

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

c. Stoping (Cont.)

Subs Above the 8th Level (Cont.)  
225' Sub Level (Cont.)

One contract stoped an area 200' x 30' in the orebody south of the dike and completed operations in the first half of the year. The standard grade ore in this part of the deposit was confined to a very narrow seam lying along the footwall side and this was mined with the overlying lean material to produce a silica grade. At the east end of this orebody a small triangular area lying between the dike and the original stope was mined by a scam stope operation.

210' Sub Level

In the main orebody four contracts mined at this elevation during the year, and two were still engaged in mining at the close of the year. At the west end sub caving operations were conducted from No. 804 and 805 Raises by two contracts that completed operations in the third quarter of the year. At the close of the year one contract was conducting slicing operations to the east of No. 808 Raise and the first drift and slice was completed to the east of the raise. To the west of the latter area a second contract was also conducting slicing operations to the east of No. 811 Raise and the first drift was completed in this direction. The lower limit of mining from 8th Level raises has been reached in both areas and the floor elevation is only 16' above the 8th Level floor.

In the orebody south of the dike a small amount of Silica grade was recovered at this elevation along both sides of the transfer that was driven for the stope. As previously mentioned one contract conducted operations in this area during the first half of the year.

8th Level

There was no mining done on the 8th Level but in December one contract was making preparations to conduct caving operations at the east end. Due to mining approaching very close to the level a large portion of the haulage drift is crushing badly and is becoming difficult to maintain for tramming. A section of the drift near the east end is being retimbered so a scraper slide can be constructed for loading cars directly from a caving operation that will be started under a pillar at No. 820 Raise. To make it possible to conduct this mining it has also been necessary to install drain lines in the floor of the drift for several hundred feet to drain a large amount of water from the east end.

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

d. Timbering

There was a large decrease in the consumption of timber, poles and lagging. The reduction in the size of the underground operation combined with the more extensive use of caving and stoping methods accounts for the decrease. The price of timber supplies increased about 28% over the previous year but due to the smaller consumption the cost per ton was only one-half the cost in 1946. The recovery of a large tonnage of Silica grade during the last stages of stope operations also affected timber costs favorably.

During a large part of the year only a small scale timber repair program was required but as mining approached the 8th Level a larger scale program became necessary. In the latter months of the year the 8th Level drifts were subject to such heavy crushing that it became necessary to start a week-end program to keep up with the work.

Due to the relatively short life of the mining raises it has been found more economical to use hardwood cribbing to a larger extent because of its better resistance to abrasion. In raises where rotting is the controlling factor tamarack is still employed and in portions of the rock ventilation connections between the 8th and 4th Levels where support is required steel sets are used in preference to timber. Most of the steel sets were installed in the two previous years but some additional steel was installed in the 4th Level airway in 1947. In the 9th Level drifts in rock wherever support is required it is planned to use steel exclusively in place of timber.

The following is a comparative timber statement for the past two years:

	<u>Lineal Feet</u>	<u>Avg. Price Per Foot</u>	<u>Amount 1947</u>	<u>Amount 1946</u>
6" to 8" Cribbing Tbr.	9,955	.06	597.30	672.45
8" to 10" Stull Timber	9,429	.108	1018.35	1628.45
10" to 12" " "	15,453	.156	2410.70	4850.67
12" to 14" " "	6,787	.214	1452.36	4116.74
Total Timber 1947	41,624	.1318	5478.71	
Total Timber 1946	107,756	.1046		11268.31
	<u>Per 100 Feet</u>			
7' Lagging	328,735	1.48	4890.58	7582.06
9½' Poles	90,279	2.13	1922.56	4721.31
Total Lagging & Poles	419,014	1.62	6813.14	12303.37
Product - Tons			253,976	247,853
Feet of Timber per Ton of Ore			.164	.336
Feet of Lagging per Ton of Ore			1.294	2.026
Feet of Lagging per Foot of Timber			7.898	6.027
Cost per Ton for Timber			.0216	.0455
Cost per Ton for Lagging			.0192	.0306
Cost per Ton for Poles			.0076	.0190
Cost per Ton for all Timber			<u>.0484</u>	<u>.0951</u>
Equivalent Stull Timber to Board Measure			91,862	251,004
Feet of Board Measure per Ton of Ore			.3617	1.0127

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

d. Timbering (Cont.)

The following table shows a comparison of total cost of timbering for the past five years:

<u>Year</u>	<u>Amount</u>	<u>Cost Per Ton</u>
1947	12,291.85	.0484
1946	23,571.68	.0951
1945	37,553.85	.1150
1944	44,893.17	.1192
1943	44,830.23	.0907

e. Drifting and Raising

The development footage was considerably less than in the previous year due to the smaller underground operation. There was an increase, however, in the amount of large ore drift because of the more extensive use of sub caving. The major portion of the footage again is for sub level stopes and to a smaller extent for sub caving.

<u>Year</u>	<u>Drifting</u>		<u>Total</u>	<u>Ore</u>	<u>Raising</u>		<u>Grand Total</u>
	<u>Ore</u>	<u>Rock</u>			<u>Rock</u>	<u>Total</u>	
1947	2826'	30'	2856'	1430'	52'	1482'	4338'
1946	3598'	98'	3696'	1518'	42'	1560'	5256'

The following table shows a comparison of the development footage excluding the footage classified under small drift and raise:

<u>Year</u>	<u>Drifting</u>		<u>Total</u>	<u>Ore</u>	<u>Raising</u>		<u>Grand Total</u>
	<u>Ore</u>	<u>Rock</u>			<u>Rock</u>	<u>Total</u>	
1947	1581'	30'	1611'	-	-	-	1611'
1946	1181'	32'	1213'	12'	22'	34'	1247'

f. Explosives, Drilling and Blasting

The cost per ton for explosives was less than in the previous year despite the large increases in the price of powder, fuse and blasting caps. The amount of these supplies consumed was less due to the reduced size of the underground operation but the lower explosives cost has resulted from a larger tonnage being mined by caving and stoping methods. Another factor that had the effect of lowering powder consumption is the recovery of a large tonnage of Silica grade during the last stages of mining in the stopes. The amount of development work also decreased and was a factor contributing to the smaller powder consumption. The Hercomite powder that was introduced in 1946 to replace the Gelamite has continued to be used almost exclusively in the mining contracts but due to its more granular character it is not entirely satisfactory for all purposes. Gelamite being more plastic has better tamping qualities and it is still favored for use in the long vertical holes employed in the caving and stoping methods.



LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

f. Explosives, Drilling and Blasting (Cont.)

Gelatin powder also has continued to be used in small amounts in the rock development. Excluding the work under E & A cc-159 very little rock development was done other than driving several short drift and raise connections for ventilation purposes. A small amount of Herculite #4 powder was again used in blasting the frozen stockpile during the early part of the shipping season. This powder is favored for this purpose due to its slower detonating velocity and good results have been obtained with it. Master fuse cartridges have continued to be used with good results in all raise work. In the stope operations primacord was again used in blasting the long radial holes because there is more assurance that the long train of powder is all detonated than when blasting with conventional fuse.

Electric blasting was introduced at the start of the sinking operations in the winze. It is planned to continue the electrical blasting in the drift headings that will be driven on the 9th Level mainly because of ventilation. Considerably less smoke and gases are produced when the powder is detonated electrically so it will be possible to maintain better ventilation in the headings until a connection for this purpose is driven to the 8th Level.

The explosives statements are shown in the following tables:

<u>BREAKING ORE</u>	Quantity	Average	Amount	Amount
	Lbs.	Price	1947	1946
Gelamite Powder No. 1	500	13.50 C	67.50	3,276.23
60% Gelatin	359	16.25 C	58.34	526.68
Hercomite 2-X	63,911	13.50 C	8,873.38	8,085.12
Herculite No. 4	350	12.50 C	43.75	10.00
Total Powder	65,120	13.94	9,042.97	11,898.03
Fuse - Feet	215,968	8.19 M	1,769.62	1,425.72
Temptite Shells	700	6.00 M	4.20	-
No. 6 Blasting Caps	29,790	13.09 M	390.02	467.37
Primacord	1,000	32.00 M	32.00	96.00
Fuse Lighters	5,000	6.75 M	33.75	62.95
Tamping Bags	1,000	2.15 M	2.15	4.30
Fuse Cartridges	2,000	19.86 M	39.72	25.85
Total Fuse, Caps, Etc.			2,271.46	2,082.19
Total Expense Breaking Ore			11,314.43	13,980.22
Product - Tons			253,976	247,855
Lbs. of Powder Per Ton of Ore			.390	.412
Cost Per Ton for Powder			.035	.048
Cost Per Ton for Fuse, Caps, Etc.			.008	.0084
Cost Per Ton for All Explosives			.044	.056



LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)f. Explosives, Drilling and Blasting (Cont.)

<u>DEVELOPMENT IN ROCK</u>	Quantity	Average	Amount	Amount
	Lbs.	Price	1947	1946
Hercomite 2-X	134	13.54 C	18.15	-
Fuse - Feet	480	8.19 M	3.93	-
No. 6 Blasting Caps	60	12.00 M	.36	-
Total Fuse, Caps, Etc.			4.29	-
Total Explosives			22.44	-

DEVELOPMENT IN ROCK - E & A cc-159

60% Gelatin	8,968	16.25 C	1,457.30	263.14
Electric Blasting Caps-Delays	1,500	17.63 C	264.45	-
Connecting Wire - Lbs.	43	.198	8.51	-
Fuse - Feet	6,880	8.70 M	59.86	10.26
No. 6 Blasting Caps	800	13.68 M	10.94	3.17
Hot Wire Lighters	200	6.75 M	1.35	.34
Powder Bags	12	1.68	20.16	5.04
Total Fuse, Caps, Etc.			365.27	18.81
Total Explosives			1,822.57	281.95
Total Explosives Used In Mine			13,159.44	14,262.17
Average Price Per Lb. for Powder			.1417	

g. Ventilation

The ventilation in the mine has been quite satisfactory throughout the year. The main fan on the 4th Level at Section 6 shaft has continued to give good service but the volume of air delivered to the active workings has continued to decrease as mining has progressed in depth. This is due to the increase in the mine resistance and also an increase in the number of points where a loss of air due to leakage occurs. In the last survey a volume of 10,270 C.F.M. was being supplied to the working level compared to a volume of 15,600 C.F.M. in the previous year. This decrease is not as objectionable as it appears because there has been more than a proportionate decrease in the number of areas to ventilate.

In the early part of the year when mining was being conducted at the 7th Level elevation and a short distance below, a number of areas could be very conveniently ventilated because raise connections from the 8th to the 7th Level could be maintained. But as mining reached lower elevations these connections were lost and ventilation was then dependant in many cases on the exhaust air reaching the upper levels through the old workings. At the close of the year as mining approached the 8th Level, ventilation of the remaining areas was seriously hindered due to lack of a suitable connection to the level above. Booster fans were used to improve ventilation where there is lack of a positive current of air and in the stope south of the dike this method was employed during the entire period when mining was underway.

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

g. Ventilation (Cont.)

There were no rock connections driven for ventilation purposes other than short connections from mining sub levels to nearby airways. Permanent connections in rock are provided from the 8th to the 4th Levels and these will continue to serve as airways for the remaining life of the mine. A similar connection in the footwall west of the orebody will be driven between the 9th and 8th Levels in the coming year. Due to the extension of the underground workings and particularly because of the 9th Level the mine resistance to the flow of air will increase beyond the capacity of the present fan to adequately ventilate the mine. On this account it is planned to install another fan in the system between the 8th and 9th Levels to increase the mine volume for operations on the new level.

8. COST OF OPERATING

a. Comparative Mining Costs

	<u>1947</u>	<u>1946</u>
Product - Tons	253,976	247,853
Underground Costs	1.539	1.658
Surface Costs	.303	.229
General Mine Expense	.429	.357
Cost of Production	<u>2.271</u>	<u>2.244</u>
Depreciation	.077	.193
Taxes	.048	.036
Loading and Shipping	.154	.051
Total Cost at Mine	<u>2.550</u>	<u>2.524</u>
Budget Estimated at Mine	2.813	2.607
No. of Shifts & Hours	3, 1-8 Hr.	3, 1-8 Hr.
	297, 2-8 Hr.	215, 2-8 Hr.
Total Operating Days	<u>298½</u>	<u>218</u>
Average Daily Product	850	1,137

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

8. COST OF OPERATING (Cont.)b. Detailed Cost Comparison

	1947		1946	
	Amount	Per Ton	Amount	Per Ton
1. Exploring in Mine	10,654.21	.042	6,262.23	.025
3. Development in Rock	191.51	.001	327.78	.001
4. Development in Ore	22,036.60	.087	33,342.94	.135
5. Stopping	130,626.55	.514	145,722.86	.587
6. Timbering	103,069.47	.406	114,134.95	.460
7. Trammig	46,597.24	.183	45,494.20	.184
8. Ventilation	1,128.56	.004	2,352.66	.009
9. Pumping	15,418.89	.061	8,071.57	.033
10. Compressors & Air Lines	19,236.79	.076	18,186.38	.073
12. Underground Superintendence	22,864.54	.090	20,166.23	.081
14. Maint: Comp. & Power Drills	105.94	.000	990.49	.004
15. Scrapers & Mech. Loaders	9,026.15	.035	6,073.15	.025
16. Elec. Tram Equipment	9,576.66	.038	9,333.51	.038
17. Pumping Machinery	600.83	.002	673.61	.003
Total Undg. Costs	390,922.06	1.539	411,132.56	1.658
18. Hoisting	28,012.89	.110	19,668.86	.079
19. Stocking Ore	11,581.06	.046	8,406.51	.035
20. Screening-Crushing at Mine	460.88	.002	290.14	.001
21. Dry House	12,493.00	.049	10,105.37	.041
22. General Surface Expense	13,592.61	.054	9,931.83	.040
23. Maint: Hoisting Equipment	5,897.47	.023	4,782.68	.019
24. Shaft	2,619.48	.010	1,716.81	.007
25. Top Tram Equipment	1,538.94	.006	1,006.79	.004
26. Docks, Trestles & Pockets	599.63	.002	737.17	.003
27. Mine Buildings	228.73	.001	98.31	.000
Total Surface Costs	77,024.69	.303	56,744.47	.229
28. Geological	1,077.28	.004	—	—
29. Mining Engineering	2,812.38	.011	1,834.49	.007
30. Mech. and Elec. Engineering	637.36	.003	739.55	.003
31. Analysis & Grading	13,483.44	.053	8,292.39	.033
32. Safety Department	1,543.89	.006	1,214.89	.005
33. Tel. & Safety Devices	2,115.77	.008	1,942.33	.008
34. Local & Gen. Welfare	1,944.96	.008	3,111.00	.013
35. Special Exp., Pensions & Allow.	3,242.87	.013	2,951.06	.012
36. Ishpeming Office	10,080.64	.040	10,530.66	.042
37. Mine Office	18,256.34	.072	14,678.53	.060
38. Insurance	5,659.60	.022	2,533.94	.010
39. Personal Injury	12,807.71	.050	13,704.71	.055
40. Social Security Taxes	11,510.49	.045	8,579.20	.035
41. Employees Vacation Pay	23,795.21	.094	18,625.70	.075
Annuities			319.13	.001
Total Gen. Mine Expense	108,967.94	.429	88,419.32	.357
Cost of Production	576,914.69	2.271	556,296.35	2.244



LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

8. COST OF OPERATING (Cont.)b. Detailed Cost Comparison (Cont.)

	<u>1947</u>		<u>1946</u>	
	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>
41. General Supplies	10,001.32	.039	12,962.49	.052
42. Iron & Steel	2,604.90	.010	6,117.41	.025
43. Oil & Grease	1,378.60	.005	1,084.59	.005
44. Machinery Supplies	9,355.11	.037	6,126.03	.025
45. Explosives	11,336.87	.045	13,980.22	.056
46. Lumber & Timber	15,457.74	.061	25,614.74	.103
47. Fuel	3,152.30	.012	2,206.09	.009
48. Electric Power	36,439.37	.144	29,518.28	.119
49. Sundries	11,318.09	.045	8,803.12	.035
Total Supplies	101,044.30	.398	106,413.17	.429

The following are explanations of operating costs that show significant variations compared with the previous year:

1. Exploring in Mine:

The large increase in expenditures in this account is due to more footage drilled and the higher cost of labor and supplies.

3. Development in Rock

Excluding the development under E & A cc-159 there was only a small amount of rock development and this accounts for the smaller expense.

4. Development in Ore

The smaller expenditure in this account is due to a decrease in the size of the development program as the underground operation decreased in size.

5. Stoping

The decrease in this account is due to the bulk of the product being mined by stoping and caving methods and also due to recovery of a large tonnage of Silica grade from caved stopes.

	<u>1947</u>		<u>1946</u>	
	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>
General Supplies	4,547.81	.018	5,750.98	.023
Iron & Steel	1,303.71	.005	3,831.92	.015
Oil & Grease	218.58	.001	156.89	.001
Machinery Supplies	1,181.93	.005	745.16	.003
Explosives	9,245.20	.037	11,556.04	.047
Timber & Lumber	66.38	.000	--	--
Electric Power	4,811.83	.019	3,740.88	.015
Sundries	1,463.43	.005	3,273.30	.013
Expense Accounts	959.19	.004	800.43	.003
Total	23,798.06	.094	28,365.28	.114

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

8. COST OF OPERATING (Cont.)b. Detailed Cost Comparison (Cont.)5. Stoping (Cont.)

	<u>1947</u>		<u>1946</u>	
	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>
Payroll Labor	98,817.15	.389	110,135.26	.444
Gen. Storehouse & Gen. Shops Labor	701.13	.003	1,078.13	.004
Shops, Labor, etc.	7,310.21	.028	6,144.19	.025
Total Labor	106,828.49	.420	117,357.58	.473
Grand Total	130,626.55	.514	145,722.86	.587
Production Tons Stopped	238,901		225,904	
Avg. Miners Rate Stopping	13.54		10.85	
Avg. Tons Per Man Stopping	40.86		24.58	

6. Timbering

The smaller timbering cost is due to less timber used in the caving and stoping methods and the timber repair program was not as large as in the previous year.

7. Tramming

The increase is due to higher labor costs. A reduction in the size of the tramming operation has not been possible in the same proportion as a decrease in the number of contracts occurred.

9. Pumping

The increase in the pumping costs was due mainly to the increase in mine water that made it necessary to employ pumpmen on a 3-8 hour shift schedule for a period of three months while the effects of the spring run off were experienced. About 45% of the underground water was diverted to the Morris Mine and the charges by the Inland Steel Company for pumping this water increased due to a larger proportion of Lloyd water to their total volume. The higher labor and supply costs also increased the expense in this account.

<u>Year</u>	<u>Total Inland Steel Co.</u>			<u>C.C.I. Co. Prop.</u>		
	<u>Amount</u>	<u>Percent</u>	<u>Avg.Gals.Per Min.</u>	<u>Amount</u>	<u>Percent</u>	<u>Avg.Gals Per Min.</u>
1947	65,474.05	90.0%	966.8	7,482.69	10.0%	109.2
1946	43,090.37	91.4%	887.4	5,600.69	8.6%	83.5
1945	43,150.99	89.9%	857.6	6,518.28	10.1%	96.8
1944	59,011.80	91.6%	887.9	5,393.50	8.4%	83.1
1943	64,159.88	89.9%	932.0	6,577.81	10.1%	104.9

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

8. COST OF OPERATING (Cont.)

b. Detailed Cost Comparison (Cont.)

9. Pumping (Cont.)

The following table shows a distribution of the total Lloyd Mine water pumped:

	<u>Average Gallons Per Minute</u>	
	<u>1 9 4 7</u>	<u>1 9 4 6</u>
Second Level Water Supply	25.1	32.1
Fifth Level Water Supply	106.6	64.4
Seventh Level to Morris Mine	109.2	83.5
Total	<u>240.9</u>	<u>180.0</u>

The peak volume in mine water was reached in May when an average of 386.7 G.P.M. was pumped. This is the largest volume recorded in many years and it is due to the heavy spring run off resulting from the heavy snowfall in the previous winter.

10. Compressors and Air Lines

This expense was slightly higher due to the increase in supply and labor costs. It has been necessary to operate two compressors throughout the year despite the decrease in the size of the underground operation.

12. Underground Superintendence

The supervisory force was reduced by transferring one shift boss to surface work in the middle of the year. The increase is due to the substantial salary increase that was granted foremen effective May 1st.

15. Maintenance of Scrapers and Mechanical Loaders

16. Electric Tram Equipment

The increase in these accounts is due to the higher labor and supply costs.

17. Pumping Machinery

The smaller expense is due to very little repairs needed and there was no new equipment purchased.

18. Hoisting

The increase is due to the higher labor and supply costs. No reduction in the number of hoisting engineers has been possible despite the smaller size underground operation.

19. Stocking Ore

The increase in this account is also due to the increase in wages. A reduction in the number of landers from three to two men on each shift was made at the end of the shipping season.



LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

8. COST OF OPERATING (Cont.)

b. Detailed Cost Comparison (Cont.)

21. Dry House

22. General Surface Expense

The increase is due to purchase of a new stoker for the dry house heating plant. The size of the labor force on surface was reduced at the close of the shipping season and again late in the year. The higher labor and supply cost are reflected in the increase in both accounts.

23. Maintenance of Hoisting Equipment

24. Shaft

25. Top Tram Equipment

The increase in the expense in these accounts is due mainly to the increase in wages. There has been no major breakdowns to this equipment other than repairs to a top tram car that was damaged when it was derailed and fell off the trestle.

26. Docks, Trestles & Pockets

The decrease is due to less trestle construction and pocket repairs.

27. Mine Buildings

The increase in this account is due to repairing the roof of the engine house building.

28. - 41. Inclusive

Most of the direct charges increased due to the increase in wages and salaries. There was a decrease in several accounts due to the smaller proportion of these charges as the labor force decreased in size. Employees' vacation pay expense showed a large increase due to higher wages and the enlargement of benefits under the vacation plan.

9. EXPLORATION AND FUTURE EXPLORATIONS

The only exploration conducted consisted of drilling two holes into the structure south of the main orebody. Late in the previous year one hole into this area from the end of the south crosscut on the 8th Level proved a number of dikes and favorable formation but no ore was encountered. The nearly vertical dip to the formation and dikes indicated a structure with considerable depth below the level so two angle holes were drilled, one from the end of each of the crosscuts on the 8th Level. The first of these holes showed up two short runs of ore lying between dikes and the second hole which was drilled from the end of the most easterly crosscut penetrated 21' of ore. The small amount of ore that was proven lies at depths of 380' and 260' respectively below the 8th Level. There appeared no chance of proving new reserves in this structure that would be mineable from the 9th Level so drilling was abandoned upon completion of the second hole.

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

9. EXPLORATION AND FUTURE EXPLORATIONS (Cont.)

A location lower down in the structure will be available for exploration from the 9th Level. After the headings on this level have been driven it appears advisable to explore the same structure with holes that will reach to a considerably lower depth than any previous drilling to date. The following table shows the cost of drilling:

<u>Feet</u>	<u>Cost Per Foot</u>	<u>Total</u>
1397'	7.63	\$ 10,654.21

The following is a log of the drilling:

<u>D.D.H. No. 178</u>		<u>D. D. H. No. 177</u>	
<u>8th Level - Dip 30° - Due South</u>		<u>8th Level - Dip 46° - Due South</u>	
<u>Depth</u>	<u>Material</u>	<u>Depth</u>	<u>Material</u>
0' - 148'	Slate and Greywacke	( 0' - 15'	Greywacke
148' - 170'	Dike	15' - 208'	Slate & Greywacke
170' - 177'	Slate	208' - 245'	Slate & Greywacke
177' - 208'	Dike	245' - 278'	Dike
208' - 229'	Diabase Dike	278' - 365'	Slate & Greywacke
229' - 393'	Slate	365' - 388'	Tr. Jas. & Slate
393' - 400'	Trans. Jas. & Slate	388' - 398'	Soft Ore Jasper
400' - 420'	Soft Ore Jasper	398' - 404'	Ore
420' - 422'	Lean Ore	404' - 513'	Soft Ore Jasper
422' - 484'	Soft Ore Jasper	513' - 528'	Dike
484' - 491'	Dike	528' - 543'	Ore
491' - 499'	Soft ore Jasper	543' - 564'	Dike
499' - 515'	Soft Ore Jasper	564' - 581'	Soft Ore Jasper
515' - 530'	Lean Ore	581' - 624'	Soft Ore Jasper
530' - 551'	Ore	624' - 640'	Dike
551' - 559'	Soft Ore Jasper	640' - 654'	Soft Ore Jasper
559' - 584'	Dike	654' - 658'	Dike
584' - 649'	Soft Ore Jasper	658' - 753'	Soft Ore Jasper
649' - 653'	Dike	753' - 758'	Mixed L.O. & S.O.J.
653' - 661'	Soft Ore Jasper	758' - 762'	Dike
661' - 665'	Dike	762' - 819'	Slate
665' - 679'	Soft Ore Jasper	819' - 830'	Tr. Slate & Jas.
679' - 750'	Soft Ore Jasper (Complete)	830' - 845'	Soft Ore Jasper
		845' - 849'	Soft Ore Jasper
		849' - 851'	Lean Ore
		851' - 855'	Soft Ore Jasper

(Completed)

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

10. TAXES

The following shows a comparison of the taxes paid in 1947 and 1946 in Ishpeming Township:

	<u>1 9 4 7</u>		<u>1 9 4 6</u>	
	<u>Valuation</u>	<u>Taxes</u>	<u>Valuation</u>	<u>Taxes</u>
<u>Lloyd &amp; Section 6</u>				
SW $\frac{1}{4}$ of NW $\frac{1}{4}$ Sec 6, 47-27, 40 Acres)				
N $\frac{1}{2}$ of SW $\frac{1}{4}$ Sec 6, 47-27, 81.67 " )				
N $\frac{1}{2}$ of SE $\frac{1}{4}$ Sec 6, 47-27, 80 " )	135,000	2,168.18	405,000	6,464.04
Person, Ore in Stock, Supplies and Equipment	605,000	9,716.36	445,000	7,102.20
Total by State Tax Commission	740,000	11,884.54	850,000	13,566.24
Collection Fees		118.84		135.66
Total Taxes		12,003.38		13,701.90
<u>C.C.I. Co. Misc. Lands</u>				
S $\frac{1}{2}$ of NE $\frac{1}{4}$ Sec 6, 47-27, 80 Acres	320	5.14	320	5.12
SE $\frac{1}{4}$ of NW $\frac{1}{4}$ Sec 6, 47-27, except R of W	350	5.62	350	5.59
S $\frac{1}{2}$ of SW $\frac{1}{4}$ Sec 6, 47-27, except R of W	700	11.24	700	11.18
SW $\frac{1}{4}$ of SE $\frac{1}{4}$ Sec 6, 47-27, except R of W	350	5.62	350	5.59
SE $\frac{1}{4}$ of SE $\frac{1}{4}$ Sec 6, 47-27, except R of W	575	9.24	575	9.18
Total	2,295	36.86	2,295	36.66
Collection Fees		.37		.37
Total C.C.I. Co Misc. Lands		37.23		37.03
Total Lloyd Mine	742,295	12,040.61	852,295	13,738.93
Taxes Lot 4, Block 2, West Ish.)				
Lots 19 and 20, Block 9	300	4.87	250	4.04
<u>North Lake Dwellings</u>				
Houses on Sec 6, 47-27	4,000	64.88	4,500	72.54
Total Dwellings		64.88		72.54
Total Ishpeming Township	746,595	12,110.36	857,045	13,815.51
Rate		1.606		1.596

The decrease in taxes is due to the reduced valuation on the smaller reserves. The valuation on personal property was higher due to the large tonnage in stockpile but this increase was more than offset by the smaller valuation on reserves. The tax rate has remained practically the same.

	<u>1947</u>	<u>1946</u>	<u>1945</u>	<u>1944</u>	<u>1943</u>
Taxes per ton produced	.048	.056	.056	.052	.049
Taxes per ton shipped	.029	.069	.054	.070	.043



LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

11. ACCIDENTS AND PERSONAL INJURY

The accident frequency rate was higher and the severity rate was slightly lower than in the previous year. There were nine compensable accidents, one less than in the previous year but fortunately none of the accidents were of a very serious nature. Late in the previous year a minor injury to an employee preceded a chain of events that terminated in the death of the employee four months later. This employee contracted pneumonia and pleurisy following a slight injury to his chest and an autopsy later proved a malignant growth to be the direct cause of death. This case was settled early in the year on the basis of partial liability.

The total man days worked was 40,520 compared with 41,996 in 1946. The man days lost on account of all accidents was 398 and for compensable accidents only there was a total of 357 man days lost. This compares with 480 and 454 man days respectively in the previous year. The following table shows a comparison of the frequency and severity rates in the past two years:

<u>Year</u>	<u>Frequency Rate</u>	<u>Severity Rate</u>
1947	74.05	1.228
1946	56.60	1.43

Frequency Rate - Number of accidents per 1,000,000 man hours.

Severity Rate - Number of days lost per 1,000 man hours.

The compensable accidents are listed in detail as follows:

Accident No. 872, February 3, 1947, Nick Linna, Contract Miner. While cutting out a raise a slab of ore fell off the breast and a piece broke off and rolled striking him on the right foot as he was standing on stage in the ladder compartment. - Fracture of third, fourth, and fifth metatarsals right foot - Time Lost - 53 days.

Accident No. 873, March 4, 1947, John Marietti, Contract Miner. He was breaking a chunk of ore with a sledge and while turning the chunk he lost his balance and fell, twisting his right knee. - Sprain of right knee. - Time Lost - 20 days.

Accident No. 874, March 7, 1947, Walter Ruohomaki, Contract Miner. While barring a mill raise a piece of ore rolled down the side of the pile and struck him on the left foot. - Bruised instep left foot. - Time Lost - 8 days.

Accident No. 875, April 26, 1947, Roland St. Andre, Contract Miner. He was descending the ladder from his working place when dirt got into his eye. - Foreign body in right eye. - Time Lost - 9 days.

Accident No. 876, May 19, 1947, Andrew Maki, Contract Miner. While barring a mill raise a piece of pole about 3' long in the pile of broken ore was struck by a falling chunk causing the pole to bounce and strike him in the leg. - Fracture of left leg. - Time Lost - 90 days.

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

11. ACCIDENTS AND PERSONAL INJURY (Cont.)

Accident No. 877, June 5, 1947, John Marietti, Contract Miner. He was barring loose pieces of ore from the top of the cap after a blast had been made and a piece rolled down the pile and struck him on the right ankle. - Fracture of right ankle. - Time Lost - 104 days.

Accident No. 878, October 10, 1947, John Marietti, Contract Miner. He stepped on the door covering the raise while carrying some lagging and the door dropped about 6" causing a sprain in his right ankle. - Sprained right ankle. - Time Lost - 20 days.

Accident No. 879, October 20, 1947, Charles Saardini, Contract Miner. He was walking along the side of the drift as a train of cars was passing and when he thought the last loaded car had passed he stepped toward the track and there was an empty car on the end of the train that he hadn't noticed and he was squeezed between the car and a timber leg. - Bruised chest. - Time Lost - 32 days.

Accident No. 880, November 10, 1947, Reino Lepisto, Contract Miner. While pulling some old blocking from the back of the drift as he was making repairs he strained his right side. - Separation of cartilage from rib. - Time Lost - 21 days.

12. NEW CONSTRUCTION AND  
PROPOSED NEW CONSTRUCTION

There was no new construction on surface other than the usual erection of wood trestle at the close of the shipping season. A total of 15 bents were erected for stocking Silica grade to the east of the shaft and 8 bents of trestle were also erected in the same area for Lloydale grade.

The new construction underground was part of the 9th Level development and it consisted of erecting a timber head frame over the winze on the 8th Level and installation of an auxiliary hoist. The head frame was constructed of 12" x 12" fir timber and at the top 12" x 16" bearers were installed to support the head sheaves. A small size raise was put up from a point directly over the drum of the hoist to the head sheaves so the hoisting ropes can pass through this opening. The spare hoist that originally came from the Wade Mine was installed in a room that was excavated in the rock a short distance from the winze. A concrete base with a drum pit was poured for the hoist and motor and the concrete foundation was also constructed under the panels and switches. A concrete floor about 4" thick was also laid in the hoist room

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

13. EQUIPMENT AND PROPOSED EQUIPMENT

There has been very little new equipment purchased in the last several years. A surplus of used drill machines and scraper hoists has accumulated as the operation has become smaller but many of these are obsolete. Now that development of the 9th Level is being undertaken some new equipment will be needed and this will consist chiefly of larger and higher speed scraper hoists including larger size scrapers. A small number of new drill machines and jack legs will also be purchased. Another fan will be needed for ventilation in the mine and it is planned to install this in a drift and raise connection that will be driven between the 9th and 8th Levels. Another piece of new equipment that will be needed for the 9th Level is a small size centrifugal pump to raise the water to the 8th Level.

The following is the new equipment added to the inventory in 1947:

<u>Number of Items</u>	<u>Items</u>	<u>Cost</u>
1	I. R. Centrifugal Motor Pump	\$ 769.00
2	5' Diameter Head Sheaves	922.40
1	Brownell Stoker	871.50
1	Alberger Centrifugal Pump	547.50
1	Chicago Pneumatic Sludge Pump	238.00
1	I. R. H. U. 4 Utility Air Hoist	570.00
		\$ 3,918.40

14. MAINTENANCE AND REPAIRS

a. Mine

There has been no major repair program conducted but the cost of the maintenance work was higher. The buildings around the surface plant have required only a small amount of attention in maintaining them in condition. No repairs have been needed on the combined office, dry house and shop building, but some exterior painting is needed in the near future to put it into better condition and appearance. The roof of the enginehouse was given another coat of asphalt and the windows and wood trim on this building will also need painting. The other mine buildings have required no repairs. The repair work in the shaft house has consisted of replacing worn out plate in the skip dumps and also in the chutes and storage pockets below the top landing. The 12" x 16" fir bearer timbers that support the cage head sheave showed signs of rotting and these were replaced with new ones during a week-end in October. The equipment in the enginehouse has required no more than the usual maintenance to keep it in good running condition. Both compressors have been in operation throughout the year and other than cleaning the valves on both units occasionally no other maintenance has been required. A new stoker was purchased for the main heating plant replacing one that was giving very poor service due to frequent break downs.

Repairs in the shaft have continued at about a normal rate and consisted of replacing some worn out runners and nailing hardwood wearing strips on the sides of the runners in the skip roads. In the upper part of the shaft where some old casing plank is showing signs of rot new casing was installed. The routine shaft inspections have been continued in the middle of the week and also on weekends when most of the repair work was done.



LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

14. MAINTENANCE AND REPAIRS (Cont.)

a. Mine (Cont.)

Repairs to timbered drifts underground have been confined almost entirely to the 8th Level. The main level drift in ore that extends from the west to the east limits of the orebody has required additional support and lining sets have been installed in this section. The east end of this drift was first subject to heavy crushing and a considerable amount of timbering was done to maintain this section open for tramping as mining approached the level elevation. As mining in other sections approached closer to the level, the level drift directly below was affected making it necessary to close timber almost the entire drift in ore. Early in the year some repair work was done on the 7th Level to maintain a ventilation connection to a raise from the level below. When the raise itself was affected by mining so that it could no longer be maintained there was no need of further repair work on the 7th Level. On the 5th Level a portion of the old drift that is being maintained as an airway required a small amount of repairs where the back of the drift began to spall badly. A section of the 4th Level drift near the Section 6 Shaft also required additional support and some steel sets were placed here.

Repairs to raises has decreased as mining progressed to lower levels and the length of the raises were shortened. Some heavy crushing was experienced in the raises at the west end of the deposit and sections of the chute compartments of two raises were recribbed. Most of the raise repairs consisted of relining them with hardwood plank but the amount of this work has diminished compared with other years. Hardwood cribbing due to its better resistance to abrasion is favored for use in the chute compartments of the raises and it is planned to use hardwood extensively in the new raises that will be put up from the 9th Level.

Repairs to underground equipment was confined mostly to scraper hoists and tramping equipment. Most of the scraper hoists are the 15 H.P. size and they have been giving good service for many years where the scraping distance does not exceed much over 75'. Better efficiency is realized with larger scrapers and longer scraping distances, employing larger and hi-speed hoists. On this account the small type hoists are becoming obsolete and major repairs to these machines are not warranted. Repairs to electric tram equipment has consisted of the usual replacements of worn parts on the cars and occasional armature and wheel assembly changes on the motors. The repair cost on power drills has been small due to a large amount of spare equipment of this kind that has accumulated as the size of the operation has decreased.

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

14. MAINTENANCE AND REPAIRS (Cont.)

b. Location

1. General Maintenance

The costs of the location maintenance increased due to the increase in wages. Operation of the water supply system was again the largest item of expense and as in other years a portion of the underground pumping cost is charged to this account. Another large expense was the repair work that was required on the reservoir tank. The concrete tank has deteriorated badly and it is questionable how much longer it will continue to be serviceable. Numerous large cracks have developed in the concrete walls and during the year new leaks broke out to the extent that very little storage capacity could be maintained. An attempt to seal the cracks with a sealing compound was unsuccessful and the only means by which the major leaks could be stopped was by driving wooden wedges into the cracks.

There were no extensions laid to water mains but a number of leaks broke out at various points necessitating repairs. During the winter months it was necessary on numerous occasions to thaw frozen lines with the electrical apparatus that has been provided for this purpose.

	<u>Labor</u>	<u>Supplies</u>	<u>Total</u>
Water	-	2,778.31	2,778.31
Water Mains	268.26	85.60	353.86
Water Tank	1,486.65	905.70	2,392.35
Total	1,754.91	3,769.61	5,524.52

The following table shows a comparison of the location maintenance expense for the past five years:

<u>Year</u>	<u>Amount</u>
1947	5,524.52
1946	4,854.44
1945	3,464.61
1944	4,358.71
1943	4,433.54

2. Rented Buildings

Maintenance expense was higher on buildings due to the purchase of a new stoker for the superintendent's house and installation of fire extinguishers in the store building. These are the only two rented buildings remaining in the location. Some rewiring of the electrical circuit was done in the store building to conform with recommendations made by insurance company representatives. In the coming year some repairs will be made to the front of the store building and this will consist of replacing several rotted timber sills under the display windows. The building will also need painting to put it in better condition.

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

14. MAINTENANCE AND REPAIRS (Cont.)b. Location (Cont.)2. Rented Buildings (Cont.)

The following is a comparison of the expenditures on rented buildings for the past five years:

<u>Year</u>	<u>Amount</u>
1947	581.23
1946	92.22
1945	403.95
1944	3,290.52
1943	737.91

There has been no maintenance work on the club house which was closed in July of the previous year. The power and water has been shut off and the windows boarded up since the building was closed. One basement room is still let for use by a local club that is providing their own lighting and heat.

15. POWER

Delays to operations due to lack of electric power have been of very short duration when they occurred and were of no serious consequence to operations. The following is a five year comparison of power consumption:

<u>Year</u>	<u>K.W.H.</u>	<u>Cost</u>	<u>Rate</u>
1947	2,335,200	36,760.08	.0158
1946	2,011,200	29,830.08	.0148
1945	2,937,800	43,337.04	.0148
1944	3,090,000	44,655.12	.0145
1943	3,633,600	50,669.76	.0139

16. WATER SUPPLY

The water supply has continued to be obtained from two sources; the 2nd Level and the Morris No. 8 deep well. The demand for water in the summer months has increased and during this period a larger amount is drawn from the surface well. The average consumption is approximately 65 G.P.M. but the peak demand in the summer months reaches three or four times this amount but this has been supplied as needed by the well. The water has continued to be chlorinated at both sources and when contamination has been reported this has been overcome each time by increasing the chlorine content. To maintain the chlorinator for the surface well water in good working condition it has been necessary to replace a number of worn out parts but the chlorinator for the underground supply has been practically trouble free.

LLOYD MINE  
ANNUAL REPORT  
YEAR 1947

16. WATER SUPPLY (Cont.)

The Ishpeming Township authorities have presently under consideration a plan to connect the location water system to the city of Ishpeming supply and it is very likely that the plan will receive approval in the coming year. Acceptance of this plan is welcomed because the present water system is maintained and operated at a deficit each year. The income from water service at the present time is only 44% of the operating cost and in the past years this discrepancy has been larger. The water supply to the mine can still be obtained from the underground source and the cost of operating this part of the system will be a small fraction of the expense as compared to maintaining the entire system.

17. CONDITION OF PREMISES

The premises have been kept in condition by routine cleaning and in the summer months the lawn and flower garden have been maintained in attractive appearance. There has been no landscaping done on the premises for many years but existing shrubbery and trees have been maintained in attractive condition.

18. NATIONALITY OF EMPLOYEES

	<u>American Born</u>	<u>Foreign Born</u>	<u>Total</u>	<u>Percent</u>
Finnish	24	19	43	36
Italian	5	21	26	22
French	23	-	23	19
English	11	2	13	11
Swedish	7	3	10	8
Norwegian	2	-	2	2
Austrian	-	1	1	1
Irish	1	-	1	1
	73	46	119	100



MINING  
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1. (Cont.) MINING DEPT.

The following conditions have been observed during the visit to the location of the water supply and it is very likely that the plan is without effect. The water supply is maintained and operated as a public utility. The water service at the present time is only for the purpose of supplying the mine. It is believed that the water supply can be maintained in the past years. The water supply can be maintained in the past years. The water supply can be maintained in the past years.



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2. (Cont.) MINING DEPT.

The progress have been kept in condition by routine clearing and the ground surface has been lower. There has been no indication of the progress. There has been no indication of the progress. There has been no indication of the progress.

3. NATURALITY OF MINING

Amount	Total	Foreign Born	American Born	Nationality
38	10	19	21	British
32	28	21	2	Irish
19	23	-	23	French
11	13	2	11	Swedish
8	10	2	8	Swedish
3	2	-	2	Swedish
1	1	1	-	British
1	1	-	1	Irish
100	119	46	73	

GILBERT  
COTTON FIBRE

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

1. GENERAL:

Operations during the seventh year since the beginning of shaft sinking were in considerable contrast with 1946, when the property was strike-bound for a period of 3½ months. Production increased from 339,433 to 729,669, or 115%, with every indication at the end of the year that it would be substantially increased during 1948.

There was only one operating delay of any consequence. This delay occasioned a loss of seven operating days, from February 19th to 26th inclusive, occasioned by a sudden increase in the underground water, which required emergency measures.

Labor relations continued to be completely satisfactory, as was indicated by the attitude of the major portion of the crew on returning to work after the strike. There were no formal grievances during the year, and only one meeting with the Grievance Committee on a minor matter, which was disallowed. By the end of the year, membership in the Union had decreased from 85% to 70%.

Pocket shipments were started as soon as the opening of navigation permitted, and continued throughout the entire shipping season, during which all of the ore in stock was also loaded and shipped.

The 5th Level was the major producer throughout the entire year, with the 2nd a close runner-up. A very limited tonnage was obtained from the 3rd Level, as was a small amount of development ore from the 6th.

By the end of the year, development work in advance of the rapidly increasing mining operation presented the major operating problem. It is now definite that, in order to continue the large volume of production, it will be necessary to sink the shaft in order to make the 7th Level available for mining, and as soon as possible, drift back to "A" Shaft from the new "B" Shaft at a still undetermined depth below the bottom of our present operation.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

2. PRODUCTION,  
SHIPMENTS &  
INVENTORIES:

a. Production by Grades:

	<u>1947</u>			<u>1946</u>	
	<u>Product</u>	<u>Transfers</u>	<u>Stockpile Overrun</u>	<u>Total</u>	<u>Total</u>
Mather	452,123	6,555	5,707	464,385	207,269
Mather Special	265,495	6,555	6,344	265,284	132,164
Total	717,618	0	12,051	729,669	339,433
Rock				94,501	83,045

b. Shipments:

	<u>Pocket Tons</u>	<u>Stockpile Tons</u>	<u>Total Tons</u>	<u>Total 1946</u>	<u>Increase</u>
Mather	294,424	180,317	474,741	163,276	311,465
Mather Special	163,579	71,955	235,534	154,075	81,459
Total	458,003	252,272	710,275	317,351	392,924

Stockpile inventories of both grades were cleaned up during September and October. Year end figures are the amounts produced after the end of the shipping season.

c. Stockpile Inventories:

	<u>1947</u>		<u>1946</u>	
Mather	47,593	Tons	57,949	Tons
Mather Special	42,650	"	12,900	"
Total	90,243	"	70,849	"

d. Division of Product by Levels:

	<u>Mather</u>	<u>Mather Special</u>	<u>Total Tons</u>
Second (1600') Level	226,948	28,005	254,953
Third (1750') Level	255	89,877	90,132
Fifth (2050') Level	217,431	147,613	365,044
Sixth (2200') Level	7,489	-	7,489
	452,123	265,495	717,618
Transfers	6,555	6,555	0
Stockpile Overrun	5,707	6,344	12,051
Total	464,385	265,284	729,669

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

2. PRODUCTION,  
SHIPMENTS &  
INVENTORIES:  
(Continued)

e. Production by Months:\*

<u>Months</u>	<u>Mather</u>	<u>Mather Special</u>	<u>Total</u>	<u>Rock</u>
January	29,298	20,906	50,204	13,530
February	26,484	10,123	36,607	7,260
March	38,348	18,142	56,490	8,404
April	43,076	21,688	64,764	7,898
May	42,219	19,243	61,462	3,300
June	35,577	18,394	53,971	6,435
July	39,070	20,329	59,399	7,843
August	36,586	19,336	55,922	6,303
September	52,940	17,636	70,576	8,778
October	42,189	29,315	71,504	8,613
November	30,130	35,201	65,331	6,963
December	<u>42,761</u>	<u>28,627</u>	<u>71,388</u>	<u>9,174</u>
Total	458,678	258,940	717,618	94,501
Current Year				
Stockpile Overrun	<u>5,707</u>	<u>6,344</u>	<u>12,051</u>	
	464,385	265,284	729,669	

\* Including Net Transfers: Mather +6,555; Mather Special -6,555

f. Ore Statement:

	<u>Mather</u>	<u>Mather Special</u>	<u>Total</u>	<u>Total Last Year</u>
On Hand January 1, 1947	57,949	12,900	70,849	48,767
Output for Year	452,123	265,495	717,618	334,632
Transfers	6,555	6,555	-	-
Overrun	<u>5,707</u>	<u>6,344</u>	<u>12,051</u>	<u>4,801</u>
Total	522,334	278,184	800,518	388,200
Shipments	474,741	235,534	710,275	317,351
Balance on Hand	47,593	42,650	90,243	70,849
Increase in Output	251,707	131,279	382,986	133,323
Increase in Ore on Hand			19,394	22,082



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

2. PRODUCTION,  
SHIPMENTS &  
INVENTORIES:  
(Continued)

Working Schedule:

1947 - 2-8 hr. shifts,\* 6 days per week, Jan. 1st to Feb. 18, 1947.  
Idle account of water trouble, Feb. 19th to 26th, 1947.  
2-8 hr. shifts,\* 6 days per week, Feb. 27th to Dec. 31st, 1947.

\* Main Level development 3-8 hr. shifts, 6 days per week.

1946 - 2-8 hr. shifts,\* 6 days per week, Jan. 1st to Feb. 7th, 1946.  
Idle account of strike, Feb. 8th to May 21st, 1946.  
2-8 hr. shifts,\* 6 days per week, May 22nd to Dec. 31st, 1946.

\* Main Level development 3-8 hr. shifts, 6 days per week.

1945 - 3-8 hr. shifts, 5 days per week, Jan. 1st to 3rd, 1945.  
2-8 hr. shifts, 5 days per week, Jan. 4th to 19th, 1945.  
2-8 hr. shifts, 6 days per week, Jan. 22nd to Dec. 31st, 1945.

1944 - 3-8 hr. shifts, 5-1/3 days per week, Jan. 1st to July 31st, 1944.  
3-8 hr. shifts, 5 days per week, Aug. 1st to Dec. 31st, 1944.

1943 - 3-8 hr. shifts, 5-2/3 days per week, Jan. 1st to 31st, 1943.  
3-8 hr. shifts, 5-1/3 days per week, Feb. 1st to Dec. 31st, 1943.

g. Operating Delays:

The only operating delay that occasioned any loss of product was the idle period of seven days from February 19th to 26th inclusive. This delay was occasioned by a sudden large increase in the amount of underground water, which necessitated stopping mining operations.

The estimated loss of product was 15,000 tons.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

3. ANALYSIS:

a. Average Mine Analysis on Output:

<u>Grade</u>	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>	<u>Sulphur</u>
Mather	59.88	.104	7.97	.045
Mather Special	59.10	.107	7.75	.246

b. Average Analysis on Straight Cargoes:

All of the shipments during 1947 were in mixed cargoes.

c. High Sulphur Ore:

In general, the occurrence of high sulphur ore did not vary appreciably with the situation as described in the report for 1946. There was a material decrease in the reserves of Special ore above the 2nd and 3rd Levels due to the fact that the year's mining of that grade exceeded the development of new ore. The estimate of sulphurous ore above the 5th and 6th Levels and below the 6th Level increased tremendously as predicted in the previous report. During the year, approximately half of the total production from the property was obtained from the areas above the 5th Level, and considerably over half of the Special grade was produced from that same area. The bulk of this sulphurous ore was found in the upper sub-levels on both the east and west sides of the main fault and, in general, north of #5 Dike. The material south of the dike, while somewhat spotty in certain areas, averaged well within the Standard ore grading limit of .050%. Farther to the east, there was new evidence of the occurrence of sulphur both in drifting and diamond drilling. The interbedded ore was quite sulphurous in #7 Cross-cut on the level and a short distance above #6 Cross-cut. In the same drilling, at a considerable height above the level, extremely high sulphur was found to the south in stringers of ore beyond #5 Dike.

Continued exploration to the east in the large trough above the interbedded slate and north of #5 Dike indicates the occurrence of a rather large reserve of high sulphur ore, starting a short distance above #7 Cross-cut and extending vertically approximately 250' to #7 Cross-cut on the 3rd Level. It is highly probable that this ore extends to the west in a previously unexplored area south of the main drift on 3rd Level. By the end of the year, D.D.H. #45, which was planned to intercept this ore, was a short distance away from where it should occur.

On the 6th Level, diamond drilling and main level drifting has developed a fairly accurate picture of conditions from #1 Cross-cut east through #4 Cross-cut. With the exception of the interbedded ore in #1 Cross-cut, which averaged .104% in sulphur, all of the ore encountered on the level was well within the Standard grading limit. However, it is probable that the downward easterly trend of the sulphurous areas on the 5th Level will extend to the easterly portion of the 6th Level.

Due to the substantial increase in the average sulphur content of ore developed during the year, the average of Special grade increased from .160% in 1946 to .246% in 1947. Following this same trend, the estimate for 1948 was increased to .325%, with the warning that individual cargoes would probably run considerably higher from time to time.

d. Complete Analysis of Ores in Stock:

	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sulph.</u>	<u>Loss</u>	<u>Moist.</u>
Mather	59.06	.110	8.75	.28	2.91	.40	.42	.069	2.03	11.95
Mather Special	58.65	.109	8.61	.25	2.85	.76	.51	.273	2.47	11.30

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

4. ESTIMATE AND  
ANALYSIS OF  
ORE RESERVES:

Once again the estimate was made by augmenting, with underground information, the original estimate made from the surface drill hole sections. This year underground operations had extended far enough to the east to include a portion of the reserves formerly estimated from the surface drilling. Accordingly, this estimate was reduced and the underground estimate increased in line with the new information.

Assumption: 12 cu. ft. equal one ton.  
10% deduction for rock and loss in mining.

	<u>Mather Standard</u>	<u>Mather Special</u>	<u>Total Underground</u>	<u>Diamond Drilling</u>	<u>Total Tons</u>
Reserves Indicated By Surface Diamond Drilling.....	6,204,151			6,204,151	
Reserves Indicated By Underground Development:					
Above 2nd Level....	314,507	226,256	540,763		
Between 2nd & 3rd Levels.....	58,229	179,062	237,291		
Between 3rd & 5th Levels.....	1,671,455	479,813	2,151,268		
Between 5th & 6th Levels.....	2,606,350	106,875	2,713,225		
Below 6th Level....	<u>680,417</u>	<u>28,333</u>	<u>708,750</u>		
Total Gross as of November 30, 1947	5,330,958	1,020,339	6,351,297	6,204,151	12,555,448
Less December 1947 Production.....	<u>42,761</u>	<u>28,627</u>	<u>71,388</u>	-	<u>71,388</u>
Total Gross as of December 31, 1947..	5,288,197	991,712	6,279,909	6,204,151	12,484,060
Less 10% for Rock and Loss in Mining	<u>533,096</u>	<u>102,034</u>	<u>635,130</u>	<u>620,415</u>	<u>1,255,545</u>
Net Total as of December 31, 1947	4,755,101	889,678	5,644,779	5,583,736	11,228,515

The above figures do not include the large tonnages with sulphur content too high for the Special grade.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

4. ESTIMATE AND  
ANALYSIS OF  
ORE RESERVES:  
(Continued)

A comparison with last year's estimate indicates a gross gain, including the production for the year, of 331,451 tons as compared with 1,800,000 tons gain in 1946. The gross in the Mather grade was a loss of 108,000 tons, and in the Special a gain of approximately 440,000 tons.

	<u>Mather Standard</u>	<u>Mather Special</u>	<u>Total Tons</u>
Net Total Dec. 31, 1947	10,338,837	889,678	11,228,515
Net Total Dec. 31, 1946	<u>10,911,696</u>	<u>715,037</u>	<u>11,626,733</u>
Net Gain in Reserves		174,641	
Net Loss in Reserves	572,859		398,218
1947 Production	<u>464,385</u>	<u>265,284</u>	<u>729,669</u>
Gross Gain in Reserves		439,925	331,451
Gross Loss in Reserves	108,474		

Expected Average Natural Analysis of Ore Reserves:

<u>Grade</u>	<u>Total Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sulph.</u>	<u>Loss</u>	<u>Moist</u>
Mather by Surface											
Diamond Drilling...	5,583,736	53.15	.122	5.08	.25	2.62	.58	.60	.014	1.97	12.50
Mather by Undg.											
Development.....	4,755,101	52.70	.120	7.30	.20	2.40	.80	.50	.044	2.45	11.50
Mather Special by											
Undg. Development..	<u>889,678</u>	52.20	.120	7.30	.20	2.50	1.60	.50	.288	2.00	11.50
	11,228,515										



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

5. LABOR AND WAGES:

a. Comments:

With the exception of a short time during the summer, the supply of labor throughout the year was adequate, although the available number of acceptable experienced underground men was very small. Also, the labor turn-over was quite large, due in part to the determination to weed out unsatisfactory men, and in part to the fact that a good many of the younger returning veterans found it very difficult to settle down. Early in the year, prospective members of the new shaft sinking crew were picked up from time to time as they became available, with an eye to transferring them to "B" Shaft when and as they were needed. This group accounted for 49 of the 114 separations listed in the table below. Of the 92 transfers from other mines of the Company which are included in the 282 additions to the payroll, 41 were transferred from the Negaunee Mine as that operation decreased in size.

Number of Men 1/1/47.....	350	
Added to Roll During the Year.....	282*	( 92 Transfers 190 New Men)
	<u>632</u>	
Total.....	632	
Separations.....	<u>114</u>	(49 to "B" Shaft)
Total on Payroll 12/31/47.....	518	
Net Gain.....	168	

\* of the 282 new men, 86 were veterans, 144 had some previous underground experience, 138 had no previous underground experience.

Of the 518 men on the payroll at the end of the year, 184 were World War II veterans.

It is obvious from the above figures that the problems of supervision increased greatly throughout the year. The rapidly expanding operation made it necessary to hire likely looking young men when experienced miners were not available. This in turn required the rapid advancement of men who showed aptitude and ability, and had the result, in a good many cases, that young inexperienced men were performing jobs which ordinarily require a number of years of service. This in turn made it necessary to rapidly increase the supervisory force to train these young men. Efficiency was also made more difficult due to constant experiments with, and changes in the mining methods. During the year, 12 new salaried shift bosses were appointed (4 effective 1/1/48) and 2 probationary shift bosses started their training period, also effective at the end of the year. A number of others, which will be needed in 1948, will be chosen and trained early in the year.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

5. LABOR AND WAGES:  
(Continued)

a. Comments (Continued)

Most of the new men hired were for underground work, although the surface crew was increased somewhat to take care of the large amount of construction work and the expanding operation. On surface, as well as underground, most of the men hired were inexperienced and required considerable training to fit them for their various jobs.

The very satisfactory labor relations which have always been enjoyed at this property, continued throughout the year without incident. There were no formal grievances presented and only one meeting with the grievance committee. This meeting was requested by the union in an attempt to forestall the discharge of one of the committee members. The request for leniency was denied, the man was discharged and nothing more was heard of the incident.

The contract with the C.I.O. was continued and a new trend was noted. Throughout the last several years the percentage of eligible men belonging to the union increased gradually and steadily to 85% by the end of 1946. This trend was reversed throughout 1947 and was reduced to 70% by the end of the year. For the first time, a number of men availed themselves of a short escape period to withdraw from the union.

There was no change in the working schedule. Mining was continued on a two shift basis, six days per week, with main level development and a small amount of tramping and hoisting on a three shift schedule. There was a substantial increase in wages of  $12\frac{1}{2}\text{¢}$  per hour effective 5/9/47, with fringe benefits of hospitalization insurance effective 9/1/47. The wage increase resulted in a rate of \$1.09 per hour for common surface labor, and a minimum underground rate of \$1.12 $\frac{1}{2}$ . The company-account miner's rate is now \$1.17 $\frac{1}{2}$  per hour, or \$9.40 per day exclusive of the 5¢ per hour shift differential and the insurance benefits. The established contract miner's incentive pay rates remained the same, with the hourly increases added after calculating. The high contract pay for the year was \$20.24 per day as compared with \$16.92 the previous year, exclusive of overtime and shift differential. The increase in the average wages in the following table reflects the wage increase, which amounted to \$1.00 per day, and averaged approximately \$27.00 per month throughout the year.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

5. LABOR AND WAGES: (CON'T)b. Comparative Statement of Product,  
Men, Hours and Wages:

	<u>1947</u>			<u>1946</u>			<u>Increase Or Decrease</u>		
	<u>Surface</u>	<u>Underground</u>	<u>Total</u>	<u>Surface</u>	<u>Underground</u>	<u>Total</u>	<u>Surface</u>	<u>Underground</u>	<u>Total</u>
Production			729,669			339,433			390,236
Number of Days Operated			391½			218			73½
Number of Shifts and Hours			1-8    0- 2-8    583			1-8    3 2-8    430			1-8    3 2-8    153
Average Daily Product			2,503			1,568			935
Average Number of Men Working	92	307	399	55	154	209	37	153	190
<u>Tons Per Man Per Day:</u>									
Total			6.93			6.24			.69
In Ore			30.64			26.96			3.68
Total Number of Man Days	26,608	78,759	105,367	17,609	36,763	54,372	8,999	41,996	50,995
Total Hours Worked	219,563	730,974	950,537	133,077	371,720	504,797	86,486	359,254	445,740
Total Wages Paid Above Employes	\$277,990.06	\$1,079,994.73	\$1,357,984.79	\$149,685.55	\$505,839.27	\$655,524.82	\$128,304.51	\$574,155.46	\$702,459.97
Average Earnings Per Man Per Month	\$251.80	\$293.16	\$283.62	\$226.80	\$273.72	\$261.37	\$25.00	\$19.44	\$22.25
Average Wages Per Man Per Day	\$ 10.13	\$ 11.82	\$ 11.43	\$ 9.00	\$ 10.87	\$ 10.39	\$ 1.13	\$ .95	\$ 1.04
Average Contract Wages Per Day			\$ 13.92			\$ 12.82			\$ 1.10
Total Operating Labor Per Cost Sheet	\$270,492.04	\$927,313.91	\$1,197,805.95	\$161,789.39	\$401,977.34	\$563,766.73	\$108,702.65	\$525,336.57	\$634,039.22
Labor Cost Per Ton	\$.371	\$1.271	\$1.642	\$.477	\$1.184	\$1.661	\$.106	\$.087	\$.019

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

6. SURFACE:

a. Buildings:

With the exception of the installation of the approved fire doors between the engine house and the shop and dry wings, maintenance of the mine buildings was of a routine nature. Additions to the facilities in the change rooms were made as needed when new men were hired. At the end of the year a new project had been started. This consisted of the installation, by contract on a firm bid, of a second steam boiler and new hot water tanks and the necessary piping. This equipment, which is urgently needed but will probably not be completed until sometime in the spring of 1948, is being installed by the Walker Jamar Company of Duluth, Minnesota. The new water tanks are necessary to permit the removal of the original main tank in the boiler room, which will furnish the required additional space needed for the second boiler. This new boiler, which is approximately the same size and capacity as the present one, will serve two important functions: It will augment the present one and serve as a standby unit during normal weather, and will also furnish the additional heat needed for a shaft air heater, which will be installed under the same contract.

b. Headframe:

The west half of the south railroad pocket was completed early in the year, and both of these pockets of the new design performed satisfactorily, particularly in colder weather. No other important changes were made in the headframe, and none are indicated as long as pocket loading during freezing weather can be confined to the south side. If the volume increases in the future, it may well be necessary to change the north pockets to the same design, since ore cannot be handled in them under freezing conditions.

c. Stockpiles and Stocking Trestles:

As was expected and predicted, the fact that the strike in 1946 made it impossible to complete the extensions to the stocking trestles, caused considerable difficulty during the winter stocking season. As soon as the stockpiles reached the rail elevation on the respective trestles, trouble was experienced in attempting to extend the track out onto the pile. Although every conceivable method was tried, it was immediately apparent that this method could not be used to handle large daily tonnages. The ore piles continued to slump slowly and steadily and it was impossible to hold the grade on the tracks and to handle the volume which was



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

6. SURFACE:  
(Continued)

c. Stockpiles and Stocking Trestles: (Continued)

being hoisted. Accordingly, three 15-ton Euclid trucks were obtained from the Company's Tilden Mine and used to stockpile the ore of both grades. Three trucks were required during the day and afternoon shifts, and one on the night shift, with the larry cars continuing to handle the waste rock in the usual manner. This method of stocking proved most elastic and satisfactory, except for the cost, which was considerably higher than other known methods of stocking from either permanent or temporary trestles. Accordingly, the extensions to the trestles, which had been planned for two years, were finally started late in the fall after both stockpiles had been loaded out. These extensions followed the same general design, using the concrete filled tubular column bents at 125' centers. The only important change was from the original open box girder design to a closed torsion box section, slightly tapered from top to bottom and streamlined to prevent the ore from adhering to it. Heavy guard rails were also added, enclosing the car, for the protection of the operator, and two additional guard rails were installed outside the running rails to preclude any possibility of the car derailing and falling from the trestle. At the end of the year the erection of the new trestles was well underway, with every likelihood of completion early in January.

The grading of the stocking area was continued to the east, but not completed. This work will be advanced as rapidly as needed as production increases. Another year's experience in loading out the stockpiles indicates the probability that two additional permanent stockpile loading tracks would greatly increase the efficiency of the loading operation, and decrease the cost both to the railroad and the Company. This idea has been discussed with railroad officials and an experimental track will probably be installed in 1948.

d. Landscaping, Roads and Parking Area:

Except for one short piece of road from the northeast corner of the shop area to the east timber yard, all of the work on the grounds was confined to maintenance. A double row of snow fencing was installed on the west side of the plant, extending from the pocket track south to Wabash Street. By the end of the year, this addition had proved well worthwhile. A large "Four Wheel Drive", short wheel-base truck, equipped with a hydraulically operated snow plow, was purchased late in the year. This additional equipment was badly needed due to the large areas which have to be plowed.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

6. SURFACE:  
(Continued)

e. Timber Tunnels:

The excavation of the rock in the open cut in the west timber yard and tunnel was continued, but not completed, due to other more important jobs which required the use of the power equipment, particularly the crawler crane. This work will be continued next summer and probably completed.

Early in the summer, drifting in the east timber tunnel was resumed and continued throughout the summer months. Drifting for the year totaled 361' of full size untimbered rock drift, wide enough for a double track, and 32' of concrete tunnel in the connection between the rock drift and the lower tunnel north of the shaft. By the end of the year, this job was practically completed, although a small amount of track work remained to be done. Late in the year Lindberg & Sons, contractors, moved to the property and began the work of removing approximately 70,000 cubic yards of material in the preparation of the east timber yard proper. This yard will be developed over several years as additional capacity is required. In addition to the removal of the excess material, there will be the installation of a concrete tunnel for the loading of stull timber, and the installation of miscellaneous surface tracks for the handling of poles, lagging and other supplies.

f. Surface Drainage:

Early in the year, a considerable amount of work was done in the vicinity of a shallow lake known as the Lily Pond, which lies almost entirely in Section 2, but partly in Section 1 ("B" Shaft). Preliminary pumping and testing indicated the feasibility of completely draining the lake by means of a relatively inexpensive ditch from the east end to a large storm sewer in the city of Negaunee system. This work, which was done by Lindberg & Sons, contractors, was almost entirely in Section 1 and was covered in the report for that operation. Later in the year after the lake was drained, it was decided to conduct further testing, with an eye to developing a system whereby a major portion of the water in the overburden could be removed. Late in the year, the Layne-Northwest Company was employed to put down a series of test holes in the area above the large mining territory where surface caving is most likely to occur. Two holes, #58 and #59, were put down before the end of the year, and a third, #60, was started. The first two holes provided information showing that the overburden is not materially different from that encountered in other holes in this district. In both cases, the static water level was approximately 60' above ledge, but the sand was too fine to indicate the probability of developing a completely satisfactory drainage well. However, the second hole indicated the possibility of developing a well which would produce between 300 and 400 G.P.M. and materially lower the water table in the vicinity where a surface cave is most likely to occur. Accordingly, a contract was signed with the Layne-Northwest Company to develop a well at this spot and to continue putting down test holes during the early part of 1948.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:

a. Shaft Sinking:

There was no shaft sinking during the year, but the definite opinion is being developed that it will soon be necessary to sink the shaft in order to permit the opening of the 7th Level in the not too distant future.

b. Development:

c. Stoping:

The discussion of "Development" and "Stoping" are so closely related that the discussion is combined in the following account of underground operations by levels and territories.

Sub-level caving, as adapted to the peculiar conditions at this property, was continued in a number of territories throughout the mine. The vertical interval in new development was increased from 25' to 30', and the horizontal interval was continued at 25'. In general, with vertical intervals in excess of 30', it is quite frequently necessary to do intermediate sub-level development, which adds to the cost and decreases the rate of production. In most cases, the mining method was entirely satisfactory, although some trouble was experienced by dilution from the jasper capping. Its use will be continued under conditions which do not warrant or permit the use of a more efficient system, which was developed during the year.

Except for a small amount of mining in existing openings, sub-level stoping by the benching method was discontinued in favor of a new method which was developed during the year to a high degree of efficiency. As it is now practiced at this property, this method could best be named "Combined Radial Stoping and Sub-level Caving".

Except for the original opening in which short benches are used, the new method eliminates the necessity for men working in the open stope. In addition to eliminating the well known hazards of working in the opening from a bench, the system also cuts down the amount of necessary development and has greatly increased the productivity of the miners. The original experiment with radial drilling was made from the usual small-size sub-level drifts with jackhammers and 3" drifters. This proved rather unsatisfactory, due to the limited space for drilling, and the slow drilling speed. As currently practiced, a number of transfer drifts, usually three or four, are driven at 25' intervals at the bottom of the block to be mined, and a single timbered sub-level drift 25' above the floor of the transfers is driven through the center of the block. All of these drifts are standard size and supported by 8' timber. The original opening is made by coning out the two outside mills at the end of the stope. Small-size untimbered drifts are then driven from the end of the mill sub drift to these openings and a



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND: (Continued)

b. Development:

c. Stoping:

(Continued)

slot, or trench, about 8' wide and 8' high is cut across the end of the stope by removing the ore from the sides and top of the small drifts. Long hole radial drilling is then started from the protection of the timbered mill sub drift. The initial large blast is made directly over the slot at the end of the stope, and the remaining drilling is done by retreating back along the mill sub drift. The normal radial blast varies from six to eight holes, 40' to 60' in length, which at the present time are being drilled with  $3\frac{1}{2}$ " automatic drifters mounted on posts. The holes are drilled with  $2\frac{1}{4}$ " jackbits and  $7/8$ " one-quarter octagon sectional rods, which are coupled to the standard  $1\frac{1}{4}$ " rod at the machine. The  $2\frac{1}{4}$ " diameter holes accommodate 2" diameter by 24" powder, which has proved very effective in breaking the ore. At the end of the year, new machines were being tried and it is hoped that lighter equipment can be used which will speed up the drilling process.

The ore is drawn from the stope into the several mill sub drifts, where secondary reduction is accomplished when necessary. It quite frequently happens that risers in the capping cave during the stoping process. This ore is recovered with the blasted material. When stoping proper is completed, the ore remaining between the transfer drifts and up to the elevation of the bottom of the stope, is recovered by sub-level caving. After the initial opening has been made, this method consistently produced between twenty and thirty 6-ton cars per shift of two miners, and quite frequently produced in excess of 40 cars, with a high for the year of 49.1 six-ton cars per shift of two men.

2nd Level West:

This division includes the area from the west side of #1 Cross-cut to the center of the area between #3 and #4 Cross-cuts, and is naturally divided into two separate mining territories. The territory above and to the west of #1 Cross-cut is the one in which the first work at this property was done in 1943. In 1945, operations were discontinued because of the large amount of water in the working places. In 1946, after the draining of the old Cleveland Hematite Mine, mining was resumed with considerable success. These operations were continued throughout 1947 and resulted in the completion of all mining from above the +15' sub-level down to the -50' elevation. The method used was a continuation of the open stopes and subsequent sub-level caving beneath them. Later in the year, a considerable amount of development was done on the -75', -110' and -125' sub-levels, this latter being directly above the level, in preparation for a continuation of both stoping and caving. The ore on the upper sub-levels was of Standard grade, and on the lower sub-levels approximately one-half Standard and one-half Special.



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND: (Continued)

b. Development:

c. Stoping:  
(Continued)

2nd Level West:(Continued)

The territory above #3 Cross-cut had been developed at the +100' elevation, or to a height of 235' above the level by the end of 1946. Stoping was started early in the year above the transfer elevation on the +75' sub-level, and mining was completed to the jasper capping at elevation +140' by the middle of the year. The deposit was limited in area at this height to a length of approximately 150' east and west, by 60' north and south. On completion of stoping operations above that elevation, the balance of the ore was recovered by sub-level caving on the +75' sub-level. Meanwhile, development work was being continued on the +15', -60' and the -75' sub-levels. By the end of the year, stoping had been resumed on the +50' sub-level, with the ore being handled through new transfers on the +15' elevation. The ore in the upper part of the deposit was low in sulphur, but a large percentage of the lower portion is Special grade.

2nd Level East:

This area extends from a point midway between #3 and #4 Cross-cuts to the Jackson boundary 200' east of #7 Cross-cut, and was the major producing area during 1946. Operations were completed in this territory late in that year, with the exception of the relatively small area above #3 and #5 Cross-cuts, which accommodated several crews throughout 1947. Mining operations by the radial stoping method were completed from above the +50' sub-level down to the transfer elevation on the -60' sub-level, except for a small area to the west, which was developed and ready for stoping by the end of the year. This was a most successful operation, consistently producing between 6,000 and 8,000 tons of Standard ore per month. Immediately to the east, and adjacent to this territory, mining was continued in Special grade ore and completed down to the -85' elevation by the sub-level caving method, with a few small stopes under the capping. By the end of the year, mining was being continued on the -110' sub-level immediately above the level between #4 and #5 Cross-cuts. Operations between #5 Cross-cut and the Jackson boundary were limited to the recovery of pillars from the stoping and caving operations on the -140' sub-level above the 3rd Level.

There was no work on the 2nd Level, with the exception of the recovery of pillars from mining operations on the -140' sub-level.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND: (Continued)

- b. Development:
- c. Stoping:  
(Continued)

3rd Level:

Operations on and above the 3rd Level were confined to mining by two contracts on the -140' and -185' sub-levels, and a small amount of development work on the level. Sub-level caving operations, with a small amount of radial stoping, were continued by two crews of miners, which worked throughout most of the year on the -140' sub-level. This operation, which was completed by December, recovered all of the ore remaining above this elevation to the -110' sub-level and lying between #6 Cross-cut on the 2nd Level and the Jackson boundary. This operation was not particularly successful, since the deposit was very narrow, very hard and high in sulphur. By the end of the year, both crews were mining on the -185' sub-level, where the original transfer drift had been driven in the crotch between the footwall and the main dike. This entire territory will be completely mined out early in 1948.

Work on the 3rd Level consisted of a ventilation drift, a new raise from the 5th Level, and a small amount of exploration discussed in a subsequent paragraph. Late in the year, the main drift east of #7 Cross-cut was continued to the east toward the boundary. This drift, which has acquired the name "Cambria Connection", had been advanced a distance of 350' by the end of the year. It will be continued a distance of 100' to accommodate a raise which will be put up to, and connected with the 7th Level of the Cambria-Jackson Mine. The cost of this connection, which will serve as a second outlet for both properties, is being shared jointly by both mines. Also during December, a new car-loading transfer drift was started above the level. This drift, which will be driven to the south midway between #3 and #7 Cross-cuts, will serve two purposes: A raise will be put up to complete the mining of the ore between #4 and #6 Cross-cuts on the 2nd Level, and a permanent ventilation connection from the 5th Level will also be connected with this drift.

5th Level:

The main producing area during the year extended from the shaft pillar west of #1 Cross-cut to a point 150' east of #3 Cross-cut. This area is naturally divided into four distinct territories by the main fault running northwest-southeast, and #5 Dike which runs northeast-southwest. The deposit west of the fault and north of the dike was the last of the four to be discovered and developed and, without any question, is the highest. The displacement along the fault is approximately 200' horizontally and at least 150' vertically. The deposit was originally discovered by Raise #5104 and later developed from this raise and Raise #5202-"A", both above a transfer drift in the interbedded ore on the -535' sub-level. During the year, a large amount of development work was carried out from these two raises on the -390' sub-level, which is very near the bottom of the crotch between the interbedded slate and the dike. Development continued upward to the -360' sub-level, where it was being continued in December. There is now no doubt that this deposit, which is practically all Special grade, continues upward to, and above the 3rd Level elevation, where high sulphur ore was outlined by diamond drilling south of #1 Cross-cut.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND: (Continued)

- b. Development:
- c. Stoping:  
(Continued)

5th Level:(Continued)

The deposit west of the fault and south of the dike was originally discovered in Raise #5211 and was developed on the -485' sub-level, from which a considerable quantity of ore was mined prior to this year. Subsequent development and discovery has outlined an extensive deposit, all low in sulphur, on that elevation and upward to the -360' sub-level. By December, mining had been practically completed above the -390' sub-level and development was being continued on the -435' sub-level between #1 and #2 Cross-cuts.

The area east of the fault and south of the dike extends from #2 Cross-cut to a distance of 100' east of #3 Cross-cut. This was one of the first areas to be discovered and developed above the 5th Level. Mining was very extensive in this area during 1946, and it continued to be a major producer throughout 1947. It was in one of the stopes in this territory where the large flow of water in February caused considerable difficulty. By the end of the year, mining had been completed under the jasper capping from the -400' elevation down to the -460' sub-level adjacent to the fault, and down to the -570' elevation east of #3 Cross-cut, where the jasper pitches down to the level. Between #2 and #3 Cross-cuts, there is still a large unmined area where stoping and development work were being continued at the end of the year. In general, this large territory was very low in sulphur.

East of the fault and north of the dike a very large territory was developed. The ore in the upper sub-levels was very high in sulphur, with a small amount of Standard ore at lower elevations, where the deposit becomes quite narrow between the interbedded slate and the dike. Development and mining reached the jasper capping at elevation -330', which is 250' above the level. At this height, the deposit was extremely high in sulphur, 300' long east and west by 80' north and south. At lower elevations, both the length and width became greater, with the largest dimensions being found on the -435' sub-level, with a length of 350' and a width of 200'. Below this elevation, the deposit rapidly becomes narrower in the crotch between the interbedded slate and the dike. This area was a very large producer of Special grade during the year, at times accommodating as many as seven mining and development crews. By the end of the year, most of the mining was completed down to the -400' elevation, with extensive development work being continued on the -475', -485' and -500' sub-levels. The bottom of the ore is approximately at elevation -550'.



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND: (Continued)

b. Development:

c. Stoping:  
(Continued)

5th Level:(Continued)

In the central part of the 5th Level area, exploration and development were far less successful. Initial work in #4, #5 and #6 Cross-cuts indicated a very favorable structure and a large deposit of high grade Standard ore. Subsequent development at height indicated that the deposit was not extensive, was badly mixed with jasper and was extremely high in sulphur a short distance above the level. Operations were confined to the completion of the cross-cuts, a connection in ore between #4 and #5 Cross-cuts and a small amount of exploration raising and drifting above the level. At the end of the year, a single crew was developing a small stope above Raise #5512, and the car-loading transfer drift #5415. Additional work on the level is covered in subsequent paragraphs under "Exploration" and "Ventilation".

6th Level:

As later discussed under "Exploration", operations on this level disclosed a most complicated geological picture. The continuation of #1 Cross-cut beyond Raise #6101 was postponed indefinitely. #2 Cross-cut was continued a distance of 655' south of the main drift. #3 Cross-cut was planned to run parallel to the main fault. The fault, however, turned sharply to the east, with the result that the cross-cut was driven through it. Later, a connection was made between these two in the small amount of ore lying in the crotch between the interbedded slate and #4 Dike. #4 Cross-cut was driven a distance of 230' south of the main drift, just far enough to permit the starting of development work, which is urgently needed for the continuation of the large production program. The main drift was then continued to the east to a point 150' beyond the turn-out for #5 Cross-cut by the end of the year. The cross-cut itself had been advanced to the P.T. Present plans call for the continuation of #5 Cross-cut far enough to permit the starting of development work, a cross-cut to the north far enough to permit a permanent ventilation raise, after which drifting will be continued to the east toward "B" Shaft as rapidly as possible. Early in the year, a second crew will be organized to complete the cross-cuts.

6½ Level

By the end of the year, plans had been completed and an authorization approved for the development of a skip loading level half way between the 6th Level and the bottom of the shaft 150' below. The badly fractured rock at the plat on the 6th Level was complicated by the presence of a dike. These conditions made it definitely inadvisable, if not practically impossible, to put in the usual storage trenches



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND: (Continued)

b. Development:

c. Stoping:  
(Continued)

6 $\frac{1}{2}$  Level: (Continued)

at the shaft. Accordingly, direct loading pockets, each holding two cars or one skip, were installed. The subsequent development of the plans for sinking "B" Shaft and making the initial connection on this level, created a definite problem in that it will be necessary to handle large quantities of rock for a long time to come, as well as two grades of ore. Accordingly, a plan was devised whereby either the rock or the ore can be dropped through a raise to a skip loading drift at the lower elevation. This will separate the handling of the rock and the ore, and provide storage capacity for one or the other. Work will be started on the new project early in the year, as will plans for the sinking of the shaft to make the 7th Level available for production. Plans and an estimate for this project will be made early in 1948.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:  
(Continued)

d. Timbering:

The use of 8' stull timber on mining sub-levels, and 9' timber in the main level drifts was continued throughout the year. In addition, there was a large increase in the use of structural steel, particularly for replacement of stull timber in the main level drifts. By the end of the year, this material had proved so satisfactory that efforts were being made to obtain additional supplies for use on some of the mining transfer drifts where caving and crushing is a major problem. Steel was used to replace rotted timber in between 4,000' and 5,000' of main level drift, and steel was installed during the driving of a few hundred feet of drift. This latter has not proved too satisfactory, due to the fact that a considerable amount of steel is damaged if installed while the drift is being driven. At the present time, indications are that 300 tons of structural steel a year will be required to replace main level timber. Initial cost of this is approximately \$15.00 per set as compared with \$5.00 per set for the usual size stull timber. Installation charges, however, are enough lower to bring the cost of a steel set installed to approximately the same price as timber. The timber lasts 3 to 4 years, and the steel indefinitely.

The following is a record of all timber and timbering supplies used during the year on all operations.

Statement of Timber Used - All Operations

	<u>LINEAL FEET</u>	<u>AVG. PRICE PER FOOT</u>	<u>AMOUNT 1947</u>	<u>AMOUNT 1946</u>
5'4" Cribbing	158,255	.07057	\$11,167.95	\$ 9,148.57
8" - 10" Stulls	44,696	.14409	6,440.11	3,467.26
10" - 12" Stulls	68,317	.17948	12,261.55	4,955.52
12" - 16" Stulls	31,806	.20042	6,374.52	4,719.06
16' & 18' Mining Timber	3,320	.18186	603.76	494.35
Total	306,394	.11700	\$35,847.89	
Total 1946	236,933	.09617		\$22,784.76
		<u>PER 100'</u>		
7' Lagging	1,512,365	1.5329	\$23,182.68	\$15,779.41
9½' Poles	487,533	2.4779	12,080.63	11,570.37
Total	1,999,898	1.7633	\$35,263.31	
Total 1946	1,578,463	1.7327		\$27,349.78
		<u>PER FOOT</u>		
4" x 4" "H" Beam 13# Per Foot	30,001	.41644	\$12,493.75	
4" x 8" "I" Beam 23# Per Foot	2,146	.69788	1,497.66	
3/8" x 2" x 2" Angle Iron	28,101#	.03863	1,085.66	
Misc. (Bolts, Plates, etc.)			1,194.09	
Total			\$16,271.16	
Total 1946				\$ 422.77
 GRAND TOTAL INCLUDING STEEL			 \$87,382.36	 \$50,557.31

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:  
(Continued)

d. Timbering: (Continued)

The cost per ton for timbering supplies, including almost \$14,000.00 worth of steel, decreased as compared with the previous year. Most of the steel was used to replace rotted timber in main level drifts.

Statement of Timber Used Under Operating Account "Timbering":

	<u>LINEAL FEET</u>	<u>AVG. PRICE PER FOOT</u>	<u>AMOUNT 1947</u>	<u>AMOUNT 1946</u>
5'4" Cribbing	158,024	.07058	\$11,152.70	\$ 8,688.17
8" - 10" Stulls	41,267	.14572	6,013.59	3,443.60
10" - 12" Stulls	60,742	.16605	10,086.49	4,301.88
12" - 16" Stulls	25,937	.19840	5,145.78	2,447.35
16' & 18' Mining Timber	2,450	.19029	466.21	244.95
Total	288,420	.11395	\$32,864.77	
Total 1946	211,173	.09057		\$19,125.95
		<u>PER 100'</u>		
7' Lagging	1,192,486	1.5341	\$18,294.30	\$11,284.47
9½' Poles	362,596	2.4826	9,001.73	8,928.31
Total	1,555,082	1.7553	\$27,296.03	
Total 1946	1,159,276	1.74356		\$20,212.78
		<u>PER FOOT</u>		
4" x 4" "H" Beam 13# Per Foot	25,530	.41261	\$10,534.04	
4" x 8" "I" Beam 23# Per Foot	1,869	.69245	1,294.19	
3/8" x 2" x 2" Angle Iron	24,403#	.03950	964.00	
Miscl. (Bolts, Plates, etc.)			949.13	
Total			\$13,741.36	
Total 1946				.00
GRAND TOTAL INCLUDING STEEL			\$73,902.16	\$39,338.73
			<u>1947</u>	<u>1946</u>
Product for Year			729,669	339,433
Ft. Timber per Ton of Ore			.3953	.6221
Ft. Lagging per Ton of Ore			1.6343	2.3132
Ft. Poles Per Ton of Ore			.4969	1.1021
Ft. Lagging per Ft. of Timber			4.1345	3.7182
Cost per Ton for Timber			.0450	.0563
Cost per Ton for Lagging			.0251	.0332
Cost per Ton for Poles			.0123	.0263
Cost per Ton for Steel			.0188	-
Cost per Ton for Timber, Lagging, Poles & Steel			.1012	.1158

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:  
(Continued)

d. Timbering (Continued)

Amount and Cost of Timber Used in 3,812' of Main Level  
Timbered Rock Drift

	<u>LINEAL</u> <u>FEET</u>	<u>AMOUNT</u>	<u>AMOUNT PER FT.</u> <u>TBRD. DRIFT</u>
5'4" Cribbing	139	9.15	
8" - 10" Stulls	2,510	332.69	
10"- 12" Stulls	6,035	949.55	
12"- 16" Stulls	5,138	1,043.86	
16' & 18' Mining Timber	<u>474</u>	<u>74.63</u>	
Total	14,296	2,409.88	<u>.632</u>

Amount and Cost of Poles & Lagging for 4,536' of Main  
Level Timbered Rock Drift

7' Lagging	276,291	4,244.87	
9½' Poles	<u>109,293</u>	<u>2,688.55</u>	
Total	385,584	6,933.42	<u>1.529</u>

Total Per Foot of Timbered Drift..... 2.161

Amount and Cost of Steel & Steel Supplies Used in 724'  
of New Main Level Rock Drift Supported by Steel Sets

4" x 4" "H" Beams 13#	4,120	1,800.54	
4" x 8" "I" Beams 23#	254	186.94	
3/8" x 2" x 2" Angle Iron	3,400#	111.78	
Misc.(Bolts, Plates, etc.)	<u>        </u>	<u>225.06</u>	
Total	4,374	2,324.32	<u>3.210</u>

Total Per Foot Including Lagging & Poles..... 4.739

GRAND TOTAL INCLUDING STEEL..... 11,667.62

The average cost per foot for main level rock drift supported with timber remained approximately the same as the previous year. A larger amount of new rock drift, equipped with steel sets, was driven in 1947 at an average cost per foot for steel of \$3.21, and an over-all average cost including poles and lagging of \$4.74. The major portion of this work in the future will probably be done after the drift is driven, because of considerable damage to steel which is installed during the process. The difficulty of obtaining adequate supplies indicates the necessity for conserving steel for replacement in those portions of the mine where the rotting of main level timber is already becoming a problem. This would leave very little steel available for installation while the drifts are in progress. Accordingly, a large supply of tamarack stull timber has been obtained for use in main level drifts only. This material, while costing somewhat more than hard wood, lasts about twice as long and will further postpone the time when replacement will be necessary.



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:  
(Continued)

e. Drifting and Raising:

The following table shows all of the miscellaneous drifting and raising during the year including: Main levels, sub-levels, mining drifts, and the work done in the new 6th Level pumping plant and the east timber tunnel.

	<u>Drifting</u>		<u>Raising</u>		<u>Total</u>
	<u>Ore</u>	<u>Rock</u>	<u>Ore</u>	<u>Rock</u>	
Large Size	15,784'*	7,731'**	648'***	656'***	24,819'
Small Size	<u>2,831'</u> 18,615'	<u>778'</u> 8,509'	<u>8,642'±</u> 9,290'	<u>668'±±</u> 1,324'	<u>12,919'</u> 37,738'

* Timbered	Stripping & Timbering.....	<u>714'</u>
** 5,874' Timbered	Grand Total.....	38,452'
*** Cribbed	Grand Total Last Year.....	24,258'
± 3,541' Cribbed		
±± 320' Cribbed		

The bulk of main level drifting and cross-cutting was on the 5th and 6th Levels. This was all capital account work under E&A's NM-26A and 27A, with the exception of cross-cutting in ore, which was carried on the cost sheet under "Development in Ore". There were two relatively short drifts driven on the 3rd Level, one a ventilation drift under E&A NM-48, and the other the so-called "Cambria Connection", which was taken up on the cost sheet as "Development in Rock".

	<u>Timbered Ore Drift</u>	<u>Timbered Rock Drift</u>	<u>Naked Rock Drift</u>	<u>Total</u>
3rd Level Cambria Connection			382'	382'
3rd Level Vent. Drift E&A NM-48		285'		285'
E&A NM-26A 5th Level	696'	2,363'		3,059'
E&A NM-27A 6th Level	<u>185'</u>	<u>2,173'</u>		<u>2,358'</u>
Total	<u>881'</u>	<u>4,821'</u>	<u>382'</u>	<u>6,084'</u>
Total 1946	238'	4,666'	-	4,904'

Other capital account work is listed below:

NM-29 "East Timber Tunnel"	- 361' of untimbered rock drift (10' x 14'). 32' concrete tunnel (completed).
NM-27A (Perm. Vent. between 5th & 6th Levels)	- 108' Miscellaneous rock raising and drifting.
NM-26A (Perm. Vent. above 5th)	- 518' Miscellaneous rock raising and drifting.
NM-39 "6th Level Pumping Plant"	- Completed excavating pump rooms, main sumps and suction sumps - concreting nearly completed.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:  
(Continued)

f. Explosives, Drilling and Blasting:

The price of all explosives and blasting supplies was increased substantially during the year. The continued use of Hercomite #2, a cheaper bulk powder, partially offset the higher prices. The following table is a record of all explosives and supplies used on all operations during the year.

	<u>Quantity</u>	<u>Average Price</u>	<u>Amount 1947</u>	<u>Amount 1946</u>
40% Gelatin	7,897#	15.00 CWT	\$ 1,184.80	-
60% Gelatin	54,121#	15.538 CWT	8,409.16	\$ 8,815.46
80% Gelatin	5,984#	19.00 CWT	1,136.96	575.00
Gelamite	1,000#	14.25 CWT	142.50	4,466.75
Hercomite #2	343,452#	13.434 CWT	46,139.95	20,047.58
Hercomite 2" x 24"	29,251#	13.499 CWT	3,948.76	-
Total Powder	441,705#	13.801 CWT	\$60,962.13	
Total Powder 1946	271,014#	12.51 CWT		\$33,904.79
Blasting Fuse	1,002,000'	6.98 M	\$ 6,996.35	\$ 3,116.35
No. 6 Blasting Caps	126,311	1.367 C	1,727.51	953.31
No. 14 Lead Wire	44,250'	26.57 M	1,176.03	711.29
Electric Blasting Caps	42,305	16.869 C	7,136.60	5,243.31
7" Fuse Lighters	29,300	6.75 M	197.82	135.01
Paper Shells	21,000	6.46 M	135.77	98.70
#1 Powder Bags	11	1.569 ea.	17.26	14.00
#2 Powder Bags	140	5.909 ea.	827.39	189.75
Primacord	43,900'	3.20 C	1,404.80	-
Master Fuse Shells			-	9.93
No. 20 Conn. Wire			-	.55
Total Fuse, Caps, Wire, etc.....			\$19,619.53	\$10,472.20
GRAND TOTAL EXPLOSIVES & BLASTING SUPPLIES.....			\$80,581.66	\$44,376.99

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:  
(Continued)

f. Explosives, Drilling and Blasting (Continued):

The increased price of blasting supplies is reflected in the cost per ton for breaking the ore produced in "Development in Ore" and "Stoping", which increased approximately 10%. Improvements in blasting methods partially offset the increased costs.

Explosives Used in Breaking 729,669 Tons of Ore in  
Stoping and Development in Ore

	<u>Quantity</u>	<u>Average Price</u>	<u>Amount 1947</u>	<u>Amount 1946</u>
40% Gelatin	7,897#	15.00 CWT	\$ 1,184.80	-
60% Gelatin	12,966#	15.42 CWT	1,999.95	443.00
80% Gelatin	3,206#	19.00 CWT	609.14	-
Gelamite #1	1,000#	14.25 CWT	142.50	3,920.59
Hercomite#2	256,434#	13.445 CWT	34,477.11	14,134.49
Hercomite 2" x 24"	28,987#	13.50 CWT	3,913.12	-
Total Powder	310,490#	13.632 CWT	\$42,326.62	-
Total Powder 1946	150,423#			\$18,498.08
Blasting Fuse	913,510'	6.98 M	\$ 6,376.69	\$ 2,839.86
No. 6 Blasting Caps	114,726	1.366 C	1,567.59	869.95
No. 14 Lead Wire	7,750'	2.104 M	163.10	36.06
Electric Blasting Caps	7,353	16.92 C	1,244.30	353.63
7" Fuse Lighters	21,800	6.75 M	147.19	135.01
Paper Shells	18,900	6.34 M	119.91	98.70
#1 Powder Bags	11	1.569 ea.	17.26	14.00
#2 Powder Bags	121	6.064 ea.	733.86	144.90
Primacord	30,650'	3.20 C	980.80	-
Master Fuse Shells			-	9.93
Total Caps, Wire, Fuse, etc.....			\$11,350.70	\$ 4,502.04
GRAND TOTAL EXPLOSIVES & BLASTING SUPPLIES.....			\$53,677.32	\$23,000.12
Product			<u>1947</u> 729,669	<u>1946</u> 339,433
Pounds of Powder per Ton of Ore			.426	.443
Tons of Ore per lb. of Powder			2.350	2.256
Cost per Ton for Powder			.058	.054
Cost per Ton for Fuse, Caps, etc.			.016	.013
Cost per Ton for all Explosives			.074	.067

The cost of explosives used in miscellaneous rock work, and charged to "Development in Rock", totaled \$5,463.25 as compared with \$2,500.12 the previous year.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:  
(Continued)

f. Explosives, Drilling and Blasting: (Continued)

Explosives Used in Driving 4,536' of  
Main Level Timbered Rock Drift

	<u>Quantity</u>	<u>Amount</u>	<u>Pounds of</u> <u>Powder Per</u> <u>Foot of Drift</u>	<u>Cost Per</u> <u>Foot</u>
60% Gelatin Powder	5,740#	\$ 907.97		
Hercomite #2	66,918#	8,898.30		
Total Powder	72,658#	\$ 9,806.27	16.02	2.16
Miscl. Blasting Supplies		\$ 5,122.91	-	1.13
Grand Total		\$14,929.18	16.02	3.29
Grand Total 1946 - 4,666'			18.65	3.30

A much smaller proportion of drifting in the very hard rock encountered on the 6th Level in 1946, accounts for the decrease in the amount of powder used per foot of drift. This kept the cost for all blasting supplies per foot of drift equal with that of the previous year, in spite of the increased prices of these supplies.

g. Loading and Trammig:

Constant maintenance work was necessary throughout the year to keep two of the three Conway Model 125 electric loaders working satisfactorily. Without the third stand-by machine, considerable lost time due to break-downs would have been occasioned. Two of these machines are now five years old, and the third is approximately three years old. Accordingly, a study has been made which indicates the desirability of purchasing a machine manufactured by the Einco Corporation. This machine, known as the Model 40 Hydro-electric, is considerably cheaper than the present Conway, and will probably not be as expensive to maintain. An order will probably be placed early in 1948, in view of the large drifting program still to be carried out in both "A" and "B" Shafts. A new Model 21 air operated Einco shovel was purchased and delivered during the year. This machine is in constant use in cleaning up spillage and driving short rock drifts on the various levels.

The 100 cubic foot "Lake Shore Lohed" tram cars continued to work with complete satisfaction in both ore and rock. Twenty-four were delivered during the year, and twelve more placed on order for 1948. A considerable amount of experimenting has been done in trying to eliminate the tendency of the ore to stick to the bottoms of all of the makes of cars. A preliminary study, involving the use of a loose sheet of 1/2" thick rubber in the bottoms of these cars, indicates the possibility that a satisfactory solution will be worked out in the very near future.



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:  
(Continued)

g. Loading and Trammig (Continued)

Two of the three new General Electric storage battery locomotives were received late in the year, with the third scheduled for delivery early in 1948. Increased trammig needs indicate the need for more of this equipment, orders for which will be placed early in the year. One of the older machines was used on surface from time to time, when it could be spared from underground operations. The increased trammig distance in the east timber tunnel indicates the more or less permanent use of one of the heavy machines on surface.

h. Ventilation:

A number of important additions were made to the main ventilation system during the year. A by-pass drift some 300' long was completed on the 3rd Level early in the year, and a new 100,000 C.F.M. ventilating fan, purchased from the Joy Manufacturing Company, was delivered late in the year. By the end of the year, the excavation and concrete bases for this fan were completed. One new permanent ventilation opening between the 3rd and 5th Levels was completed in Raise #5701 from #7 Cross-cut on the 5th to #7 Cross-cut on the 3rd. The connection was accomplished by a raise from the 5th to approximately the 4th Level elevation (-435' Sub-level), a drift into the footwall on this elevation a distance of 60', and a raise through to the 3rd Level elevation.

There were two other underground connections in the main level circuit: Raise #6101 was completed early in January to the 5th Level elevation and a connection made to the west side of #1 Cross-cut. In December, a second was completed to the 5th Level elevation in Raise #6309, and a connection made with the south end of #3 Cross-cut. During the year, some work was done on another connection between the 5th and 3rd Levels from #518, which was started as a top timber car-loading sub-level. This is being driven to the north into the footwall, from which a raise will be put through to the 3rd Level. Additional connections to this raise will also serve to mine at least a portion of the interbedded ore.

In general, the same ventilation system was continued, with the fresh air entering the mine through the cage compartment of the shaft onto the 3rd Level, where the main fan is in operation. A small portion of the air is then allowed to exhaust up through the workings to the 2nd, through the workings above the 2nd and up the skip compartments of the shaft. The balance of the air is forced down to the 5th Level workings and thence to the 6th, where it is exhausted through the skip compartments. Volumes during the year varied between 30,000 and 40,000 C.F.M., depending on the number and size of the underground openings and the surface temperature. The new fan, which will be installed as early as possible in 1948, will greatly increase these volumes. In order to utilize these volumes and still prevent freezing in the shaft, a shaft heating plant is necessary.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:  
(Continued)

h. Ventilation: (Continued)

Plans for this plant were completed during the year, and included in a contract to install a second boiler. By the end of the year, this project was well underway, but there was little hope that it would be completed in time to heat any of the shaft air during the cold months early in 1948.

Included in the shaft heating project was an auxiliary air shaft west of, and adjacent to the main shaft. This opening, which was 8' x 8' in cross-section, was completely excavated and cribbed by the end of the year to a depth of 42' below the collar. As early as weather conditions will permit in 1948, the sides and bottom of this opening will be concreted. The heating arrangement for the shaft air consists of a large blower fan with a capacity of 76,000 C.F.M. at 3" water gauge static pressure, and a large bank of steam heaters capable of heating 100,000 cubic feet of cold air from  $-40^{\circ}$  to  $+40^{\circ}$  F. The steam consumption is to be thermostatically controlled by an element approximately 100' down in the shaft, and also controlled by pressure-stats which will automatically turn off the fan if the steam pressure falls below 50# per square inch. This thermostatic control is necessary to prevent freezing of the heaters in extremely cold weather. A second safe-guard is accomplished by means of aqua-stats in the return water line, which also shut off the blower if the temperature drops below a safe point. In addition, the blower is equipped with a variable speed motor to take care of changing underground conditions.

i. Pumping:

During the latter months of 1946 and January of 1947, a steady, but not alarming, increase in the amount of underground water was noted. The major portion of the increase was coming from the mining area above #2 and #3 Cross-cuts on the 5th. By February 16th, the flow was so great that emergency measures were started. A temporary dam was installed on the 6th Level and as much water as possible was stored behind this dam by running it down from the 5th Level through the newly completed ventilation raise. Later an emergency dam was also necessary on the 5th Level. Briefly, the volume increased to a peak of approximately 4,000 G.P.M. by the 19th, and then decreased to less than 500 on the 25th, after which it was back to a normal of 300 by April. Other emergency measures consisted of bailing with the skips, utilizing additional centrifugal pumps from the 5th to 3rd, storing water behind a temporary dam on the 3rd Level and emergency pumping through the main air line in the shaft from the 6th Level to the 960' Level and thence to surface. In all, approximately 10,000,000 gallons of water over and above the normal flow were handled between the 19th and the 25th of the month, with approximately 5,000,000 being handled on the 19th and 20th, when conditions were most extreme. By the 27th of the month, the emergency was over and normal operations had been resumed.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND:  
(Continued)

i. Pumping: (Continued)

A subsequent study of the stoping area above the south end of #3 Cross-cut immediately under the jasper capping produced a very definite answer to the large flow of water. Under ordinary circumstances, there is a considerable amount of water in the capping and this flows at a rather slow rate into the first mining opening which exposes the capping. In this case, stoping had been carried on to a considerable extent in an area designed to handle the water through inclined transfer drifts, draining away from the car-loading transfer. Late in 1946, the flow of water in this stope reached the point where it was decided to leave a pillar and resume mining beyond it in fairly dry conditions. Later, as was to be expected, the pillar collapsed and was ultimately recovered by sub-level caving. However, as luck would have it, this pillar was supporting a large "pipe" or "chimney" of ore which rose to a considerable height into the capping. The collapse of the pillar allowed the ore in the chimney to start caving and this in turn intercepted a great many seams of water, which produced the unusually large flow. Under ordinary circumstances, this same volume of water would have seeped into the stope across the fracture planes at a much lower rate.

After the crest of the water had subsided, drifting operations on the 6th Level were not resumed, the crew and equipment being utilized to rush to completion the excavating of the new pumphouse and sumps. Drifting was not resumed until this work was completed. The material encountered was such as to require concreting of the entire pumphouse and a portion of the sumps. This work was carried on throughout the balance of the year, and nearly completed by the end of December. Meanwhile, the installation of the new discharge line to the shaft column was underway, as well as the installation of the first pump, which was almost ready for service by the end of the year.

Except for February and March when the volume of water was unusual and difficult to measure accurately, the volume from the mine varied from a high of 240 G.P.M. on the 3rd Level and 130 on the 960', to a low of 222 and 25 respectively in November. This very low figure from the 960' Level is the amount left over after utilizing the balance for underground wet drilling.



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

8. COST OF OPENING, EQUIPPING,  
DEVELOPING AND OPERATING:

a. Comparative Mining Costs:

The large increase in production did not entirely off-set the increases in both labor and supplies. One large increase in cost was occasioned by the necessity for retimbering large portions of the main level drifts. Wherever possible this was done with steel and the cost taken up on the operating cost sheet. One other new cost factor was added in 1947 under "Depreciation", which formerly carried an increment of \$.20 per ton. During 1947 this was increased to \$.255.

	<u>1947</u>	<u>1946</u>
Product - Tons	729,669	339,433
Underground Costs	1.900	1.734
Surface Costs	.285	.336
General Mine Expense	<u>.384</u>	<u>.414</u>
Cost of Production	2.569	2.484
Depreciation: Plant & Equipment	.106	.200
Development after 12/31/44	.109	-
Pre-Production Development	.036	-
Movable Equipment	.004	-
Taxes	.163	.199
Loading and Shipping	<u>.049</u>	<u>.062</u>
Total Cost at Mine	3.036	2.945
Budget - Estimated Cost per Ton	2.915	3.149
Number of Shifts and Hours	-	3 1-8 hr.
	<u>291½ 2-8 hr.</u>	<u>215 2-8 hr.</u>
Total 8 hr. Operating shifts	583	433
Number of Operating Days	291½ 2-8 hr.	216½ 2-8 hr.
Average Daily Product	2,503	1,568

Proportion of Labor and Supplies

	<u>Amount</u>	<u>Per Ton</u>	<u>Per Cent</u>
Labor	\$1,291,633.51	1.770	58%
Supplies	<u>923,420.36</u>	<u>1.266</u>	<u>42%</u>
Total Cost at Mine	\$2,215,053.87	3.036	100%



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

8. COST OF OPERATING: (Continued)b. Detailed Cost Comparison:

	<u>1947</u>		<u>1946</u>	
	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>
Exploring in Mine	24,898.68	.034	5,962.06	.018
Development in Rock	38,519.43	.053	20,322.74	.060
Development in Ore	51,230.14	.070	20,331.33	.060
Stoping	499,597.50	.684	224,364.37	.661
Timbering	336,855.74	.462	132,865.50	.391
Tramming	173,421.96	.238	81,653.69	.241
Ventilation	11,649.32	.016	4,265.84	.013
Pumping	29,506.84	.040	13,739.80	.040
Compressors and Air Pipes	42,225.59	.058	18,029.80	.053
Underground Superintendence	48,995.86	.067	19,660.41	.058
Maint. Comp. & Power Drills	384.35	.000	65.38	.000
Scrapers & Mechanical Loaders	63,298.07	.087	25,966.05	.076
Tramming Equipment	34,751.34	.048	17,533.29	.052
Pumping Machinery	31,227.58	.043	3,889.30	.011
Total Undg. Costs	<u>1,386,562.40</u>	<u>1.900</u>	<u>588,649.56</u>	<u>1.734</u>
Hoisting	65,212.83	.089	30,768.49	.090
Stocking Ore	23,530.33	.032	6,910.01	.020
Dry House	26,652.38	.037	16,806.55	.050
General Surface Expense	28,554.32	.039	13,436.96	.039
Maint. Hoisting Equipment	31,332.16	.043	16,887.59	.050
Shaft	1,661.51	.002	1,869.81	.006
Top Tram Equipment	10,034.99	.014	3,023.90	.009
Docks, Trestles & Pockets	16,927.98	.023	20,310.82	.060
Mine Buildings	4,014.64	.006	4,104.87	.012
Total Surface Costs	<u>207,921.14</u>	<u>.285</u>	<u>114,119.00</u>	<u>.336</u>
Geological	3,648.79	.005	-	-
Mining Engineering	19,637.90	.027	8,549.77	.025
Mechanical & Elect. Engrg.	3,987.57	.005	1,723.82	.005
Analysis & Grading	36,738.98	.051	19,416.84	.057
Safety Department	3,240.69	.004	1,424.95	.004
Telephones & Safety Devices	11,665.26	.016	2,583.74	.008
Local & General Welfare	5,148.13	.007	2,465.99	.007
Spec. Exp. Pensions & Allow.	9,165.69	.013	4,658.42	.014
Ishpeming Office	28,459.21	.039	14,480.87	.043
Mine Office	44,633.88	.061	26,682.05	.079
Insurance	13,569.05	.019	3,455.26	.010
Personal Injury	36,696.45	.050	9,109.80	.027
Social Security Taxes	28,598.10	.039	26,557.59	.077
Employees Vacation Pay	35,113.20	.048	19,256.53	.057
Group Annuity	-	-	312.71	.001
Total Gen. Mine Expenses	<u>280,302.90</u>	<u>.384</u>	<u>140,678.34</u>	<u>.414</u>
COST OF PRODUCTION	1,874,786.44	2.569	843,446.90	2.484

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

8. COST OF OPERATING (Continued)

Charges Distributed by Mine Office:

	<u>1947</u>		<u>1946</u>	
	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>
General & Electrical Supplies	102,901.33	.141	36,895.54	.109
Iron and Steel	42,080.46	.058	10,934.83	.032
Oil and Grease	6,286.49	.008	2,304.22	.007
Machinery Supplies	54,694.47	.075	23,525.49	.069
Explosives	58,976.95	.081	25,476.55	.075
Lumber and Timber	83,362.41	.114	46,117.31	.136
Fuel	6,463.94	.009	4,553.56	.013
Electric Power	120,123.87	.165	56,585.34	.167
Other Items of Expense	12,723.50	.018	9,613.35	.029
Rental	2,388.16	.003	399.80	.001
Sales Tax	-	-	138.51	.000
 Total	 490,001.58	 .672	 216,544.50	 .639

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

8. COST OF OPENING,  
EQUIPPING, &  
DEVELOPING:

Capital account expenditures for the year were \$692,229.87, which brought the total for the property to \$4,691,945.60. This figure does not include an amount of \$318,223.11 previously charged to Negaunee Mine Company "Idle Expense". The addition of this amount brings the grand total to date to \$5,010,168.71 after credit for ore produced during development. "General Expense" and "Maintenance" for the past three years have been charged into "Operating".

Main level drifting and permanent ventilation connections accounted for approximately \$212,000.00, or 31% of the total capital expenditures for the year. Of this, slightly more than one-half was on and above the 5th Level, with the balance on the 6th. Drifting on the 6th was delayed several months by the necessity for using the crew in the excavation of the pumphouse early in the year. During that time, drifting was continued on the 5th Level. By the end of the year, drifting on the 5th had been stopped due to unfavorable geological developments, but was being continued on the 6th.

Expenditures for mining and haulage equipment were approximately \$178,000.00, or somewhat more than double that for the previous year. This expenditure included new haulage locomotives and underground tram cars, a large number of new scraper hoists and scrapers, and miscellaneous drill machines and other mining equipment.

Another large capital expenditure during the year was the sum of approximately \$140,000.00 expended in the new pumping plant on the 6th Level. This included approximately \$30,000.00 for two 500 G.P.M. Duplex horizontal pumps and a large amount for excavating and concreting the pumphouse drifts and sumps. It is expected that the major portion of this work will be completed before the middle of 1948.

Capital expenditures on surface were increased considerably over the previous year and amounted to \$162,000.00, or 23% of the total. This included \$56,000.00 for the purchase and erection of two additional compressors; \$27,000.00 for the new steam boiler plant and shaft heating equipment; \$31,000.00 in a continuation of the work in the timber tunnels and yards; \$12,000.00 for a new crawler crane and \$7,500.00 for a new Four Wheel Drive truck. The other major expenditure was \$15,000.00 on the extension to the permanent stocking trestles, with bills to be paid in January and February of approximately \$60,000.00



## 8. COST OF OPENING, EQUIPPING, AND DEVELOPING:

		TOTAL EXPENDITURES TO DEC. 31, 1947						
	E&A REFERENCE	TOTAL AUTHORIZED	GROSS EXPENDITURES	CREDITS A/C ORE MINED IN DEVELOPMENT	NET EXPENDITURES	UNEXPENDED BALANCE	1947 EXPENDITURES	
<b>1. BUILDINGS AND EQUIPMENT:</b>								
a. Main Building .....	(10-10&19 10-10&19A)	280,000.00	279,990.27	-	279,990.27	9.73	-	
b. Change House & Shop Equip..	10-26	60,000.00	59,296.57	-	59,296.57	703.43	1,412.54	
c. Initial Shop Equipment.....	(10-4/10-4A)	5,732.73	5,732.73	-	5,732.73	-	-	
d. One 35 Ton Overhead Crane..	(10-9/10-9A)	8,894.94	8,894.94	-	8,894.94	-	-	
e. Temporary Equipment.....	10-18	15,000.00	14,079.62	-	14,079.62	920.38	-	
f. Erecting & Equipping Storage Building.....	31	20,900.00	20,900.00	-	20,900.00	-	69.11	
g. Compressor Plant	10-23/47	131,600.00	127,675.04	-	127,675.04	3,924.96	55,989.84	
h. Hot Milling Equipment.....	43	2,871.20	2,871.20	-	2,871.20	-	2,871.20	
i. Steam Boiler and Heating Equipment.....	52	55,000.00	26,718.34	-	26,718.34	28,281.66	26,718.34	
<b>TOTAL.....</b>		<b>579,998.87</b>	<b>546,158.71</b>	<b>-</b>	<b>546,158.71</b>	<b>33,840.16</b>	<b>86,922.81</b>	
<b>2. SURFACE:</b>								
<b>a. Equipment:</b>								
1. Temporary Surface Plant	10-3	31,130.00	26,506.28	-	26,506.28	4,623.72	-	
2. Truck and Tractor .....	10-1	18,575.00	18,289.42	-	18,289.42	285.58	-	
3. Electric Shovel .....	18	85,000.00	85,000.00	-	85,000.00	-	3,003.82	
4. Top Tram Equipment.....	(10-24/10-24A)	46,000.00	43,375.13	-	43,375.13	2,624.87	-	
5. Timber Tunnel, Tracks Pumphouse and Sump....	(10-20 10-20A)	58,000.00	57,867.78	-	57,867.78	132.22	-	
6. Timber Tunnel & Yards..	29	74,800.00	54,504.06	-	54,504.06	20,295.94	30,969.20	
7. Mechanical Additions - Headframe.....	32	27,500.00	27,500.00	-	27,500.00	-	-	
8. Crawler Crane.....	51	12,000.00	11,841.65	-	11,841.65	158.35	11,841.65	
9. Four Wheel Drive Truck.	53	7,500.00	7,497.72	-	7,497.72	2.28	7,497.72	
<b>Total.....</b>		<b>360,505.00</b>	<b>332,382.04</b>	<b>-</b>	<b>332,382.04</b>	<b>28,122.96</b>	<b>53,312.39</b>	
<b>b. General:</b>								
1. Diamond Drilling.....	9	81,000.00	80,965.78	-	80,965.78	34.22	-	
2. Moving Two Houses.....	10-2	3,458.00	3,458.00	-	3,458.00	-	-	
3. Drainage Well.....	10-11/56	36,896.00	4,283.56	-	4,283.56	32,612.44	2,387.56	
4. Road Bldg., Paving Parking Lot, etc.....	25	23,760.00	17,146.36	-	17,146.36	6,613.64	-	
<b>Total.....</b>		<b>145,114.00</b>	<b>105,853.70</b>	<b>-</b>	<b>105,853.70</b>	<b>39,260.30</b>	<b>2,387.56</b>	
<b>TOTAL SURFACE.....</b>		<b>505,619.00</b>	<b>438,235.74</b>	<b>-</b>	<b>438,235.74</b>	<b>67,383.26</b>	<b>55,699.95</b>	
<b>3. SHAFT, HEADFRAME AND TRESTLE:</b>								
a. Sinking in Sand .....	10-15/10-15A	16,302.44	16,302.44	-	16,302.44	-	-	
b. Sinking in Rock (2,870 ft).	10-16/10-16A	440,000.00	435,677.44	2,559.15	433,118.29	6,881.71	-	
c. Shaft Sets (2,870 ft.).....	10-5/10-5A	160,975.45	159,754.21	-	159,754.21	1,221.24	-	
d. Headframe Foundation & Ore Trestle.....	(10-21 10-21A)	78,000.00	77,417.73	-	77,417.73	582.27	-	
e. Headframe and Trestle.....	10-7/10-7A	186,028.83	186,028.83	-	186,028.83	-	-	
f. Extensions to Permanent Stockpile Trestles.....	(36/42 42-1)	145,152.48	65,057.48	-	65,057.48	80,095.00	15,554.20	
g. Headframe & Power Ho. Eqpt.	10-22/10-22A	225,000.00	224,451.51	-	224,451.51	548.49	-	
h. Elec. Equip. for Cage & Sk. Hsts.	10-8	221,783.00	221,783.00	-	221,783.00	-	-	
i. l Cage Hoist & l Skip Hoist	10-6	143,000.00	143,000.00	-	143,000.00	-	-	
j. Elevator for Headframe.....	10-12/10-12A	4,853.00	4,853.00	-	4,853.00	-	-	
k. Double Deck Cage - Spare...	37	7,000.00	3,134.75	-	3,134.75	3,865.25	-	
l. Pinion Brake for Cage Hoist	45	4,000.00	3,847.70	-	3,847.70	152.30	3,847.70	
<b>TOTAL SHAFT, HEADFRAME AND TRESTLE.....</b>		<b>1,632,095.20</b>	<b>1,541,308.09</b>	<b>2,559.15</b>	<b>1,538,748.94</b>	<b>93,346.26</b>	<b>19,401.90</b>	



8. COST OF OPENING, EQUIPPING AND DEVELOPING:  
(Continued)

		TOTAL EXPENDITURES TO DEC. 31, 1947						
		E&A	TOTAL	GROSS	CREDITS A/C	NET	UNEXPENDED	1947
		REFERENCE	AUTHORIZED	EXPENDITURES	ORE MINED IN	EXPENDITURES	BALANCE	EXPENDITURES
					DEVELOPMENT			
<b>4. UNDERGROUND:</b>								
<b>a. Plant:</b>								
1. Pumping - 3rd Level....	10-25/10-25A		55,000.00	53,738.88	-	53,738.88	1,261.12	-
2. Pumping Plant - 6th Level	39		215,600.00	179,197.25	-	179,197.25	36,402.75	139,472.98
Total.....			270,600.00	232,936.13	-	232,936.13	37,663.87	139,472.98
<b>b. Equipment:</b>								
1. Mining Equipment.....	19		44,550.00	44,550.00	-	44,550.00	-	-
2. Mining Equipment.....	28		51,700.00	49,004.32	-	49,004.32	2,695.68	1,923.21
3. Mining Equipment.....	40		61,710.00	61,710.00	-	61,710.00	-	31,936.92
4. Mining Equipment.....	41		28,050.00	26,682.80	-	26,682.80	1,367.20	15,490.80
5. Mining Equipment.....	55		23,870.00	13,105.25	-	13,105.25	10,764.75	13,105.25
6. Haulage Equipment.....	10-29/10-29A		110,000.00	107,968.83	-	107,968.83	2,031.17	-
7. Haulage Equipment.....	23		90,420.00	87,833.30	-	87,833.30	2,586.70	5,558.05
8. Haulage Equipment.....	46		84,755.00	68,210.28	-	68,210.28	16,544.72	67,919.44
9. Underground Substations	38		14,300.00	16,468.26	-	16,468.26	2,168.26	5,216.38
10. Main Ventilating Fan....	48		24,200.00	13,664.30	-	13,664.30	10,535.70	13,664.30
11. Twelve Scraper Hoists..	50		33,000.00	21,677.60	-	21,677.60	11,322.40	21,677.60
12. Scraper Hoists.....	54		49,500.00	2,570.00	-	2,570.00	46,930.00	2,570.00
Total.....			616,055.00	513,444.94	-	513,444.94	102,610.06	175,215.53
<b>c. Development:</b>								
<b>1. Main Level Development:</b>								
Plats and Pockets.....	(10-28/10-28A 26-26A/27-27A)		220,000.00	217,118.05	-	217,118.05	2,881.95	566.80
Drifting.....	(10-27/24/26- 26A/27-27A/33)	1,137,871.20	1,024,333.61	80,404.67	-	943,928.94	193,942.26	202,609.68
Ventilation & 2nd Outlet.....	26-26A/27-27A		53,900.00	20,847.04	-	20,847.04	33,052.96	9,470.70
2. Development & Mining above Levels....	(24/26-26A/27- 27A/34)	203,728.80	194,487.12	49,921.83	-	144,565.29	59,163.51	-
3. Undg. Exploration.....	21		35,000.00	31,729.54	-	31,729.54	3,270.46	2,799.71
Total.....		1,650,500.00	1,488,515.36	130,326.50	-	1,358,188.86	292,311.14	215,446.89
d. Dewatering Hematite Workings	30		66,000.00	64,232.28	-	64,232.28	1,767.72	69.81
TOTAL UNDERGROUND.....			2,603,155.00	2,299,128.71	130,326.50	2,168,802.21	434,352.79	530,205.21
GRAND TOTAL BEFORE CONTINGENCIES			5,320,868.07	4,824,831.25	132,885.65	4,691,945.60	628,922.47	692,229.87
Plus 10% for Contingencies.....			228,217.26	-	-	-	228,217.26	-
GRAND TOTAL INCLUDING CONTINGENCIES			5,549,085.33	4,824,831.25	132,885.65	4,691,945.60	857,139.73	692,229.87
General Expense.....	10-13		-	271,716.98	-	271,716.98	-	1947 Expense
Maintenance.....	10-14		-	37,050.73	-	37,050.73	-	taken up in "Cost
Building Roads & Landscaping...	10-17		-	9,455.40	-	9,455.40	-	of Operating"
Total to Negaunee Mine Company Idle Expense.....			-	318,223.11	-	318,223.11	-	
GRAND TOTAL.....			5,549,085.33	5,143,054.36	132,885.65	5,010,168.71	857,139.73	692,229.87

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

8. COST OF OPENING,  
EQUIPPING &  
DEVELOPING:  
(Continued)

With the exception of two short drifts on the 3rd Level, one for the "Cambria Connection", which was charged to "Development in Rock", and the other for the ventilation by-pass drift, which was charged to E&A NM-48, all of the main level drifts and cross-cuts were driven on the 5th and 6th Levels and required support with either timber or steel. On these two main levels, the total drifting was 4,536', of which 2,363' were on the 5th and 2,173' on the 6th. The following breakdown of the average costs for both levels shows a substantial increase over the previous year, due almost entirely to the large increase in the labor costs.

Timbered Rock Drift	Actual Per Foot	Timbering Supplies & Labor Per Foot	Total Per Foot	Distribu- tive Charges Per Foot	Grand Total Per Foot	1946 Grand Total Per Foot-4,666'
4,536'	33.18	5.10	38.28	5.32	43.60	36.39

There was only a slight variation in the average cost per foot between the two levels.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

9. EXPLORATIONS  
AND  
FUTURE  
EXPLORATIONS

There was no surface exploration, as such, in Section 2 during the year, except for the surface test holes described under 6 (f) "Surface Drainage".

Underground exploration consisted of work in 21 holes, #28 to #48 inclusive. D.D.H. #28 was completed from 355' to 462' early in January, and #43, #45 and #48 were being continued at the end of the year.

3rd Level

Shortly after the middle of the year, the new ventilation Raise #5701 encountered a small amount of Standard ore immediately under the 3rd Level elevation in the vicinity of #7 Cross-cut. Accordingly, Hole #37 was drilled to the southwest from this cross-cut in an attempt to further outline the deposit. Several short runs of ore, with intervening seams of lean ore and jasper were encountered in the first 70', after which the hole was stopped at a depth of 112' in jasper. The small amount of encouragement in this hole indicated the desirability of further testing. This was carried on throughout the balance of the year, with Hole #45 on this same elevation, and others on the -325' and -435' sub-levels.

Hole #45 was drilled at a slight, upward angle, due south from the main drift several hundred feet west of #7 Cross-cut. The hole passed through footwall slate and encountered the interbedded horizon, which was unenriched, through the interbedded slate and into transition slate and jasper at a depth of 286' by the end of the year. At this writing, the hole is completed, and a run of high sulphur ore 122" in thickness was disclosed beyond #2 Dike under the jasper capping. Apparently this rather large deposit extends upwards a distance of approximately 300' above the 5th Level.

-325' Sub

Two short holes, #42 and #44, were drilled to the southeast and south of a small exploration drift at this elevation. They served to outline the east end of the same deposit lying north of #4 Dike. In spite of the fact that all of the ore was quite high in sulphur, plans are being made to develop a mining area in the very near future.

-435' Sub

Two comparatively short holes, #47 and #48, were drilled to the south and southwest of the ventilation drift on this sub-level, which is approximately the 4th Level elevation. In #47, intermittent runs of high sulphur ore, mixed with jasper, indicate the east end of the trough. D.D.H. #48, to the southwest, was in soft ore jasper at a depth of 60' by the end of the year. Drilling early in January disclosed a very long run of rich ore, quite high in sulphur.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

9. EXPLORATIONS  
AND  
FUTURE  
EXPLORATIONS  
(Continued)

-475' Sub

One short hole, #41, was drilled to the southeast of Raise #5511 at this elevation in the exploration of the deposit above #5 Cross-cut. Except for an initial run of 11' of Standard ore, the balance of the hole was in soft ore jasper north of #4 Dike, which was encountered from 209' to 218', where the hole was stopped.

5th Level

Hole #28, which was started in November of 1946, had shown a run of high grade Standard ore from 225' to 355' by the end of the year. This hole was continued in ore to a depth of 405', beyond which was mixed dike, lean ore and soft ore jasper, in which the hole was stopped at 462'.

D.D.H. #32 was then started from practically the same location, due south at an angle of  $+36^{\circ}$ . This hole was put in to better outline this same deposit at some height above the level. This hole outlined the interbedded ore, which was of Standard grade, immediately above the level; disclosed a very short run of high sulphur ore immediately north of #5 Dike, and then cut alternate runs of lean ore, jasper and high sulphur ore, and was finally stopped in jasper at a depth of 353'. The information obtained from these two holes indicated: (1) that the large deposit on the level apparently rose to a considerable height along the dike, and (2) that not too far above the level it changed from Standard to very high sulphur ore.

Hole #30 was drilled due south from the stub end of #6 Cross-cut primarily to determine whether or not there was sufficient concentration to warrant the continuation of the cross-cut. The interbedded ore was encountered in its normal position, although no important enrichment was disclosed beyond. The hole was ultimately stopped in soft ore jasper several hundred feet south of the second dike at a depth of 582'. A small amount of Standard ore was disclosed south of the second dike.

Hole #34 was then drilled from the same location, due south at a dip of  $+40^{\circ}$ . The object of this hole was to explore, at greater height, the same deposit which was explored by Holes #28 and #32. The most important evidence produced by this hole was the fact that a few feet above the level the interbedded ore was very high in sulphur and that, also very high in sulphur, there was considerable enrichment 200' above the level, south of #5 Dike.



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

9. EXPLORATIONS  
AND  
FUTURE  
EXPLORATIONS  
(Continued)

5th Level (Continued)

These four holes indicated an extensive deposit in the trough between the footwall and the dike to the south. In spite of the disappointing occurrence of extremely high sulphur, it was decided to complete #4, #5 and #6 Cross-cuts, and connect #4 and #5 in the ore. Development for mining immediately above the level between #4 and #5 Cross-cuts proved that the ore was not continuous and that it was very spotty and mixed with seams of jasper, in spite of the lengthy runs and high grade encountered on the level itself.

Later, Hole #46 was drilled to the south from the south side of the drift connecting #4 and #5 Cross-cuts, and 35' east of Raise #5413. This hole showed only 10' of ore south of the drift, then a 54' run of jasper, and another short run of ore totaling 43', with 100' of jasper beyond. This very narrow width and lack of continuity completed the disallusionment regarding this particular deposit.

#7 Cross-cut was extended far enough to the south to permit the placing of a raise in the interbedded ore. This cross-cut showed considerable displacement along #5 Dike, in that the interbedded ore and over-lying slate were repeated south of the dike. In both cases the ore was very high in sulphur. D.D.H. #38 was drilled to the south from the end of the cross-cut. A very small dike and an unimportant short run of ore were encountered from 121' to 127', after which the hole was continued through slaty jasper and soft ore jasper and stopped at a depth of 409'. This hole proved that there was nothing to be gained by continuing the cross-cut.

#8 Cross-cut was continued only to the P.T., which occurred just south of #5 Dike. Hole #35 was drilled to the south from this location through the footwall slate, the interbedded horizon which was unenriched, the interbedded slate and an additional 200' through jasper, where it was stopped at a depth of 511'. This very disappointing information prevented the continuing of #8 Cross-cut.

The main level drift was continued beyond the turn-out for #9 Cross-cut, which was completed only as far as the P.T. Hole #43 was drilled to the south from this location through the footwall slate; the interbedded horizon, which was unenriched and high in sulphur; through the interbedded slate and 150' of soft ore jasper to a depth of 504' by the end of the year. At the present writing, the hole is completed at a depth of 906', without any indication of enrichment. Obviously, there was no object in either extending the main level drift or the cross-cut. At least one more hole is planned to the southeast of this location in an attempt to find new structures and enrichment.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

9. EXPLORATIONS  
AND  
FUTURE  
EXPLORATIONS  
(Continued)

6th Level

Exploration on this level during the year, both by drilling and drifting, disclosed a most complicated geological picture. #1 Cross-cut was driven to the south and stopped a short distance from the main drift, but leaving enough room for the first permanent ventilation raise. Later, D.D.H. #33 was drilled to the southeast and finally stopped at a depth of 692' in soft ore jasper. This hole disclosed no enrichment other than the interbedded ore, which was 30' thick and rather high in sulphur.

Later, Hole #36 was drilled to the south at an angle of +20° in an attempt to further outline the rather small deposit found in the southeast end of #1 Cross-cut on the 5th Level. This hole cut the interbedded ore in its normal position, with a thickness of 27' and of Standard sulphur content. The hole was continued beyond the ore in jasper and mixed slate, and finally stopped at a depth of 409'. The small amount of ore in the interbedded horizon does not warrant the completion of this cross-cut.

#2 Cross-cut was stopped a short distance beyond the P.T. and D.D.H. #31 was put in to the southeast. This hole cut the interbedded ore, the interbedded slate and a considerable run of soft ore jasper, beyond which lay an important run of Standard ore under the jasper capping. Accordingly, the cross-cut was driven along a more easterly course, and encountered the same sequence, with some small variations. On its completion, Hole #40 was put in an additional 90', encountering two new dikes, with jasper between them and beyond them.

Based on the information from #2 Cross-cut, #3 Cross-cut was put in parallel to the strike of the main fault, as it appears on the 5th Level. The fault, however, turned sharply to the east and was encountered by the cross-cut, which was then turned slightly to the west and stopped in jasper beyond #6 Dike. Hole #29 was then put in to the south a distance of 239', where it was stopped in jasper, beyond a new dike. This hole disclosed a short run of ore, which is apparently a riser in the capping from the main ore body originally discovered below this elevation by Surface Hole #38.

Beyond #3 Cross-cut, the main drift was turned to the north more deeply into the footwall and continued beyond the turn-out for #4 Cross-cut, where Hole #39 was put in to the southeast. This hole disclosed the same complicated series of structures, with an unusually wide run of Standard ore in the interbedded horizon, and a fairly long run of Standard ore north of #5 Dike. South of #5 Dike, additional Standard ore was found north of #6 Dike, with Standard ore beyond #6 Dike, in which the hole was stopped at a depth of 404'. The Cross-cut was then extended sufficiently to permit the starting of development work, after which work was resumed in the main footwall drift. The cross-cut will be completed early in 1948, after other more urgent work has been done.

MATHER MINE "A" SHAFT EXPLORATION  
YEAR 1947

<u>NO.</u>	<u>LOCATION</u>	<u>DIRECTION</u>	<u>DIP</u>	<u>DATE</u>		<u>MATERIAL</u>	<u>FINISHED DEPTH</u>
				<u>STARTED</u>	<u>FINISHED</u>		
28	5th Level (2050') #5 Cross-cut	S. 0° 14' W	+0° 30'	11/29/46	1/16/47	355' - 405' Standard Ore 405' - 445' Dike and Ore 445' - 453' Lean Ore 453' - 462' Soft Ore Jasper	462'
29	6th Level (2200') #3 Cross-cut	S. 0° 18' W	+3°	1/29/47	2/13/47	0' - 56' Jasper 56' - 77' Standard Ore 77' - 147' Soft Ore Jasper 147' - 149' Dike 149' - 239' Soft Ore Jasper	239'
30	5th Level (2050') #6 Cross-cut	S. 0° 40' W	+2°	2/4/47	4/24/47	0' - 17' Ferruginous Slate 17' - 64' Standard Ore 64' - 160' Ferruginous Slate 160' - 246' Slate and Jasper 246' - 247' Dike 247' - 257' Soft Ore Jasper 257' - 277' Lean Ore 277' - 303' Dike #4 303' - 326' Standard Ore 326' - 582' Soft Ore Jasper	582'
31	6th Level (2200') #2 Cross-cut	S. 18° 53' E	+2½° Continued	2/17/47 4/22/47	2/17/47 6/9/47	0' - 220' Slate and Graywacke 220' - 249' Standard Ore 249' - 337' Slate and Jasper 337' - 449' Standard Ore 449' - 465' Soft Ore Jasper 465' - 490' Standard Ore 490' - 514' Soft Ore Jasper	514'

MATHER MINE "A" SHAFT EXPLORATION  
YEAR 1947

<u>NO.</u>	<u>LOCATION</u>	<u>DIRECTION</u>	<u>DIP</u>	<u>DATE</u>		<u>MATERIAL</u>	<u>FINISHED DEPTH</u>
				<u>STARTED</u>	<u>FINISHED</u>		
32	5th Level (2050') #5 Cross-cut	S.0°22'E	+36°	4/29/47	6/9/47	0' - 30' Slate & Graywacke	353'
						30' - 53' Standard Ore	
						53' - 147' Slate and Jasper	
						147' - 164' High Sulphur Ore	
						164' - 170' Jasper	
						170' - 182' Dike #5	
						182' - 191' Lean Ore and Jasper	
						191' - 203' Soft Ore Jasper	
						203' - 211' High Sulphur Ore	
						211' - 238' Soft Ore Jasper	
						238' - 251' High Sulphur Ore	
251' - 297' Soft Ore Jasper							
297' - 331' High Sulphur Ore							
331' - 353' Soft Ore Jasper							
<hr/>							
33	6th Level (2200') #1 Cross-cut	S.19°43'E	+3°15'	6/12/47	8/5/47	0' - 395' Slate	692'
						395' - 426' High Sulphur Ore	
						426' - 580' Slate and Jasper	
						580' - 692' Lean Ore and Jasper	
<hr/>							
34	5th Level (2050') #6 Cross-cut	S.0°03'E	+40°21'	6/13/47	7/25/47	0' - 21' Slate and Jasper	379'
						21' - 37' High Sulphur Ore	
						37' - 161' Slate and Jasper	
						161' - 165' Dike and Jasper	
						165' - 191' Soft Ore Jasper	
						191' - 196' Lean High Sulphur Ore	
						196' - 206' Dike #5	
						206' - 272' High Sulphur Ore	
						272' - 356' Soft Ore Jasper	
						356' - 376' Dike #4	
376' - 379' Soft Ore Jasper							



MATHER MINE "A" SHAFT EXPLORATION  
YEAR 1947

<u>NO.</u>	<u>LOCATION</u>	<u>DIRECTION</u>	<u>DIP</u>	<u>DATE</u>		<u>MATERIAL</u>	<u>FINISHED DEPTH</u>
				<u>STARTED</u>	<u>FINISHED</u>		
35	5th Level (2050') #8 Cross-cut	S. 0°08'E	+2°29'	7/30/47	9/22/47	0' - 302' Slate and Jasper 302' - 511' Soft Ore Jasper	511'
36	6th Level (2200') #1 Cross-cut	S. 0°11'E	+19°50'	8/8/47	9/22/47	0' - 175' Slate 175' - 179' Dike #5 179' - 273' Slate 273' - 300' Standard Ore 300' - 409' Slate and Jasper	409'
37	3rd Level (1750') #7 Cross-cut	S. 60°12'W	+4°20'	9/26/47	10/6/47	0' - 7' Jasper 7' - 20' Standard Ore 20' - 25' Jasper 25' - 35' Standard Ore 35' - 40' Jasper 40' - 55' Lean Ore 55' - 65' Jasper 65' - 70' Lean High Sulphur Ore 70' - 112' Soft Ore Jasper	112'
38	5th Level (2050') #7 Cross-cut	S. 0°13'W	+2°	9/25/47	10/29/47	0' - 121' Slate, Jasper and Lean Ore 121' - 122' Dike 122' - 127' Standard Ore 127' - 250' Slaty Jasper 250' - 409' Soft Ore Jasper	409'
39	6th Level (2200') #4 Cross-cut	S. 24°29'E	+2°32'	9/27/47	10/29/47	0' - 20' Slate 20' - 24' Dike 24' - 59' Slate 59' - 70' Slate and Ore 70' - 130' Standard Ore 130' - 182' Slate 182' - 235' Slaty Lean Ore 235' - 314' Standard Ore 314' - 324' Dike 324' - 363' Standard Ore 363' - 368' Dike 368' - 404' Standard Ore	404'

MATHER MINE "A" SHAFT EXPLORATION  
YEAR 1947

<u>NO.</u>	<u>LOCATION</u>	<u>DIRECTION</u>	<u>DIP</u>	<u>DATE</u>		<u>MATERIAL</u>	<u>FINISHED DEPTH</u>
				<u>STARTED</u>	<u>FINISHED</u>		
40	6th Level (2200') #3 Cross-cut	S.35°22'E	+3°	10/8/47	10/17/47	0' - 8' Soft Ore Jasper 8' - 18' Dike 18' - 48' Soft Ore Jasper 48' - 52' Dike 52' - 90' Soft Ore Jasper	90'
41	-475' Sub-level	S.20°32'E	+2°	10/10/47	11/19/47	0' - 11' Standard Ore 11' - 209' Soft Ore Jasper 209' - 218' Dike #4	218'
42	-325' Sub-level	S.37°33'E	+3°32'	10/25/47	11/5/47	0' - 96' High Sulphur Ore 96' - 109' Dike #4	109'
43	5th Level (2050') #9 Cross-cut	S.1°38'E	+2°52'	11/3/47		0' - 219' Slate and Graywacke 129' - 203' Slate 203' - 266' Soft Ore Jasper 266' - 345' Interbedded Slate 345' - 376' Transition Jasper & Slate 376' - 504' Soft Ore Jasper	Not Completed
44	-325' Sub-level	S.0°01'W	+4°19'	11/7/47	11/29/47	0' - 10' Jasper 10' - 80' High Sulphur Ore 80' - 95' Dike #4 95' - 115' Blue Jasper	115'

MATHER MINE "A" SHAFT EXPLORATION  
YEAR 1947

<u>NO.</u>	<u>LOCATION</u>	<u>DIRECTION</u>	<u>DIP</u>	<u>DATE</u>		<u>MATERIAL</u>	<u>FINISHED DEPTH</u>
				<u>STARTED</u>	<u>FINISHED</u>		
45	3rd Level (1750')	S.0°41'W	+3°26'	11/12/47		0' - 254' Slate and Jasper 254' - 260' Dike 260' - 265' Dike, Trans. Slate & Jasper 265' - 286' Transition Slate & Jasper	Not Completed
46	5th Level (2050') #4 Cross-cut	S.1°00'E	+1°27'	11/22/47	12/23/47	0' - 10' Standard Ore 10' - 64' Soft Ore Jasper 64' - 107' Standard Ore 107' - 213' Soft Ore Jasper	213'
47	-435' Sub-level	S.1°03'E	+4°54'	12/6/47	12/23/47	0' - 60' Slate and Jasper 60' - 70' High Sulphur Ore 70' - 85' Jasper 85' - 90' Dike 90' - 105' High Sulphur Ore 105' - 120' Soft Ore Jasper 120' - 131' Dike 131' - 219' Soft Ore Jasper	219'
48	-435' Sub-level	S.33°W	+2°	12/29/47		0' - 20' Jasper and Slate 20' - 60' Soft Ore Jasper	Not Completed

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

9. EXPLORATIONS  
AND  
FUTURE  
EXPLORATIONS:  
(Continued)

The following statement shows the cost of drilling 6,525' during 1947, all of which was taken on the cost sheet under "Exploring in Mine". In spite of general increases in labor and supply costs, the average cost per foot did not increase materially. This was due in part to the fact that most of the holes were relatively shallow, as compared with one unusually deep hole the previous year.

	<u>1947</u> <u>Expenditures</u>	<u>Cost</u> <u>Per Foot</u>	<u>Cost Per</u> <u>Foot 1946</u>
<u>Equipment:</u>	-	-	-
<u>Drilling Costs:</u>			
Labor.....	\$11,453.86	\$1.756	\$2.220
Miscellaneous Supplies & Diamond Drill Carbon....	10,254.66	1.571	1.030
Diamond Drill Rental....	707.50	.108	-
Total.....	<u>\$22,416.02</u>	<u>\$3.435</u>	<u>\$3.250</u>
<u>Overhead Expense:</u>			
Analysis.....	\$ 703.09	.108	.124
Geological.....	1,072.09	.164	.186
D.D. Supt.....	685.98	.105	.192
Social Security.....	-	-	.033
Auto Mileage.....	21.50	.003	-
Total.....	<u>\$ 2,482.66</u>	<u>\$ .380</u>	<u>\$ .535</u>
 Grand Total.....	 \$24,898.68	 \$3.815	 \$3.785

The above amount was taken up on the cost sheet at the rate of \$.034 per ton. In addition, there was an expenditure of \$2,799.71 for equipment under E&A NM-21 for an underground "Longyear Gopher" core diamond drill.



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

10. TAXES:

The taxes for both Section 2 (Mather Mine "A" Shaft) and Section 1 (Mather Mine "B" Shaft) were taken up on the "A" Shaft cost sheet. The valuation of Section 2 was increased sharply in the amount of \$640,000.00, or 32%, and was offset slightly by a small reduction in the tax rate. The valuation of Section 1 was increased 10%, from \$500,000.00 to \$550,000.00, and the rate increased slightly. As usual, the rate in Negaunee is much higher than in Ishpeming.

	<u>1947</u>			<u>1946</u>		
	<u>VALUATION</u>	<u>RATE</u>	<u>TAXES</u>	<u>VALUATION</u>	<u>RATE</u>	<u>TAXES</u>
Section 2, 47-27, except the N 600' of NE of NE and the Rights of Way						
Real	\$1,875,000		\$ 67,137.56	\$1,615,000		\$57,999.50
Personal	765,000		27,392.13	385,000		13,826.51
Total	<u>\$2,640,000</u>	<u>\$35.8067</u>	<u>\$ 94,529.69</u>	<u>\$2,000,000</u>	<u>\$35.9130</u>	<u>\$71,826.01</u>
Coll. Fee	-	-	-	-	-	-
Total	<u>\$2,640,000</u>	<u>\$35.8067</u>	<u>\$ 94,529.69</u>	<u>\$2,000,000</u>	<u>\$35.9130</u>	<u>\$71,826.01</u>
Mather Mine Pipe Line, parcel in Section 3, 47-27	\$ 250	<u>\$35.8067</u>	\$ 8.95	\$ 350	<u>\$35.9130</u>	\$ 12.57
Total Mather Mine "A" Shaft (Sec. 2, City of Ishpeming)	<u>\$2,640,250</u>	<u>\$35.8067</u>	<u>\$ 94,538.64</u>	<u>\$2,000,350</u>	<u>\$35.9130</u>	<u>\$71,838.58</u>
Jackson, Section 1, 47-27	\$ 550,000	<u>\$44.2664</u>	\$ 24,346.52	\$ 500,000	<u>\$44.1433</u>	\$22,071.65
Coll.Fee 1%	"	<u>.4427</u>	243.46	"	<u>.4414</u>	220.72
Total Mather Mine "B" Shaft (Sec. 1, City of Negaunee)	<u>\$ 550,000</u>	<u>\$44.7091</u>	<u>\$ 24,589.98</u>	<u>\$ 500,000</u>	<u>\$44.5847</u>	<u>\$22,292.37</u>
GRAND TOTAL	<u>\$3,190,250</u>		<u>\$119,128.62</u>	<u>\$2,500,350</u>		<u>\$94,130.95</u>

	<u>1947</u>		<u>1946</u>	
	<u>Tons</u>	<u>Per Ton</u>	<u>Tons</u>	<u>Per Ton</u>
Taxes per Ton Produced	729,669	\$0.163	339,433	\$0.199
Taxes per Ton Shipped	710,275	\$0.168	317,351	\$0.213

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

11. ACCIDENTS  
AND  
PERSONAL  
INJURY:

There were 26 compensible injuries during the year, which occasioned lost time of 1,065 days, and one fatality which added 6,000 statistical days, for a total of 7,065. There were also 39 non-compensible injuries, which added 94 days lost time, for a grand total of 7,159. This resulted in a frequency rate of 68.14 injuries per million man hours, and a severity rate of 7.392 days lost per thousand man hours, compared with Company averages for underground mines of 58.74 and 8.918. The total hours worked were 968,519 as compared with 521,338 last year, an increase of approximately 85%. The following is a brief summary of the compensible accidents:

<u>DATE</u>	<u>NAME</u>	<u>NATURE OF INJURY</u>
1/19/47	Robert E. Nelson	Laceration of chin.
1/20/47	Alfred H. Hyde	Contusion of right forearm with fracture of tip of right radius.
1/21/47	Rudolph R. Saari	Severe laceration of ring finger of left hand.
1/24/47	Clyde Prin	Sprain of left knee.
2/19/47	Roy A. Wendt	Fatally injured.
2/19/47	George E. Ferguson	Fracture of pelvis and injury to spine.
2/19/47	Adolph S. Seppi	Sprain of right shoulder and contusion of right thigh.
2/17/47	Carl Swahn	Minor bruises of 4th, 5th, and 6th ribs left side.
5/31/47	Leo W. Antilla	Dislocation left shoulder.
6/22/47	Albert Corkin	Dislocated shoulder.
6/20/47	Elmer Reikki	Foreign body left eye.
6/30/47	Edwin Tuoriniemi	Minor contusions.
7/1/47	Bruno Nardi	Minor contusions.
7/3/47	John Montcalm	Severe and extensive lacerations right hand.
7/11/47	Ralph Fernea	Minor lacerations between toes right foot.
8/19/47	Lawrence Gaboury	Minor muscle contusion in vicinity of right shoulder.
9/6/47	Glenn Pohlman	Contusions of right ankle.
9/16/47	Uno Kangas	Contusions and abrasions of back and fracture of 2nd and 3rd (lumbar) transverse processes left side.
9/24/47	Edward J. LaForge	Crushed thumb.
9/26/47	Lawrence Anderson	Fracture of lower end of left tibia without displacement.
9/28/47	George Emanuelson	Incomplete fracture of middle of left radius.
8/8/47	Waino Bjerne	Minor contusion of lower chest in lumbar region.
10/4/47	Oscar Jarvela	Minor contusions of left foot.
10/9/47	Paul Collick	Contusion of right shoulder and simple fracture of right clavicle.
10/28/47	Leroy Hill	Contusions and strain of ligament of right knee.
11/12/47	Eugene Kemp	Laceration of 2nd and 3rd fingers and fracture of 2nd finger
12/8/47	William J. Jandreau	Bruise left thigh and leg.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

12. NEW CONSTRUCTION  
AND PROPOSED  
NEW CONSTRUCTION:

The major items of new construction were:

- (1) A 375' extension to the north trestle and a 250' extension to the south trestle, both of which were practically completed by the end of the year.
- (2) The completion of the east timber tunnel drift and small amounts of new work in both timber yards.
- (3) The erection of a permanent steel building adjacent to the west side of the headframe for the housing of the new shaft heating equipment.
- (4) The sinking of the new ventilation shaft which was discussed previously.

The only new construction contemplated at present is the completion of the two timber yards under existing authorizations.

13. EQUIPMENT AND  
PROPOSED  
EQUIPMENT:

A large amount of new equipment was purchased during the year for both surface and underground use. The major items on surface were:

- (1) The purchase and installation of two war surplus Ingersoll-Rand compressors of 2700 C.F.M. capacity each. These machines are practically the same age as the two originally purchased for the mine, and with a nominal amount of cleaning and repairing will be as good as new. The installation of the foundations for this equipment was completed and the machines were almost ready for use by the end of the year.
- (2) The addition of a second boiler to the main heating plant, and the necessary piping and installation of the shaft heating equipment. By the end of the year, all of this equipment was on the job and installation was proceeding satisfactorily.
- (3) A new pinion brake for the man hoist, which was installed and ready for use by the end of the year.
- (4) A hot mill for the treatment of detachable bits.
- (5) A 15-B Bucyrus-Erie crawler crane.
- (6) A 5-ton Four Wheel Drive truck.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

13. EQUIPMENT AND  
PROPOSED  
EQUIPMENT:  
(Continued)

The major items for underground use were:

- (1) An Eimco Model 21 "Rocker" shovel.
- (2) Twenty-four 100 cu. ft. underground cars.
- (3) Two 6-ton General Electric battery locomotives with extra batteries.
- (4) One 100,000 C.F.M. main ventilating fan.
- (5) Two Worthington 500 G.P.M. horizontal Duplex double-acting pumps, and three suction feed pumps.
- (6) One Longyear Gopher diamond core drill.

In addition to the above, there was a large amount of miscellaneous mining equipment, including double and single drum hoists of various capacities, both air driven and electric, and miscellaneous drill machines, etc. The medium size double drum electric scraper hoist with the Westinghouse 25 H.P. high slip, high torque, punch press type motor is now the standard equipment for most mining operations. The next larger frame hoist with a 40 H.P. motor is standard for skip loading at the shaft and large semi-permanent transfer scraping jobs.

Proposed new equipment includes additional locomotives, cars, and mining equipment as needed, and a top tram larry car of a new design which will ultimately replace the present cars which are now seven years old. A Model 40 Hydro-electric Eimco shovel is also on order for delivery early in the year.



MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

14. MAINTENANCE  
AND REPAIRS:

One major job, which was charged to "Maintenance of Docks, Trestles and Pockets", was completed early in the year. This was the changing of the south railroad pockets to a new design which was discussed in last year's report. The change was very successful.

The other two major maintenance jobs were on the top tram larry cars and the three Conway underground loaders. Continual trouble was experienced with the larry cars as soon as severe cold weather set in. Drive motor burn-outs were frequent and, in general, the cars were very difficult to maintain in proper operating condition. For the second consecutive year, the situation became so bad that it was necessary to tram the ore to the stockpiles by means of the Euclid dump trucks from the Tilden Mine. A much simpler car is being designed and it is hoped that the first of several units will be ready for use by the end of the year.

The Conway underground loaders, two of which are now five years old, are in badly worn condition and required constant and extensive maintenance work throughout the year, during which time two of the three units were completely overhauled. This situation is not surprising in view of the fact that the machines have operated 24 hours per day, six days per week throughout most of their lives. A new shovel was ordered from the Rimco Corporation for delivery early in 1948. If this machine proves as efficient and less costly to maintain, it is planned to purchase additional units in the future.

MATHER MINE "A" SHAFT  
ANNUAL REPORT  
YEAR 1947

15. POWER:

	<u>CONSUMPTION</u> <u>K.W. HOURS</u>	<u>AVERAGE</u> <u>MAX. DEMAND</u>	<u>AVERAGE</u> <u>DEM.FACTOR</u>	<u>COST OF</u> <u>CURRENT</u>	<u>AVERAGE PRICE</u> <u>PER K.W. HOUR.</u>
1947 -	10,059,000	2,160 K.W.	53%	\$140,078.60	\$0.0139
1946 -	5,570,000	1,530 K.W.	48%	80,677.20	.0144
1945 -	4,720,000	1,245 K.W.	43%	69,566.20	.0148
1944 -	3,893,000	965 K.W.	46%	56,121.80	.0144
1943 -	2,785,000	600 K.W.	48%	39,725.80	.0142
1942 -	1,510,830	325 K.W.	47%	23,448.14	.0155

In line with the increasing operation, there was another sharp increase in both the total consumption and the average maximum demand. The increase in consumption being greater than the increase in maximum demand, there was a substantial decrease effected in the average cost per kilowatt hour, from \$.0144 to \$.0139.

16. WATER SUPPLY:

	<u>CONSUMPTION</u>	<u>COST</u>	<u>COST PER</u> <u>THOUSAND GAL.</u>
1947 -	17,241,600	\$1,436.52	\$.083
1946 -	10,620,100	928.41	.086
1945 -	7,628,800	710.71	.093
1944 -	5,205,200	481.82	.092
1943 -	4,868,000	446.64	.092
1942 -	2,487,000	231.36	.093

As was to be expected, there was a substantial increase in the consumption of water purchased from the City of Ishpeming. Another substantial increase is expected next year, since it will be possible to pipe drinking water underground as soon as the arrangements have been completed for pre-heating the ventilating air.

18. NATIONALITY OF EMPLOYEES:

	<u>American</u> <u>Born</u>	<u>Per</u> <u>Cent</u>	<u>Foreign</u> <u>Born</u>	<u>Per</u> <u>Cent</u>	<u>Total</u>	<u>Per</u> <u>Cent</u>
American	23	4.4%	-	-	23	4.4%
English	66	12.8	11	2.1	77	14.9
Finnish	185	35.7	17	3.3	202	39.0
Canadian	22	4.2	1	.2	23	4.4
Swedish	51	9.8	3	.6	54	10.4
Norwegian	16	3.1	-	-	16	3.1
German	7	1.3	-	-	7	1.3
Irish	6	1.2	-	-	6	1.2
Danish	1	.2	-	-	1	.2
Italian	44	8.5	11	2.1	55	10.6
French	38	7.3	-	-	38	7.3
Manx	1	.2	-	-	1	.2
Dutch	2	.4	-	-	2	.4
Austrian	6	1.2	2	.4	8	1.6
Polish	3	.6	-	-	3	.6
Belgian	2	.4	-	-	2	.4
	<u>473</u>	<u>91.3%</u>	<u>45</u>	<u>8.7%</u>	<u>518</u>	<u>100.0%</u>

MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

1. GENERAL

Production and shipments, after being limited in 1945 by the manpower shortage and in 1946 by a  $3\frac{1}{2}$  month wage strike, returned to more nearly normal figures. The change to the single Morris grade, established late in 1946, aided production and scaled royalty payments were on the basis of nearly 50.40% natural iron content for the 1947 output.

Inland Steel Company on May 9th was the first iron ore operator to sign a contract with the CIO Steelworkers Union covering a wage increase of  $12\frac{1}{2}\phi$  per hour, and other marginal adjustments on vacations, severance allowance and contract mining supply costs. The new contract extends for two years, but may be reopened after a year on wages by the company or the union. Signing of the contract averted a walkout of employees, and labor difficulties were minimized thereafter. The working force at the mine showed little change during the year with an average of about 155 employees.

Underground mining conditions improved with continued emphasis on use of the lower cost sub level stoping and caving systems of mining. Encouraging extensions and new finds of ore occurred mainly on the lease lands, with the result that ore reserves held close to last year's peak.

The steel headframe was repaired during the vacation period in August, with improvements added to the skip dump, pockets, and larry car barn. Surface water control continued by means of deep well pumping, but with a lower average rate than for some years past. Underground water increased due to extended mining areas tapping new water channels particularly on the 9th Level, and a diversion ditch for the Carp River was partially dug to prepare for the time that subsidence may be expected from stoping operations on the fee lands at the east end of this level.

Mr. R. D. Satterley continued as General Superintendent of Inland's iron ore mining operations, and at the end of the year Mr. E. W. Whitman was promoted from Assistant Superintendent to Superintendent of the Morris Mine.

2. PRODUCTION  
SHIPMENTS &  
INVENTORIES

a. Production

<u>Grade</u>	<u>Tons</u>
Morris	267,236
Total last year	238,855

The 1947 production came from fee and leased lands in the following proportions:

MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

2. PRODUCTION  
SHIPMENTS &  
INVENTORIES (Cont.)

<u>Grade</u>	<u>Fee</u>	<u>Lease</u>	<u>Total</u>
Morris	77,951	189,285	267,236
Percentage	29.2	70.8	100.0

The percentage figures compare with 19.2 and 80.8 respectively last year. The maximum proportion of ore from the fee lands was 48.1% in 1936, and the minimum 11.4% in 1941. A summary of fee and lease total production since the Inland Steel Company acquired the Morris Mine lease starting with 1933, or over a fifteen year period, is listed below:

	<u>Tons</u>	<u>Percent</u>
Lease ore product 1933-1947	3,290,949	75.3%
Fee ore " " "	1,082,191	24.7%
Total " "	4,373,140	100.0%

b. Shipments

Shipment of ore from the Morris Mine reached a high of 442,199 tons in 1943. This was followed by decreases in each of the next three years, but with the trend starting upward again in 1947 when 278,916 tons were forwarded compared to 182,007 in 1946. The 1947 total was divided as follows:

<u>Grade</u>	<u>Pocket</u>	<u>Stockpile</u>	<u>Total</u>
Morris	171,849	107,067	278,916

  

<u>Grade</u>	<u>Fee</u>	<u>Lease</u>	<u>Total</u>
Morris	77,367	201,549	278,916

A table showing shipments from the mine in each of the past five years follows:

<u>Year</u>	<u>Grade</u>		<u>Total Tons</u>
1947	Morris		278,916
	<u>Standard</u>	<u>Silicious</u>	
1946	142,157	39,850	182,007
1945	175,688	69,480	245,168
1944	236,764	83,169	319,933
1943	316,805	125,394	442,199

The summary of shipments since Inland acquired the lease shows a total of 4,347,588 tons of ore.



MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

PRODUCTION  
SHIPMENTS &  
INVENTORIES

c. Ore in Stock

The stockpile balance of the Morris grade was below last year's total of 37,236 tons on December 31st:

<u>Grade</u>	<u>Tons</u>
Morris	25,560

d. Production by Months

	<u>Days Worked</u>	<u>Average Number Men</u>	<u>Morris Grade Tons</u>	<u>Tons per man per day</u>
January	24	153	20,960	5.93
February	22	153	19,972	6.22
March	23½	156	23,140	6.48
April	24	158	23,336	5.90
May	21½	157	20,649	5.81
June	23	158	21,601	6.39
July	24	159	21,908	6.75
August	12	164	10,560	3.86
September	23	159	21,568	6.35
October	25	156	27,686	7.56
November	21½	154	25,612	8.50
December	23	156	23,380	6.51
<hr/>				
Total	266½	157	260,372	
Stockpile overrun			6,864	
Total 1947			267,236	6.38

Productive efficiency reached a low in 1945 when sub level stoping was at a minimum. The increase in use of this system of mining raised the average tons per man per day from 4.80 in 1945 to 5.72 in 1946 and then to the figure shown above for 1947.

The working schedule of 2 shifts 5½ days per week, which was placed in effect September 1st, 1945, continued through 1947, and the mine operated a total of 266½ days.

f. Delays

Employees in past years have been given their vacations on a staggered basis over an extended period to minimize production loss. This year, however, a 2 week vacation period with consequent production loss was necessary to repair shaft timber adjacent to the 4th Level, and to replace some of the main structural members of the headframe.

MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

2. PRODUCTION  
SHIPMENTS &  
INVENTORIES (Cont.)

f. Delays (Cont.)

This work was done in August and in the shaft consisted of renewal of timber in a 60' section where the 4th Level pocket, long unused, had settled and thrown a strain on the west side of the shaft timber. The pocket timbers were removed and the rotted shaft timber replaced with new fir which was jacked into alignment with the sections above and below. The bearing set at the bottom of the pocket fortunately was in good shape and served as the base on which to support the new timber.

Structural members of the headframe which had been weakened by corrosion were replaced, mainly in the section under the landing floor where the use of salt in the winter months had hastened the process. Each skip dump chute was rebuilt to provide a pocket to hold one skip load, but after several months trial, their use was discontinued for ore because, in company with other installations on the Marquette Range, of the tendency to pack even though the ore is held for only a few minutes. The pockets thus reverted to oversize chutes through which the skips dumped directly into the waiting larry cars.

3. ANALYSIS

Shipments

The analysis of ore sampled and analyzed by Inland Steel Company in 1947 was as follows:

<u>Grade</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Moist.</u>
Morris, Dry	278,916	56.872	.087	10.94	.58	3.03	11.54
" Natl.	"	50.309	.077	9.68	.51	2.68	11.54

Ore in Stock (Natural Analysis)

<u>Grade</u>	<u>Tons</u>	<u>Iron Natl.</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Sul.</u>	<u>Moist</u>
Morris	25,560	49.36	0.088	10.68	0.39	-	-	11.50

Ore Reserves-Expected Natural Analysis

Morris	3,852,609	50.50	.079	10.00	0.43	2.80	.013	11.70
" Hi-Su.	249,756	52.17	.095	7.25	0.40	2.27	.400	10.50

MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

3. ANALYSIS (Cont.)

The only change worthy of comment is a reduction of the expected silica content of the ore reserve from 11.03 in 1946 to 10.00 in 1947. It may be remembered that last year in this report the notation was made that the ore in place ran about 8% silica, and that if the above dilution took place the minable reserve should be increased about 25% over and above the estimated reserve.

4. ESTIMATE OF  
ORE RESERVES

Development in 1947 added 244,751 tons to the engineer's estimate after allowance for ore mined during the year. An additional 377,676 tons was proved on Chase Lease #9, but this was partly offset by a reduction of 132,925 tons in 84A ore body on the Fee Lands above the east end of the 9th Level, where development on the -290' sub disclosed a narrower width than had been anticipated. Westward development in 84C ore body, however, may in the near future be expected to replace a part or all of this loss in the Fee Land reserve picture.

Shortly after December 31st, indications were well nigh confirmed that Nos. 86 and 33 ore bodies were one and the same 300' width of ore along the position of the future third crosscut on the 9th Level. This exploratory development by No. 12 contract was thus only partly taken into account in the estimate of ore reserves summarized in the table below, and which shows by leases the changes that occurred in 1947:

Description	Estimate 12-31-46	1947 Production	Estimate Deducting Product	Actual Estimate 12-31-47	Inc. or Dec. over 1946 Est.
Chase Lease #26	26,140	-	26,140	26,140	-
Chase Lease #25	33,273	-	33,273	33,273	-
Chase Lease #24	243,456	58,934	184,522	229,176	44,654
Chase Lease #24, Hi-Sul.	144,608	9,483	135,125	210,235	75,110
Chase Lease #9	2,105,266	120,830	1,984,436	2,242,348	257,912
Total Chase Leases	2,552,743	189,247	2,363,496	2,741,172	377,676
C.C.I.Co. Lands	1,532,586	77,989	1,454,597	1,321,672	132,925
C.C.I.Co.Lands, Hi-Sul.	39,521	-	39,521	39,521	-
Total C.C.I.Co.Lands	1,572,107	77,989	1,494,118	1,361,193	132,925
GRAND TOTAL	4,124,850	267,236	3,857,614	4,102,365	244,751

MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

5. LABOR AND  
WAGES

The new contract signed with the CIO Steelworkers Union May 9th provided for a 12½¢ wage increase which brought the hourly minimum to \$1.09, and again followed the pattern established by earlier negotiations between the U.S. Steel Corporation and the Union. The contract was signed just prior to midnight of the last day of the former contract extension, and was the first one concluded in the Lake Superior iron ore field.

The working force at the mine showed little change during 1947, although in January the method of reporting employees was changed to exclude all salaried personnel such as engineers, office force, captain and shift bosses. Exclusion of the last three classifications places the Morris Mine on a different basis than other mines in the district in a comparison of tons per man, with of course the advantage to the Morris, because of the fewer men charged.

6. SURFACE

The repairs and improvements to the headframe were described under the delay to production section of this report.

Excavation of the surface drainage ditch, which may be used in the future to divert the mine water and the Carp River northeasterly to Gold Mine Creek, was started under contract with Lindberg Brothers in the spring, and at the end of the year about 50,000 of a total of 55,000 cu.yds. of excavation had been completed. Included in the contract is a 14 acre settling basin entirely on leased land to reduce the velocity of flow with the intention of settling out the mine mud and coloring before the Morris discharge water joins with the flow of Gold Mine Creek into the Deer Lake storage basin. Also near the Morris Mine shaft in the stream bed of the Carp River, a dam has been constructed which will permit controlling and splitting of the flow of the River during coming years prior to any new cave reaching surface. The present intention is to divert a portion of the Carp flow from northwest of the shaft to the new diversion ditch to mix with the mine water discharge and to permit the remaining flow to continue over mining territory and maintain approximately the old stream flow in the regular channel with the help of the discharge from the deep wells, which for some years past has been laundered to the Carp River at a point south of any possible future surface cave limits.

Surface Pumping

Water pumped from the surface sand and gravel above ledge in order to reduce the water table over the ore bodies averaged 2,605 gpm in 1945, 2,015 in 1946 and 1,622 gpm in 1947. A seven months shutdown of the 500 gpm No. 10 well to study the effectiveness of the former pumping rate was mainly responsible for the decreased quantity in 1947. This study was made in



MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

6. SURFACE (Cont.)

consultation with the U. S. Geological Survey ground water experts and showed that indirectly, through the effect on other wells nearer the caves, that pumping should be continued from No. 10. Accordingly the well was being readied for operation scheduled to resume early in 1948. The following comparison shows the rates in effect at the several wells at the beginning and end of 1947:

<u>Well Number</u>	<u>GPM January</u>	<u>GPM December</u>
1	260	260
2	Motor burnout	42
3	110	80
3A	290	270
5	177	134
8	425	425
9	145	121
10	<u>515</u>	<u>Test</u>
Average Total	1922	1332

The reduced pumping in 1947 had the effect of reversing the downward trend in the average water level on ledge, and the effect of the No. 10 well curtailment is clearly shown in the following recapitulation:

<u>Month</u>	<u>GPM Surface Pumping</u>	<u>Drop in Test Holes Feet</u>
January	1922	0.6
February	1877	0.4
March	1887	0.2
April	1940	0.0
May	1677	0.3
June	1487	0.8
July	1504	0.9
August	1418	0.9
September	1408	0.9
October	1524	0.3
November	1487	0.3
December	<u>1332</u>	<u>0.0</u>
Average	1622	0.3
Total		3.2
Average 1946	2015.0	0.2
Total 1946		1.8

MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

6. SURFACE (Cont.)

The average drop in water level on December 24, 1946 amounted to 34.7' due to the deep well pumping, and as measured in the test holes. This was reduced to 31.9' on December 26, 1947 as shown in the following table:

<u>Test Hole</u>	<u>Drop 8-25-37 to 12-26-47</u>	<u>Depth Remaining to Ledge</u>
501	65.8	27.3
503	76.7	123.1
504	70.7	78.4
505	53.5	76.7
506	54.2	33.1
507	(123.3)	
508	60.4	72.7
509	70.5	116.2
510	29.9	93.4
511	30.4	124.0
512	40.2	121.5
514	29.9	96.3
515	16.0	112.6
516	34.6	9.0
517	19.9	92.2
518	17.6	90.8
519	48.4	109.1
520	(42.5)	
521	(28.5)	
522	20.1	74.1
523	(36.5)	
524	69.4	30.3
526	10.0	104.0
527	10.4	64.6
528	0.3	99.8
531	4.7	71.8
532	2.8	81.2
533	3.7	128.3
534	1.6	95.5
Peronto Well	(9.4)	
Total	<u>797.7</u>	<u>2126.0</u>
Avg. drop to Dec. 26, 1947	31.9	

MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

6. SURFACE (Cont.)

Two motor burnouts in 1947 offset the reduced pumping power charges and with the higher labor cost the total expense increased from \$13,960.00 in 1946 to \$16,612 in 1947. The comparison is as follows:

	<u>1946</u>	<u>1947</u>
Average surface well pumping rate, gpm.	2015	1622
Operating Expenditure	\$ 13,960	\$ 16,612
Cost per ton of ore produced	\$ .075	\$ .062

7. UNDERGROUND

A. Pumping

The initial Morris surface cave occurred in March 1939, and the following year the water entering the mine reached a high of 1157 gpm. Since 1940 the average has varied from a low of 844 gpm. and high of 931, so 1947 was an exception with a rate of 969.4 gpm pumped from the underground workings.

Extension of the underground workings and presumably therefore, cracks or water channels from the surface caves, has resulted in an increased quantity each of the past three years. This is shown in the following table which shows the pumping rates by levels for the past five years:

<u>Averages</u> <u>Year</u>	<u>Levels</u>					
	<u>4th</u>	<u>6th</u>	<u>7th</u>	<u>8th</u>	<u>9th</u>	<u>Total</u>
1942	78.2	40.4	277.4	268.8	179.3	844.1
1943	128.5	43.6	237.3	298.3	223.5	931.2
1944	149.2	46.5	180.1	267.0	252.4	895.2
1945	158.4	42.8	146.1	244.0	266.2	857.9
1946	147.3	44.1	153.4	254.9	278.8	888.4
1947	149.9	34.7	144.7	287.3	352.8	969.4

The increased quantity of water pumped, the higher labor cost and greater sump cleaning expense combined to raise the underground pumping expense from \$46,143 in 1946 to \$65,862 in 1947. A comparison of all pumping costs for the last five years is shown in the following table:

<u>Year</u>	<u>Surface Pumping</u> <u>Optg. Expense</u>	<u>Underground</u> <u>Optg. Expense</u>	<u>Total Pumping</u> <u>Optg. Expense</u>	<u>Cost per ton</u> <u>ore produced</u>
1947	\$ 116,612	\$ 65,862	\$ 82,474	\$ .308
1946	13,960	46,143	60,103	.324
1945	22,105	61,036	83,141	.349
1944	41,859	59,219	101,078	.327
1943	20,134	58,521	78,655	.180

MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

b. Development

Underground development in 1947 was carried forward by an average of four contracts and centered mainly in two areas above the 9th Level. The first of these was on the Fee Lands, at the east end of the property, and the second in the central portion of Lease #9. Development in general added to the program that was begun in 1945 by drifting on the 9th Level, and brought into production three new stopes as well as continuing the outlining of the ore bodies and furnishing a new timber supply raise from the 8th Level to the -220' or intermediate sub above the 9th Level. Practically all of the work continued in ore and lean ore formation so that for the fourth successive year no rock was hoisted from the Morris Mine.

The most interesting development in the year 1947 was the upward and lateral extension of both 84A and 84C ore bodies at the east end of the 9th Level. No. 30 contract developed #84C ore body to a height of six subs above the 9th Level, and by means of an easterly inclined stoping raise, advanced this development across the Morris Lloyd boundary line into the Lloyd property a distance of approximately 100'. Development in this area included the extension of the main level drift an additional 22' to the east to provide room for tram cars and the drifting and raising on sub levels, five in number, above the transfer drift. This development confirmed the belief this higher than average phosphorus content ore body continued easterly and up the dip between the north slate footwall and the fault dike on the south. Because of the phosphorus content, and the necessity for proper mixing for inclusion in the general mine ore grade, mining operations when started late in the year were limited to one shift. Although a small stope 60' in diameter had been opened here in December, the east limit of the ore had not been defined, and a conference was held with Inland officials so development may be continued in this direction with the aim of ultimately providing for complete extraction of the ore in this deposit on the Lloyd Mine side of the boundary line.

Development in #84A deposit above the south side of the easterly portion of the 9th Level drift continued intermittently in 1947 by Nos. 1 and 6 contracts. The proved length of this deposit was extended a considerable distance to the west, although narrower than first supposed, by No. 1 contract, while No. 6 alternately developed and mined by the sub level stoping method near the east end of the deposit. The transfer drift driven 400' east of #904 raise in ore on the -290' sub by No. 1 contract was planned to introduce the shaker conveyor system of transportation from stope to tram cars and the conveyor was tried out late in the summer. Because of difficulties occasioned by packing and stratification of fines in the conveyor, the system had to be discontinued and reverted to the use of scrapers



MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

B. Development (Cont.)

for ore transfer in the fall. Accordingly in October a new transfer drift was driven from 84B to 84A deposits in a southerly direction from the main 9th Level on the -290' sub in order to shorten the scraping distance as the stope above advances to the west.

The second major development section on Chase Lease #9 comprised three separate areas. The first of these was in the central portion of #33 deposit on the -220' intermediate sub level between the 8th and 9th Levels, where No. 10' contract, by means of a timbered drift, connected the new raises advanced above the 9th Level to the mining territory above. This work necessitated a change in ore outlines at this elevation and moved the supposed ore-footwall contact an additional distance of approximately 100' to the east, thereby adding considerably to the reserve estimate in 1947. This change shows that the ore body instead of following the normal westward pitch, on the east side at least has descended nearly vertically from the 8th Level ore limit. No. 17 contract also aided in the preparation for mining in this central area above the 9th Level by extending a long drift in ore in a northeasterly direction on the -220' sub into the slate footwall. From the north end of this drift a timber supply raise was advanced on a  $+35^{\circ}$  incline as a permanent connection in the slate footwall to the 8th Level. The connection was made at the 8th Level elevation by extending a turn-out north of the main drift to intersect the raise at a point approximately 40' north of the contact. Following completion of the timber supply raise, No. 12 contract then began development of the top timber supply drift on the line of the proposed 9th Level third crosscut in order to secure the information on the position of the footwall-ore contact prior to the driving of a crosscut. Late in the year this drift intersected the contact at a point approximately 175' north of that shown on the maps for estimate purposes, and this in turn also added to the estimate of ore reserves at the end of the year. Farther west and above the 9th Level, No. 10 contract started development in the higher than average sulphur #79 deposit, preparatory to absorbing this ore in the regular mine product as conditions permitted. The long transfer drift was driven due west from #940 raise from the -240' sub and stoping operations were started above this development in October.

Summarizing, the above development in 1947 shows a continuation of the opening of the 9th Level and the extension of ore areas for mining either by sub level caving or sub level stoping methods which followed. Rather extensive additional development in completing this same purpose is scheduled for 1948. As in 1946 the ore reserve picture was improved by this program, except for the narrowing of #84A deposit on the -290' sub level, and there is no reason to suppose that this situation will differ materially in the coming year.

c. - Stoping

Mining operations continued on Chase Lease #24, Chase Lease #9 and the Fee Lands to the south and east. The vertical extent of mining operations ranged

MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

c. Stoping (Cont.)

from the -20' sub level on Chase Lease #24 to the -260' sub level on Chase Lease #9 and the Fee Lands. The Mine product, which averaged approximately 22,000 tons per month, came from an average of 13 contracts, and of this number during 1947 an average of two were top slicing, nine were sub-level caving, and two sub level stoping.

The total of thirteen contracts compared with an average of twelve in the previous year and the mining methods employed were a carry-over from the last several months in 1946 when the change was made to production of a single Morris grade carrying the lower average iron content and a silica content ranging from 10 to 11%. The change to this single grade was of particular advantage in the sub level caving method of mining where controlled dilution was of considerable help in maintaining a maximum mining efficiency.

During December there were three sub level stopes in full production, one by No. 10 contract in #79 deposit on Chase Lease #24; the second and third by Nos. 6 and 30 contracts on the Fee Lands at the east end of the property. With these three stopes in the early stages of production, the outlook for 1948 is excellent from the standpoint of improved production and low cost, because of the higher proportion of the product resulting from this method of mining.

The detailed description of mining operations follows:

CHASE LEASE #24

Four contracts mined on the easterly portion of this lease during 1947. Early in the year two of these contracts continued sub level caving and small scale sub level stoping operations in the westerly portion of #75 deposit on subs from the -20' to the -70'. The greatest area mined was adjacent to #807 and #808 at the extreme west end of #75 deposit, where No. 4 contract sub caved an area approximately 170' long with a width of 90' on the -40' sub level. Sub level caving operations of No. 21 contract were both on the east and west sides of the lease boundary line in #75 deposit and to the east of #806 raise. In December this contract mined two slices north and south of their transfer drift in the central portion of the mining area.

No. 9 contract continued combined sub level caving and sub stoping operations in #82 deposit southwest of the triple boundary corner of Leases #9 and #24 and the Fee Lands. This mining operation extended from the -110' to the -170' sub, with the major share of the mining done on the -150' sub. In November and December, the contract advanced a new transfer drift to the east to connect with former workings for ventilation and preparatory to continuing the

MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

c. Stoping (Cont.)

the sub caving operation at this new elevation. The fourth contract on Chase Lease #24, early in the year developed the higher than average sulphur deposit, #79, for stoping operations which were begun in October 1947. The new transfer drift under this ore body is 20' below the former transfer used in 1943 and the mining late in the year opened a stope at this lower elevation approximately 80' long and 40' wide. The mining advance in this stope will be continued easterly and above to the jasper capping which rises in this direction to above the 8th Level drift within a short distance.

FEE LANDS

During 1946 the east end of the mine on the Fee Lands above the 9th Level was largely under development. The major share of 1947 mining was done by one additional contract and this explains the sudden increase in the proportion of the product originating on the Fee Lands. During 1947 No. 7 contract continued sub level caving immediately east of the Chase Lease #9-Fee Land boundary. No. 16 contract continued mining in the southwest portion of #33 deposit south of the Lease #9 boundary line, while No. 6 contract added the major share of the production from the new large stope in #84A deposit above the east end of the 9th Level. Late in the year a second stope was added in this area when No. 30 contract, after developing easterly across the Lloyd boundary line, began mining operations in #84C deposit on the east side of the boundary line.

The sub level caving operations of No. 7 contract extended vertically from the -20' to the -70' sub levels near the east end of #33 deposit, and the largest area mined was on the -50' sub at a distance of about 75' east of Lease #9 boundary line. In December the operations of No. 7 contract had extended westerly across the line on to Lease #9 where a ventilation connection was being driven between the two mining raises. No. 16 contract continued sub caving operations east of the triple boundary corner by way of the two branch raises above the 9th Level. Because of the water usually encountered in this territory, where the ore at the west end of #33 deposit lies on the dike, a new mining system was put into effect which consisted of first advancing a transfer drift between two branch raises and then following by extending sub level caving drifts at right angles through the dike to the footwall to the south of this transfer. Early in the year a small sub level stope was opened above the transfer on the -190' sub and after caving had been induced, the workings were extended a distance 90' to the west and at the end of the year were about that distance from the boundary line between Chase Lease #24 and the Fee Lands. The mined area on the -190' sub was approximately 170' east and west and 70' north and south.



MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

c. Stoping (Cont.)

The highly productive stoping operations of No. 6 contract in #84A deposit above the east end of the 9th Level actually extended as high as the -110' sub or a distance of 20' above the 8th Level. The stope face in 1947 was advanced in a southwesterly direction with the greatest advance occurring at about the 8th Level elevation, where it measured 70' across a width of 70'. Mining in this stope extended downward to the -260' sub and gave the stope at the end of the year a height of 150'. No. 6 contract also kept their manway drift and raise development ahead of the stope by advancing small untimbered openings in a southwesterly direction, generally above the new transfer drift that had been driven at the -290' elevation by No. 1 contract when the use of the shaker conveyor had been anticipated for the moving of this ore to #904 raise on the main 9th Level drift. Late in the year sub level stoping operations were also begun by #30 contract at a distance of about 50' east of the Morris Mine boundary line, with the largest opening occurring on the -150' sub where the stope had been opened by benches to an average diameter of 60', tapering to the mining raise with a diameter of 10' on the -220' sub below. The average phosphorus content of the ore from this east end of the deposit approximated .150 so the mining here was restricted to one shift per day in order to more readily absorb this higher average in the general mine product, which increased approximately from .075 phos. dried to .085 content.

CHASE LEASE #9

The vertical range of mining on Chase Lease #9 extended from the sub level caving of No. 21 contract immediately east of the Lease #24 boundary line to the use of the same system of mining by No. 13 contract on the -290' sub in the central portion of #33 deposit above the 9th Level. In December the sub caving retreat of No. 21 contract had returned westerly to Chase Lease #24 on the -40' sub while the same type of mining operations by Nos. 3, 8 and 15 contracts had advanced to the -100' sub in the easterly portion of #33 deposit. The top slicing operations of No. 14 contract near the central portion of #33 deposit also extended from the -100' sub, and at the end of the year this system of mining was employed by two additional contracts in this same area by way of double compartment raises which had been advanced above the 9th Level during 1947. In December Nos. 11, 14 and 2 contracts were top slicing at the 8th Level elevation on both sides of the crushed former main level drifts. These three gangs furnished a high grade product from top slicing operations which aided in maintaining the iron content of the product when sub level caving operations in other areas ran below grade.

The single but highly productive mining operation on this lease below the 8th Level was the sub caving of No. 13 contract which extended from the -190' to the -290' subs. This sub caving operation extended along the south side of the former No. 10's stope under the jasper capping in the northwest portion



MORRIS MINE  
ANNUAL REPORT  
YEAR 1947

7. UNDERGROUND (Cont.)

c. Stoping (Cont.)

of #33 deposit on this lease. An area some 100' by 70' wide was caved on the -240' sub retreating from west to east, and this was then followed by repeating the process in a smaller area on the -260' sub. While the retreat was being made at this lower elevation, the ore area on the 2200 west coordinate line suddenly extended an additional 80' to the south following a curve in the jasper capping, so in December mining was halted and No. 13 contract returned to exploration and development on the -190' sub above, preparatory to probably extending the former No. 10 stope to the east under this rising jasper capping.

TILDEN MINE  
ANNUAL REPORT  
YEAR - 1947

1. GENERAL

The Tilden Mine operated on a much more continuous schedule during 1947 than in 1946, as production did not start until July 7th, and there was very little idle time up to November 24th when the snow and ice conditions caused a cessation of operations. There was approximately 39,000 tons of ore in stock at the end of the season, and this should be sufficient to fill the early orders without having to hire a full crew until June 1st or even later, if the total sales do not exceed 175,000 tons. A minimum crew was used during most of the year, as there was very little drilling necessary until late in the fall.

The total production for 1947 was 163,669 tons, as compared with 101,968 tons last year, and this included 26,718 tons of low phos. ore. Due to a very close boat schedule, accompanied by a scarcity of railroad cars, it was necessary to load approximately 19,000 tons from the stockpile in October. Otherwise the total production would have been increased by at least 12,000 tons, thus obtaining a lower cost of production, on account of not being able to use the crew at maximum efficiency. With only two shovels it is impossible to load from the pits and from stockpile at the same time, and therefore when stockpile loading is necessary, to speed up deliveries, non-productive jobs have to be found for the majority of the crew.

Silica ore was loaded from the lower bench in the West Pit and the upper bench in the East Pit, while the low phos. ore consisted of both Summit Pit and East Pit ore. Part of the Summit Pit ore is stocked during idle periods in the lower bench of the East Pit to shorten the haul and maintain full crusher capacity when shipping, and at the end of the season there were approximately 15,000 tons broken, of which 3,475 tons were in the East Pit to take care of an early order. The loading was done entirely with the 120 Bucyrus and the Marion Shovels, as the two 80B Shovels were transferred to other properties. This caused more moving of shovels between pits and stockpile, but occasioned very little delay, and it was also fortunate that neither shovel had to be tied up for very long on account of break-downs. The ore was all transported to the crusher and also stocked with the five fifteen-ton Euclid trucks, and here again there was very little delay due to repairs.

There was only one blast necessary during the year, and that was in October and occurred in the West Pit. Previous to that time there had been no churn drilling required, but after the blast two drills were put in operation, and drilling continued until the pit was closed. The Summit Pit was drilled in 1946, as well as 11 holes in the East Pit, and these can be blasted whenever more broken ore is required in 1948.

It was necessary to employ a small crew for stockpile loading and repairs to equipment during May and June, and this crew also completed the stripping in the Summit Pit, started last year. After blasting the existing holes in this pit, all future work will be divided between an upper and lower bench, as the height has been too excessive for safety or economy.

The only additional equipment it is proposed to purchase during 1948 are two more Euclid trucks and a portable compressor. The former are to be transferred from the Mesabi Range and have been in use there for some time, but it was decided that they had enough service still remaining so they could be used as spares in the event of breakdowns in the present equipment. A compressor was purchased by the Mather "B" Shaft, and it was intended to transfer this unit to the Tilden for use in drilling toe and large chunks, after their

TILDEN MINE  
ANNUAL REPORT  
YEAR - 1947

1. GENERAL (Cont.)

permanent compressor was installed. However, it was felt that the portable compressor was needed between Mather "A" and "B" Shafts, and therefore one should be purchased for the Tilden, as it would effect considerable saving in both labor and cost of operating and maintaining the present compressor, together with the elimination of the necessary excessive length of air lines. These air lines also cause delay in the pits when moving shovels.

Repairs made during the year occurred mostly on the crusher, but a general overhaul of all equipment, especially the various motors and generators on shovels and crushers, will be necessary before operations are resumed, as there has been very little work done in the last two years. A small crew was employed in December on repairs to trucks, crusher, and shovels, and it will be some time next year before this work is completed. The boom and dipper stick on the Marion Shovel are in bad shape and need a complete overhaul.

2. PRODUCTION, SHIPMENTS & INVENTORIES

a. Production by Grades

	<u>1947</u>	<u>1946</u>	<u>Increase</u>
Tilden Silica	141,951	101,968	39,983
Tilden Low Phos.	26,718		26,718
Total	<u>168,669</u>	<u>101,968</u>	<u>66,701</u>

b. Shipments

	<u>Pocket</u>	<u>Stockpile</u>	<u>Total</u>	<u>Total Last Year</u>
Tilden Silica	83,967	65,365	149,332	95,437
Tilden Low Phos.	25,392		25,392	
Total	<u>109,359</u>	<u>65,365</u>	<u>174,724</u>	<u>95,437</u>
Total Last Year	45,733	49,699	95,437	
Increase	<u>63,621</u>	<u>15,666</u>	<u>79,287</u>	

c. Stockpile Inventories

<u>Grade</u>	<u>Balance on Hand Dec. 31, 1946</u>	<u>Stocked 1947</u>	<u>Shipped from Stockpile 1947</u>	<u>Balance on Hand Dec. 31, 1947</u>
Tilden Silica	31,281	59,310	51,550	39,041
Tilden Low Phos.	13,815		13,815	
Total	<u>45,096</u>	<u>59,310</u>	<u>65,365</u>	<u>39,041</u>

e. Product by Months

<u>Month</u>	<u>Days Operated</u>	<u>Average Tonnage Per 8-Hr. Shift</u>	<u>Total Tons</u>
July	21	1,559	34,308
August	21	1,802	37,853
September	22	2,006	44,142
October	20	1,562	31,259
November	15	1,407	21,107
Total	<u>97</u>	<u>1,739</u>	<u>168,669</u>

TILDEN MINE  
ANNUAL REPORT  
YEAR - 1947

2. PRODUCTION, SHIPMENTS & INVENTORIES

e. Product by Months (Cont.)

The average tons per shift for 1947, while slightly increased over 1946, was still low on account of having only two power shovels and having to do considerable moving to and from stockpiles and pits. There were 65,000 tons removed from stockpile and 59,000 had to be restocked to maintain a sufficient supply for spring deliveries. Stockpile loading reduces the tons per shift, as part of the trucks have to be used for stocking.

Distribution of Product by Pits

	<u>1947</u>	<u>1946</u>	<u>Increase</u>	<u>Decrease</u>
West Pit (Upper Bench)		4,632		4,632
West Pit (Lower Bench)	93,446	66,617	26,829	
East Pit	57,677	30,719	26,958	
Summit Pit	17,546		17,546	
Total	<u>168,669</u>	<u>101,968</u>	<u>66,701</u>	

f. Ore Statement

	<u>Tilden Silica</u>	<u>Tilden Low Phos.</u>	<u>Total</u>	<u>Total Last Year</u>
On Hand January 1, 1947	31,281	13,815	45,096	38,565
Output for Year	141,951	26,718	168,669	101,968
Transfers	15,141	15,141		
Total	<u>188,373</u>	<u>25,392</u>	<u>213,765</u>	<u>140,533</u>
Shipments	<u>149,332</u>	<u>25,392</u>	<u>174,724</u>	<u>95,437</u>
Balance on Hand December 31, 1947	39,041		39,041	45,096

The total of 15,141 tons transferred from low phos. to silica was partly occasioned by loading out of stockpile as silica 13,815 tons which had been carried on the books as low phos. This tonnage was stocked in 1940 and 1941 when the requirements for low phos. were .020 instead of .015, and although it might have been possible to recover a small percentage at the lower phos. content, the throw-outs would have had to be held in cars for a silica shipment at some later date, thus tying up too much equipment. There are now only two shovels at the Tilden, and it is necessary to load both East Pit and Summit Pit ore at the same time to maintain the required iron analysis. This small pile of ore interfered with stocking the maximum amount possible, and it was therefore decided to consider everything as silica grade.

Comparison of Working Schedules, 1945 to 1947

1947 - Pit idle January 1st to July 7th. A small crew were employed during May and June on repairs and stockpile loading, the latter starting on May 14th. Operating one 8-hour shift six days per week July 7th to November 24th. Drilling was then also suspended and only a small crew remained in December for the necessary repairs.



TILDEN MINE  
ANNUAL REPORT  
YEAR - 1947

2. PRODUCTION, SHIPMENTS & INVENTORIES

Comparison of Working Schedules, 1945 to 1947 (Cont.)

1946 - Pit idle January 1st to May 22nd. Part crew repairing May 22nd to June 15th. Operating 1 8-hour shift, six days per week June 15th to November 30th. Gradually decreasing crew repairing and storing equipment November 30th to December 31st, except for one shift stocking ore in October. Stockpile loading was intermittent from May 22nd to November.

1945 - Pit idle January 1st to April 23rd. Small crew drilling and repairing. Operating April 23rd to June 1st, 1 8-hour shift 5 2/3 days per week. June 1st to November 1st, 1 8-hour shift six days per week. (Pit idle week of August 13th for vacation.) Total operating shifts - 97. Idle November 1st to December 1st. Small crew repairing and overhauling equipment. December 1st to December 31st entire crew laid off except for watchman, foreman, and clerk.

g. Delays

There were no major delays during 1947.

3. ANALYSIS

a. Average Mine Analysis on Shipments

<u>Grade</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Loss by Ignition</u>
Tilden Silica	39.85	.042	41.32	.07	.75	.29	.21	.015	.25
Tilden Low Phos.	36.47	.015	46.51	.06	.60	.11	.09	.010	.28

b. Average Analysis on Straight Cargoes

	<u>Mine</u>			<u>Lake Erie</u>	
	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Iron</u>	<u>Moist.</u>
Tilden Silica	39.68	.040	41.68	40.00	2.18
Tilden Low Phos.	36.43	.015	46.46	36.70	1.48

c. Analysis of Ore in Stock

	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Loss</u>	<u>Moist.</u>
Tilden Silica	39.77	.046	41.02	.07	.75	.29	.21	.015	.125	1.95

4. ESTIMATE OF ORE RESERVES

a. Developed Ore

1. West Pit - Above Floor at 1430'

Assumption: 13 Cu. Ft. equal one ton.

Total Stripped & Developed as of January 1, 1947	1,636,931 Tons
Mined during 1947	93,446 "
Total Remaining December 31, 1947	<u>1,543,485</u>

TILDEN MINE  
ANNUAL REPORT  
YEAR - 1947

4. ESTIMATE OF ORE RESERVES

a. Developed Ore (Cont.)

2. East Pit - Above Floor at 1440'

Assumption: 14 Cu. Ft. equal one ton.

Total Stripped & Developed - 1440' to 1500'	
as of January 1st, 1947	1,278,320 Tons
Total Stripped & Developed above 1500'	
as of January 1st, 1947	1,893,245 "
Mined during 1947	57,677 "
Total Remaining above 1500' as of Dec. 31, 1947	1,835,568 "
Total Remaining above 1440' as of Dec. 31, 1947	3,113,888 "

3. Summit Pit - Above Floor at 1620'

Assumption: 14 cu. ft. equal one ton.

Total Stripped & Developed as of Jan. 1, 1947	443,618 Tons
Mined during 1947	17,546 "
Total Remaining as of Dec. 31, 1947	426,072 "

Total Developed Ore as of December 31, 1947

West Pit	1,543,485 Tons
East Pit	3,113,888 "
Summit Pit	426,072 "
Total all Pits	5,083,445 Tons

Broken Ore in Pits Included Under Developed Ore

	<u>West Pit</u>	<u>East Pit</u>	<u>Summit Pit</u>	<u>Total</u>
	<u>Lower Bench</u>			
December 31, 1947	50,799 Tons	80,178 Tons	14,734 Tons*	145,711 Tons

\*Includes 3,475 tons stocked in East Pit.

Total Prospective Ore

<u>West Pit</u>		
Balance remaining in E & A CC 117		500,000 Tons
<u>East &amp; Summit Pits</u>		
Total above Floor at 1500' as of Jan. 1, 1948		2,235,500 Tons
Total Prospective Ore January 1st, 1948		2,735,500 Tons

TILDEN MINE  
ANNUAL REPORT  
YEAR - 1947

4. ESTIMATE OF ORE RESERVES (Cont.)

c. Estimated Analysis of Reserves

	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Ign.</u>	<u>Moist.</u>
1. <u>West Pit</u>										
Dried	39.17	.050	41.91	.09	.90	.20	.22	.009	.24	
Natural	38.50	.049	41.20	.09	.88	.20	.22	.009	.24	1.70
2. <u>East Pit</u>										
Dried	37.00	.020	45.00	.09	.54	.20	.17	.009	.34	
Natural	36.50	.020	44.40	.09	.53	.20	.17	.009	.34	1.34
3. <u>Summit Pit</u>										
Dried	36.00	.015	46.00	.09	.54	.20	.17	.009	.34	
Natural	34.50	.015	45.40	.09	.54	.20	.17	.009	.34	

f. Estimate of Production

Production in the latter years has had to be limited by the amount required to be shipped plus the amount that could be stocked, and the maximum capacity of the present stockpile grounds is approximately 75,000 tons. The maximum production possible, however, is as follows:

	<u>5 Days Per Week</u>	<u>6 Days Per Week</u>
Single Shift	224,000 Tons	282,000 Tons
Double Shift	400,000 "	500,000 "

It would be possible to obtain from 50,000 tons on single shift to 100,000 tons on double shift of low phos. ore grading .015.

5. LABOR AND WAGES

a. Comments

The crew at the Tilden Mine was decreased by eight men as compared with previous years until November, when it was necessary to start churn drilling. When operations were started in June, eight of the regular crew remained at other properties to operate shovels, tractors, etc., five of whom were transferred permanently and men from other occupations broken in to fill their places.

Effective May 9th there was an increase of 12½ cents per hour in wages and a proportional raise in the salaries of the captain and clerk.

The men received their vacation pay in August, but as the pit only works part of the year it was decided that operations would be continued as usual. The schedule of vacation payments was increased to allow three weeks for anyone who had worked 25 years or more for the Company.

- 3 Men, or 9%, received pay for 3 weeks, based on 48 hours per week.
- 16 Men, or 49% received pay for 2 weeks, based on 48 hours per week.
- 7 Men, or 21% received pay for 1 week.
- 7 Men, or 21% were ineligible, as they had worked less than one year.