possible. In the winter months toboggan sleds and men packers were used to convey supplies.

Also about 150 miles of close reconnoissance was made while instrumental surveys were in progress. Following is a statement showing approximate mileage covered in reconnoissance.

#### South of Nez Perces Pass

Butte - Anaconda - Flint Lake - Nez Perces Pass	150	Miles
Flint Lake, Skalkaho Pass - Grantsdale	85	"
Skalkaho Pass - Willow Creek - Grantsdale	25	"
	<u>260</u>	"

#### Lolo Pass

Missoula - Lolo Creek to Lolo Pass	50	"
Lolo Pass via South Fork - Fish Creek to Rivulet	25	"
	<u>75</u>	"

#### Fish Lake Pass Route

Rivulet, Fish Creek - Fish Lake Pass	75	"
Trout Creek - Lost Pass	25	"
	<u>100</u>	"

#### Superior Cedar Creek Routes

Superior - Cedar Creek - Oregon Gulch	100	"
Divide from Lolo Pass to head of Oregon Gulch	75	"
	<u>175</u>	"

Butte to Saltese; River Valleys	230 Miles
Saltese to St. Paul Pass - Mountains	50 "
Close reconnaissance during instrumental Surveys	150 "
	<hr/> 430 "
Total	1040 Miles

This 1040 miles covered in reconnaissance as compared with the 230 miles of adopted line indicates that the territory was quite thoroughly investigated, about  $4\frac{1}{2}$  miles being covered in reconnaissance for each mile of adopted line.

### SURVEYS

Taking up the preliminary surveys in consecutive order, two parties were outfitted at Missoula, Montana, about December 15, 1905. One had instructions to go to Lolo Pass and made a traverse of the summit of the Bitter Root Mountains from Lolo Pass north-westerly for the purposes of obtaining all information possible as to the existence of any and all passes that might be available for a crossing of the Bitter Root Mountains. This survey was to be made with transit, stadia rod and barometer. Provisions for the party were assembled at Missoula, hauled by team to Lolo Hot Springs and thence to the divide, by man power on sleds, as the depth of snow prevented the use of pack horses, except for the first few trips. A large amount of provisions were hauled to a cache at the summit and drawn upon as required. Trails were cut from Lolo Hot Springs to the cache and kept open by frequent trips. About 20 men were constantly employed with this party. Actual work on the traverse commenced December 25th, 1905, and was finished March 4th, 1906. During that time 40 miles of traverse lines were run and platted. This work included running outside lines and platting positions of possible tunnel sites and approaches. Continuous snow storms on the high elevations of the Bitter Root Divide made this work slow, dangerous and tedious, as well as costly.

The other party was also sent to the Lolo Pass with orders to run a preliminary line down Lolo Creek. Work was commenced by this party December 25th, 1905, at Lolo Pass and ended at Hot Springs, February 1st, 1906; 15 miles of preliminary line with full contours being run and projection made.

In July, 1906, another party took up this survey at Lolo Hot Springs, and ran down Lolo Creek to Missoula and at the same time made additional surveys at Lolo Pass. This party ran 31 miles of preliminary, 3.5 miles of location and 42 miles of close reconnaissance covering 7 weeks' time.

Above covers all the work done on the Lolo Pass Route in Montana.

Working Northerly from Lolo Pass the next survey was made in May, 1906, from Rivulet, up Fish Creek, a distance of 15 miles consuming 3 weeks' time.

The next survey consisted of a traverse of the Bitter Root divide from the head waters of Cedar Creek, which discharges into the Missoula River, near Iron Mountain, Montana. The party, for this work, moved from the Lolo Pass Traverse, down Fish Creek to Rivulet, thence to Iron Mountain, thence to the divide at the head waters of Cedar Creek. Work on this traverse was commenced March 14th, 1906, and completed August 1st, 1906. Lines were run Southeasterly along the divide, with many side trips locating tunnel sites, etc. 60 Miles of preliminary, with 100 miles of close reconnaissance work, required 6½ months with a large crew averaging 19 men. All provisions for this crew were hauled by pack trains from Iron Mountain. A second party worked on this traverse from August 1, to August 25th, 1906, running 13 miles of traverse with contours and 2 miles of location. Total territory covered was 72 miles of preliminary, 100 miles of close reconnaissance and 2 miles of location, requiring 7 months.

The next preliminary surveys were made up Cedar Creek, beginning at Iron Mountain, crossing the divide, between the head waters of aforementioned Creek, and the St. Joe River. Three separate parties worked on this Creek on the East or Montana Slope of the Bitter Roots. Total time consumed for all parties was 5 months, seventy-eight miles of preliminary line were surveyed in this time with an average of 16 men in each party.

The parties next took up the preliminary on the adopted, or St. Paul Pass Route, beginning in August, 1906, and completing in November of the same year. The total time for all parties was 5½ months, during which time 66 miles of preliminary lines with contours were run and projected locations made.

Work was started on surveys between Ross, 10 miles west of Butte, and Salt Lake, in August, 1906, nine parties being placed in the field almost simultaneously. These parties carried on the preliminary and location survey work for about 211 miles of adopted line. The territory east of St. Regis was fairly well settled with wagon roads available in most places, and operated railroads were in close proximity. Here the work lay entirely in the valleys of the Deer Lodge, Hellgate, Missoula and St. Regis Rivers, which required a large amount of topographical survey and projection work to obtain a suitable location. West from St. Regis mountain conditions as to surveying prevail, with a medium heavy growth of timber.

The location work was carried on in conjunction with the preliminary survey work and will be considered in the same summary.

Following is a statement showing the mileage, etc., of survey work.

Number of crews in field	-----10
Time on the work--Months--All Parties	---49
Average number men in each party	-----20
Miles of preliminary Survey	-----994
Miles of location Survey	-----423

Miles of line as adopted ----- 220  
 Ratio, mileage of Preliminary Surveys, to mileage adopted line 4.5  
 to 1  
 Ratio mileage of location Surveys to mileage adopted line----- 1.9  
 to 1

The progress was variant, about 12½ miles of preliminary per month being the average in the mountains as compared with the average progress of 27 miles per month in the valleys.

In the mountains every prospect was investigated, while in the river valleys the work was confined to the betterment of the one possible route.

Between Butte and Ross an independent line was located by the G. M. & St. P. Company in 1910, covering about 14 miles of line. A large amount of topography was taken on this stretch and the valley thoroughly contoured before the line was finally located.

#### ENGINEERING ORGANIZATION

The construction engineering organization consisted of a Division Engineer, in charge of the entire section, who reported to the Chief Engineer in Seattle, two assistant Division Engineers, five District Engineers, and twenty-seven Resident Engineers with the usual assistants and crews. The plans and bills of material for the temporary bridges, etc., were worked up in the Division Engineer's office. The usual inspectors, etc., were also employed.

#### CONTRACTS

This section was built under two separate contracts at different periods. The work from Cliff Junction (now Finlen) west to the state line being done on the original construction program, 1906 to 1909, and the work between Colorado Junction and Finlen in 1912 and 1913. The tracks of the Butte Anaconda and Pacific Railway were used for the operation of the G. M. & St. P. trains between the last named places until October, 1913.

The work from Cliff Junction to the State Line was let, under competitive bids from a large number of well known contracting firms, to the Winston Brothers Co. of Minneapolis on February 19th, 1907. The principal sub-contractors were W. B. Cronk, A.D. McDougal & Co., Stewart & Welch and Streeter & Lusk. Besides the above there were a large number of firms handling shorter portions of the work and many station men. The first grading work was started near Missoula in July, 1906, but as a whole, grading operations were commenced in April and May 1907, and completed in December, 1908, though portions of the line east of Missoula were not finished until June, 1909.

The work from Colorado Junction to Cliff Junction (now Finlen) was done partly by contract and partly by the Railway

Company's forces. The principal contractors were Guthrie McDougal & Co. The work done by the Railway Company's forces consisted of train hauling material on the B. A. & P. Ry. Co. tracks to construct embankments where adjacent borrow could not be obtained. This work was started in September, 1912, and completed in October, 1913.

### CONSTRUCTED LINE

Construction on the main line between Colorado Junction, and Finlen was commenced in September, 1912. Starting at Colorado Junction the line descends Silver Bow Creek parallel to the B. A. & P. Ry. and the Northern Pacific Railway with light work for six or seven miles. The line then enters Silver Bow Canyon where the construction involved many difficult features due to the proximity of the two existing tracks and Silver Bow Creek. The sides of the canyon are high perpendicular cliffs with the creek occupying a considerable portion of the narrow valley. The heavy rock work covers about six miles, terminating near Finlen. West of Finlen construction was started in May, 1907. Here the line swings sharply to the north and enters the wide valley of Deer Lodge Creek, which it follows with side hill development work involving heavy cuts and fills, for about fourteen miles, or to the first crossing of Deer Lodge Creek. From this point to four miles west of Kohrs the work is light, and after crossing the Northern Pacific at Sinclair, the line is parallel and about one hundred feet distant from the Northern Pacific line. From four miles west of Kohrs to Garrison work is quite heavy, deep cuts and high fills being dominate features.

The above described section of line, from Finlen to Garrison lies in a wide flat valley, partly under cultivation by irrigation methods. Alignment is good - maximum curvature 3 degrees and gradient 4/10 of one per cent.

Near Garrison, the Deer Lodge and Blacktail Rivers unite to form the Hellgate River. The valley of this river is followed to Bonner. The general characteristics of this river are embodied tersely in its name. In June floods it carries a large amount of water, the drainage area from adjoining mountains being extensive. Generally speaking, the valley is narrow, widening out occasionally which places are usually under cultivation. As a measure of safety, the grade line here is high, and where channel changes were made, a large cross-section area was provided. The construction of two lines of railway, together with the space occupied by the channel of the river consumed the entire width of the valley in many places. To maintain a maximum of 3 degree curvature many deep cuts and four tunnels through projecting rock points were necessary, between Garrison and Missoula, and many channel changes were made to save frequent crossings.

At Bonner the Big Blackfoot River joins the Hellgate and forms the Missoula River, which is followed to St. Regis.

For the first 20 miles west from Missoula the roadbed lies in a wide highly cultivated and irrigated valley, fairly smooth, making light work as a rule. However, there is some extremely heavy work between 6 and 9 miles west of Missoula.

Just west of Huson the valley converges with high bluffs on either side. Between here and St. Regis benches are occupied at considerable elevation above the river, which is crossed three times on expensive steel structures. Considerable cross drainage is encountered also, causing other expensive waterway openings.

At St. Regis the ascent of the east slope of the Bitter Roots is commenced along the St. Regis River with moderately heavy work and some sharp curvature to Haugan. Here the mountain grade and corresponding heavy mountain work commences and continues to the east portal of the St. Paul Pass Tunnel. This is typical mountain work, characterized by deep cuts, tunnels, and high embankments. Numerous high timber bridges were built during original construction, which were filled later. Here the maximum gradient is 1.70 percent with maximum curvature of 10 degrees. Grade compensation is made for curvature.

In general this 230 miles of railway lies entirely, with the exception of the distance from Haugan to the state line, along streams of varying size, which caused more than the average amount of bridging and bank protection work. The existence of one or more railways in the same valley also added complications to the construction although it relieved the transportation problem.

#### CLEARING AND GRUBBING:

There was very little clearing necessary between Butte and Garrison as most of the land crossed by the right of way was previously under cultivation, with the exception of the portion in the Silver Bow Canyon which was rocky and devoid of vegetation. Between Garrison and Missoula medium heavy clearing was encountered. Practically no clearing was done between Missoula and Huson. From Huson west to St. Regis some medium heavy clearing was necessary.

West from St. Regis heavy clearing was encountered. The right of way was cleared for full width, except through the forest reserve, where extra widths were required by the government. Strict rules were enforced as to burning brush and skidding and decking logs by the government inspectors. Permits were required for burning and all precautions possible were taken against forest fires. These items all added to the expense of the work.

The grubbing varied about as the clearing and was paid for as per specifications.

#### GRADING:

The outfits and supplies for the construction work on this section were shipped in over foreign lines to the nearest point and hauled to the work in the best way possible. Between Butte and Haugan the close proximity of other railroads was a great help, but often the work of moving from the point of unloading to the work was arduous owing to the fact that in most

cases the foreign line was on the opposite bank of the river and very few wagon crossings existed. In some places temporary bridges or ferries were built. These were expensive, however, on account of the swift water and steep rocky banks.

For the work east of Bonner the Chief points of purchase for contractor's supplies were Butte and Deer Lodge. The main commissary was established at Deer Lodge. Missoula was the point of purchase for supplies in that vicinity and west. Important commissaries were established at Bonner, Huson, and Taft. Supplies were distributed to the various camps from these points, sometimes by rail to the nearest point of delivery and from there by wagon. At Bonner a boat was used to ferry the supplies across the river from the Northern Pacific station. This was expensive and a good many supplies were lost here on account of the swift current.

Material handled by the contractors in this section was variant in the different valleys traversed. In the Deer Lodge River Valley common excavation predominates with a small portion of classified material. In the deep cuts along the Hellgate River, a large amount of solid rock and other classified material was encountered. Conditions as to material in the Missoula River Valley are practically the same as in the Hellgate Valley up to Missoula. West from there for twenty-two miles the material handled was largely common. From the twenty-two mile point west to the commencement of the mountain work at Mile 98, the excavation developed more or less solid rock.

From the foot of the 1.7 percent grade to East Portal, solid rock is the predominating classification of the excavation.

From the point where the line leaves the St. Regis River Valley to the St. Paul Pass Tunnel, the country was virgin forest with no trails, therefore it was necessary to build roads at a heavy expense.

On the lowlands, where common material predominated, the grading work was largely done with teams. Most of the rock work was done by station men, using trap tunnels wherever possible, and rock cars and track to carry the material to the fills. Steam shovels were used on the heavy work done jointly with the Northern Pacific in the Hellgate Canyon, and at a few other points, but as a rule the transportation problem eliminated this class of equipment.

In closing the subject of grading, contracts, etc. it might be mentioned that after Winston Brothers had finished the contract work, Railway Company forces were used to a large extent in filling temporary bridges, raising and widening banks and daylighting cuts.

A large part of the later bridge filling in the Bitter Root Mountains was sluiced in place.

Some of the structures were filled with material from daylighted and widened cuts.

The work between Colorado Junction and Finlen was done to a great extent under adverse conditions. A large amount of blasting was a necessary part of the construction. Care was used in blasting so that traffic on the parallel railroads would not be interfered with or trains endangered by flying rock. Train haul work done by use of the B. A. & P. Ry. Co's tracks was necessarily interfered with by the passage of that Company's trains. All of above tended to increase cost of this section.

#### BRIDGES, TRESTLES & CULVERTS:

All bridges except steel structures were built by contract in accordance with the standard plans of the C. M. & P. S. Ry. Co. under the direction of Winston Brothers Co. as per contract. Stringers were of Douglas fir and piles of cedar. The former were purchased and shipped from the Pacific coast to stations on the Northern Pacific Railway, where they were unloaded and hauled by team to the various points of erection.

Stringers used on the high bridges in the Bitter Root District were shipped to DeSmet on the N. P. Ry. then hauled west again on the Coeur d'Alene branch of that railway to Haugan, Saltese and Taft, from which points they were hauled by team over the newly constructed roads and trails to points of erection.

Trestle timber other than stringers, such as posts, sills braces and caps were also purchased at Coast points, except a small portion which was obtained from local saw mills.

Idaho cedar piles were used, originating on west slope of the Bitter Roots loaded at stations on the N. P. Ry., thence shipped to points of erection.

Culverts between Colorado Junction and Finlen are constructed of timber, cast iron pipe and concrete. Haul on cast iron pipe was from Chicago and vicinity on C. M. & St. P. Railway, concrete arches were built by Railway Company's forces. Concrete pipe was built at Tomah, Wisconsin and hauled to Butte on C. M. & St. P. rails. Timber culverts were built by the Railway Company with material furnished from stock.

Between Finlen and Cyr all culverts were built of sawed timber, which originated at Bonner and was hauled on the N. P. Ry. to stations on that railway nearest to points of erection, thence by team.

Iron for culverts was shipped from Chicago and other Eastern points, freight being paid on foreign roads from Minneapolis.

Between Cyr and Superior many log culverts were built from local timber.

From Superior to Saltese both sawed and hewn timber obtained locally was used in culvert construction.

On the Bitter Root slope there were many long culverts under high fills. Timber used in these was sawed and hewn and a large amount of log cribbing was constructed. Most of this timber was hauled by team to sites.

#### PERMANENT BRIDGES:

The permanent foundations for the steel bridges in the Missoula and Hellgate River Valleys were built by Contractors and the steel was erected by Company's forces. Floods caused considerable damage to all of this work which was under construction in the summer of 1908. This delay caused the foundation work to be done during the following winter which added to the expense.

The cement for these foundations was shipped from the east to the nearest point on a foreign railway and transferred from there to the point of construction by teams.

The concrete aggregates were obtained at the nearest local point possible.

The steel work was fabricated in the east and shipped via C. M. & St. P. Ry. to Butte, from there by foreign lines to the nearest material yard, from where it was taken by work train to the point of erection.

#### SPECIAL FEATURES:

Between Finlen and Huson irrigation ditches were encountered which required in many cases special construction.

A grade revision has been made near Sinclair reducing the original 1 per cent gradient to a 4/10 of one per cent.

Many large channel changes were made in the Hellgate River Valley. These were extra large on account of the extreme flood periods of this river.

An unusual flood occurred in the Hellgate and Missoula River Valleys during the summer of 1908, which seriously damaged the C. M. & St. P. work under construction and the Northern Pacific operated line, as well as flooding cultivated fields and carrying away construction material and equipment. After the flood several grade and line revisions were made. Some of which were done jointly with the Northern Pacific.

An expensive wagon road was built in the Bitter Root Mountains for construction purposes, part of which is chargeable to this valuation section. This is more fully described in the Historical Sketch Valuation Section Idaho 1.

Many slides occurred on this section during construction and early operation, which added to the construction expense.

Large areas of land were purchased and damaged timber paid for in connection with the bridge fill sluicing in the Bitter Roots.

A 5 ton cable tramway was built between the east portal of St. Paul Pass Tunnel and the summit, for handling bridge timber, for structures on the west slope. This was about 5000 feet long and was built of native hewn timber.

During the years of 1907-08-09 when the railway company had a large construction force working in this district, they were able to keep down the forest fires originating from the burning of clearing, camps and other customary causes, by the use of fire patrols, which were maintained at all times during the dry season. In cases where the fire patrols were not able to cope with the fires, there were always large construction forces close at hand, which could be called upon for assistance at any time, and there was no hesitancy in calling on construction forces when there was danger of a fire getting beyond control. During the summer of 1910, at a time when the entire country was dry, and the railway company forces were materially reduced in this district, there were several small fires at various points. During the early summer as such fires occurred, they were handled by the National and State forest forces, assisted by the Railway Company forces, and in a general way, the fire situation was considered as being under good control until August 20th, when there occurred an unexpected change of weather, resulting in high winds which reached tornado velocity. The occasional smoldering fires at various points, with the entire country very dry, were soon increased to such an extent that the entire district from Avery to Saltese was largely a mass of fire. The strong winds transferred burning embers and sheets of flame from point to point, so that practically nothing escaped. All living creatures perished with the exception of those that managed to get into the tunnels. The Forestry Department buried the bodies of 25 fire fighters in the vicinity of Avery on August 24th. Between 75 and 100 fire fighters are supposed to have lost their lives in this territory between August 21st and 25th, 1910.

In addition to the loss of life above mentioned, loss of property was enormous and consisted of standing timber over the whole burned area, owned by Government and private parties. Railway Company property consisting of construction camps, supplies, equipment, construction material on hand, cars, turn tables, station buildings, track, etc.

The reconstruction of, approximately, the 40 miles of railway damaged by this fire cost the Railway Company about \$300,000.

The old construction wagon road, which had not been used since the line was opened for traffic, was cleared and repaired for handling the supplies and material. Employees and material from all divisions were rushed to the scene as fast as possible. The gathering together of material and equipment was exceedingly hard as all the mills in the vicinity had been burned and those farther away had closed down and prepared to fight the fire. The country was

scoured for teams to haul material. The timber bridges were in most cases totally destroyed, and steel bridges were warped and weakened. The rails were bent and broken from the intense heat and the track was covered with fallen timber.

The line was out of commission for 16 days so the loss in suspension of traffic was also great.

About twenty miles of timber flumes being used in the bridge fill sluicing were burned, and it was necessary to reconstruct them before the work could be completed.

#### TUNNELS:

Between Garrison and St. Paul Pass, there are six tunnels, the first one being numbered 14 and located near Garrison. This tunnel is 1975 feet in length with the usual standard section. An unusual amount of over break occurred here caused by striking an extensive pocket of disintegrated rock. There was also a large amount of force account work done here due to the unusual conditions.

No unusual conditions occurred at tunnels number 15 and 16.

No tunnel was contemplated, on the original line, at the present location of tunnel 16½. The flood of 1910 undermined the river banks and roadbed, which had been constructed at this point, causing a change of alignment, throwing the center line farther into the bluff and making the construction of this tunnel necessary.

This change came so late in the construction program, however, that it was impossible to complete the tunnel in time for track laying and a temporary run around was constructed.

Ordinary conditions existed at tunnels number 17 and 18. At tunnel number 19 a serious slide occurred soon after track was laid, making it necessary to line it with concrete at once.

The work on the aforementioned tunnels was all done by hand, the top heading method being used. Cars and track with horses carried the material to the fills and waste banks. The timber lining was largely coast fir shipped to the nearest point on foreign railway lines and from there hauled by team.

The work on the St. Paul Pass Tunnel was done by Winston Brothers Company. The top heading was driven first after which the lower portion was drilled and broken up. Model 20 Marion shovels operated by air worked in from each end, loading the material on 1½ yard cars, which were handled by electric motors.

To furnish the electricity a power house was built at Taft, and a transmission line from there to the east portal of the tunnel, where a substation was installed. A transmission line was also built over a summit to serve the west end.

The tunnel was lighted by electricity and trolley wires were strung for the motors. The power plant at Taft was operated by steam. Three 8 hour shifts were maintained entirely through the construction as the work was rushed all possible to avoid delay to track laying and the consequent opening of the line.

Men were hard to keep as the work was disagreeable and hard. Several large veins of water were encountered and at times the working conditions were almost unbearable. The deep snow in the winter also retarded the work and made the men dissatisfied. To overcome the shortage of men a bonus system of payment was established.

The timber lining at the east end was foreign lumber shipped to Taft and hauled from there by team. Lining in the west end was largely native timber from the Clear Creek Saw Mill.

The tunnels on this section, have been lined, where necessary, with concrete, since the line was opened for traffic, with the usual high car outfit.

#### TRACK LAYING:

For track laying purposes, material yards for storing track material of all kinds were established at Morel and Huson. Track laying operations covered ten months as a whole - actual work of laying covered about 160 days, making an average of 1.4 miles per day. Commencing at Cliff Junction August 8, 1908 track was laid in several sections at different times reaching Missoula March 29, 1909. Rails, fastenings and other track material were shipped from the East over foreign lines - ties from Western points on foreign lines. Main line steel was new 85 pound, sidings and yards were laid with second hand - 75, 60 and 56 pound material. Work was all done with a Roberts Brothers Machine. Track laying began at Huson September 7, 1908 and continued west to Cyr ending there September twenty ninth. The same crew began again at Huson October 2, 1908 and laid track east to Missoula, ending October twenty-first. From Cyr west track laying began December 1908 and ended at St. Regis January 6, 1909. From Haugan track was laid east to St. Regis between October fourth and December 5, 1908 and from Haugan, west to the State line between October fifth and November 5, 1908. Continuous track laying was impossible on account of delay due to construction of the larger steel structures.

#### BALLAST:

For ballasting operations on the part of this section from Cliff Junction to East Portal, gravel pits were developed, at Sinclair, Haskell, Thelma, Frenchtown, Superior and Haugan.

The line from Colorado Junction to Cliff Junction was ballasted in 1913 from the gravel pit at Deer Lodge.

#### WATER SUPPLY:

For track laying operations numerous temporary water stations were installed. Owing to the fact that the line follows

waterways along the entire distance as far as Saltese, there were no unusual difficulties experienced in obtaining an adequate supply of good water. Temporary tanks were later replaced with permanent standard structures.

#### FENCES AND SNOW PROTECTION:

Soon after track was laid fence material was distributed by work train and the construction was started. The right of way was fenced on both sides except in inaccessible and isolated places. Cattle guards and wing fences were built at important road crossings and gates were installed at farm crossings.

Snow sheds were built at points where developments indicated they were required. The daylighting and widening of cuts in the mountains was also in line with protection from snow.

#### BUILDINGS:

As rapidly as material could be assembled, after track was laid, the necessary buildings for operation were constructed. Engine terminals were built at Deer Lodge and Alberton with quite extensive shops at the former place. Permanent frame depots have been built at the important stations, and neat parks are maintained. At Missoula a commodious brick depot, with second story for Division Offices, was built and artistic parking and well arranged driveways add to its appearance. A brick freight depot with extensive track layout was built here also. Buildings for section facilities were built where needed.

#### TELEGRAPH:

Material for telegraph lines was distributed by work train. This work was finished as soon as possible as it was the most important feature for safety in train operation. In addition to the telegraph instruments, dispatchers' telephones were installed in the depots, and in booths at blind sidings.

#### SIGNALS:

Automatic block signals are used throughout.

#### EQUIPMENT:

Rotary snow plows are operated over the line west of St. Regis during the winter season. East of St. Regis flangers are used to keep the track clear of the comparatively light snow fall.

#### ELECTRIFICATION:

This entire section is electrically operated. Substations have been built at Morel, Gold Creek Ravenna, Primrose,

Tarkio, Drexel and East Portal. Power for the Morel station is obtained from the Montana Power Company's Plant at Great Falls, and for the others from the plant at Thompson Falls. The power is received at the substations at 100,000 volts, alternating current, where it is transformed and regenerated to 3000 volts direct current, for train operation.

OPERATION AND MANAGEMENT:

The east end of this section between Colorado Junction and Deer Lodge is a part of the Rocky Mountain operating division and is handled by the Superintendent and his Assistants at Three Forks, Montana.

The part between Deer Lodge and the state line is the major portion of the Missoula operating division with Superintendents' headquarters at Deer Lodge.