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REVIVAL OF THE ESTELLA

An Essay submitted during the Third Year of the Course in Applied Science at the University of British Columbia.

JAMES ALBERT SOLES

November 15, 1950

Hut 40F,
Little Mountain Camp,
Vancouver, B.C.,
November 15, 1950.

Dean of Applied Science,
University of British Columbia,
Vancouver, B.C.

Dear Sir:

In accordance with University Calendar Regulations for Third Year Applied Science, I am submitting this essay, 'Revival of the Estella', for your consideration.

Yours truly,

J.A. Soles

J.A. Soles.

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P R E F A C E

The material used in this essay was obtained chiefly from personal experience acquired while I was employed by Estella Mines, Ltd. as an engineer's assistant, and from the study of authoritative extracts relating to the lithographic features of the area considered.

I am greatly indebted to Mr. Alfred R. Allen, geological engineer for the company, and Mr. Ralph Sostad, mine superintendent, who have given me much assistance in interpreting the geological and economical aspects of the property.

J. A. Soles

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November 15, 1950

REVIVAL OF THE ESTELLA

Purpose and Scope of this Essay

This essay illustrates the work and problems involved in the re-opening of the Estella Mine at Wasa, B.C. It covers, in general, the geological nature of the area under consideration, the reasons for the original exploration and abandonment of the mineral claims, the work involved in re-opening the mine, and the present economic circumstances which have necessitated certain steps to be taken in the mine's further development.

Lithography of the Area

Location

The Estella group of mineral claims is part of the Ft. Steele mining division, and lies on the eastern side of the Rocky Mountain Trench approximately forty miles north of Cranbrook, B.C.[1] It borders, geologically, on the northeast corner of the Cranbrook map-area, and

[1]See Map I

hence the lithographic features follow that of the Cranbrook area formations for that locality.[1]

Cranbrook Area

Approximately half of the lithographic formations of the Cranbrook area are Lower Purcell; the remainder consist mainly of Cenozoic glacial drift, in the Rocky Mountain Trench, and isolated sections of Palaeozoic and Cenozoic rocks, occuring on both sides of the Trench.

The Purcell Series has been widely intruded by Purcell diorite sills and dykes, late Precambrian in age, the larger bodies being found in the Ft. Steele and Aldridge formations. Both the sedimentary and intrusive rocks were intensely folded, probably before and during the orogeny of the Rocky Mountain Range to the immediate east. Granodiorite and syenite dykes of late Cretaceous and early Tertiary age, respectively, occur in smaller intrusive bodies throughout the area; the granodiorite is genetically related to mineral deposits, as is the Purcell diorite, but the syenite apparently did not foster extensive mineralization. Quartz-calcite fissure veins of later origin are abundant.

Glaciation during the Pleistocene epoch, and subsequent weathering, played an important part in the exposure of much of the series. Activity was confined mostly to Alpine glaciation, for the ice mass in the Trench was apparently relatively stable throughout the Wisconsin glacial period.[2]

Estella Area

(a) Geology

The Estella group surrounds and includes a large cirque, approximately 1/4 mile in diameter, which was cut out of a section of the Aldridge and Ft. Steele formations by an Alpine glacier. The area is

[1]Rice, H.M.A. 'Cranbrook Map Area, B.C.' G.S.C. Memoir 207
[2]Rice, H.M.A. (1936)'Glacial Phenomena near Cranbrook, B.C.' Jour. Geol. Vol. 44.

typically Lower Purcell; the host rock, rusty-weathering grey argillite and argillaceous quartzites of the Aldridge and light-colored cherty quartzites and black argillites of the Ft. Steele, contains dark green Purcell diorite and light pink porphyritic syenite as the intrusives. Stratigraphically, the area appears to be on the eastern limb of a steeply-plunging anticline bearing northwest-southeast.

(b) Topography

The terrain about the property is steep, rough, and is cut by many trenches, but in general has been eroded to the extent that drift and talus covers much of the rock to a depth of from 2 to 50 feet. Large bluffs of rock protrude on the steeper faces. The area had been mostly forested at one time, but a fire in the late 1920's burned off the trees on the western slopes; secondary growth is now well advanced.

The cirque is pear-shaped, and is bounded on three sides by precipitous rock slopes leading to peaks 8000 feet or more in height. In its centre is a pseudo-drumlin, approximately 800 feet in width and height, left during glaciation. The neck terminates as a modified hanging valley 6000 feet high, from which Tracy Creek, the stream draining the basin, flows into a steep valley descending westward toward Wasa and the Kootenay River.

(c) Mineral Deposits

A Purcell diorite dyke dipping southward at 60 to 80 degrees cuts eastward across the cirque drumlin. The main Estella orebody, a high grade replacement deposit containing chiefly sphalerite and galena, appears to be directly associated with this dyke.

Surface showings on the west side of the drumlin reveal 600 feet of ore varying from 1 to 10 inches wide, with two bulges 3 feet in width and approximately 10 feet in length. On the east side, the vein appears at Tracey Creek in a 5-foot bulge 20 feet long, and

narrows to 8 inches for another 50 feet.[1] Various small quartz-calcite fissure veins, carrying fair amounts of silver, copper, gold, and galena, cut through the Purcell rocks and the syenite.

History of the Mine

Discovery and Ownerships

In the late 19th century, widespread prospecting was being carried on in southeastern B.C., for the building of the railways through the Rogers and Crow's Nest Passes to the west coast made it possible to transport ore and equipment at a reasonable cost and speed. Exploration of the Tracy Creek basin began around 1880, but no mention of claims was made in mining records until 1894. In that year eight mineral claims, which became known as the Stella group, were staked by prospectors unknown to the writer. Six Crown leases were later added to the group. In 1898 the group was bonded to Alex Polson and named the Estella. Polson or his heirs retained the ownership until 1950, when Estella Mines, Ltd., a private company, exercised an option to purchase the property.[2]

Exploration

The sequence of exploratory work was as follows.

(a) Test-pitting, winze sinking, and minor tunneling on outstanding surface veins,

(b) Driving the Estella adit,

(c) Excavating the Rover drift,

(d) Diamond drilling.

The first work done on the property was with the view of mining the gold-silver ore exposed in veins along the banks of Tracy creek. Two short tunnels and one shaft were first driven into the creek banks,

[1] See Maps II and III
[2] See Map IV

following veins, then the Estella adit was driven to cross-cut these veins and others farther to the east, including the zinc-lead orebody. Excavation ceased short of the latter. Since the gold-silver deposits proved to be economically unmineable, excavation shifted to the Rover drift, for a large zinc-lead deposit was indicated by shafts No. 1 and 2 and other exploratory work. By 1910 over 3000 feet of exploration work had been reported, which covered all development on the property as it is found to date.[1] In 1910 the group was bonded for $175,000.00, but low metal prices and penalties imposed by the smelters on zinc-lead ore made exploitation impractical, so the property was abandoned.

In 1927 the Consolidated Mining and Smelting Co. Ltd. obtained an option on the Estella property and diamond drilling was begun to ascertain the extent of the orebody. Ten holes were placed, seven intended to intersect the vein, and three to explore mineralized zones on the western wall of the cirque.[1] The option was dropped in 1929, but later, in 1944, the same company made the first recorded survey of the surface geology of the area.

Re-opening of the Mine

General

In May, 1950, a group of Vancouver businessmen received an option to purchase the property from the owners, and a company, Estella Mines Ltd., was formed with the object of inspecting the property and bringing it into production if the findings warranted exploitation.

Preliminary Work

In late April, twenty-six additional claims were staked about the Tracy creek basin, but deep snow prevented any examination of the

[1] See Map V

surface. On May 20 a small crew began work on the old trails and camp, and on the tunnels, which had caved at the portals. By June 15 all obstacles were cleared, and investigation of the orebody was begun.

Inspection of the Workings[1]

(a) Surface Expression

It has been mentioned that approximately 600 feet of vein, running in bulges and narrow seams, extends east and west across the drumlin. Two shafts and two exploratory tunnels follow the vein from the surface showings, and reveal the following:

Shaft No. 1: caved, but reported to have exposed 3.5 feet of ore for 50 feet,

Shaft No. 2: water-filled at the time of examination, but reports and later inspection showed 5 to 8 feet of ore to a depth of 60 feet,

Lower Tunnel: caved, but reported to have ended at a large shear zone before intersecting the vein,

Upper Tunnel: 2 to 5 feet of ore for 10 feet along the vein.

Examination of sample boxes, and reference to the C.M.&S.Co. maps showed that three drill holes, all on the eastern extension, intersected the vein, thereby indicating continuity of the orebody. Cores show 3 to 4 feet of ore of a lower average grade than that of the main deposit.

(b) Estella Adit

The Estella adit, elevation 6100 feet, was driven in a south-easterly direction from the northern base of the drumlin beside Tracy creek. It is approximately 980 feet long, and has three cross-cuts and one raise. Examination was not carried out intensively, as the drift did not intersect the major zinc-lead orebody; however, it exposed minor gold-silver-copper veins which may prove valuable as sources of secondary

[1] See Maps III, IV, and V

production, revealed many large shear zones which might aid in interpreting shifts of the ore deposits, and appeared sufficiently large to provide a main avenue for removal of the ore from the zinc-lead orebody by raising and stoping. Compact quartzites and argillites indicate that little support for the adit will be required.

(c) Rover Drift

The Rover portal is approximately 150 feet above the Estella and 500 feet to the southwest; the drift strikes southeast, following the ore vein. Fifteen short crosscuts were driven along its length of 860 feet; also, a 60-foot raise and a winze of approximately the same depth were excavated.

Preliminary examination showed that the vein pinched and swelled in the same manner as the surface expression, but mineralization was far more extensive. The orebody appeared to be bounded on the hanging wall by the diorite and on the footwall by argillaceous quartzites. Dissemination of sphalerite and galena was evident in both, but marked only in the quartzite. In the larger replacement zones the ore varied from medium-grained, dark, ferrous sphalerite with low galena content to a compact zinc-lead combination containing fair silver values. The disseminated sphalerite appeared in the purer, light-colored form.

The orebody extended for 500 feet along the drift with widths varying from 10 inches to 15 feet, the average being 4.5 feet. On the inner end of the drift, however, the vein faded out, and the last 200 feet or so was driven through barren argillite containing only quartz-calcite fissure veins. Two major shear zones crossed the drift, but the vein was displaced only a few feet by one of them.

The tunnel was re-surveyed, and the orebody was sampled to determine the value of the deposit. Eighteen channel samples were taken across the vein throughout its length, and five diagonally across or lengthwise within the vein zones. The winze was water-filled at the time

SAMPLES AND ASSAYS

Sample Number	Width Inches	LOCATION	SILVER OZ/Ton	LEAD %	ZINC %	GOLD OZ/Ton
211	34	No.2 Shaft collar	4.8	15.0	33.6	0.01
213	18	Surface near No.1 Shaft	3.2	10.1	15.6	
214	36	Surface about 60 feet from NO.1 Shaft	5.2	20.0	25.7	
4752	66	No.1 Crosscut - Rover Tunnel	1.0	1.0	25.2	Tr.
4755	60	N.E. Wall near No.1 Winze	0.5	0.9	24.6	
4760	60	N.E. Wall near raise	0.4	2.0	30.2	
4761	72	4 crosscut - inner section	3.2	8.0	34.6	0.01
4763	78	No. 5 crosscut	2.0	5.2	9.6	
4773	130	N.W. Wall No. 12 crosscut	2.6	10.0	29.6	
4774	48	No. 12 crosscut face	9.0	25.8	35.0	
4785	18	N.E. wall - near No. 8 crosscut	1.0	3.8	3.0	
215	-	Selected from Dump - Tracy Tunnel	25.6	15.8	1.6	0.14
4766	55	No. 11 crosscut - outer section	1.1	5.8	56.4	

of inspection, and the raise timbers were unsafe, hence sampling of both was postponed.

Results of Sampling

The appended list is characteristic of the assay returns from mine and surface sampling of the property; it is condensed from overall assay returns. In general, the following is indicated:

(a) gold content is low,

(b) silica and lime constitutes approximately 10% of the deposit,

(c) iron content of about 10% is indicated,

(d) silver, lead, and zinc average 2 ounces per ton, 7%, and 23% respectively.

Silver-lead-copper specimens yield high silver and had values, but thorough sampling of the deposits is required to obtain an average value.

Conclusions

Inspection of the workings revealed the following points:

(a) calculations based on a vein extension 150 feet above the Rover and 100 feet below showed a possible 75,000 to 100,000 tons of zinc-lead ore available for immediate removal;

(b) the metals content far exceeded the minimum requirements for exploitation of such a deposit at current base metals prices;

(c) continuation of the vein to the east was indicated by previous drilling, but further drilling from both the surface and within the drifts was necessary to ascertain more accurately the lateral extent, the width, and the depth of the vein-replacement body;

(d) a suitable millsite could be excavated between the

two tunnels, thereby permitting the removal of ore from both drifts, if desired;

(e) a road could be constructed to transport the concentrate by truck to the railway at Wasa for shipment to the Trail smelter.

The conclusion drawn from the examination was that the Extella property could be mined at a substantial profit even if further examination revealed that development beyond the exposed zones would be impractical.

Economic Considerations

Marketing Values

Two alternatives for disposal of the Estella ore were open for consideration:

(a) it could be shipped directly to the smelter as extracted;

(b) it could be concentrated on the property and sold to the smelter in the refined form.

The following calculations show possible returns per ton of ore mined, considering direct shipment and selective flotation concentration. Metal prices are based on July markets, with zinc and lead values set at 16.25 and 12.1 cents per pound, respectively, and silver at 80.3 cents per ounce. Operating and transportation costs and smelter losses are approximations.

(a) Direct Shipment

The smelter pays for only 50% of the zinc extracted from run-of-mine ore, less 6 cents per pound. All lead is paid for, less 2.5 cents per pound. If the average assay of 23% zinc, 7% lead, and 2 ounces silver per ton is representative of the Estella ore, smelter

payments would be as follows:

Zinc.	23(20)(16.25 - 6)(.5)	=	$23.57 per ton
Lead.	7(20)(12.1 - 2.5)(.925)	=	$12.43 per ton
Silver.	2(.95)(80.3)	=	$ 1.52 per ton
	Smelter payments	=	$37.52 per ton

Costs will approximate the following:

Base smelter charge	$12.00
Transportation to railway by truck	$ 1.75
Smelter by train	$ 4.00
Production costs	$ 5.00
Total	$22.75

The estimated profit will therefore be $14.77 per ton of ore if shipped direct to the smelter.

(b) Concentration by Selective Flotation

The smelter pays for all zinc less 3.25 cents per pound. Assuming the recovery to be 95% of the original sulfide content and the concentrating ratio to be 2.5: 1, the concentrate will assay 54.62% zinc, 16.62% lead, and 4.75 ounces of silver per ton. Returns will be as follows:

Zinc.	1092.5(16.25 - 3.25)(.82)	=	$116.46 per ton
Lead.	332.5(12.1 - 2.5)(.925)	=	29.52 per ton
Silver.	3.75(80.3)(.95)	=	3.62 per ton
	Smelter payments		$149.60 per ton

Smelter deductions:

Base Smelter charge	=	$13.00
Rail transportation to Trail	=	7.00
Total		$20.00

Production Costs:

Mining and development	$4.00
Concentrating	3.00
Transporting concentrate to Wasa	.85
Plant depreciation etc.	.75
Other costs	1.40
Total	$10.00

Net Smelter payments are $129.60 per ton of concentrate or 129.60 (1/2.5) = $51.84 per ton of ore. The net profit will therefore be $41.84 per ton of ore.

Concentration by the sink-float method yields an estimated $41.50 per ton on the same basis of calculation. The net profit to be realized per ton of ore from each method is therefore found to be:

(a)	Direct shipment	$14.77
(b)	Concentration by flotation	$41.84
(c)	Concentration by sink-float	$41.50

Recent increases in the base metals prices raise the last two values to $54.00 per ton of ore mined.

Conclusions

Calculations based on current base-metal prices show a possible profit of 4 million dollars or more for the available ore if concentration is carried out, and a profit of 1.5 million if ore is shipped direct; hence, the installation of a .5 million dollar plant, or even double that for all building costs, would be well worth the primary expense. Loss to the investors would result if base-metals prices dropped so that the original investment could not be liquidated, a value which would be less than half of the current prices; on the other hand, the mine may prove to have a much larger deposit than is indicated, and the investors could realize a greater profit at lower market prices.

Recommendations

The economic and physical details of the mine's possibilities, as shown, resulted in the recommendation by the engineer that:

1. the Estella property, including a lot near the abandoned village of Tracy, be purchased according to the terms of the agreement with the owners;
2. a 150-ton concentration plant, with provision made for expansion to double that capacity, be erected upon the property, the type chosen to best conform to the concentrating characteristics of the ore;
3. a road suitable for the transportation of the ore be constructed from the mine to meet the secondary government road near Tracy;
4. development of the mine camp and working areas be begun as soon as a primary 'cart-road' to the mine was completed.

Recent Development

Construction of the primary 'cart-road' held up large-scale development of the proposed camp and the surface workings during July and August of 1950, but since that time much has been accomplished. A camp large enough to accomodate fifty men has been erected; a small dam in the creek above the Estella portal has been built, and the water piped to the buildings; a diesel power unit and lighting system have been installed; and a 6-10% permanent nine-mile road has been surveyed and bulldozed through to the property.

Future Possibilities

The mine is now only in a secondary state of development, but

within a year full production will be possible; hence, precluding a great drop in the value of base metals, the Estella will become a profitable mine, if not a large one.

116°00'

49°-45'

HIGHWAY

MACADAMIZED

KIMBERLEY

Chapman Camp

Marysville

ST. MARYS RIVER

St. MARYS Lake

Trail

Creek

Angus

LEADER CAMP

Creek

Hellroaring

WASA

LK. WASA

Lewis Cr.

TRACY CAMP

TRACY CREEK

PRIMARY RD.

SECONDARY ROAD

ESTELLA CAMP

GRAVEL SURFACED

KOOTENAY

RIVER

C. P. R.

HIGHWAY

Fort Steele

C. P. R.

C. P. R.

CRANBROOK

inches

0 1

0 1 2

centimetres

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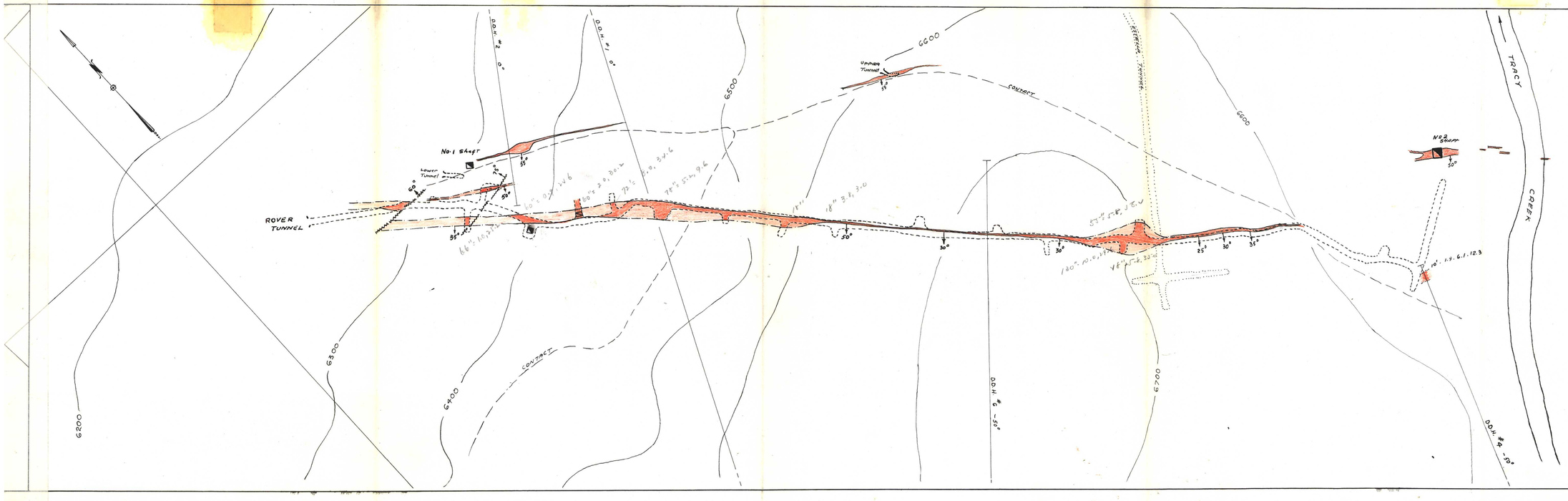
Scale in Miles

a.R.a. 1950



ESTELLA MINES

LTD. N.P.L.

PLAN VIEW OF

VEIN EXPRESSION

SCALE: 1 IN. = 40 FT.

JULY 1950

6650
6600
6550
6500
6450
6400
6350
6300
6250
6200
6150
6100
6050

UPPER TUNNEL

Narrow Vein Exposed 1'

Vein well Exposed

No.1 SHAFT

LOWER TUNNEL

Vein Av. 3.5'

Vein Av. 25'

Vein Ave. 5.1'

ROVER DRIFT

Vein 0.5'

No Vein in drift

No.2 SHAFT
Vein 5'

Vein 5' to 8'

Vein 1'

Tracy Creek

Vein 0.5'

6550
6500
6450
6400
6350
6300
6250
6200
6150

D.D.H. #1.
Intersected 3.0' Quartz Vein — minor Lead-Zinc

D.D.H. #4
Vein 10'

Intersected Vein 0.2' thick.
ESTELLA

Intersected 2.0' Quartz Vein Minor Lead-Zinc

D.D.H #6

ESTELLA MINES

LTD. N.P.L.

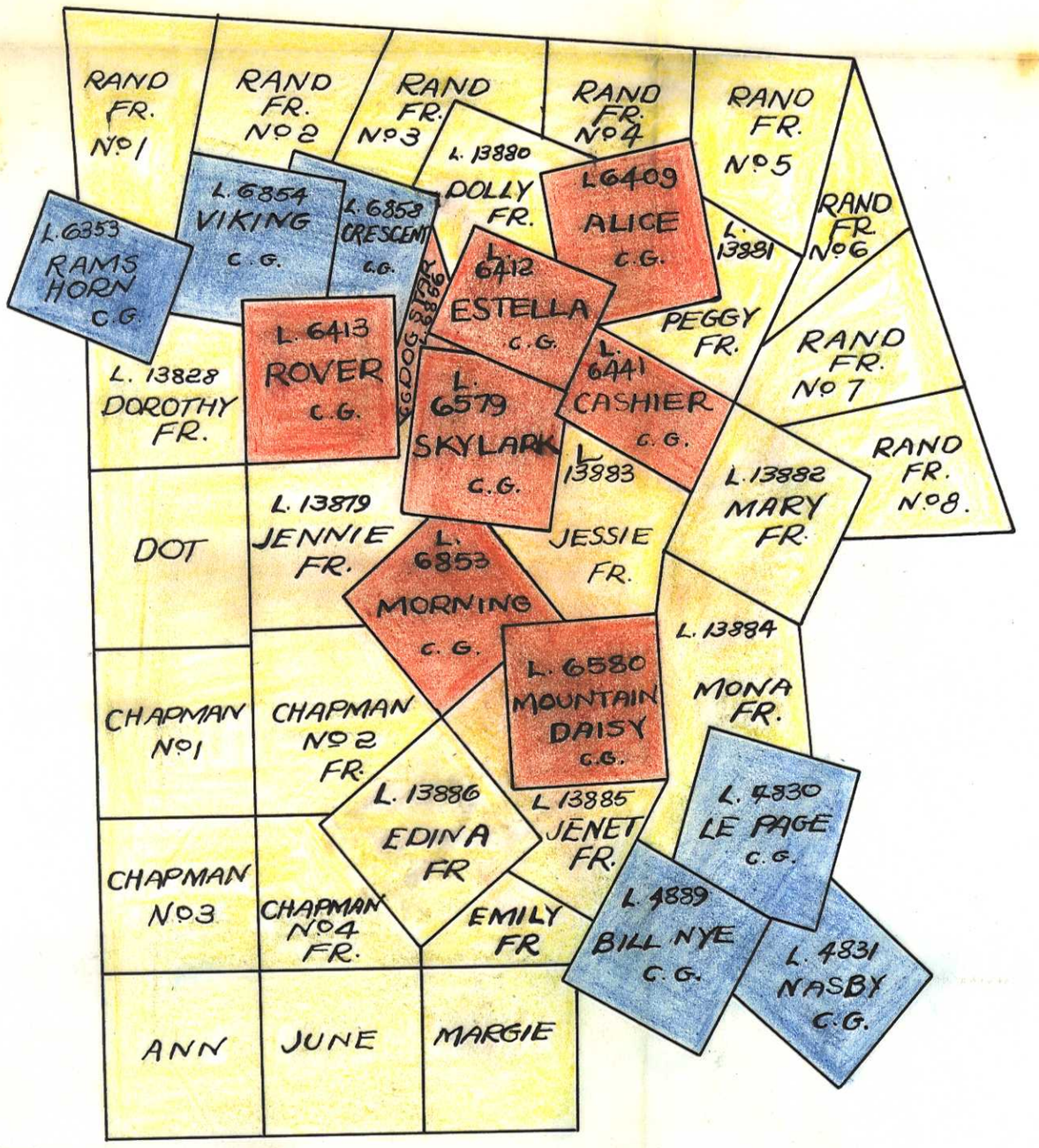
VERTICAL PROJECTION

OF WORKINGS

40 0 20 40 60 80 100

Scale — Feet

July, 1950



LEGEND

- ESTELLA GROUP.
- CROWN LEASES.
- LOCATED CLAIMS.

inches 0 1 0 1 2 centimetres

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ESTELLA GROUP & SURROUNDING CLAIMS

FORT STEELE M.D.

SCALE: 1500' = 1 IN.

May, 1950.

Plan of ESTELLA MINE

FORT STEELE M. DIV.
B. C.

SCALE: 1 inch = 100 feet

L. 6413
ROVER

L. 6854
VIKING

L. 13879
JENNIE

L. 6853
CRESCENT

L. 13880
DOLLY

L. 6856
DOG STAR

L. 6579
SKYLARK

L. 6412
ESTELLA

ROVER ADIT

ESTELLA ADIT

SHAFT

CABIN

TRAIL

- Porphyritic Syenite
- Diorite; Greenstone. On sections diorite has X
- Aldridge-Argillite-Siltstone.
- Fort Steele – Argillite-Siltstone
- Uncorrelated argillite etc. of footwall.
- Veins.

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