Summary File Report
Third, Second, Submarine, Monroeville
and Intermediate Beaches, Nome District, Alaska

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by

Paul A. Metz
Mineral Industry Research Laboratory
University of Alaska
Fairbanks, Alaska 99701

Approved by:

Ernest N. Wolff
Associate Director
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SUMMARY FILE NARRATIVE

Property Name: Third, Submarine, Second, Monroeville and Intermediate Beaches, Nome, Alaska

Property Location: The properties are located T11S, R33W, T11S, R34W, and T12S, R33W, Kateel Meridian. The location of the properties is shown on Figure 1.a. 1:250,000 map of the Nome quadrangle, Alaska. The properties are located within 5 km of Nome and are accessible via motor vehicle.

Detailed ownership data: The properties are owned and operated by the Alaska Gold Company. The company is a subsidiary of U. V. Industries, Inc., 437 Madison Avenue, New York, New York 10022.

History and production: The early history of the Nome mining district was reviewed in Collier (1908). Gold was discovered on Anvil Creek, a tributary of Snake River on September 22, 1898 by Jafet Lindeberg, Jon Brynteson and Eric O. Lindblom. The great rush to the district began in 1899 and continued through 1900. By 1900 the deep gravels and beach placers had been discovered and a long period of economic stability commenced (Koschmann and Bergendahl, 1960). Koschmann and Bergendahl (1968) estimate that from 1897 to 1959 the district produced at least 3,606,000 troy ounces of gold however there is no production data for the period 1931-1946. Mulligan (1967) estimated that total placer production for the district had exceeded 4 million troy ounces. U. S. Bureau of Mines unpublished data shows reported production through 1974 of approximately 2 million troy ounces. Since 1974, the Alaska Gold Company has been the major producer in the district. The reported production of 117 days in 1975 was 7,796 troy ounces after processing 566,399 cubic meters (740,391 cubic yards) of gravel. Production was from one 9 cu. ft. dredge working the Third Beach. The 1976 production totalled 14,320 troy ounces of gold from 913,884 cubic meters (1,194,620 cubic yards) of gravel. The 1977 production came from one 9 cu. ft. dredge working the Third Beach at a rate of 6,885 cubic meters (9,000 cubic yards) per day and one 9 cu. ft. dredge working the Submarine Beach at a rate of 5,355 cubic meters (7,000 cubic yards) per day.

General Geology: The Nome Beaches are located on the southwest coast of the Seward Peninsula. The Peninsula includes approximately 65,000 square kilometers of complex geology and diverse topography. Geologic units include Precambrian schist, phyllite, slate and limestone, Paleozoic carbonates, Mesozoic volcanics and Cenozoic volcanic and clastic sedimentary rocks. The older rocks are intruded by Cretaceous granitic rocks ranging in composition from diorite to two-mica granite.

The rocks of the Seward Peninsula have undergone intense tectonic deformation thus they exhibit varying degrees of dynamic metamorphism.
The geologic column has been complicated by tectonic mixing on a large scale near major thrust faults (Sainsbury, 1975). The oldest rocks in the Nome area are metavolcanic and metasedimentary Precambrian rocks. The rocks were formerly referred to as the "York Slate" and the Nome Group. The metavolcanic sequence includes greenschist and associated schistose marble. The rocks contain chlorite, epidote, albite, quartz, calcite, amphibole, sphene and minor local garnet and glaucophane. The metasedimentary sequence includes graywacke, siltstone, slate, phyllite, phyllitic schist, schist, metasiltite, calcareous and micaceous schist and minor marble. The sequences are intruded by mafic sills and dikes. The rocks show multiple S-planes indicating polymetamorphism. The prominent drag folding is overturned to the east thus indicating eastward movement. The Precambrian rocks in the Nome area are intersected by fractures and fracture filling quartz veins. The veins and fracture zones exhibit sericitic-clay-quartz alteration. The veins contain sulfide minerals and scheelite. The Precambrian rocks are unconformably overlain by Paleozoic limestone and marbles. The limestones are light to dark gray and in part dolomitic. The rocks have been tentatively assigned to the Devonian based on fossils in similar lithologies in other areas of the Seward Peninsula.

Pleistocene and Holocene beach deposits overlie the Precambrian and Paleozoic rocks. The deposits include silt, sand and gravel. The beach deposits are the hosts for the placer gold deposits of the Nome District. The localization of the placer gold deposits of the Seward Peninsula in general and the Nome beach deposits in particular is controlled by the following regional factors.

1. The presence of the Precambrian rocks.
2. The presence of granitic rocks or the indication of buried intrusives by the localization of intense fracturing, by the presence of intricate quartz vein systems and by the occurrence of hydrothermal alteration.

Description of the Ore Bodies: Cobb (1973) described in detail the placer deposits of the Nome District. The beach and offshore placer deposits were formed by eustatic changes in sea level during the Pliocene and Pleistocene. Cobb (1978) has summarized the deposits as follows.

Glacial erosion of lodes and stream placers in hills north of Nome coastal plain distributed gold in glacial drift on coastal plain and on sea bottom offshore of present beach. Gold was concentrated by wave action during pauses in eustatic changes in sea level during late Pliocene and Pleistocene. Gold also on old marine abrasion platforms (particularly along what was once thought to be an old channel of Anvil Cr.). 6 beaches at or above and 6 beaches below present sea level. Gold first discovered and mined at present beach in 1899. Since then gold has been mined from second, third, intermediate, and Monroeville beaches above sea level and from inner and outer submarine beaches below sea level; submarine beaches are landward from present shoreline. Offshore beaches may contain gold; have not been adequately explored. Fourth beach (at base of
hills) is too low grade to be mined, but has contributed gold to minable stream placers in coastal plain. Offshore are probable buried stream channels that may contain gold and thin auriferous relict gravels from which fine and light material has been winnowed by currents; mining would present technological problems because of thinness (about 1 ft.) of gravels. Beach deposits have been mined by rockers (present beach), much drift mining, and (since about 1909) dredges that also worked auriferous glacial drift, particularly near Anvil and Little Creeks. For economic reasons dredging ceased in 1962; resumed in 1975. Most creeks in coastal plain concentrated gold from glacial drift and (or) old beaches. Only metallic minerals found in beach and coastal plain deposits are scheelite (Saturday Cr.) and sulfides (including chalcopyrite and arsenopyrite probably locally derived from as yet undiscovered lodes."

Figure 2 is a diagrammatic sketch of the Nome Beach deposits showing their relationship to the Precambrian and Paleozoic rocks. The depths of the beach placers ranges from 13.68 meters (44.86 ft.) to 23.35 meters (76.60 feet). The deposits cover 518.01 hectares (1,280 acres) and contain 97,024,950 cubic meters (126,830,000 cubic yards) of gravel.

Probabilistic grade quantity matrix calculations: Reserve data was taken from unpublished company data dated May 1, 1975. Reserves are estimated at 1,193,000 troy ounces of gold (0.0123 troy ounces per cubic meter or 0.0094 troy ounces per cubic yard).

Mining and Beneficiation Methods: The Third Beach is currently being mined by a single 9 cu. ft. bucketline dredge with a capacity of 6,885 cubic meters (9,000 cubic yards) per day. The Submarine Beach is being mined with a 9 cu. ft. bucketline dredge at a rate of 5,355 cubic meters (7,000 cubic yards) per day.

Since itemized costs for the existing operations were not available, estimates were made for the existing and proposed operations. The unit costs of mining for the Third, Second, Submarine and Monroeville and Intermediate Beaches are $1.42, $2.09, $1.39 and $1.60 per cubic meter respectively. The corresponding capital costs are $14,111,553, $14,093,124, $13,721,780, and $15,118,666. The unit beneficiation costs are $0.19, $0.19, $0.25 and $0.19 per cubic meter respectively. The estimated capital cost of beneficiation for each of the operations is $2,000,000.
REFERENCES CITED


BIBLIOGRAPHY


APPENDIX A. - Probabilistic Grade Quantity Matrix Calculations

The yardage of dredgeable gravel and the grade of each of the beaches is given in Table I which is taken from the Alaska Gold Company Prospectus, dated May 1, 1975. Total reserves for the Nome beaches as of February 18, 1975 were 126,830,000 cubic yards containing an estimated 1,193,000 troy ounces.
APPENDIX B. - Surface Mining Calculations

B-1. Swell factor (all beaches same):

In place density: 2.00 g/cm$^3$

Loose density: 1.67 g/cm$^3$

\[
\% \text{ Swell factor} = \frac{(2.00 - 1.67)(100)}{1.67} = 20\%
\]

\[
\text{Swell factor} = \frac{100}{100 + \% \text{ Swell}} = \frac{100}{200} = 0.83
\]

B-2. Percent waste rock (all beaches same):

Assume overburden muck only waste material mined.

Muck only very small portion of total geologic column

2 ft. (average depth) x 1280 acres (table 1) x

43560 ft$^2$/acre/27 ft$^3$/yd$^3$ = 4,130,133 yds$^3$

\[
4,130,133 \text{ yds}^3 \times \frac{0.765 \text{ ft}^3/\text{yd}^3}{\text{m}^3/\text{yd}^3} = 3,159,552 \text{ yd}^3
\]

\[
\% \text{ waste rock} = \frac{(\text{overburden m}^3)(100)}{(\text{overburden m}^3)+(\text{productive gravel m}^3)}
\]

\[
= \frac{97,024,950 + 3,159,552}{3,159,552} = 3.15\%
\]

B-3. Preproduction stripping: none

B-4. Mine production:

B-4a. Thawing operations

Third Beach

Area approximately (900 ft x 14,000 ft)

Acres 293

Square feet 12,763,080

Drill hole spacing 32 ft x 32 ft

Area 1024 ft$^2$
Average Depth 76.60 ft
Life 23.67 yrs

Dredge/Thaw Area per Year
12,763,080 ft²/23.67 yrs = 539,209 ft²/yr

Number of Thaw Points per Year
539,209 ft²/yr/1024 ft²/pt = 527 pts

Length of Drilling per Year
527 pt/yr x 76.60 ft/pt = 40,368 pt/yr

Water Requirements (use 20 x 28 = 560 pts)
1.5 MI*/pt @ 25-30 psi =
1.5 MI/pt x 1.5 cfm/MI =
2.25 cfm/pt
560 pts x 2.25 cfm/pt =
1260 cfm
7.48 gal/ft³ x 1260 cfm =
8924 gpm

Pump Requirements
2 each 12" x 10" centrifugal slurry, rubber lined closed impeller, 200 hp each
2 each synchronous motors (1800 rpm)

Pipe Requirements
Main Line

$$h_f = \text{Head Loss}$$

$$f = \text{Friction Factor}$$

$$L = \text{Length of Pipe}$$

*MI = Miners Inch
**fig. 21 Mechanical Engineers Handbook
G = Volume in gpm
D = Diameter of Pipe in inches
\[ h_f = fL G^2/32.1D^5 \]
\[ = f(2.5)(5280)(8924)^2/32.1 D^5 \]
\[ = 3.27 \times 10^{10} f/D^5 \]
R = Reynolds Number
u = 0.0179 poise
p = 1 g/cm³
R = 31.6 Gp/uD
\[ = (31.6)(8924)(1)/0.0179D \]
\[ = 1.58 \times 10^7/D \]

Trial 1, D = 36"
\[ R = 4.39 \times 10^5, f = 0.015 \]
\[ h_f = 3.27 \times 10^{10}(0.015)/(36)^5 \]
\[ = 8.11 \text{ ft} \]

Trial 2, D = 42"
\[ R = 3.76 \times 10^5 f = 0.015 \]
\[ h_f = 3.27 \times 10^{10}(0.015)/(42)^5 \]
\[ = 3.75 \text{ ft} \]

Trial 3, D = 48"
\[ R = 3.29 \times 10^5 f = 0.015 \]
\[ h_f = 3.27 \times 10^{10}(0.015)/(48)^5 \]
\[ = 1.93 \text{ ft} \]

Use 48" Pipe
Secondary Lines

Thaw Point Grid (20 x 28 = 560 pts)

7 each Secondary lines 864 ft long (27 x 32 ft)

\[8924 \, \text{gpm/7 lines} = 1275 \, \text{gpm/line}\]

\[h_f = \frac{fL^2}{32.1 \, D^5}\]

\[= (864)(1275)^2 \frac{f}{32.1 \, D^5}\]

\[= 4.38 \times 10^7 \frac{f}{32.1 \, D^5}\]

\[R = 31.6 \, \text{Gp/uD}\]

\[= 31.6(1275)(1)/(0.0179)D\]

\[= 2.25 \times 10^6 /D\]

Trial 1, 8"

\[R = 2.81 \times 10^5 \quad f= 0.016\]

\[h_f = (4.38 \times 10^7)(0.016)/(8)^5\]

\[= 21.39 \, \text{ft}\]

Trial 2, 12"

\[R = 1.88 \times 10^5 \quad f= 0.017\]

\[h_f = (4.38 \times 10^7)(0.017)/(12)^5\]

\[= 2.99 \, \text{ft}\]

Trial 3, 14"

\[R = 1.61 \times 10^5 \quad f= 0.018\]

\[h_f = (4.38 \times 10^7)(0.018)/(14)^5\]

\[= 1.47 \, \text{ft}\]

Use 14" Pipe

Connecting Pipes (see schematic)

\[(45.25 \, \text{ft}) \times (4) + 5 \, \text{ft} = 186 \, \text{ft}\]

\[186 \, \text{ft/5 pts} = 37.20 \, \text{ft/pts}\]

\[37.20 \, \text{ft/pt} \times 560 \, \text{pts} = 20,832 \, \text{ft}\]
Second Beach

Area (approx. 900 ft x 15,000 ft)

<table>
<thead>
<tr>
<th>Acres</th>
<th>305</th>
</tr>
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<tr>
<td>Square feet</td>
<td>13,285,800</td>
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</table>

Drill hole spacing

<table>
<thead>
<tr>
<th>Area</th>
<th>32 ft x 32 ft</th>
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<tbody>
<tr>
<td>Average depth</td>
<td>44.86 ft</td>
</tr>
<tr>
<td>Life</td>
<td>14.43 yrs</td>
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Dredge/Thaw Area per Year

13,285,800 ft²/14.43 yrs = 920,707 ft²/yr

Number of Thaw Points per Year

920,707 ft²/yr/1024/ft²/pt = 899

Length of Drilling per Year

899 pts/yr x 44.86 ft/pt = 40,329 ft/yr

Water Requirements (use 33 x 28 = 924)

1.5 MI/pt @ 25-30 psi
1.5 MI/pt x 1.5 cfm/MI
2.25 cfm/PT
924 pts x 2.25 cfm/PT = 2079 cfm
1.48 gal/ft³ x 2079 cfm = 15,551 gpm

Pump Requirements

2 each 14" x 12" Centrifugal slurry, rubber-lined closed impeller, 350 hp each

2 each Synchronous motors (1800 rpm)
Pipe Requirements

Main Line

\[ h_f = \frac{fLQ^2}{32.1D^5} \]
\[ = f(2.5)(5280)(15,551)^2/32.1D^5 \]
\[ = 9.94 \times 10^9 \frac{f}{D^5} \]

\[ R = 31.6 \frac{Qp}{uD} \]
\[ = (31.6)(15,551)(1)/0.0179D \]
\[ = 2.75 \times 10^7/D \]

Trial 1, \( D = 42" \)
\[ R = 6.55 \times 10^5 \quad f = 0.014 \]
\[ h_f = 9.94 \times 10^9 \frac{(0.014)}{(42)^5} \]
\[ = 10.65 \text{ ft.} \]

Trial 2, \( D = 48" \)
\[ R = 2.75 \times 10^7/D \]
\[ = 5.73 \times 10^5 \quad f = 0.014 \]
\[ h_f = 9.94 \times 10^{10} \frac{(0.014)}{(48)^5} \]
\[ = 5.46 \text{ ft} \]

Trial 3, \( D = 54" \)
\[ R = 2.75 \times 10^7/D \]
\[ = 5.09 \times 10^5 \quad f = 0.014 \]
\[ h_f = 9.94 \times 10^{10} \frac{(0.014)}{(54)^5} \]
\[ = 3.03 \text{ ft} \]

Trial 4, \( D = 60" \)
\[ R = 2.75 \times 10^7/D \]
\[ = 4.58 \times 10^5 \quad f = 0.014 \]
\[ h_f = 9.94 \times 10^{10} \frac{(0.014)}{(60)^5} \]
\[ = 1.79 \text{ ft} \]

Use 60" Pipe
Secondary Lines

Thaw Point Grid (33 x 28 = 924 pts)

11 each Secondary lines 864 ft long (27 x 32 ft)

15,551 gpm/11 lines = 1414 /line

\[ h_f = \frac{fL^2}{32.1} \frac{D^5}{1} \]

\[ = (864)(1414)^2 f/32.1 D^5 \]

\[ = 5.38 \times 10 \times 10^7 f/D^5 \]

\[ R = 31.6 \frac{Gp}{uD} \]

\[ = 31.6(1414)(1)/(0.0179)D \]

\[ = 2.50 \times 10^6 /D \]

Trial 1, 8"

\[ R = 3.12 \times 10^5 \quad f = 0.016 \]

\[ h_f = (5.38 \times 10^7)(0.016)/(8)^5 \]

\[ = 26.27 \text{ ft} \]

Trial 2, 12"

\[ R = 2.08 \times 10^5 \quad f = 0.018 \]

\[ h_f = (5.38 \times 10^7)(0.018)/(12)^5 \]

\[ = 3.89 \text{ ft} \]

Trial 3, 14"

\[ R = 1.79 \times 10^5 \quad f = 0.018 \]

\[ h_f = (5.38 \times 10^7)(0.018)/(14)^5 \]

\[ = 1.80 \text{ ft} \]

Use 14" Pipe

Connecting Pipes (see schematic)

\[ (45.25 \text{ ft}) \times (4) + 5" = 186 \text{ ft} \]

\[ 186 \text{ ft}/5 \text{ pts} = 37.20 \text{ ft/pt} \]

\[ 37.20 \text{ ft/pt} \times 924 \text{ pts} = 34,373 \text{ ft} \]
Submarine Beach

Area

<table>
<thead>
<tr>
<th>Acres</th>
<th>258</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square Feet</td>
<td>11,238,480</td>
</tr>
</tbody>
</table>

Drill Hole Spacing

| 32 ft x 32 ft |

Area

| 1024 ft² |

Average Depth

| 73.71 ft |

Life

| 25.78 yrs |

Dredge/Thaw Area per Year

\[ 11,238,480 \text{ ft}^2 / 25.78 \text{ yrs} = 435,938 \text{ ft}^2 / \text{yr} \]

Number of Thaw Points per Year

\[ 435,938 \text{ ft}^2 / \text{yr} / 1024 \text{ ft}^2 / \text{pt} = 426 \text{ pt} / \text{yr} \]

Length of Drilling per Year

\[ 426 \text{ pts/yr} \times 73.71 \text{ ft/pt} = 31,401 \text{ ft/yr} \]

Water Requirements (use 16 x 28 = 448 pts)

1.5 MI/pt @ 25-30 psi

\[ 1.5 \text{ MI} \times 1.5 \text{ cfm/PT} = 2.25 \text{ cfm/PT} \]

\[ 448 \text{ pts} \times 2.25 \text{ cfm/pt} = 1008 \text{ cfm} \]

\[ 7.48 \text{ gal/ft}^3 \times 1008 \text{ cfm} = 7540 \text{ gpm} \]

Pump Requirements

1 each 14" x 12" Centrifugal Slurry, Rubber lined closed impeller, 350 hp

1 each Synchronous motor (1800 rpm)
Pipe Requirements

Mainline

\[ h_f = \frac{f LG^2}{32.1 D^5} \]
\[ = f(1000) (7540)^2 / 32.1 \ D^5 \]
\[ = 1.77 x 10^9 f/D^5 \]

\[ R = 31.6 \ \text{Gp/\muD} \]
\[ = (31.6) \times (7540) (1)/0.0179 \ D \]
\[ = 1.33 x 10^7 /D \]

Trial 1, D = 36"

\[ R = 3.70 \times 10^5 \quad f = 0.016 \]
\[ h_f = 1.77 \times 10^9 \times (0.016)/36^5 \]
\[ = .47 \ \text{ft} \]

Trial 2, D = 24"

\[ R = 5.30 \times 10^5 \quad f = 0.015 \]
\[ h_f = 1.77 \times 10^9 \times (0.015)/(24)^5 \]
\[ = 3.34 \ \text{ft} \]

Trial 3, D = 12"

\[ R = 1.11 \times 10^6 \quad f = 0.015 \]
\[ h_f = 1.77 \times 10^9 \times (0.015)/(12)^5 \]
\[ = 106.76 \ \text{ft} \]

Use 24" Pipe

Secondary Lines

Thaw Point Grid (use 16 x 28 = 448 pts)

6 each Secondary lines 864 ft long (27 x 32 ft)

7540 gpm/6 lines = 1257 gpm/line
\[ h_f = \frac{f(L^2)}{32.1 \cdot D^5} \]
\[ = \left(\frac{864}{1257}\right)^2 \cdot \frac{1}{32.1 \cdot D^5} \]
\[ R = 31.6 \frac{GPa}{uD} \]
\[ = 31.6 \left(\frac{1257}{1}\right) \cdot \frac{1}{0.0179D} \]
\[ = 2.22 \times 10^5 /D \]

**Trial 1, 8"**

\[ R = 2.78 \times 10^4 \quad f = 0.026 \]
\[ h_f = \left(4.93 \times 10^7\right) \frac{(0.026)^5}{(8)^5} \]
\[ = 39.12 \text{ ft} \]

**Trial 2, 12"**

\[ R = 1.85 \times 10^4 \quad f = 0.028 \]
\[ h_f = \left(4.93 \times 10^7\right) \frac{(0.028)^5}{(12)^5} \]
\[ = 5.55 \text{ ft} \]

**Trial 3, 14"**

\[ R = 1.59 \times 10^4 \quad f = 0.030 \]
\[ h_f = \left(4.93 \times 10^7\right) \frac{(0.030)^5}{(14)^5} \]
\[ = 2.75 \text{ ft} \]

**Trial 4, 18"**

\[ R = 1.23 \times 10^4 \quad f = 0.033 \]
\[ h_f = \left(4.93 \times 10^7\right) \frac{(0.033)^5}{(18)^5} \]
\[ = 0.86 \text{ ft} \]

**Use 14" Pipe**

Connecting Pipes (see schematic)

\[(45.25 \text{ ft}) \times (4) + 5" = 186 \text{ ft}\]

\[186 \text{ ft} / 5 \text{ pts} = 37.20 \text{ ft/pt}\]

\[37.20 \text{ ft/pt} \times 924 \text{ pts} = 34,373 \text{ ft}\]
Monroeville and Intermediate Beaches

Area

<table>
<thead>
<tr>
<th>Acres</th>
<th>381</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square feet</td>
<td>16,596,360</td>
</tr>
</tbody>
</table>

Drill hole spacing

<table>
<thead>
<tr>
<th>Area</th>
<th>32 ft x 32 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square feet</td>
<td>1024 ft²</td>
</tr>
<tr>
<td>Average depth</td>
<td>55.00 ft</td>
</tr>
<tr>
<td>Life</td>
<td>22.09 yrs</td>
</tr>
</tbody>
</table>

Dredge/Thaw Area per Year

\[ 16,596,380 \text{ ft}^2 / 22.09 \text{ yrs} = 751,306 \text{ ft}^2 / \text{yr} \]

Number Thaw Points per Year

\[ 751,306 \text{ ft}^2 / \text{yr} / 1024 \text{ ft}^2 / \text{pt} = 734 \text{ pts/yr} \]

Length of Drilling per Year

\[ 734 \text{ pts/yr} \times 55 \text{ ft/pt} = 40,370 \text{ ft/yr} \]

Water requirements (use 734 pts)

\[ 1.5 \text{ MI/pt} @ 25-30 \text{ psi} \]

\[ 1.5 \text{ MI/pt} \times 1.5 \text{ cfm/MI} = 2.25 \text{ cfm/pt} \]

\[ 734 \text{ pts} \times 2.25 \text{ cfm/pt} = 1652 \text{ cfm} \]

\[ 7.48 \text{ gal/ft}^3 \times 1652 \text{ cfm} = 12,357 \text{ gpm} \]

Pump Requirements

2 each 14" x 12" centrifugal slurry, rubber lined closed impeller, 350 hp each

2 each synchronous motors (1800 rpm)

Pipe Requirements

Main Line

\[ h_f = f \frac{L \gamma}{32.1 D^5} \]

\[ = f(2)(5280)(12,357)^2 / 32.1 D^5 \]

\[ = 5.02 \times 10^{10} f / D^5 \]

\[ R = 31.6 \text{ Gp/uD} \]
\[
\begin{align*}
&= (31.6)(12,357)(1)/0.0179 \ D \\
&= 2.18 \times 10^7/D \\
\text{Trial 1, } D = 42'' \\
R &= 5.19 \times 10^5 \quad f = 0.015 \\
h_f &= 5.02 \times 10^{10}(0.015)/(42)^5 \\
&= 5.76 \text{ ft} \\
\text{Trial 2, } D = 48'' \\
R &= 4.54 \times 10^5 \quad f = 0.014 \\
h_f &= 5.02 \times 10^{10}(0.014)/(48)^5 \\
&= 2.76 \text{ ft} \\
\text{Trial 3, } D = 54'' \\
R &= 4.04 \times 10^5 \quad f = 0.015 \\
h_f &= 5.02 \times 10^{10}(0.015)/(54)^5 \\
&= 1.64 \text{ ft} \\
\text{Use 48'' Pipe} \\
\text{Secondary Lines} \\
\text{Thaw Point Grid (use } 27 \times 28 = 756 \text{ pts) } \\
9 \text{ each Secondary lines } 864 \text{ ft long } (27 \times 32 \text{ ft}) \\
12,357 \text{ gpm/9 lines } = 1373 \text{ gpm/line} \\
h_f &= fLg^2/32.1 \ D^5 \\
&= f(864)(2060)^2/32.1 \ D^5 \\
&= (31.6)(2060)^2/32.1 \ D^5 \\
&= 1.14 \times 10^8f/D^5 \\
R &= 31.6 \text{ gpm/}uD \\
&= (31.6)(2060)(1)/(0.179)D \\
&= 3.64 \times 10^5/D \\
\text{Trial 1, } D = 14'' \\
R &= 2.6 \times 10^4 \quad f = 0.027 \\
h_f &= (1.14 \times 10^8)(0.027)/(14)^5 \\
&= 5.72 \text{ ft} \\
\end{align*}
\]
Trial 2, \( D = 18" \)

\[ R = 2.02 \times 10^4 \quad f = 0.028 \]

\[ h_f = (1.14 \times 10^8)(0.028)/(18)^5 \]

\[ = 1.69 \text{ ft} \]

Use 18" Pipe

Connecting Pipes (see schematic)

\[(45.25 \text{ ft}) \times (4) + 5" = 186 \text{ ft} \]

\[186 \text{ ft/5 pts} = 37.20 \text{ ft/pt} \]

\[37.20 \text{ ft/pt} \times 448 \text{ pts} = 16,666 \text{ ft} \]

Drilling/Install Thaw Points

1 hole/hour

4 man crew - two drilling, two installing and hooking up points

Third Beach

560 points \( \times 1 \) hr = 560 machine-hours

Assume 160 hr/mo.

\[ 560/160 = 3.5 \text{ months} \]

Submarine Beach

448 points \( \times 1 \) hr. = 448 machine-hours

448 hrs \( \times 4 \) men = 1792 man-hours

Assume 160 hr/mo

\[ 448/160 = 2.8 \text{ months} \]

Second Beach

900 points \( \times 1 \) hr = 900 machine-hours

900 hrs \( \times 4 \) men = 3600 man-hours

Assume 160 hr/mo

\[ 900/160 = 5.6 \text{ months} \]
Monroeville and Intermediate Beaches

734 points x 1 hr = 734 machine - hours

734 hrs x 4 men = 2936 man - hours

Assume 160 hr/mo

734/160 = 4.6 months

Total Drilling/Installation Time = 3.5 + 2.8 +5.6 +4.6

= 16.5 months

Assume Drilling/Installation: October-April = 7 months

Total Drilling Requirements = 16.5/7 = 2.4 machine/crew

Use: 3 each rotary dills w/down hole hammers

3 each 4 man crews
B-4b. Dredging Operations

Table II lists the dredging area and volume of dredging material of the Nome Beaches.

Third Beach (actual)

9 ft³ dredge (135 buckets) = 9,000 yd³/day (6,885 m³/day)
9,000 yd³/day x 170 days/yr = 1,530,000 yd³/yr (1,170,450 m³/yr)
36,210,000 yd³/1,530,000 yd³/yr = 23.67 yrs
Use: 1 each 9 cubic foot bucket line dredge

Submarine (actual)

9 ft³ dredge (105 buckets) = 7,000 yd³/day (5,355 m³/day)
7,000 yd³/day x 170 days/yr = 1,190,000 yd³/yr (910,350 m³/yr)
30,680,000 yd³/1,190,000 yd³/yr = 25.78 yrs
Use: 1 each 9 cubic foot bucket line dredge

Second (proposed)

9 ft³ dredge (135 buckets) = 9,000 yd³/day (6,885 m³/day)
9,000 yd³/day x 170 days/yr = 1,530,000 yd³/yr (1,170,450 m³/yr)
22,075,000 yd³/1,530,000 yd³/yr = 14.43 yrs
Use: 1 each 9 cubic foot bucket line dredge

Intermediate (proposed)

9 ft³ dredge (135 buckets) = 9,000 yd³/day (6885 m³/day)
9,000 yd³/day x 170 days/yr = 1,530,000 yd³/yr (1,170,450 m³/yr)
33,805,000 yd³/1,530,000 yd³/yr = 22.09 yrs
Use: 1 each 9 cubic foot bucket line dredge
B-5. Equipment Requirements

B-5a. Third Beach

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Capital Cost</th>
<th>Monthly Operating Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bucket line dredge (9 ft$^3$)(1000 hp)</td>
<td>1</td>
<td>$5,000,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Tractor dozer (D-8)</td>
<td>2</td>
<td>360,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Piping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main 48&quot;(ft)</td>
<td>13,200</td>
<td>1,056,000</td>
<td></td>
</tr>
<tr>
<td>Secondary 14&quot;(ft)</td>
<td>6,048</td>
<td>241,920</td>
<td></td>
</tr>
<tr>
<td>Connecting (ft)</td>
<td>20,832</td>
<td>6,250</td>
<td></td>
</tr>
<tr>
<td>Thaw Points (76.60 ft x $1.62/ft x 527)</td>
<td>527</td>
<td>65,396</td>
<td></td>
</tr>
<tr>
<td>Pumps (12&quot; x 10&quot;) (350 hp ea)</td>
<td>2</td>
<td>30,000</td>
<td>150</td>
</tr>
<tr>
<td>Power Distribution lines (ft) ($7.00/ft x 13,200 ft)</td>
<td>13,200</td>
<td>92,400</td>
<td></td>
</tr>
<tr>
<td>Power (kw-hr) (1400 hp @ $.18/kw-hr)</td>
<td>751,968</td>
<td>--</td>
<td>135,354</td>
</tr>
<tr>
<td>3/4 ton pickup truck</td>
<td>2</td>
<td>17,000</td>
<td>170</td>
</tr>
<tr>
<td>Skid mounted rotary drill and misc. (1)</td>
<td></td>
<td>100,000</td>
<td>100</td>
</tr>
</tbody>
</table>

**TOTALS**

$6,968,966 $146,774

(1) Machine tools not included in dredge machine shop.
B-5b. Second Beach

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Capital Cost</th>
<th>Operating Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bucket line dredge (9 ft$^3$)(1000 hp)</td>
<td>1</td>
<td>$5,000,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Tractor dozer (D-8)</td>
<td>2</td>
<td>360,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Piping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main 60&quot;(ft)</td>
<td>13,200</td>
<td>1,254,000</td>
<td></td>
</tr>
<tr>
<td>Secondary 14&quot;(ft)</td>
<td>9,504</td>
<td>380,160</td>
<td></td>
</tr>
<tr>
<td>Connecting (ft)</td>
<td>34,373</td>
<td>10,312</td>
<td></td>
</tr>
<tr>
<td>Thaw Points (44.86 ft x $1.62/ft x 899)</td>
<td>899</td>
<td>65,333</td>
<td></td>
</tr>
<tr>
<td>Pumps (14&quot; x 12&quot;) (350 hp ea)</td>
<td>2</td>
<td>40,000</td>
<td>200</td>
</tr>
<tr>
<td>Power Distribution lines (ft)</td>
<td>13,200</td>
<td>92,400</td>
<td></td>
</tr>
<tr>
<td>(7.00/ft x 13,200 ft)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power (kw-hr)</td>
<td>913,104</td>
<td>---</td>
<td>164,359</td>
</tr>
<tr>
<td>(1700 hp @ $.18/kw-hr)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4 ton pickup truck</td>
<td>2</td>
<td>17,000</td>
<td>170</td>
</tr>
<tr>
<td>Skid mounted rotary drill and misc.</td>
<td>100,000</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td><strong>$7,319,205</strong></td>
<td><strong>$175,829</strong></td>
</tr>
</tbody>
</table>

(1) Machine tools not included in dredge machine shop.
B-5c. Submarine Beach

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Capital Cost</th>
<th>Operating Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bucket line dredge (9 ft³) (1000 hp)</td>
<td>1</td>
<td>$5,000,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Tractor dozer (D-8)</td>
<td>2</td>
<td>360,000</td>
<td>6,000</td>
</tr>
<tr>
<td><strong>Piping</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main 24&quot;(ft)</td>
<td>1,000</td>
<td>60,000</td>
<td>—</td>
</tr>
<tr>
<td>Secondary 14&quot;(ft)</td>
<td>5,184</td>
<td>207,360</td>
<td>—</td>
</tr>
<tr>
<td>Connecting (ft)</td>
<td>34,373</td>
<td>10,312</td>
<td>—</td>
</tr>
<tr>
<td><strong>Thaw Points</strong></td>
<td>426</td>
<td>50,869</td>
<td>—</td>
</tr>
<tr>
<td>(73.71 ft x $1.62/ft x 426)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pumps (14&quot; x 12&quot;) (350 hp ea)</strong></td>
<td>1</td>
<td>20,000</td>
<td>100</td>
</tr>
<tr>
<td><strong>Power Distribution lines (ft)</strong></td>
<td>5,280</td>
<td>36,960</td>
<td>—</td>
</tr>
<tr>
<td>($7.00/ft x 5280 ft)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Power (kw-hr)</strong></td>
<td>725,112</td>
<td></td>
<td>130,520</td>
</tr>
<tr>
<td>(1350 hp @ $.18/kw-hr)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3/4 ton pickup truck</strong></td>
<td>2</td>
<td>17,000</td>
<td>170</td>
</tr>
<tr>
<td><strong>Skid mounted rotary drill and misc.</strong></td>
<td>100,000</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTALS</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$5,862,501</td>
<td>$141,890</td>
</tr>
</tbody>
</table>

(1) Machine tools not included in dredge machine shop.
B-5d. Monroeville and Intermediate Beaches

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Capital Cost</th>
<th>Monthly Operating Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bucket line dredge (9 ft$^3$)(1000 hp)</td>
<td>1</td>
<td>$5,000,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Tractor dozer (D-8)</td>
<td>2</td>
<td>360,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Piping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main 48&quot;(ft)</td>
<td>10,560</td>
<td>844,800</td>
<td>---</td>
</tr>
<tr>
<td>Secondary 18&quot;(ft)</td>
<td>7,776</td>
<td>388,800</td>
<td>---</td>
</tr>
<tr>
<td>Connecting (ft)</td>
<td>16,666</td>
<td>5,000</td>
<td>---</td>
</tr>
<tr>
<td>Thaw Points (55.00 ft x $1.62/ft x 734)</td>
<td>734</td>
<td>65,399</td>
<td>---</td>
</tr>
<tr>
<td>Pumps (14&quot; x 12&quot;) (350 hp ea)</td>
<td>2</td>
<td>40,000</td>
<td>200</td>
</tr>
<tr>
<td>Power Distribution lines (ft) ($7.00/ft x 10,560 ft)</td>
<td>10,560</td>
<td>73,920</td>
<td>---</td>
</tr>
<tr>
<td>Power (kw-hr) (1700hp @ $.18/kw-hr)</td>
<td>913,104</td>
<td>---</td>
<td>164,359</td>
</tr>
<tr>
<td>3/4 ton pickup truck</td>
<td>2</td>
<td>17,000</td>
<td>170</td>
</tr>
<tr>
<td>Skid mounted rotary drill and misc. (1)</td>
<td>100,000</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td><strong>$6,894,919</strong></td>
<td><strong>$175,829</strong></td>
</tr>
</tbody>
</table>

(1) Machine tools not included in dredge machine shop. This extra drilling rig will be used as backup equipment.
B-6. Labor Requirements

B-6a. Third Beach

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
<th>Wages</th>
<th>Monthly Labor Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superintendent</td>
<td>1</td>
<td>$3,000/mo</td>
<td>$3,000</td>
</tr>
<tr>
<td>Foreman (Thaw Field)</td>
<td>1</td>
<td>2,800/mo</td>
<td>2,800</td>
</tr>
<tr>
<td>Dredge master</td>
<td>1</td>
<td>2,800/mo</td>
<td>2,800</td>
</tr>
<tr>
<td>Winchmen</td>
<td>3</td>
<td>17.00/hr</td>
<td>8,160</td>
</tr>
<tr>
<td>Machinist</td>
<td>1</td>
<td>15.00/hr</td>
<td>2,400</td>
</tr>
<tr>
<td>Mechanics</td>
<td>3</td>
<td>14.00/hr</td>
<td>6,720</td>
</tr>
<tr>
<td>Oilers</td>
<td>6</td>
<td>10.00/hr</td>
<td>9,600</td>
</tr>
<tr>
<td>Electricians</td>
<td>3</td>
<td>14.00/hr</td>
<td>6,720</td>
</tr>
<tr>
<td>Survey Technicians</td>
<td>3</td>
<td>10.00/hr</td>
<td>4,800</td>
</tr>
<tr>
<td>Deckhands</td>
<td>6</td>
<td>10.00/hr</td>
<td>9,600</td>
</tr>
<tr>
<td>Equipment operators</td>
<td>6</td>
<td>15.00/hr</td>
<td>14,400</td>
</tr>
<tr>
<td>Drillers (1)</td>
<td>3</td>
<td>15.00/hr</td>
<td>7,200</td>
</tr>
<tr>
<td>Labor (thaw field)</td>
<td>5</td>
<td>10.00/hr</td>
<td>8,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>42</td>
<td></td>
<td>$86,200</td>
</tr>
</tbody>
</table>

(1) Allocated labor from three 4-man crews of drillers and thaw point installers
### B-6b. Second Beach

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
<th>Wages</th>
<th>Monthly Labor Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superintendent</td>
<td>1</td>
<td>$3,000/mo</td>
<td>$3,000</td>
</tr>
<tr>
<td>Foreman (Thaw field)</td>
<td>1</td>
<td>2,800/mo</td>
<td>2,800</td>
</tr>
<tr>
<td>Dredge master</td>
<td>1</td>
<td>2,800/mo</td>
<td>2,800</td>
</tr>
<tr>
<td>Winchmen</td>
<td>3</td>
<td>17.00/hr</td>
<td>8,160</td>
</tr>
<tr>
<td>Machinist</td>
<td>1</td>
<td>15.00/hr</td>
<td>2,400</td>
</tr>
<tr>
<td>Mechanics</td>
<td>3</td>
<td>14.00/hr</td>
<td>6,720</td>
</tr>
<tr>
<td>Oilers</td>
<td>6</td>
<td>10.00/hr</td>
<td>9,600</td>
</tr>
<tr>
<td>Electricians</td>
<td>3</td>
<td>14.00/hr</td>
<td>6,720</td>
</tr>
<tr>
<td>Survey Technicians</td>
<td>3</td>
<td>10.00/hr</td>
<td>4,800</td>
</tr>
<tr>
<td>Deckhands</td>
<td>6</td>
<td>10.00/hr</td>
<td>9,600</td>
</tr>
<tr>
<td>Equipment operators</td>
<td>6</td>
<td>15.00/hr</td>
<td>14,400</td>
</tr>
<tr>
<td>Drillers (1)</td>
<td>3</td>
<td>15.00/hr</td>
<td>7,200</td>
</tr>
<tr>
<td>Labor (Thaw field)</td>
<td>9</td>
<td>10.00/hr</td>
<td>14,400</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>46</td>
<td></td>
<td><strong>$92,600</strong></td>
</tr>
</tbody>
</table>

(1) Allocated labor from three 4-man crews of drillers and thaw point installers.
B-6c, Submarine Beach

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
<th>Wages</th>
<th>Monthly Labor Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superintendent</td>
<td>1</td>
<td>$3,000/mo</td>
<td>$3,000</td>
</tr>
<tr>
<td>Foreman (Thaw field)</td>
<td>1</td>
<td>2,800/mo</td>
<td>2,800</td>
</tr>
<tr>
<td>Dredge master</td>
<td>1</td>
<td>2,800/mo</td>
<td>2,800</td>
</tr>
<tr>
<td>Winchmen</td>
<td>3</td>
<td>17.00/hr</td>
<td>8,160</td>
</tr>
<tr>
<td>Machinist</td>
<td>1</td>
<td>15.00/hr</td>
<td>2,400</td>
</tr>
<tr>
<td>Mechanics</td>
<td>3</td>
<td>14.00/hr</td>
<td>6,720</td>
</tr>
<tr>
<td>Oilers</td>
<td>6</td>
<td>10.00/hr</td>
<td>9,600</td>
</tr>
<tr>
<td>Electricians</td>
<td>3</td>
<td>14.00/hr</td>
<td>6,720</td>
</tr>
<tr>
<td>Survey Technicians</td>
<td>3</td>
<td>10.00/hr</td>
<td>4,800</td>
</tr>
<tr>
<td>Deckhands</td>
<td>6</td>
<td>10.00/hr</td>
<td>9,600</td>
</tr>
<tr>
<td>Equipment operators</td>
<td>6</td>
<td>15.00/hr</td>
<td>14,400</td>
</tr>
<tr>
<td>Drillers (1)</td>
<td>3</td>
<td>15.00/hr</td>
<td>7,200</td>
</tr>
<tr>
<td>Labor (Thaw field)</td>
<td>4</td>
<td>10.00/hr</td>
<td>6,400</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>41</td>
<td></td>
<td><strong>$84,600</strong></td>
</tr>
</tbody>
</table>

(1) Allocated labor from three 4-man crews of drillers and thaw point installers.
### B-6d. Monroeville and Intermediate Beaches

<table>
<thead>
<tr>
<th>Position</th>
<th>Quantity</th>
<th>Rate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superintendent</td>
<td>1</td>
<td>$3,000/mo</td>
<td>$3,000</td>
</tr>
<tr>
<td>Foreman (Thaw field)</td>
<td>1</td>
<td>2,800/mo</td>
<td>2,800</td>
</tr>
<tr>
<td>Dredge master</td>
<td>1</td>
<td>2,800/mo</td>
<td>2,800</td>
</tr>
<tr>
<td>Winchmen</td>
<td>3</td>
<td>17.00/hr</td>
<td>8,160</td>
</tr>
<tr>
<td>Machinist</td>
<td>1</td>
<td>15.00/hr</td>
<td>2,400</td>
</tr>
<tr>
<td>Mechanics</td>
<td>3</td>
<td>14.00/hr</td>
<td>6,720</td>
</tr>
<tr>
<td>Oilers</td>
<td>6</td>
<td>10.00/hr</td>
<td>9,600</td>
</tr>
<tr>
<td>Electricians</td>
<td>3</td>
<td>14.00/hr</td>
<td>6,720</td>
</tr>
<tr>
<td>Survey Technicians</td>
<td>3</td>
<td>10.00/hr</td>
<td>4,800</td>
</tr>
<tr>
<td>Deckhands</td>
<td>6</td>
<td>10.00/hr</td>
<td>9,600</td>
</tr>
<tr>
<td>Equipment operators</td>
<td>6</td>
<td>10.00/hr</td>
<td>14,400</td>
</tr>
<tr>
<td>Drillers (1)</td>
<td>3</td>
<td>15.00/hr</td>
<td>7,200</td>
</tr>
<tr>
<td>Labor (Thaw field)</td>
<td>7</td>
<td>10.00/hr</td>
<td>11,200</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td>44</td>
<td></td>
<td><strong>89,400</strong></td>
</tr>
</tbody>
</table>

(1) Allocated labor from three 4-man crews of drillers and thaw point installers.
B-7. Overhead Requirements
(40% of labor cost)

B-7a. Third Beach
0.40 x $86,200 = $34,480

B-7b. Second Beach
0.40 x $92,600 = $37,040

B-7c. Submarine Beach
0.40 x $84,600 = $33,840

B-7d. Monroeville and Intermediate Beaches
0.40 x $89,400 = $35,760

B-8. Contingency Requirements
10% of total monthly operating, labor, and overhead costs

B-8a. Third Beach
0.10 x $267,454 = $26,745

B-8b. Second Beach
0.10 x $305,469 = $30,547

B-8c. Submarine Beach
0.10 x $260,330 = $26,033

B-8d. Monroeville and Intermediate Beaches
0.10 x $300,989 = $30,099

B-9. Total monthly operating costs and estimated unit production costs

B-9a. Third Beach $294,199

Estimated unit production cost (EUP)

\[
EUP = \frac{\text{Total monthly operating cost}}{\text{Total monthly production}}
\]

\[
= \frac{\$294,199}{9000 \text{ yd}^3/\text{day} \times 30 \text{ day/mo} \times 0.765 \text{ m}^3/\text{yd}}
\]

\[
= \$1.42/\text{m}^3
\]

33
B-9b. Second Beach $336,016

Estimated unit production cost (EUP)

$$EUP = \frac{\text{Total monthly operating cost}}{\text{Total monthly production}}$$

$$= \frac{\$336,016}{7000 \text{ yd}^3/\text{day} \times 30 \text{ day/mo} \times 0.765 \text{ m}^3/\text{yd}^3}$$

$$= \$2.09/\text{m}^3$$

B-9c. Submarine Beach $286,363

Estimated unit production cost (EUP)

$$EUP = \frac{\text{Total monthly operating cost}}{\text{Total monthly production}}$$

$$= \frac{\$286,363}{9000 \text{ yd}^3/\text{day} \times 30 \text{ day/mo} \times 0.765 \text{ m}^3/\text{yd}^3}$$

$$= \$1.39/\text{m}^3$$

B-9d. Monroeville and Intermediate Beaches $331,088

Estimated unit production cost (EUP)

$$EUP = \frac{\text{Total monthly operating cost}}{\text{Total monthly production}}$$

$$= \frac{\$331,088}{9000 \text{ yd}^3/\text{day} \times 30 \text{ day/mo} \times 0.765 \text{ m}^3/\text{yd}^3}$$

$$= \$1.60/\text{m}^3$$
B-10. Estimated mine capital costs

B-10a. Third Beach

1. Acquisition cost: $4,164,000
   (10% of gross value @ $150/tr oz)

2. Exploration cost: 134,663
   (3 holes/5 acres x 293 acres x
    76.6 ft/holes x $10.00/ft)

3. Development cost: 1,667,128
   (one season operating cost)

4. Equipment cost: 6,968,966

5. Working capital cost: 1,176,796
   (cost of four months of operations)

   TOTAL $14,111,553

B-10b. Second Beach

1. Acquisition cost: $3,444,000
   (10% of gross value @ $150/tr oz)

2. Exploration cost: 81,764
   (3 holes/5 acres x 305 acres x
    44.68 ft/hole x $10.00/ft)

3. Development cost: 1,904,091
   (one season operating cost)

4. Equipment cost: 7,319,205

5. Working capital cost: 1,344,064
   (cost of four months of operation)

   TOTAL $14,093,124
B-10c. Submarine Beach

1. Acquisition cost: $4,977,000
   (10% of gross value @ $150/tr oz)

2. Exploration cost: 114,103
   (3 holes/5 acres x 258 x
   73.71 ft/hole x $10.00/ft)

3. Development cost: 1,622,724
   (one season operating cost)

4. Equipment: 5,862,501

5. Working capital cost: 1,145,452
   (cost of four months of operation)

TOTAL $13,721,780

B-10d. Monroeville and Intermediate Beaches

1. Acquisition cost: $4,897,500
   (10% of gross value @ 150/tr oz)

2. Exploration cost: 125,730
   (3 holes/5 acres x 381 acres x
   55.00 ft/hole x $10.00/hole)

3. Development cost: 1,876,165
   (one season operating cost)

4. Equipment cost: 6,894,919

5. Working capital cost: 1,324,352
   (cost of four months of operations)

TOTAL $15,118,666
APPENDIX C - Beneficiation Calculations

C.1. Mill Design Capacity

C.1a. Third Beach

Mill design capacity: 6885 m³/day (9000 yd³/day)
Estimated recovery of beneficiation product: 95%
Estimated percentage of gold in concentrate: 85%
Estimated amount of beneficiation product shipped:

\[
\frac{6885 \text{ m}^3}{\text{day}} \times \frac{0.31162 \text{ g}}{\text{m}^3} \times 0.95 \times \frac{1}{0.85} \times \frac{0.001 \text{ kg}}{\text{g}} = 2.398 \text{ kg/day}
\]

C.1b. Second Beach

Mill design capacity: 6885 m³/day (9000 yd³/day)
Estimated recovery of beneficiation product: 95%
Estimated percentage of gold in concentrate: 85%
Estimated amount of beneficiation product shipped:

\[
\frac{6885 \text{ m}^3}{\text{day}} \times \frac{0.42296 \text{ g}}{\text{m}^3} \times 0.95 \times \frac{1}{0.85} \times \frac{0.001 \text{ kg}}{\text{g}} = 3.255 \text{ kg/day}
\]

C.1c. Submarine Beach

Mill design capacity: 5355 m³/day (7000 yd³/day)
Estimated recovery of beneficiation product: 95%
Estimated percentage of gold in concentrate: 85%
Estimated amount of beneficiation product shipped:

\[
\frac{5355 \text{ m}^3}{\text{day}} \times \frac{0.43975 \text{ g}}{\text{m}^3} \times 0.95 \times \frac{1}{0.85} \times \frac{0.001 \text{ kg}}{\text{g}} = 2.632 \text{ kg/day}
\]

C.1d. Monroeville and Intermediated Beaches

Mill design capacity: 6885 m³/day (9000 yd³/day)
Estimated recovery of beneficiation product: 95%
Estimated percentage of gold in concentrate: 85%
Estimated amount of beneficiation product shipped:

\[
\frac{6885 \text{ m}^3}{\text{day}} \times \frac{0.39279 \text{ g}}{\text{m}^3} \times 0.95 \times \frac{1}{0.85} \times \frac{0.001 \text{ kg}}{\text{g}} = 3.023 \text{ kg/day}
\]
C.2. Equipment Requirements and Capital Costs

C.2a. Third Beach

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Capital Cost (1)</th>
<th>Monthly Operating Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bucket line dredge</td>
<td>1</td>
<td>$2,000,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Power (kw-hr)</td>
<td>107,424</td>
<td>---</td>
<td>19,336</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>$2,000,000</strong></td>
<td></td>
</tr>
</tbody>
</table>

C.2b. Second Beach

(same as Third Beach)

C.2c. Submarine Beach

(same as Third Beach)

C.2d. Monroeville and Intermediate Beaches

(same as Third Beach)

C.3. Labor Requirements

C.3a. Third Beach

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Rate (hr.)</th>
<th>Monthly Operating Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panners</td>
<td>3</td>
<td>$12.00/hr.</td>
<td>5,760</td>
</tr>
<tr>
<td>Labor</td>
<td>3</td>
<td>10.00/hr.</td>
<td>4,800</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6</td>
<td></td>
<td><strong>$10,560</strong></td>
</tr>
</tbody>
</table>

C.3b. Second Beach

(Same as Third Beach)

C.3c. Submarine Beach

(Same as Third Beach)

C.3d. Monroeville and Intermediate Beaches

(Same as Third Beach)

(1) Five sevenths of the capital and operating costs of the dredge is allocated to the mining operation.
C.4. Overhead requirements

40% of labor

C.4a. Third Beach

0.40 \times \$10,560 = \$4,224

C.4b. Second Beach

(Same as Third Beach)

C.4c. Submarine Beach

(Same as Third Beach)

C.4d. Monroeville and Intermediate Beaches

(Same as Third Beach)

C.5. Contingency Requirements

10% of total monthly operating, labor and overhead costs

C.5a. Third Beach

0.10 \times \$36,120 = \$3,612

C.5b. Second Beach

(Same as Third Beach)

C.5c. Submarine Beach

(Same as Third Beach)

C.6. Total Monthly Operating Costs

C.6a. Third Beach \quad \$39,732

C.6b. Second Beach \quad \$39,732

C.6c. Submarine Beach \quad \$39,732

C.6d. Monroeville and Intermediate Beaches \quad \$39,732
C.7, Estimated Unit Production Cost (EUP)

\[
EUP = \frac{\text{Total monthly operating cost}}{\text{Total monthly production}}
\]

C.7a. Third Beach

\[
EUP = \frac{$39,732/\text{mo}}{6885 \text{ m}^3/\text{day} \times 30 \text{ days/mo}} = $0.19/\text{m}^3
\]

C.7b. Second Beach

(Same as Third Beach)

C.7c. Submarine Beach

\[
EUP = \frac{$39,732/\text{mo}}{5344 \text{ m}^3/\text{day} \times 30 \text{ days/mo}} = .25/\text{m}^3
\]

C.7d. Monroeville and Intermediate Beaches

(Same as Third Beach)
Figure 2 - Block diagram of Nome Beaches

EXPLANATION

- Recent alluvium
- Glacial drift
- Auriferous beach deposits
- Paleozoic or older bedrock

1. Norton Sound
2. Outer Submarine Beach
3. Second Beach
4. Inner Submarine Beach
5. Snake River
6. Intermediate Beach
7. Monroeville Beach
8. Third Beach
9. Fourth Beach
<table>
<thead>
<tr>
<th></th>
<th>Area (acres)</th>
<th>Dredgeable Gravel (cubic yards)</th>
<th>Dredgeable Gravel (cubic meters)</th>
<th>Estimated Gold (tr.oz)</th>
<th>Estimated Gold (tr.oz/cubic meter)</th>
<th>Estimated Gold (g/cubic meter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Beach</td>
<td>293</td>
<td>36,210,000</td>
<td>27,700,650</td>
<td>277,600</td>
<td>0.01002</td>
<td>0.31162</td>
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<tr>
<td>Submarine Beach</td>
<td>258</td>
<td>30,660,000</td>
<td>23,470,200</td>
<td>331,800</td>
<td>0.01414</td>
<td>0.43975</td>
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<tr>
<td>Second Beach</td>
<td>305</td>
<td>22,075,000</td>
<td>16,887,375</td>
<td>229,600</td>
<td>0.01360</td>
<td>0.42296</td>
</tr>
<tr>
<td>Monroeville/Intermediate Beaches</td>
<td>381</td>
<td>33,805,000</td>
<td>25,860,825</td>
<td>326,500</td>
<td>0.01263</td>
<td>0.39279</td>
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<tr>
<td>Other areas</td>
<td>43</td>
<td>4,060,000</td>
<td>3,105,900</td>
<td>27,500</td>
<td>0.00885</td>
<td>0.27536</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td><strong>1,280</strong></td>
<td><strong>126,830,000</strong></td>
<td><strong>97,024,950</strong></td>
<td><strong>1,193,000</strong></td>
<td></td>
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</tr>
</tbody>
</table>
Table II  Dredging area and volume of dredging material of the Nome Beaches

<table>
<thead>
<tr>
<th></th>
<th>Area (acres)</th>
<th>Area (square yards)</th>
<th>Area (hectares)</th>
<th>Area (square meters)</th>
<th>Volume (cubic yards)</th>
<th>Volume (cubic meters)</th>
<th>Average Depth (yards)</th>
<th>Average Depth (feet)</th>
<th>Average Depth (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Beach</td>
<td>293</td>
<td>1,418,120</td>
<td>118.58</td>
<td>1,185,800</td>
<td>36,210,000</td>
<td>27,700,650</td>
<td>25.53</td>
<td>76.60</td>
<td>23.35</td>
</tr>
<tr>
<td>Submarine Beach</td>
<td>258</td>
<td>1,248,720</td>
<td>104.41</td>
<td>1,044,100</td>
<td>30,680,000</td>
<td>23,470,200</td>
<td>24.57</td>
<td>73.71</td>
<td>22.47</td>
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<tr>
<td>Second Beach</td>
<td>305</td>
<td>1,476,200</td>
<td>123.43</td>
<td>1,234,300</td>
<td>22,075,000</td>
<td>16,887,375</td>
<td>14.95</td>
<td>44.86</td>
<td>13.68</td>
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<tr>
<td>Monroeville/ Intermediate Beaches</td>
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<td>1,844,040</td>
<td>154.19</td>
<td>1,541,900</td>
<td>33,805,000</td>
<td>25,860,825</td>
<td>18.33</td>
<td>55.00</td>
<td>16.77</td>
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<tr>
<td>Other</td>
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<td>17.40</td>
<td>174,000</td>
<td>4,060,000</td>
<td>3,105,900</td>
<td>19.51</td>
<td>58.52</td>
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