NI 43-101 TECHNICAL REPORT
Prefeasibility Study
for the
OCHOA PROJECT
Lea County, New Mexico

PREPARED FOR IC POTASH CORP

Effective date: December 30, 2011

Signature date: December 30, 2011

PREPARED BY
William J. Crowl, R.G., QP MMSA
Donald E. Hulse, P.E.
Gary Tucker, P.E., FLSmidth

GUSTAVSON ASSOCIATES
GEOLOGISTS · ENGINEERS · ECONOMISTS · APPRAISERS

WILLIAM J. CROWL, R.G.

Vice President, Mining
Gustavson Associates, LLC
274 Union Boulevard, Suite 450
Lakewood, Colorado 80228
Telephone: 720-407-4062 Facsimile: 720-407-4067
Email: wcrowl@gustavson.com

CERTIFICATE of AUTHOR

I, William J. Crowl do hereby certify that:

1. I am currently employed as Vice President, Mining by Gustavson Associates, LLC at:

   274 Union Boulevard
   Suite 450
   Lakewood, Colorado 80228

2. I am a graduate of the University of Southern California with a Bachelor of Arts in Earth Science (1968), and an MSc. in Economic Geology from the University of Arizona (1979), and have practiced my profession continuously since 1973.
3. I am a member in good standing of the Mining and Metallurgical Society of America, member #01412QP.
4. I have worked as a geologist for a total of 38 years since my graduation from university; as a graduate student, as an employee of a major mining company, a major engineering company, and as a consulting geologist.
5. I have read the definition of "qualified person" set out in NI 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
6. I am responsible for the preparation of the report titled "NI 43-101 Technical Report Prefeasibility Study for the Ochoa Project, Lea County, New Mexico," effective date, December 30, 2011 (the "Technical Report"), with specific responsibility for Sections 1 through 12 and oversight of the entire document.
7. I conducted a visit to the Ochoa project site on April 28 and 29, 2010.
8. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

9. I do not hold, nor do I expect to receive, any securities or any other interest in any corporate entity, private or public, with interests in the properties that are the subject of this report or in the properties themselves, nor do I have any business relationship with any such entity apart from a professional consulting relationship with the issuer, nor to the best of my knowledge do I have any interest in any securities of any corporate entity with property within a two (2) kilometer distance of any of the subject properties.
10. I am independent of IC Potash Corp. according to the criteria stated in Section 1.5 of NI 43-101.
11. I previously contributed to the preparation of the technical report on the Ochoa project titled "NI 43-101 Technical Report on the Polyhalite Resources and Preliminary Economic Assessment of the Ochoa Project in Lea County, Southeast New Mexico," dated August 19, 2009, "NI 43-101 Technical Report on the Polyhalite Resources and Preliminary Economic Assessment of the Ochoa Project in Lea County, Southeast new Mexico," dated January 14, 2010, and "NI 43-101 Technical Report on the Polyhalite Resources and Updated Mineral Resources Estimate for the Ochoa Project Lea County, Southeast New Mexico," dated November 25, 2011. I have previously worked on the Ochoa project as a consultant
12. I have read NI 43-101 and Form NI 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.
13. I consent to the filing of the Technical Report with any stock exchanges or other regulatory authority and any publication by them, including electronic publication in the public company files on the websites accessible by the public, of the Technical Report.

Dated this 30th day of December, 2011.

/s/ William J. Crowl (Signature)

Signature of Qualified Person

"William J. Crowl"

Print name of Qualified Person

DONALD E. HULSE, P.E.

Vice President
Gustavson Associates, LLC
274 Union Boulevard, Suite 450
Lakewood, Colorado 80228
Telephone: 720-407-4062 Facsimile: 720-407-4067
Email: dhulse@gustavson.com

CERTIFICATE of AUTHOR

I, Donald E. Hulse do hereby certify that:

1. I am currently employed as Vice President by Gustavson Associates, LLC at:

   274 Union Boulevard
   Suite 450
   Lakewood, Colorado 80228

2. I am a graduate of the Colorado School of Mines with a Bachelor of Science in Mining Engineering (1982), and have practiced my profession continuously since 1983.
3. I am a registered Professional Engineer in the State of Colorado (35269).
4. I have worked as a mining engineer for a total of 28 years since my graduation from university; as an employee of a major mining company, a major engineering company, and as a consulting engineer.
5. I have read the definition of "qualified person" set out in NI 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
6. I am responsible for the preparation of the technical report titled "NI 43-101 Technical Report Prefeasibility Study for the Ochoa Project, Lea County, New Mexico effective date, December 30, 2011 (the "Technical Report"), with specific responsibility for Sections 14 through 16 and 18 through 28.
7. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.
8. I am not aware of any material fact or material change with respect to the subject matter of the Technical Report that is not reflected in the Technical Report, the omission to disclose which makes the Technical Report misleading.

9. I do not hold, nor do I expect to receive, any securities or any other interest in any corporate entity, private or public, with interests in the properties that are the subject of this report or in the properties themselves, nor do I have any business relationship with any such entity apart from a professional consulting relationship with the issuer, nor to the best of my knowledge do I have any interest in any securities of any corporate entity with property within a two (2) kilometer distance of any of the subject properties.

10. I am independent of IC Potash Corp. according to the criteria stated in Section 1.5 of NI 43-101.

11. I previously contributed to the preparation of the technical report on the Ochoa project titled "NI 43-101 Technical Report on the Polyhalite Resources and Preliminary Economic Assessment of the Ochoa Project in Lea County, Southeast New Mexico," dated August 19, 2009,"NI 43-101 Technical Report on the Polyhalite Resources and Preliminary Economic Assessment of the Ochoa Project in Lea County, Southeast new Mexico," dated January 14, 2010, and "NI 43-101 Technical Report on the Polyhalite Resources and Updated Mineral Resources Estimate for the Ochoa Project Lea County, Southeast New Mexico," dated November 25, 2011. I have previously worked on the Ochoa project as a consultant

12. I have read NI 43-101 and Form NI 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.

13. I consent to the filing of the Technical Report with any stock exchanges or other regulatory authority and any publication by them, including electronic publication in the public company files on the websites accessible by the public, of the Technical Report.

Dated this 30th day of December, 2011.

/s/Donald E. Hulse (Signature)

Signature of Qualified Person

"Donald E. Hulse"

Print name of Qualified Person

Gary L. Tucker, P.E.
Project Manager
FLSmidth Salt Lake City, Inc.
7158 S. FLSmidth Drive
Midvale, Utah 84047
Telephone: 801-233-5812 Facsimile: 801-233-5655
Email: gary.tucker@flsmidth.com

CERTIFICATE of AUTHOR

I, Gary L. Tucker, do hereby certify that:

1. I am currently employed as a Project Manager by FLSmidth Salt Lake City, Inc. at:

   7158 S. FLSmidth Drive
   Midvale, Utah 84047

1. I am a graduate of the Rose-Hulman Institute of Technology with a Bachelor of Science in Civil Engineering (cum laude 1976), and have practiced my profession continuously since graduation.
2. I am currently registered as a Professional Engineer in the State of Indiana (PE60019557), the State of Arizona (Civil-44060), and the State of Colorado (29702).
3. I have worked as a civil and a mining engineer for a total of 35 years since my graduation from Rose-Hulman; as an employee of a major mining company, and as an employee of major and minor engineering consulting companies.
4. I have read the definition of "qualified person" set out in NI 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
5. I am responsible for the preparation of portions of the technical report titled "NI 43-101 Technical Report Prefeasibility Study for the Ochoa Project, Lea County, New Mexico effective date, December 30, 2011 (the "Technical Report"), with specific responsibility for Sections 13, 17, and process aspects of Sections 18, 22, and 23.
6. I am not aware of any material fact or material change with respect to the subject matter of the Technical Report that is not reflected in the Technical Report, the omission to disclose which makes the Technical Report misleading.
7. I do not hold, nor do I expect to receive, any securities or any other interest in any corporate entity, private or public, with interests in the properties that are the subject of this report or in the properties themselves, nor do I have any business relationship with any such entity apart from a professional consulting relationship with the issuer, nor to the best of my

knowledge do I have any interest in any securities of any corporate entity with property within a two (2) kilometer distance of any of the subject properties.

8. I have read NI 43-101 and Form NI 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.
9. I consent to the filing of the Technical Report with any stock exchanges or other regulatory authority and any publication by them, including electronic publication in the public company files on the websites accessible by the public, of the Technical Report.

Dated this 30th day of December, 2011.

/s/Gary L. Tucker (Signature)

Signature of Qualified Person

"Gary L. Tucker"

Print name of Qualified Person

TABLE OF CONTENTS

Section **Page**

TABLE OF FIGURES

TABLE OF TABLES

Table **Page**

ACRONYMS

2D	2-dimensional
ac	acres
ACFM	actual cubic feet per minute
ac-ft/yr	acre-feet per year
Ai	abrasion index
AOI	Area of Interest
AQB	Air Quality Bureau
ASTM	American Society for Testing and Materials
ASTs	aboveground storage tanks
bgs	below ground surface
BLM	Bureau of Land Management
BTU	British thermal units
C	Celsius
Ca	calcium
Capitan Basin	Capitan Administrative Basin
Carlsbad Basin	Carlsbad Administrative Basin
CBM	coalbed methane
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGM	conceptual groundwater model
CIM	Canadian Institute of Mining, Metallurgy, and Petroleum
Cl	chlorine
cm	centimeters
CMAs	critical management areas
CRA	cost reimbursement agreement
Cu	copper
D&A	drilled and abandoned
DEIS	draft environmental impact statement
DEWS	Double Eagle Water System
DOE	U.S. Department of Energy
DTA	Differential Thermal Analysis
DWi	drop-weight index
EAs	environmental analyses
EIS	environmental impact statement
EIT	Engineer In Training
EPA	U.S. Environmental Protection Agency
E-type	average model
FEIS	final environmental impact statement

FLSmidth	FLSmidth Salt Lake City, Inc.
F	Fahrenheit
FEFLOW	Finite Element subsurface FLOW system model
ft	feet
ft/day	ft per day
ft^2/day	square feet per day
ft^3/ton	cubic feet per ton
gpm	gallons per minute
Gustavson	Gustavson Associates LLC
GWQB	Ground Water Quality Bureau
HP	horse power
HPD	a subsidiary of Veolia Water Solutions & Technologies
ICP	Intercontinental Potash Corporation (USA) and IC Potash Corp.
IRR	Internal Rate of Return
k	thousand
K	potassium
kg	kilogram
K-Mag ®	Fertilizer by The Mosaic Company
kV	kilovolt
kW	kilowatt
kWH	kilowatt-hour
kWH/t	kilowatt per ton
Lea County Basin	Lea County Administrative Basin
LLDPE	linear low-density polyethylene
MA	milliamperes
MCC	motor control center room
Mg	magnesium
mgd	million gallons per day
mg/L	milligrams per liter
mi	miles
miner	continuous miner
mm	millimeters
MMD	Mining and Minerals Division
MMSA	Mining and Metallurgical Society of America
MODFLOW	three-dimensional finite-difference groundwater model
MOP	muriate of potash
MOU	memorandum of understanding
MPO	Mine Plan of Operations
MSHA	Mine Safety and Health Administration
M-type	median model

MVR	Mechanical Vapor Recompression
MW	megawatt
Na	sodium
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NI 43-101	National Instrument 43-101
NOI	notice of intent
North Custer	North Custer Mountain Unit No. 1
NMAQCR	New Mexico Air Quality Control Regulation
NMED	New Mexico Environment Department
NM OSE	New Mexico Office of the State Engineer
NMSA	New Mexico Statutes Annotated
NMSLO	New Mexico State Land Office
NPDES	National Pollutant Discharge Elimination System
NPV	Net Projected Value
NSPS	New Source Performance Standards
OES	optical emission spectrometry
P&A	plug and abandon
pcf	Pounds per cubic foot
PEA	Preliminary Economic Assessment
PEST	Parameter Estimation and Uncertainty Analysis
PFS	Prefeasibility Study
ppm	parts per million
PSD	Prevention of Significant Deterioration
psd	particle size distribution
psia	pounds per square inch absolute
PST	Petroleum Storage Tank Bureau
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RDi	Resource Development Inc.
RMP	Resource Management Plan
RO	reverse osmosis
ROD	record of decision
ROM	run of mine
RWi	rod mill work index
S	sulfur
SDIC	State Development and Investment Corporation
SEAWAT	Three-dimensional variable-density groundwater flow model
SGeMS	Stanford Geostatistical Modeling Software

SGS	Sequential Gaussian Simulation
SHPO	State Historic Preservation Office
SMC	Sag Mill Comminution
SME	Society for Mining, Metallurgy, and Exploration
SOP	sulfate of potassium/ potassium sulfate
SOPM	sulfate of potash magnesia potassium-magnesium sulfate
SRM	standard reference materials
SWPPP	stormwater pollution prevention plan
TDS	total dissolved solids
TGA	Thermo-gravimetric Analysis
TPH	tons per hour
tpy	tonnes per year
TWDB	Texas Water Development Board
U	uranium
Upstream	Upstream Resources LLC
USACE	U.S. Army Corps of Engineers
USBM	U.S. Bureau of Mines
USTs	underground storage tanks
WC	water column
WIPP	Waste Isolation Pilot Plant
WRD	Water Rights Division
XRD	x-ray diffraction
XRF	x-ray fluorescent

1 SUMMARY

1.1 Introduction

IC Potash Corp. (ICP) commissioned Gustavson Associates LLC (Gustavson) to complete a Prefeasibility Study (PFS) for the Ochoa Polyhalite Project in Lea County, New Mexico. Gustavson subcontracted numerous aspects of the report to industry experts, consultants, and engineering groups who contributed significantly to this document. The purpose of this report is to summarize the results of the PFS in compliance with Canadian National Instrument 43-101 (NI 43-101) Standards of Disclosure for Mineral Projects.

The following experts, consultants, and engineering groups significantly contributed to this document:

- Gustavson Associates, LLC
- FLSmidth Salt Lake City, Inc.
- HPD
- Chastain Consulting
- Neuman Consulting
- Upstream Resources
- Chemfelt
- INTERA
- Walsh
- CRU
- FEECO
- Roth Associates

1.2 Property Description and Ownership

The Ochoa Project is located in the Pecos Valley section of the southern Great Plains physiographic province, approximately 60 miles (mi) east of Carlsbad, New Mexico, and less than 20 mi west of the Texas-New Mexico state line. The local climate is typical of a high plains desert environment. Terrain is relatively flat with shallow arroyos and low-quality semi-arid rangeland. Elevation ranges from 3,100 ft to 3,750 ft above sea level. Exploration, mining, and mineral processing can occur year-round.

Through its wholly-owned subsidiary, Intercontinental Potash Corp. (USA) (ICP) holds a 100% interest in the Ochoa Project in New Mexico. The Ochoa Project is composed of 34 federal Bureau of Land Management (BLM) potassium prospecting permits covering approximately 76,000 acres (ac) and 17 New Mexico State Land Office (NMSLO) mining leases covering approximately 26,000 ac. The Ochoa Project is currently in advanced exploration status.

1.3 Geology and Mineralization

The Ochoa Project lies at the northeastern margin of the Delaware Basin, a structural sub-basin of the large Permian Basin that dominated the region of southeast New Mexico, West Texas, and northern Mexico from 265 mega-annum (Ma) to 230 Ma. The project area is located in the southeast corner of New Mexico, approximately 25 mi east of a major potash producing district near Carlsbad. ICP's exploration target is polyhalite contained in the Tamarisk Member of the Rustler Formation. The Rustler Formation overlies the Salado Formation, which is host to the McNutt potash zone in the Carlsbad area. The Rustler Formation is predominantly made up of marine anhydrite and dolomite, and represents a transition between the predominantly halite-bearing evaporites of the Salado Formation to the continental red beds of the Dewey Lake Formation. The Tamarisk Member is comprised of three sub-units that are a basal anhydrite, a middle halite-rich mudstone, and an upper anhydrite. Polyhalite occurs within the anhydrite. The thickness of the Tamarisk Member varies principally as a function of the thickness of the middle halite unit.

1.4 Status of Exploration

Exploration work completed at the Ochoa Project includes six widely distributed drill holes completed between December 2009 and February 2010 (Phase I), seven in-fill drill holes completed between April and September 2010 (Phase 2), and seven additional in-fill drill holes completed between January and June 2011 (Phase 2B). Other exploration work includes study of a roughly 1,000-mi^2 area in order to identify major geologic features and determine the basic distribution of lithologic units, including polyhalite mineralization. This work relied on published reports and was supplemented with petroleum data records and well logs obtained from public and commerical sources. ICP also aquired 812 geophysical borehole logs from IHS Energy Incorporated. Wireline log readings from these boreholes have been used to interpret subsurface lithology.

1.5 Mineral Resource Estimate

The mineral resource estimate reported for the Ochoa Project as of November 25, 2011, was completed by Zachary J. Black, E.I.T., Gustavson Staff Geological Engineer, under the supervision of Donald E. Hulse, P.E., VP. The mineral resource was updated to include data from seven new core holes drilled during ICP's Phase 2B drilling program. This mineral resource estimate is compliant with NI 43-101 Standards of Disclosure for Mineral Projects and Canadian Institute of Mining, Metallurgy, and Petroleum (CIM) Definition Standards.

Gustavson used conditional simulation and an ordinary kriging algorithm to estimate polyhalite thickness and grade to insert into a grid model. Geophysical data from oil and gas wells drilled in and around the Ochoa Project area were combined with ICP drill core data available as of September 1, 2011 and used to correlate and verify geologic interpretations and polyhalite thicknesses. A two-dimensional, gridded polyhalite thickness model was generated by Upstream

Resources LLC (Upstream) using the Petra® software package. A tonnage factor of 11.43 cubic feet per ton (ft^3/ton) was derived from core hole density tests in 2009. Densities indicated by the results of process and rock mechanics testing in 2011 are slightly lower, averaging 11.76 ft^3/ton. Gustavson used a weighted average of 11.53 ft^3/ton for the resource estimation. The updated polyhalite mineral resource estimate for the Ochoa Project is presented in Table 1-1.

Table 1-1 Ochoa Project Mineral Resource Tabulation

Conditional Simulation Median Model				
4 ft Minimum Thickness	**Measured**	**Indicated**	**Measured plus Indicated**	**Inferred**
Tons (million)	422	562	984	440
Grade Polyhalite	80.2%	79.9%	80.0%	80.6%
Eq Grade K_2SO_4	22.7%	22.6%	22.7%	22.8%
5 ft Minimum Thickness	**Measured**	**Indicated**	**Measured plus Indicated**	**Inferred**
Tons (million)	**390**	**448**	**838**	**269**
Grade Polyhalite	**80%**	**80.2%**	**80.3%**	**80.7%**
Eq Grade K_2SO_4	**22.8%**	**22.7%**	**22.8%**	**22.9%**
6 ft Minimum Thickness	**Measured**	**Indicated**	**Measured plus Indicated**	**Inferred**
Tons (million)	42	21	63	.8
Grade Polyhalite	84.5%	84.4%	84.5%	84.2%
Eq Grade K_2SO_4	24.0%	23.9%	23.9%	23.9%

(1) Mineral resources that are not mineral reserves have not demonstrated economic viability and may be materially affected by environmental, permitting, legal, title, taxation, sociopolitical, marketing, or other relevant issues, and are subject to the findings of a full feasibility study.

(2) The quantity and grade of reported inferred mineral resources in this estimation are uncertain in nature and exploration is insufficient to define these inferred resources as indicated or measured mineral resources and it is uncertain if further exploration will result in upgrading inferred resources to indicated or measured resources.

(3) The mineral resources reported here were estimated according to the Canadian Institute of Mining, Metallurgy, and Petroleum (CIM) standards on Mineral Resources and Reserves, Definitions and Guidelines dated November 27, 2010.

1.6 Market Studies and Contracts

ICP commissioned CRU Strategies (CRU Group) to evaluate the world-wide fertilizer market and forecast the expected sales prices for the Ochoa Project's finished products of potassium sulfate (SOP) and potassium-magnesium sulfate (SOPM) in ICP's main target markets of North and South America and Asia. The demand for SOP, the main finished product from the Ochoa Project, is expected to rise by 1.3 million tons during the 15-year period analyzed from 2010 to 2025, with 0.95 million tons of that increase occurring from 2015 to 2025. Ochoa is projected to produce 250,000 tons of SOP in 2016 and ramp up to its normal level of 568,000 tons in 2018. ICP believes that its production will not exceed the market's ability to absorb it.

The CRU study projects the following sales prices for granular SOP and SOPM for Ochoa production planned for 2016 – 2025. The average of the projected SOP and SOPM prices from years 2022 – 2025 were used for the rest of the 40 years in the study.

Table 1-2 Forecast Sales Prices, SOP and SOPM; 2016-2055

Production Year	Projected SOP Sales Price, $	Projected SOPM Sales Price, $
2016	592	206
2017	622	210
2018	642	215
2019	704	231
2020	765	246
2021	815	261
2022	915	285
2023	813	261
2024	778	253
2025	745	245
2026 - 2055	817	261

1.7 Mineral Reserve Estimate

A 40 year mine plan was created for a portion of the mineral resource based on a production scenario of producing 660,000 tons (600,000 tonnes) per year of SOP equivalent. The area that was chosen for the initial 40 year mine plan focused on an area within the reserves that has the thickest and highest quality polyhalite as well as having the least amount of active of oil and gas wells. This area for the mine plan has the capability of future expansion to approximately 90 years based on the proposed production rate.

The PFS has demonstrated that the project is economically viable; therefore Measured and Indicated Mineral Resources contained in the mine plan are considered Proven and Probable Reserves. The Mineral Reserve Estimate for the Ochoa Project is based on a proposed 40 year mine plan with a forecast sale price of $623 per ton of finished product over the life of the project. An economic cutoff grade of 16% polyhalite was calculated based on the sale price of material and the estimated operating costs, though a much higher 70% polyhalite cutoff grade was used.

Mineral Reserves were estimated by Gustavson according to CIM definitions based on technical data and information received prior to September 1, 2011. Using assumed design parameters and proposed production rates, Proven and Probable Mineral Reserves for the Ochoa Project totals 414 million tons at polyhalite grade of 83.98%, which is sufficient to allow the mine approximately 93 years of production.

A minimum mining thickness of 5 feet (ft) was used to estimate the Mineral Reserves, based on the operating height of proposed mining equipment. In areas where the polyhalite is less than 5 ft thick, the ore is diluted with waste material (anhydrite) above and below the polyhalite bed in order to achieve the minimum mining thickness. Dilution was also added to the modeled polyhalite thickness to incorporate uncertainty in ore selectivity. A minimum dilution of 0.2 ft of material both above and below the polyhalite seam was added as dilution. The Mineral Reserve Estimate is tabulated in Table 1-3.

Table 1-3 Mineral Reserve Estimate

Reserves Within 40 Year Mine Plan				
	Total Ore Tons	Recovery Factor	Recovered Ore Tons	Diluted Grade Percent Polyhalite
Proven	76,950,000	84.29%	64,861,000	80.14%
Probable	93,632,000	79.69%	74,613,000	78.78%
Total Proven & Probable	**170,582,000**	**81.76%**	**139,474,000**	**79.39%**
Remaining Reserves Within Proposed Mine Plan				
Proven	115,709,000	84.62%	97,911,000	76.51%
Probable	128,163,000	83.44%	106,935,000	75.33%
Total Proven & Probable	**243,872,000**	**84.00%**	**204,846,000**	**75.89%**
Total Proven and Probable Reserves Within Entire Proposed Mine Plan				
	414,454,000	**83.08%**	**344,320,000**	**77.33%**

1.8 Mining

The mining method selected for the extraction of polyhalite will be room and pillar retreat in a herringbone pattern, similar to other mines in the Carlsbad mining district. The polyhalite bed varies in depth and thickness within the proposed mine area from 1,180 ft to 1,740 ft below ground surface (bgs) with a thickness range of 4.5 to 6.5 ft The area is an active production area for oil and gas companies and there are numerous active oil and gas wells within the mine plan.

An extraction rate of 90% is planned for most portions of the mine; however, in areas of the mine that are within 1,500 ft of an active gas or oil well, 60% of the polyhalite will be extracted in order to safeguard the stability of the active well and minimize ground subsidence in areas around the wells. A 200 ft radius around all active and abandoned wells will not be mined or disturbed leaving a strong pillar to reduce potential for migration of fluids or gases from well bores into the mine. There are no known natural sources of gas within the mining horizon, Nevertheless ICP has elected to follow the rules and regulations of a category III gassy mine under Mine Safety and Health Administration (MSHA) Code of Federal Regulations (CFR) 30 because there are active and abandoned gas wells in the immediate area. All mine and ventilation plans will follow the rules and regulation pertaining to a category III mine.

1.9 Processing

Much of the proposed process of transforming polyhalite into SOP and langbeinite was based upon research from the U.S. Bureau of Mines (USBM) in the 1930's. Detailed tests were done on all aspects of the processing in order to determine that producing SOP from polyhalite is both economical and can be produced on a large scale.

Polyhalite will first be crushed to minus 10 mesh, which was determined by initial testing to be the best size for extracting the potassium from the polyhalite. The second step of the processing is calcination where the crushed polyhalite is heated to 480-520˚C with 500 ˚C appearing to be optimum, making the potassium magnesium and sulfate contained in the polyhalite soluble in water for leaching. A rotary kiln was considered in the PFS, other options include vertical flash and fluid bed technology. Additional test work prior to the Feasibility Study is needed to determine the optimum equipment configuration. After calcination, the material will be leached to dissolve the polyhalite, the resulting brine will be sent to the crystallizer circuit. The crystallization circuit changed from use of evaporation ponds, previously considered in the Preliminary Economic Assessment (PEA) to Mechanical Vapor Recompression (MVR) in order to precipitate potassium sulfate and langbeinite from the solution. These products are then dried and granulated in order to create a particle suitable for the market. Exhaust gases from the process will be scrubbed and dust will be captured prior to discharging gases back into the atmosphere.

The layout of the plant was generated by FLSmidth Salt Lake City, Inc. (FLSmidth), in July 2011. FLSmidth is responsible for the front-end processes (crushing, milling, calcining, leaching) and the back-end processes (crystal drying, granulation, on-site product storage). HPD, a subsidiary of Veolia Water Solutions & Technologies, is responsible for the evaporators and crystallizers using MVR and phase chemistry to produce langbeinite, and SOP crystals.

1.10 Operating Costs

Operating costs are based on scheduled production, equipment requirements, operating hours, hourly equipment operating costs, and manpower requirements. These costs and requirements were determined from a variety of sources that included, estimates from vendors, FLSmidth, HPD, Gustavson's historical and internal cost estimates, InfoMine USA Mine and Mill Equipment Cost Estimators Guide and ICP employees' first-hand knowledge and information of the potash operations in the Carlsbad region.

The detailed equipment costs for the mine and processing plant include maintenance parts, lube, tires, wear parts, supplies, and diesel fuel where applicable. Electricity costs and labor were tracked separately from the equipment operating costs. All necessary maintenance and operational staff were included in the staff and personnel detail. The operating costs were determined based on production of 568 thousand (k) tons of SOP and 275k tons of langbeinite per year which is equivalent to 660k tons of SOP only. All costs per ton of finished product are based on a total combined basis. A summary of the average annual operating costs are shown in Table 1-4 below. Major component rebuild costs are not included within the operating costs as these items are capitalized as discussed in Section 13 on Sustaining Capital.

Table 1-4 Average Annual Operating Costs

Operating Cost	Average Annual Cost	Cost/ton ore	Cost/ton of Product
Mining	$24,033,000	$6.91	$28.95
Processing	$85,946,000	$24.72	$103.54
Loadout	$3,331,000	$0.96	$4.01
General & Administrative	$8,969,000	$2.58	$10.81
Total Operating Costs	**$122,279,000**	**$35.17**	**$147.31**

Manpower requirement and wages were estimated with extensive input from Randy Foote, Chief Operating Officer of ICP, Ken Kramer, Corporate Controller of ICP, and Tom McGuire, Director of Technical Services for ICP. All of these people have extensive knowledge in operating and staffing Potash mines and processing plants in the Carlsbad, New Mexico Region. A summary of the annual manpower costs is shown below in Table 1-5.

Table 1-5 Average Yearly Manpower Costs

Manpower Summary	# Per Year	Base Annual Costs	Annual Overtime Costs	Annual Burden Costs	Total Annual Costs
Mine Department					
Hourly Personnel	127	$6,655,000	$599,000	$2,662,000	$9,916,000
Salaried Personnel	12	$1,040,000	-	$416,000	$1,456,000
Total Mine Department	**139**	**$7,695,000**	**$599,000**	**$3,078,000**	**$11,372,000**
Plant Department					

Manpower Summary	# Per Year	Base Annual Costs	Annual Overtime Costs	Annual Burden Costs	Total Annual Costs
Hourly Personnel	158	$8,177,000	$702,000	$3,271,000	$12,150,000
Salaried Personnel	9	$754,000	-	$301,000	$1,055,000
Total Plant Department	**167**	**$8,931,000**	**$702,000**	**$3,572,000**	**$13,205,000**
Jal Loadout Crew					
Hourly Personnel	7	$360,000	$32,000	$144,000	$537,000
Salaried Personnel	0	-	-	-	-
Total Jal Loadout Crew	**7**	**$360,000**	**$32,000**	**$144,000**	**$537,000**
General & Administrative					
Hourly Personnel	0	-	-	-	-
Salaried Personnel	33	$1,975,000	-	$790,000	$2,765,000
Total G&A Department	**33**	**$1,975,000**	**-**	**$790,000**	**$2,765,000**
Project Totals	**346**	**$18,961,000**	**$1,333,000**	**$7,584,000**	**$27,879,000**

1.11 Mine Operating Costs

The mine is scheduled to operate 20 hours per day with two 10-hour shifts. The 4 hours that the mine is not in operation will allow for a daily maintenance window. The processing plant and trucking operations to the Jal loadout will operate 24 hours per day with three 8-hour or two 12-hour shifts. The Jal loadout will operate on a single 8 hour shift per day. All hourly workers have a 6% overtime allowance based on their base salary and burden is 40% of base salary for all employees of the mine.

The overall operating cost for the mine is approximately $24 million per year. Mine costs include parts, supplies and maintenance materials for all mining equipment as well as diesel for any pieces of equipment that do not run on electricity. Operating costs were determined for each individual piece of equipment and aggregated on an annual basis. The annual electricity cost for the mine was calculated from installed horsepower of the equipment in the mine at the prevailing rates.

1.12 Plant Operating Costs

Processing costs for the plant were determined by FLSmidth for all areas excluding the crystallizer portion. HPD determined the operating costs for the crystallizer portion of the plant. FLSmidth used 3% of the installed equipment costs, per year, for the plant supplies and 4% per year for the annual maintenance costs. HPD determined the annual operating costs for the crystallizers, which include equipment costs and supplies to be 1.5% of the total cost of the crystallizer portion of the processing facility. The annual electrical cost for the plant was calculated from installed horsepower of the equipment in the plant at the prevailing rates of $0.052/kWH and the natural gas price of $3.75/100 cft.

Finished product will be transported to the loadout facility in Jal, NM approximately 22 mi east of the processing plant. This study assumes ICP will run its own trucking fleet to transport the product to Jal. The operating costs in this portion include all materials, supplies, mechanical parts, diesel, and electricity. Costs were determined for each individual piece of equipment and aggregated on an annual basis. The rail load out facility will have its own electrical supply separate from the plant and mine. Road taxes are $0.04 per truck mi.

General and administrative labor costs include general management, safety, accounting, environmental, purchasing, sales, and plant power management. Office supplies and equipment are projected at $0.03 per ton of ore, insurance at $1.2 million per year (based on comparison with operations of similar size and extent in the area), and annual property taxes at 1.1% of the previous year's revenue.

1.13 Capital Costs

The Ochoa Project is expected to average an annual throughput of approximately 3.25 million tons per year over its first phase of 40 years, and to require an initial investment of $705.6 million, comprised of mine assets, plant assets, loadout facilities in Jal, site utilities, and reclamation bonding.

1.13.1 Mine Capital Cost

A capital projection for the mine was developed by Gustavson for the Ochoa mine operations utilizing the room and pillar method of mining and a conveyor system installed in a 15% decline developed to connect the underground workings to the plant facilities on surface. A 20 ft diameter shaft will be constructed to provide ventilation to the mine and to transport men into and out of the mine and to move materials and small equipment into the mine, while providing a secondary escapeway. A stockpile facility will be constructed to provide surge storage of mined ore at the beginning of the plant. Roads, parking lots, and waste storage will be developed, as well as structures for a truck repair shop, water provision/treatment for up to 1,000 gallons per minute, warehousing of supplies/parts, and laboratory services to support the operations. Continuing and sustaining capital to expand the mine, to ramp up ore delivery to match the plant throughput as the plant is brought to full capacity over 1.5 years, and to maintain mine functionality and reliability, is expected to require approximately $48.2 million in the first 5 years and around $3.2 million per year thereafter, with additional major replacements in years 11, 16, 21, 26, 31 and 36.

1.13.2 Plant Capital Cost

Initial plant capital for full-scale operations, as projected by FLSmidth and HPD, would amount to \$519.5 million, including contingency. The plant will include multiple, discrete circuits for comminution, calcining, leaching, pre-concentration, crystallization and separation, granulation, loadout and shipping, power generation, water provision, and tailings management. Sustaining capital has been estimated at approximately \$1.0 million per annum.

1.13.3 Loadout Facility Capital Cost

A finished product loadout facility will be built in Jal, NM, approximately 22 mi from the plant. It will contain receiving, storage and truck and train loading facilities totaling \$32.7 million with indirects and owner's costs.

1.13.4 Utilities and Reclamation Capital Cost

Initial site utilities, including water piping, communications, general electrical distribution and switching, gas piping, and other minor services, is estimated to require \$13.9 million. Sustaining capital of \$400,000 is expected to be required for site utilities annually. An initial \$4.0 million allowance for reclamation bonding was included, along with an annual continuing provision of \$0.5 million per year.

The table below summarizes the initial capital projections for the Ochoa Project.

Table 1-6 Estimated Capital Costs

Description	Cost
Mine Department	
Underground Equipment	$23,340,000
Surface Equipment	3,765,000
Earthwork Development	19,036,000
Administrative Capital	10,000,000
Primary Development	62,970,000
Indirect Costs @ 4.0%	4,764,000
Owner's Costs @ 3.0%	3,574,000
Total Mine Department Capital	**$127,449,000**
Plant Department	
Contracted Construction	
Crushing	$2,508,000
Milling/NaCl Wash	28,602,000
Calcining	71,450,000
Leaching	45,478,000
Production/Granulation	52,972,000
Loadout and Shipping (at plant)	10,867,000
Tailings	133,000
Concentrate Pond	109,000
Water Management	8,099,000
Electricity/Natural Gas	1,050,000
Boiler/Steam	17,132,000
Air Pollution Control	15,792,000
Total Contracted Construction Capital	**$254,192,000**
Turn-Key Construction	
Leonite Dissolver System	$1,600,000
SOP Evaporator Preconcentrator System	51,000,000
SOP Evaporator Crystallizer System	51,000,000
SOP Separation System	3,200,000
Langbeinite Crystallizer Feed Tank and Pumps	800,000
Langbeinite Evaporator/Crystallizer System	102,000,000
Langbeinite Separation System	1,600,000
Langbeinite Decomposition System	13,600,000
Leonite Separation System	2,400,000
Total Turn-Key Construction Capital	**$227,200,000**
Total Plant Department Capital	**$481,392,000**

Description	Cost
Product Loadout Department	
Jal Loadout Facility	$30,585,000
Indirect Costs @ 4.0%	1,223,000
Owner's Costs @ 3.0%	918,000
Total Product Loadout Capital	**$32,726,000**
Utilities and Reclamation	
Utilities	$12,338,000
Indirect Costs @ 4.0%	495,000
Owner's Costs @ 3.0%	370,000
Reclamation Bonding	4,000,000
Total Description	**$17,203,000**
Contingency	
Contingency, @ 5% of Mine & JAL Facilities	$8,669,000
Contingency, @ 15% of Constructed Plant	38,129,000
Total Contingency	**$46,798,000**
Total Initial Capital	**$705,568,000**

1.14 Economic Analysis

The economic evaluation for the Ochoa Project is based on the underground mine design for reserves controlled by ICP and incorporates processing, loadout, and administrative activities. The economic model assumes the first 40 years of mining available reserves. Those reserves closest to the plant location will be exploited initially at a rate of approximately 3.25 million tons per year. The starting point for the economic model is assumed to be the date final permits are obtained.

The projected unit operating costs over 40 years are based on average annual ore production of approximately 3,250,000 (~ 10,000 tons per day) and 337 days per year of operation.

Revenues are expected to average around $517.4 million per year, at a life of mine average SOP product price of $801/ton and SOPM price averaging about $257/ton. Royalties are payable to the BLM and to the State of New Mexico (at an average rate of 2.25% of gross sales), and to private parties at a rate of $1.00/ton of finished product for the first 1,000,000 tons sold and at $0.50/ton thereafter. There is a 3% net profit royalty that can be reduced to 1.5% net profit with a payment of $9 million, all of which terminates after 25 years thereafter. Total royalties are projected to average $15.5 million per year. Total payments for state and BLM royalties, property taxes, and state and federal income taxes are projected to be $5,193.1 million (25% of gross revenues) over the life of the mine.

Based upon the studies of capital, operating and marketing for finished products, the Ochoa Project's first 40 years of projected operations demonstrate robust economics based upon an initial capital investment of $706 million ($837/ton of annual finish product), with an after tax net present value, at 10% discount rate, of $1,286 million, with a projected payback period of 3.93 years, and an expected payback multiple of 14.4 (for the first 40 years only). The project would generate an internal rate of return, after tax, of approximately 25.9%. The gross operating margin, based upon the estimations referred to above, is expected to average 73.4% based on gross revenue. The base case economic model is reproduced in Table 1-7.

1.15 Sensitivity Analysis

The Ochoa Project economics are most sensitive to changes in the sales prices of its products. In this PFS, an increase of 10% in the average sales prices would augment the After-Tax, Net Present Value at 10% discount (NPV-10) by 19% as illustrated in Figure 1-1.

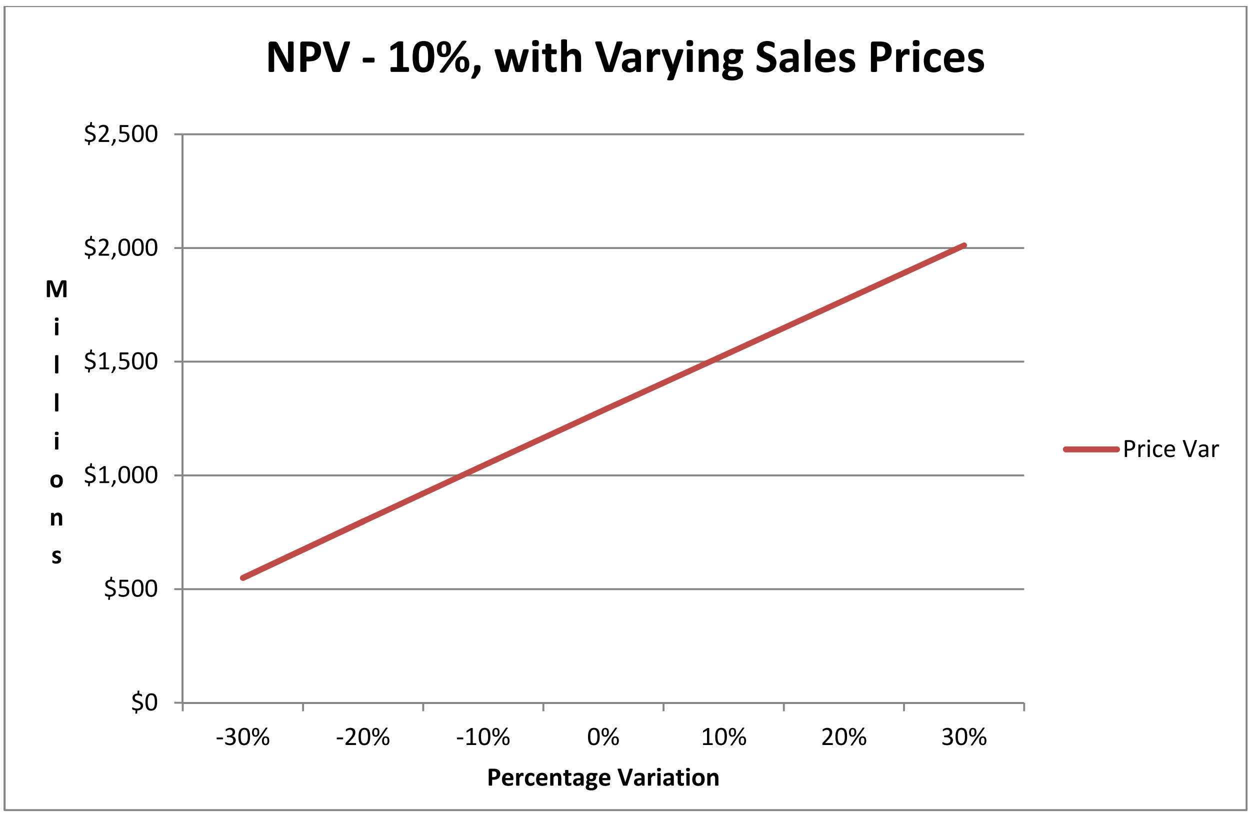


Figure 1-1 NPV – 10%

GUSTAVSON ASSOCIATES
GEOLOGISTS • ENGINEERS • ECONOMISTS • APPRAISERS

Table 1-7 Ochoa Projected Economics, Base Case

Intercontinental Potash
3,500,000 Ore tpy, MVR Processing, SOP & Langbeinite, $798 Average SOP Price/$256 Average Langbeinite Price, Start Date= 1-Jan-16

OCHOA Project

	Year -2 Total	Year -1 TOTAL	Year 1 TOTAL	Year 2 TOTAL	Year 3 TOTAL	Year 4 TOTAL	Year 5 TOTAL	Year 6 TOTAL	Year 7 TOTAL	Year 8 TOTAL	Year 9 TOTAL	Year 10 TOTAL	Year 11 TOTAL	Year 12 TOTAL
PRODUCTION SCHEDULE														
TOTAL MINE PRODUCTION														
Tons Ore	0	0	1,489,013	3,435,832	3,644,544	3,554,296	3,469,152	3,401,220	3,381,120	3,383,300	3,323,252	3,367,712	3,451,164	3,517,356
Percent Polyhalite in Ore	0.0%	0.0%	83.4%	77.1%	76.8%	78.8%	80.9%	82.3%	82.8%	82.7%	84.2%	83.1%	81.1%	79.6%
Recovery Percentage	0.0%	0.0%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%
Finished Product, K_2SO_4	0	0	250,935	536,286	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000
Finished Product, Langbeinite	0	0	121,491	259,643	275,000	274,996	274,996	274,996	274,996	275,000	274,996	274,996	274,996	274,996
Income Statement														
REVENUE														
K_2SO_4 Sales Price, $/t	0	0	592	622	642	704	765	815	915	813	778	745	817	817
Langbeinite Sales Price, $/t	0	0	206	210	215	231	246	261	285	261	253	245	261	261
Gross Revenue, K_2SO_4	0	0	148,553,000	333,570,000	364,656,000	399,872,000	434,520,000	462,920,000	519,720,000	461,784,000	441,904,000	423,160,000	464,056,000	464,056,000
Gross Revenue, Langbeinite	0	0	25,027,000	54,411,000	59,128,000	63,616,000	67,608,000	71,848,000	78,336,000	71,848,000	69,604,000	67,360,000	71,848,000	71,848,000
less: State/BLM Royalties, @ 2.25%	0	0	(3,905,000)	(8,730,000)	(9,536,000)	(10,428,000)	(11,296,000)	(12,032,000)	(13,456,000)	(12,008,000)	(11,508,000)	(11,036,000)	(12,056,000)	(12,056,000)
less: Prod Royalty, $1/t Sold, for 1st million tons, then $0.5/t	0	0	(373,000)	(796,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)
less: Production Royalty, @ 1.5% after Capital Repaid	0	0	0	0	0	(9,000,000)	(5,735,000)	(6,236,000)	(7,186,000)	(6,217,000)	(5,898,000)	(5,577,000)	(6,219,000)	(6,180,000)
Net Revenue	0	0	169,302,000	378,455,000	413,828,000	443,640,000	484,677,000	516,080,000	576,994,000	514,987,000	493,682,000	473,437,000	517,209,000	517,248,000
OPERATING EXPENSES														
Mining														
Mine Manpower	0	0	8,032,597	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600
Underground Equipment	0	0	1,889,144	4,359,114	4,624,040	4,509,412	4,388,700	4,315,204	4,289,700	4,292,468	4,216,284	4,272,692	4,378,568	4,462,548
Conveying	0	0	834,917	1,926,532	2,043,616	1,992,956	1,939,608	1,907,124	1,895,856	1,897,076	1,863,408	1,888,336	1,935,128	1,972,244
Power	0	0	1,465,741	3,382,134	3,587,684	3,498,748	3,405,088	3,348,064	3,328,276	3,330,424	3,271,312	3,315,060	3,397,228	3,462,384
Hoisting & Ventilation	0	0	139,162	321,110	340,624	332,180	323,288	317,876	315,996	316,200	310,568	314,744	322,544	328,728
Surface Equipment	0	0	1,129,936	2,607,277	2,765,736	2,697,176	2,624,976	2,581,012	2,565,760	2,567,416	2,521,648	2,555,584	2,618,912	2,669,144
Contingency, @0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Mining	0	0	13,491,497	23,967,767	24,733,300	24,402,072	24,053,260	23,840,880	23,767,188	23,775,184	23,555,040	23,718,036	24,023,980	24,266,648
Processing														
Manpower	0	0	8,912,871	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800
Crushing/Milling	0	0	256,021	590,759	626,660	611,128	594,768	584,808	581,352	581,724	571,400	579,044	593,396	604,776
Calcining	0	0	5,691,697	13,133,339	13,931,516	13,586,164	13,222,480	13,001,036	12,924,204	12,932,540	12,703,008	12,872,952	13,191,944	13,444,964
Leaching	0	0	353,214	815,027	864,560	843,128	820,560	806,816	802,048	802,564	788,320	798,868	818,664	834,364
Production/Granulation	0	0	3,655,082	8,433,942	8,946,512	8,724,736	8,491,184	8,348,960	8,299,640	8,304,992	8,157,592	8,266,728	8,471,576	8,634,060
Loadout	0	0	2,257,262	5,208,533	5,525,080	5,388,120	5,243,884	5,156,064	5,125,592	5,128,896	5,037,968	5,105,268	5,231,776	5,332,120
Water Management	0	0	14,298	32,990	34,996	34,128	33,216	32,660	32,464	32,488	31,908	32,336	33,140	33,772
Power Dissolution Circuit	0	0	2,859,609	6,598,421	6,999,440	6,825,928	6,643,208	6,531,948	6,493,348	6,497,536	6,382,216	6,467,600	6,627,868	6,754,984
Steam Production	0	0	3,385,815	7,812,159	8,286,940	8,081,516	7,865,184	7,733,460	7,687,760	7,692,716	7,556,184	7,657,272	7,847,020	7,997,524
Crystallizer Equipment and Materials	0	0	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212
Crystallizer Power	0	0	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880
Contingency, @0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Processing	0	0	57,105,761	85,550,062	88,140,596	87,019,740	85,839,376	85,120,664	84,871,300	84,896,348	84,153,338	84,704,960	85,740,276	86,561,456
JAL Loadout Facility														
Manpower	0	0	399,063	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784
Trucking Costs	0	0	675,323	1,443,266	1,528,620	1,528,612	1,528,612	1,528,612	1,528,612	1,528,620	1,528,612	1,528,612	1,528,612	1,528,612
Jal Loadout Equipment Costs	0	0	519,715	1,110,707	1,176,396	1,176,388	1,176,388	1,176,388	1,176,388	1,176,396	1,176,388	1,176,388	1,176,388	1,176,388
Road Tax and General Costs	0	0	60,295	128,859	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480
Contingency, @0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total JAL Loadout Facility	0	0	1,654,396	3,219,616	3,378,280	3,378,264	3,378,264	3,378,264	3,378,264	3,378,280	3,378,264	3,378,264	3,378,264	3,378,264
Site General & Administration														
Manpower	0	0	2,670,920	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000
Office Supplies/Expenses, @$0.03/ton Ore	0	0	44,670	103,075	109,340	106,628	103,776	102,036	101,432	101,500	99,696	101,032	103,536	105,520
Insurance	0	0	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Property Taxes	0	0	0	477,000	1,544,000	2,232,000	2,440,000	2,656,000	2,852,000	3,116,000	3,112,000	2,874,000	4,105,000	5,645,000
Contingency, @0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Site General & Administration	0	0	3,915,590	4,545,075	5,618,340	6,303,628	6,508,776	6,723,036	6,918,432	7,182,500	7,176,696	6,940,032	8,173,536	9,715,520
Cash Operating Costs	0	0	76,167,244	117,282,520	121,870,516	121,103,704	119,779,676	119,062,844	118,935,184	119,234,312	118,263,338	118,741,292	121,316,056	123,921,888
Operating Margin - before Tax Deductions	0	0	93,134,756	261,172,480	291,957,484	322,536,296	364,897,324	397,017,156	458,058,816	395,752,688	375,418,612	354,746,708	395,892,944	393,326,112
Development Deduction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amortization	0	0	18,068,800	18,068,800	18,068,800	18,068,800	18,068,800	0	0	0	0	0	0	0
Depreciation	0	0	63,069,051	108,434,984	82,803,080	61,018,519	49,071,483	47,326,705	44,992,545	28,159,327	12,550,294	12,616,552	13,429,136	13,791,888
Income - before NOL & Percentage Depletion	0	0	11,996,905	134,668,696	191,085,604	243,448,977	298,757,041	349,690,451	413,066,271	367,593,361	362,868,318	342,129,156	382,463,808	379,534,224
Net Operating Loss Adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depletion	0	0	-5,998,453	-52,983,700	-57,935,920	-62,109,600	-67,854,780	-72,251,200	-80,779,160	-72,098,180	-69,115,480	-66,288,180	-72,409,260	-72,414,720
Federal Income Tax	0	0	-2,399,381	-32,673,999	-53,259,873	-72,535,751	-92,360,905	-110,975,701	-132,914,844	-118,198,072	-117,501,136	-110,336,390	-124,021,819	-122,847,802
Taxable Income, less Tax	0	0	3,599,071	49,010,997	79,889,811	108,803,626	138,541,356	166,463,550	199,372,267	177,297,109	176,251,702	165,504,586	186,032,729	184,271,702
Cash Flow Calculation														
Adjustments for Non Cash Items														
Development Deduction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amortization	0	0	18,068,800	18,068,800	18,068,800	18,068,800	18,068,800	0	0	0	0	0	0	0
Depreciation	0	0	63,069,051	108,434,984	82,803,080	61,018,519	49,071,483	47,326,705	44,992,545	28,159,327	12,550,294	12,616,552	13,429,136	13,791,888
Net Operating Loss Adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depletion	0	0	5,998,453	52,983,700	57,935,920	62,109,600	67,854,780	72,251,200	80,779,160	72,098,180	69,115,480	66,288,180	72,409,260	72,414,720
Total Adjustments for Non Cash Items	0	0	87,136,304	179,487,484	158,807,800	141,196,919	133,995,063	119,577,905	125,771,705	100,257,507	81,665,774	78,904,732	85,838,396	86,206,608
Pre-Production Capital														
Initial Investment - Mine	61,818,973	65,630,027	0	0	0	0	0	0	0	0	0	0	0	0
Initial Investment - Plant	239,368,109	242,023,891	0	0	0	0	0	0	0	0	0	0	0	0
Initial Investment - Jal Loadout	0	32,726,000	0	0	0	0	0	0	0	0	0	0	0	0
Initial Investment - G&A	10,201,082	7,001,918	0	0	0	0	0	0	0	0	0	0	0	0
Initial Capital Contingency	22,290,000	24,508,000	0	0	0	0	0	0	0	0	0	0	0	0
Total Pre-Production Capital	333,678,164	371,889,836	0	0	0	0	0	0	0	0	0	0	0	0
Continuing and Sustaining Capital	0	0	21,959,000	27,838,000	8,874,000	8,893,000	8,902,000	14,174,000	8,934,000	8,954,000	8,966,000	8,982,000	13,867,000	7,460,000
Ongoing Reclamation Funding	0	0	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Total Capital	333,678,164	371,889,836	22,459,000	28,338,000	9,374,000	9,393,000	9,402,000	14,674,000	9,434,000	9,454,000	9,466,000	9,482,000	14,367,000	7,960,000
Working capital	0	0	15,609,000	0	0	0	0	0	0	0	0	0	0	0
Total Capital & Working Capital	333,678,164	371,889,836	38,068,000	28,338,000	9,374,000	9,393,000	9,402,000	14,674,000	9,434,000	9,454,000	9,466,000	9,482,000	14,367,000	7,960,000
CASHFLOW	-333,678,164	-371,889,836	52,667,275	200,160,481	229,323,611	240,607,545	263,134,419	271,367,455	315,709,972	288,100,616	248,451,476	234,927,318	257,504,125	262,518,310
CUMULATIVE CASHFLOW	-333,678,164	-705,568,000	-652,900,625	-452,740,144	-223,416,533	17,191,012	280,325,431	551,692,886	867,402,858	1,155,503,474	1,383,954,950	1,618,882,268	1,876,386,393	2,138,904,703

After Tax Analysis	
NPV @ 8.0% (millions)	$1,815.51
NPV @ 10.0% (millions)	$1,286.46
NPV @ 12.0%	$820.68
Internal Rate of Return	25.9%
Payback Period	3.93
Payback Multiple	14.42

The project economics will vary modestly with variations in the operating and cash costs, yielding a 5% decline in the After-Tax, NPV-10 for each 10% increase in the operating costs and a 6% decline in the After-Tax, NPV-10 for each 10% increase in the capital costs. The variation in the After-Tax, NPV-10 from the variation from changes in the sales prices as illustrated in Figure 1-2.

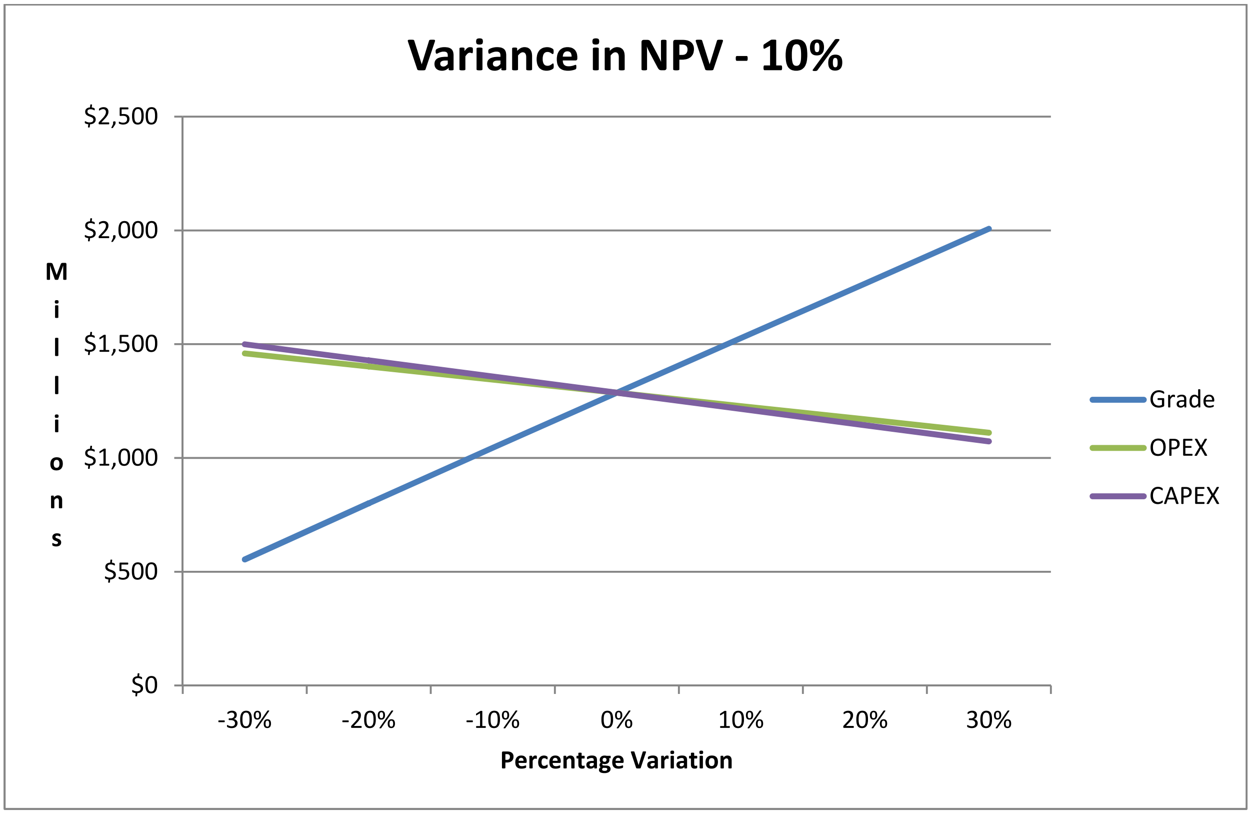


Figure 1-2 Variance in NPV – 10%

1.16 Expansion of Production by 50%

Gustavson considered sensitivity to production, raising production by 50%, to an average production level of 852,000 tons of SOP and 412,500 tons of SOPM per year (990,000 tons SOP equivalent). In this case, initial capital expenditures are expected to rise to $958.3 million (approximately $758 per ton of finished product) and annual operating costs are estimated to average around $135 per ton of finished product. The projected Net Present Value at a 10% discount would be $2,002 million after-tax for the first 40 years of operations and the Payback Period would be approximately 3.8 years. The economic model for this scenario is reproduced in Table 1-8.

Table 1-8 Ochoa Projected Economics, at 50% Expansion

Intercontinental Potash — OCHOA Project

5,300,000 Ore tpy, MVR Processing, SOP & Langbeinite, $798 Average SOP Price/$256 Average Langbeinite Price, Start Date= 1-Jan-16

	Year -2 Total	Year -1 TOTAL	Year 1 TOTAL	Year 2 TOTAL	Year 3 TOTAL	Year 4 TOTAL	Year 5 TOTAL	Year 6 TOTAL	Year 7 TOTAL	Year 8 TOTAL
PRODUCTION SCHEDULE										
TOTAL MINE PRODUCTION										
Tons Ore	0	0	1,489,013	3,975,144	5,327,734	5,212,384	5,096,976	5,067,232	5,003,784	5,133,440
Percent Polyhalite in Ore	0.0%	0.0%	83.4%	77.1%	77.6%	80.6%	82.4%	82.9%	83.9%	81.8%
Recovery Percentage	0.0%	0.0%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%
Finished Product, K_2SO_4	0	0	250,935	619,120	839,220	852,000	852,000	852,000	852,000	852,000
Finished Product, Langbeinite	0	0	121,491	299,748	406,309	412,496	412,496	412,496	412,496	412,496
Income Statement										
REVENUE										
K_2SO_4 Sales Price, $/t	0	0	592	622	642	704	765	815	915	813
Langbeinite Sales Price, $/t	0	0	206	210	215	231	246	261	285	261
Gross Revenue, K_2SO_4	0	0	148,553,000	385,092,000	538,780,000	599,808,000	651,780,000	694,380,000	779,580,000	692,676,000
Gross Revenue, Langbeinite	0	0	25,027,000	62,816,000	87,359,000	95,424,000	101,412,000	107,772,000	117,504,000	107,772,000
less: State/BLM Royalties, @ 2.25%	0	0	(3,905,000)	(10,078,000)	(14,089,000)	(15,644,000)	(16,948,000)	(18,048,000)	(20,184,000)	(18,012,000)
less: Prod Royalty, $1/t Sold, for 1st million tons, then $0.5/t	0	0	(373,000)	(776,000)	(622,000)	(632,000)	(632,000)	(632,000)	(632,000)	(632,000)
less: Production Royalty, @ 1.5% after Capital Repaid	0	0	0	0	0	(10,961,000)	(8,795,000)	(9,532,000)	(10,968,000)	(9,478,000)
Net Revenue	0	0	169,302,000	437,054,000	611,428,000	667,995,000	726,817,000	773,940,000	865,300,000	772,326,000
OPERATING EXPENSES										
Mining										
Mine Manpower	0	0	9,507,633	14,909,086	16,571,072	16,571,072	16,571,072	16,571,072	16,571,072	16,571,072
Underground Equipment	0	0	1,889,144	5,043,352	6,759,413	6,613,064	6,466,644	5,428,908	6,348,412	6,512,906
Conveying	0	0	834,917	2,228,934	2,987,356	2,922,676	2,857,964	2,841,288	2,805,712	2,878,412
Power	0	0	1,465,741	3,913,017	5,244,466	5,130,920	5,017,316	4,988,036	4,925,580	5,053,212
Hoisting & Ventilation	0	0	139,162	371,514	497,925	487,144	476,360	473,580	467,848	479,768
Surface Equipment	0	0	1,129,936	3,016,534	4,042,947	3,955,412	3,867,836	3,846,264	3,797,116	3,895,608
Contingency, @5.0%	0	0	748,327	1,474,123	1,805,158	1,784,016	1,762,860	1,757,408	1,746,776	1,769,544
Total Mining	0	0	15,714,860	30,956,560	37,908,337	37,464,304	37,020,052	36,905,556	36,661,316	37,160,424
Processing										
Manpower	0	0	8,842,283	14,737,784	16,551,788	16,551,788	16,551,788	16,551,788	16,551,788	16,551,788
Crushing/Milling	0	0	256,021	683,489	916,053	896,220	876,376	871,260	860,352	882,644
Calcining	0	0	5,691,697	15,194,840	20,365,064	19,924,144	19,483,000	19,369,304	19,126,776	19,622,384
Leaching	0	0	353,214	942,960	1,263,813	1,236,452	1,209,072	1,202,020	1,186,968	1,217,724
Production/Granulation	0	0	3,655,082	9,757,793	13,077,997	12,794,848	12,511,556	12,438,540	12,282,796	12,601,064
Loadout	0	0	2,257,262	6,026,101	8,076,553	7,901,868	7,726,736	7,681,648	7,585,464	7,782,016
Water Management	0	0	14,298	38,169	51,158	50,048	48,940	48,656	48,048	49,292
Power Dissolution Circuit	0	0	2,859,609	7,634,155	10,231,766	10,010,240	9,788,604	9,731,480	9,609,632	9,858,632
Steam Production	0	0	3,385,615	9,038,409	12,113,836	11,851,560	11,589,156	11,521,524	11,377,260	11,672,064
Crystallizer Equipment and Materials	0	0	4,383,912	4,383,912	4,383,912	4,383,912	4,383,912	4,383,912	4,383,912	4,383,912
Crystallizer Power	0	0	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880
Contingency, @5.0%	0	0	2,899,094	4,736,024	5,665,740	5,594,188	5,522,600	5,504,152	5,464,792	5,546,220
Total Processing	0	0	60,880,967	99,456,516	118,980,560	117,477,968	115,974,620	115,587,164	114,760,668	116,449,620
JAL Loadout Facility										
Manpower	0	0	341,678	490,876	536,784	536,784	536,784	536,784	536,784	536,784
Trucking Costs	0	0	675,323	1,666,192	2,258,531	2,292,924	2,292,924	2,292,924	2,292,924	2,292,924
Jal Loadout Equipment Costs	0	0	519,716	1,282,268	1,738,120	1,764,588	1,764,588	1,764,588	1,764,588	1,764,588
Road Tax and General Costs	0	0	60,295	148,763	201,649	204,720	204,720	204,720	204,720	204,720
Contingency, @5.0%	0	0	54,952	107,854	139,765	141,484	141,484	141,484	141,484	141,484
Total JAL Loadout Facility	0	0	1,651,963	3,695,953	4,874,849	4,940,500	4,940,500	4,940,500	4,940,500	4,940,500
Site General & Administration										
Manpower	0	0	3,313,240	3,466,120	3,513,160	3,513,160	3,513,160	3,513,160	3,513,160	3,513,160
Office Supplies/Expenses, @$0.03/ ton Ore	0	0	44,670	119,254	159,833	156,372	152,908	152,016	150,112	154,004
Insurance	0	0	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Property Taxes	0	0	0	477,000	1,709,000	2,954,000	3,634,000	3,983,000	4,277,000	4,673,000
Contingency, @5.0%	0	0	227,896	263,118	329,100	391,176	425,004	442,410	457,014	477,010
Total Site General & Administration	0	0	4,785,806	5,525,492	6,911,093	8,214,708	8,925,072	9,290,586	9,597,286	10,017,174
Cash Operating Costs	0	0	83,033,596	139,634,521	168,674,839	168,097,480	166,860,244	166,723,806	165,959,770	168,567,718
Operating Margin - before Tax Deductions	0	0	86,268,404	297,419,479	442,753,161	499,897,520	559,956,756	607,216,194	699,340,230	603,758,282
Development Deduction	0	0	0	0	0	0		0	0	0
Amortization	0	0	18,874,200	18,874,200	18,874,200	18,874,200	18,874,200	0	0	0
Depreciation	0	0	90,153,782	149,278,632	108,035,633	80,131,409	65,179,869	61,355,289	57,346,722	37,324,369
Income - before NOL & Percentage Depletion	0	0	-22,759,578	129,266,647	315,843,328	400,891,911	475,902,687	545,860,905	641,994,508	566,433,913
Net Operating Loss Adjustment	0	0	22,759,578	-22,759,578	0	0	0	0	0	0
Depletion	0	0	0	-41,527,779	-85,699,920	-93,519,300	-101,754,380	-108,351,600	-121,142,000	-108,125,640
Federal Income Tax	0	0	0	-25,991,717	-92,097,362	-122,949,044	-149,659,323	-175,003,723	-208,341,003	-183,323,309
Taxable Income, less Tax	0	0	0	38,987,573	138,146,046	184,423,567	224,488,984	262,505,582	312,511,505	274,984,964
Cash Flow Calculation										
Adjustments for Non Cash Items										
Development Deduction	0	0	0	0	0	0	0	0	0	0
Amortization	0	0	18,874,200	18,874,200	18,874,200	18,874,200	18,874,200	0	0	0
Depreciation	0	0	90,153,782	149,278,632	108,035,633	80,131,409	65,179,869	61,355,289	57,346,722	37,324,369
Net Operating Loss Adjustment	0	0	-22,759,578	22,759,578	0	0	0	0	0	0
Depletion	0	0	0	41,527,779	85,599,920	93,519,300	101,754,380	108,351,600	121,142,000	108,125,640
Total Adjustments for Non Cash Items	0	0	86,268,404	232,440,189	212,509,753	192,524,909	185,808,449	169,706,889	178,487,722	145,450,009
Pre-Production Capital										
Initial Investment - Mine	61,818,973	127,190,027	0	0	0	0	0	0	0	0
Initial Investment - Plant	318,156,627	322,405,373	0	0	0	0	0	0	0	0
Initial Investment - Jal Loadout	0	41,760,000	0	0	0	0	0	0	0	0
Initial Investment - G&A	13,017,676	8,934,324	0	0	0	0	0	0	0	0
Initial Capital Contingency	29,506,000	35,491,000	0	0	0	0	0	0	0	0
Total Pre-Production Capital	422,499,276	535,780,724	0	0	0	0	0	0	0	0
Continuing and Sustaining Capital	0	0	11,516,000	11,541,000	12,051,115	13,213,808	13,227,757	13,719,705	13,293,757	13,322,808
Ongoing Reclamation Funding	0	0	636,000	636,000	636,000	636,000	636,000	636,000	636,000	636,000
Total Capital	422,499,276	535,780,724	12,152,000	12,177,000	12,687,115	13,849,808	13,863,757	14,355,705	13,929,757	13,958,808
Working capital	0	0	17,145,000	0	0	0	0	0	0	0
Total Capital & Working Capital	422,499,276	535,780,724	29,297,000	12,177,000	12,687,115	13,849,808	13,863,757	14,355,705	13,929,757	13,958,808
CASHFLOW	-422,499,276	-535,780,724	56,971,404	259,250,762	337,968,684	363,098,668	396,433,676	417,856,766	477,069,470	406,476,165
CUMULATIVE CASHFLOW	-422,499,276	-958,280,000	-901,308,596	-642,057,834	-304,089,150	59,009,518	455,443,194	873,299,960	1,350,369,430	1,756,845,595

	Year 9 TOTAL	Year 10 TOTAL	Year 11 TOTAL	Year 12 TOTAL	Year 13 TOTAL	Year 14 TOTAL	Year 15 TOTAL	Year 16 TOTAL	Year 17 TOTAL	Year 18 TOTAL	Year 19 TOTAL	Year 20 TOTAL	Year 21 TOTAL	Year 22 TOTAL	Year 23 TOTAL	Year 24 TOTAL	Year 25 TOTAL	Year 26 TOTAL	Year 27 TOTAL	Year 28 TOTAL	Year 29 TOTAL	Year 30 TOTAL	Year 31 TOTAL	Year 32 TOTAL	Year 33 TOTAL	Year 34 TOTAL	Year 35 TOTAL	Year 36 TOTAL	Year 37 TOTAL	Year 38 TOTAL	Year 39 TOTAL	Year 40 TOTAL	Life-of-Mine Year -2 - Year 40
PRODUCTION SCHEDULE																																	
TOTAL MINE PRODUCTION																																	
Tons Ore	5,229,364	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,482,104	5,534,616	5,534,616	5,534,616	208,730,155
Percent Polyhalite in Ore	80.3%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	76.6%	75.9%	75.9%	75.9%	
Recovery Percentage	89.6%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	89.6%	89.6%	89.6%	89.6%	0
Finished Product, K_2SO_4	852,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	852,000	852,000	852,000	852,000	33,233,275
Finished Product, Langbeinite	412,496	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	412,496	412,496	412,496	412,496	16,089,900
Income Statement																																	
REVENUE																																	
K_2SO_4 Sales Price, $/t	778	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Langbeinite Sales Price, $/t	253	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gross Revenue, K_2SO_4	662,856,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gross Revenue, Langbeinite	104,404,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
less: State/BLM Royalties, @ 2.25%	(17,264,000)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
less: Prod Royalty, $1/t Sold, for 1st million tons, then $0.5/t	(632,000)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
less: Production Royalty, @ 1.5% after Capital Repaid	(8,956,000)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Net Revenue	740,408,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
OPERATING EXPENSES																																	
Mining																																	
Mine Manpower	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Underground Equipment	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Conveying	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Power	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Hoisting & Ventilation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Surface Equipment	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Contingency, @5.0%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Mining	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Processing																																	
Manpower	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Crushing/Milling	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Calcining	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Leaching	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Production/Granulation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Loadout	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Water Management	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Power Dissolution Circuit	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Steam Production	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Crystallizer Equipment and Materials	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Crystallizer Power	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Contingency, @5.0%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Processing	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
JAL Loadout Facility																																	
Manpower	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Trucking Costs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jal Loadout Equipment Costs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Road Tax and General Costs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Contingency, @5.0%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total JAL Loadout Facility	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Site General & Administration																																	
Manpower	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Office Supplies/Expenses, @$0.03/ ton Ore	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Insurance	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Property Taxes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Contingency, @5.0%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Site General & Administration	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cash Operating Costs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Operating Margin - before Tax Deductions	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Development Deduction	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Amortization	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Depreciation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Income - before NOL & Percentage Depletion	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Net Operating Loss Adjustment	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Depletion	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Federal Income Tax	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Taxable Income, less Tax	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cash Flow Calculation																																	
Adjustments for Non Cash Items																																	
Development Deduction	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Amortization	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Depreciation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Net Operating Loss Adjustment	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Depletion	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Adjustments for Non Cash Items	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pre-Production Capital																																	
Initial Investment - Mine	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Initial Investment - Plant	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Initial Investment - Jal Loadout	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Initial Investment - G&A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Initial Capital Contingency	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Pre-Production Capital	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Continuing and Sustaining Capital	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ongoing Reclamation Funding	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Capital	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Working capital	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Capital & Working Capital	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CASHFLOW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CUMULATIVE CASHFLOW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

After Tax Analysis	
NPV @8.0% (millions)	$2,805.64
[illegible]	[illegible]

GUSTAVSON ASSOCIATES
GEOLOGISTS • ENGINEERS • ECONOMISTS • APPRAISERS

ICP controls a large land package that hosts a substantial polyhalite resource. The polyhalite occurs at depths of 1,180 to 1,740 ft within the project area, and is considered to be minable using conventional room and pillar mining methods with continuous miners and other underground mining equipment. ICP has drilled 20 core holes into the Ochoa polyhalite bed, and the mineral resource estimate is based on data from these and 789 previously drilled petroleum exploration holes. The measured plus indicated mineral resource is estimated at 838.2 million tons grading 80.3% polyhalite, at a 5-ft minimum thickness.

Gustavson has retained industry expert consultants and engineering groups to assist in the evaluation of the Ochoa polyhalite deposit. The culmination of their work is a prefeasibility study of the project, which is summarized in this NI 43-101-compliant Technical Report.

The Ochoa Project has sufficient reserves for a mine life of over 90 years at planned production rates, of which 171 million tons of ore grading 81.76% polyhalite are mined in the 40 year mine plan considered in the economic model of this report.

The project has a capital cost of approximately $706 million with an operating cost of $147/ton of product produced, with a resulting NPV of $1.286 billion after tax, at a 10% discount rate.

Gustavson believes that results of this study warrant continued efforts to advance the Ochoa Project, and that the data and information presented herein are sufficient to support definition drilling, continued development and permitting, and preparation of a feasibility study.

Phase 3 Exploration Program and Project Development

Phase 3B	Feasibility study	$10,000,000
	Metallurgical testing	$1,500,000
	Aerial Survey	$200,000
	Geotechnical / Soil test	$500,000
	Hydrological Test	$3,500,000
	Environmental Permitting	$1,000,000
	Subtotal	$16,700,000
Phase 3c - Definition drilling		$4,000,000
	Total	$20,700,000

2 INTRODUCTION

2.1 Purpose

Gustavson was retained by ICP to complete a Prefeasibility Study for the Ochoa Polyhalite Project located in Lea County, New Mexico. The Prefeasibility Study is intended to provide a preliminary technical and economic analysis of the potential development options for the mineral project. This study includes detailed assessments of reasonably assumed mining, processing, metallurgical, economic, legal, environmental, social, and other relevant considerations, which demonstrate potential economic viability of the project. The purpose of this report is to document the results of the PFS in compliance with NI 43-101 Standards of Disclosure for Mineral Projects.

2.2 Qualified Persons

The qualified persons responsible for this NI 43-101 Technical Report are William J. Crowl, R.G., Donald E. Hulse, P.E., and Gary Tucker, P.E. Mr. Crowl is a geologist and acted as project manager during the preparation of this report and is specifically responsible for report Sections 1 through 12 as well as oversight and review of the full document. Mr. Hulse is an engineer and is specifically responsible for Sections 14, through 16 and 18 through 28. Mr. Gary Tucker, P.E., Project Manager for FLSmidth, is responsible for the processing aspects of Sections 13, 17, 18, 22, and 23 of this report.

2.3 Site Visit of Qualified Person

Mr. Crowl conducted a visit to the Ochoa Project Site April 28 and 29, 2010. A field site visit to the Ochoa Project was made by Terre Lane, then acting PFS project manager, on October 11 and 12, 2010, and various trips in 2011, to view the site, inspect core, and validate assay certifications and quality assurance / quality control (QA/QC) documents. Mr. Hulse visited the office of Upstream in Virginia on November 30, 2010, to review the geologic database, mapping and modeling procedures, and data control procedures.

2.4 Sources of Information

Gustavson sourced information from referenced documents as cited in the text and summarized in Section 28 of this report. Gustavson previously reported mineral resource estimates for the Ochoa Project in the “NI-43-101 Technical Report on the Polyhalite Resources and Preliminary Economic Assessment of the Ochoa Project in Lea County, Southeast New Mexico,” dated August 19, 2009 “NI-43-101 Technical Report on the Polyhalite Resources and Updated Preliminary Economic Assessment of the Ochoa Project in Lea County, Southeast New Mexico,” dated January 14, 2010, and last updated in “NI 43-101 Technical Report on the Polyhalite Resources and Updated Mineral Resource Estimate for the Ochoa Project, Lea County, New Mexico” dated November 25, 2011. A portion of the background information and technical data used in this study was obtained from Gustavson's 2009, 2010, and 2011 reports. Additional and updated information and technical data was provided by ICP.

2.5 Units of Measure

Unless stated otherwise, all measurements reported here are in US Commercial Imperial units, and currencies are expressed in constant 2011 US dollars. The Mineral Resource estimates cited in this report are classified in accordance with CIM Definition Standards for Mineral Resources and Mineral Reserves.

3 RELIANCE ON OTHER EXPERTS

During this study, Gustavson relied on information provided by ICP regarding land agreements, options, claims of accuracy of title, royalty information, and environmental liabilities. Gustavson also relied on the operating experience of ICP's Chief Operating Officer K. Randall Foote, B.Sc. Mining Engineering (Member, SME). Mr. Foote has over 28 years of experience in mine and mill management, as well as corporate management in Carlsbad potash operations. Mr. Foote provided complete access to technical data, reports, and the project database.

Patrick Okita, PhD, Principal and Economic Geologist with Upstream, has over 26 years of experience in international minerals, and special expertise in industrial minerals and chemical-sedimentary ore deposits. Dr. Okita's experience ranges from basin-wide and regional scale evaluations to site-specific reserve delineation drilling and feasibility studies. With regard to the Ochoa Project, Gustavson relied on Dr. Okita for information concerning field mapping, exploration and development planning and execution, drilling, sampling, and geophysical and chemical testing.

Consultants involved in the development of the PFS study included:

- Gustavson, a mining consultancy was commissioned by ICP to conduct a PFS of the Ochoa Project in Lea County, Southeast New Mexico. William J. Crowl, R.G., and Donald Hulse P.E. are the Principal Consultants at Gustavson. Gustavson managed the project and compiled the final project report. Specifically, Gustavson was responsible for reserve estimation, mine plan and design, compiling the estimated capital and operating costs, and performing the economic modeling and analysis on the Ochoa Project.

- FLSmidth is a leading supplier of equipment and services to the global cement and minerals industry. Gary Tucker, P.E. is a Project Manager for FLSmidth. Mr. Tucker's scope of work for the Ochoa Project included designing and engineering the entire processing plant with exception of the crystallizer circuit which was supplied by HPD. Additionally, FLSmidth provided an estimate of the capital costs to construct the plant and estimates of the processing plant operating costs.

- HPD is a leader in evaporation and crystallization technology in developing processes and technology for industrial clients. Work on the Ochoa Project was conducted by Don Beudreau and Jean-Claude Gallot. HPD performed crystallization test work in order to determine the viability of using mechanical vapor re-compressors to produce SOP from polyhalite as well as process engineering for the crystallization circuit of the processing facility. HPD also provided estimated capital and operating costs for the crystallizer portion of the processing circuit.

- Chastain Consulting was responsible for the overall process design and thermal chemistry. Richard Chastain, Principal Process and Chemical Engineer; B.Sc. has nearly 40 years in chemical plant engineering, design, construction, and operation. Mr. Chastain's experience includes potash due diligence and feasibility studies, process systems design, solution mining, scrubber emissions, storage design, langbeinite production, crystallization processing, and flotation facilities design.

- Neuman Consulting, Inc. was responsible for overseeing the laboratory testing at Hazen Research, HPD, and FEECO to optimize the conversion of raw polyhalite into SOP and langbeinite. Mr. Tom Neuman, Principal Chemist, B.Sc. brings 30 years of analytical development and process development experience to the Ochoa Project. Mr. Neuman has designed and developed directional processes for the leaching of potash from oil and gas caverns. He has developed more efficient systems for the increase of production in solution mining. His work in potash chemical processing, and in the chemical processing of other salts, includes process engineering design, modeling, economic data review, and extensive equipment evaluation. He is also highly experienced in salt processing flow sheet design and material balance analysis for potash solution mining process, analytical instrumentation, and chromatography methodology.

- Upstream performed the field mapping, exploration and development planning and execution, drilling, sampling, and geophysical and chemical testing. Patrick Okita, PhD, Principal Economic Geologist, has over 25 years of experience in international minerals, and with specialization in industrial minerals. Dr. Okita's experience ranges from basin wide and regional scale evaluations, through delineation drilling of reserves to feasibility studies.

- Chemfelt Engineering provided expertise in the engineering process design of all systems required to convert mined polyhalite ore into a final marketable SOP finished product. Mr. Don Felton, is a Chief Chemical Process Engineer with 40 years of experience in operating industrial mineral and chemical processing plants. His expertise includes recovery operations, modeling using METSIM, all phases of the permitting application process, pollution scrubber design, fractionator system design, evaporator design, condenser and filter system design, compliance testing, and ground water monitoring.

- INTERA Geosciences and Engineering (INTERA) provided environmental and permitting services as well as evaluation of the water availability for the Ochoa Project. Mr. Peter Castiglia, Ms. Cindy Ardito, and Mr. David Jordan of INTERA bring experience in ground water modeling, knowledge of local water rights and laws, and development of brackish groundwater as well as extensive permitting knowledge. INTERA continues to assist in all ongoing permitting issues for the Ochoa Project as well as providing a valuable liaison between ICP and the BLM.

- Walsh Environmental Scientists and Engineers, LLC (Walsh) provides a wide range of environmental consulting services to public and private sector clients domestically and internationally. Walsh provided support to the PFS by conducting baseline vegetation and wildlife surveys, researching various topics of interest, and preparing environmental text and graphics. Walsh assisted Gustavson in developing the Mine Plan of Operations for the Ochoa Project.

- CRU Strategies is a marketing and consultancy firm providing business intelligence in mining, metals and fertilizer. Mr. Steve Markey of CRU analyzed SOP markets and forecasted future prices that were used to generate revenue models.

- FEECO International provides equipment and process engineering to the fertilizer industry. Mr. Chris Kozicki performed agglomeration tests of crystallized material in order to determine a process that will allow the SOP and langbeinite to be granulated into a size that can be sold on the market.

- Roth Associates provides business consulting to the agribusiness, fertilizer, and minerals industries worldwide. For ICP, they provided consulting on entering the North American and international SOP markets. Arthur Roth has over 25 years of experience in due diligence and feasibility studies, analysis and optimization of potash fertilizer distribution systems, development of marketing and pricing strategies for fertilizer distribution, expert testimony regarding phosphate rock and fertilizer markets, business and commercial development plans, strategic planning, and market analyses and forecasts.

- Electrical Consultants, Inc. provides electrical engineering and design services. Terry L. Tippets, P.E., LC analyzed the initial electrical layout for the mine and provided electrical one line drawings as well as estimated electrical costs for the mining portion of the Ochoa Project.

- GRE Consultants provide geotechnical design and engineering for mining projects. Mr. Kevin Gunesch, P.E., and Allan Breitenbach, P.E. provided engineering and design drawings for the tailings facility, evaporation ponds, and collection ponds necessary for the Ochoa Project.

- Harrison Western provides construction services for mining operations. Mr. William Walker has more than 40 years of mining engineering experience and expertise of constructing shafts and declines. Harrison Western provided initial drawings, cost estimates, and schedules for the proposed shaft and decline, as well as test work and cost estimates for the water treatment packages.

- Hazen Research provides industrial research and development in mineral, chemical, energy and environmental fields. Mr. Tom Broderick lead Hazen test programs and research in order to optimize the conversion of polyhalite into SOP and langbeinite.

- METSIM is a processing design consultancy software company that simulates Metallurgical and Chemical Engineering Processes. Mr. John Bartlett assisted Mr. Don Felton to design and simulate all processes to convert raw polyhalite into marketable SOP and SOPM products.

- Dr. Deepak Malhotra, President of the metallurgical laboratory Resource Development Inc. (RDi), has conducted metallurgical test programs for several hundred projects. Dr. Malhotra is an adjunct professor of metallurgy at the Colorado School of Mines, and is acting as an advisor to the company providing expertise and guidance in the testing and processing of polyhalite.

Gustavson also relied on data provided by ICP employees. Ms. Terre Lane was appointed by ICP as Sr. VP Engineering and Project Management on November 1, 2011. Ms. Lane was previously Associate Principal Mine Engineer for Gustavson and was responsible for study management on behalf of ICP. Ms. Lane is a Mining and Metallurgical Society of America (MMSA) Qualified Person in Reserves and Mining. Mr. Tom McGuire, ICP's Director of Technical Services provided data and expertise of Potash mining in the Carlsbad region. Mr. Ken Kramer, ICP's controller provided financial data and information of potash operations in the region.

4 PROPERTY DESCRIPTION AND LOCATION

4.1 Location

The Ochoa Project is located about 60 mi east of Carlsbad, New Mexico, less than 20 mi west of the Texas-New Mexico state line. The project spans portions of 10 townships, with leased and permitted mineral rights totaling roughly 103,000 ac. The general location is shown in Figure 4-1.

The project is located within the Permian Basin of the Great Plains physiographic province. Evaporites in New Mexico and Texas occur in the Permian sedimentary basin, which is roughly oval in shape and elongated in a northeast–southwest direction. The Delaware and Midland sub-basins of the upper Permian Basin are separated by the Central Basin Platform and contain extensive evaporite deposits of the Ochoa Series, which lie between the Capitan Reef limestone of the underlying Guadalupe Series and the fine clastic sediments of the Dewey Lake red beds.

Figure 4-1 Ochoa Polyhalite Project Location

GUSTAVSON ASSOCIATES
GEOLOGISTS · ENGINEERS · ECONOMISTS · APPRAISERS

4.2 Mineral Tenure, Agreements, and Exploration Permits

4.2.1 Mineral Rights

The location and description of ICP's BLM permits and State of New Mexico leases are listed in Tables 4-1 through 4-3.

Table 4-1 Ochoa Project BLM Prospecting Permits

Serial Number	Township and Range	Sections and Descriptions	BLM Approval Date	Acreage of Prospecting Permit
121100	Township 24 south, Range 35 east, NMPM	Section 27: E2, W2SW Section 28: N2NE, E2SE Section 29: W2 Section 31: E2, NW, SWSW Section 33: SW, W2SE, NENE Section 34: NE, S2SW, N2SE, NWNW Section 35: S2NE, S2SE	12/1/2008	2,200.00
121101	Township 24 south, Range 35 east, NMPM	Section 23: All lands Section 24: All lands Section 25: All lands Section 26: W2, E2NE, E2SE	12/1/2008	2,400.00
121102	Township 24 south, Range 35 east, NMPM	Section 17: N2, SE Section 20: All lands Section 21: All lands Section 22: NE, N2SE, NESW, SENW	12/1/2008	2,080.00
121103	Township 24 south, Range 35 east, NMPM	Section 9: All lands Section 12: All lands Section 13: All lands Section 14: SWNW, E2NW, E2, SW	12/1/2008	2,520.00
121104	Township 24 south, Range 35 east, NMPM	Section 1: W2, W2E2 Section 6: All lands Section 7: W2, W2SE Section 8: E2, SW, E2NW Section 11: NENE Section 18: SW Section 19: SW Section 35: SENW, SESW	12/1/2008	2,520.00
121105	Township 24 south, Range 34 east, NMPM	Section 9: N2, SE Section 11: W2W2, E2E2 Section 12: E2, SW, E2NW Section 13: All lands Section 19: N2, SE, N2SW	12/1/2008	2,560.00

Serial Number	Township and Range	Sections and Descriptions	BLM Approval Date	Acreage of Prospecting Permit
121106	Township 24 south, Range 34 east, NMPM	Section 23: E2, SWSW Section 24: SE, NESW, SENE, N2NW Section 25: W2W2, E2E2 Section 26: W2 Section 27: S2, E2NE Section 34: NW, N2SW, W2SE Section 35: E2	12/1/2008	2,360.00
121107	Township 23 south, Range 34 east, NMPM	Section 6: Lots 1–7, SENW, E2SW, S2NE, SE Section 7: Lots 1–2, E2NW, NE Section 18: Lots 3–4, E2SW, SE Section 19: Lots 1–4, E2W2, E2	12/1/2008	1,892.00
121108	Township 24 south, Range 34 east, NMPM	Section 1: Lots 1–4, S2N2, N2SW, SE Section 3: Lots 1–2, S2NE, SE Section 4: Lots 1–2, S2NE, SE, S2SW, NWSW Section 5: Lots 3–4, S2NW, SW Section 7: Lots 1–2, E2NW, NE Section 8: N2, SW	12/1/2008	2,439.00
121109	Township 24 south, Range 33 east, NMPM	Section 11: N2 Section 12: All lands Section 13: SE, E2SW Section 14: W2, W2E2 Section 23: All lands	12/1/2008	2,320.00
121110	Township 24 south, Range 33 east, NMPM	Section 24: W2 Section 25: W2 Section 26: All lands	12/1/2008	1,280.00
121111	Township 23 south, Range 33 east, NMPM	Section 24: All lands Section 25: All lands Section 26: All lands Section 28: All lands	12/1/2008	2,560.00
121112	Township 24 south, Range 34 east, NMPM	Section 17: All lands Section 18: Lot 1, NENW, NE Section 20: All lands Section 21: N2, SW, W2SE Section 22: N2, SESE	12/1/2008	2,440.00
121113	Township 23 south, Range 33 east, NMPM	Section 13: S2 Section 14: S2 Section 21: All lands Section 23: All lands	12/1/2008	1,920.00

Serial Number	Township and Range	Sections and Descriptions	BLM Approval Date	Acreage of Prospecting Permit
121114	Township 23 south, Range 33 east, NMPM	Section 1: Lots 1–4, S2N2, S2 Section 4: Lots 1–4, S2N2, S2 Section 5: Lots 1–4, S2N2, S2 Section 6: Lots 1–7, E2SW, SENW, S2NE, SE	12/1/2008	2,547.00
121115	Township 23 south, Range 33 east, NMPM	Section 7: Lots 1–4, E2W2, E2 Section 8: All lands Section 9: All lands Section 11: All lands	12/1/2008	2,551.00
123690	Township 23 south, Range 32 east NMPM	Section 24: All lands Section 25: All lands Section 26: N2 Section 27: N2	3/1/2010	1,920.00
123691	Township 23 south, Range 32 east, NMPM	Section 1: SW4, W2SE4 Section 3: Lots 1-4 SE4NW4, S2NE4, S2 Section 4: Lots 1-4 S2NW4, SW4NE4, S2 Section 5: Lots 1-4 S2N2, S2 Section 6: Lot 7	3/1/2010	2,075.00
123691	Township 22 south, Range 32 east, NMPM	Section 30: Lot 4		
123692	Township 23 south, Range 32 east, NMPM	Section 6: Lots 1-6 SE4NW4, S2NE4, E2SW4, SE4 Section 8: All lands Section 9: All lands Section 10: All lands	3/1/2010	2,535.70
123693	Township 23 south, Range 32 east, NMPM	Section 12: W2, W2E2 Section 13: All lands Section 22: All lands Section 23: All lands	3/1/2010	2,400.00
123694	Township 22 south, Range 32 east, NMPM	Section 28: All lands Section 29: All lands Section 30: Lots 1-3 E2W2, E2 Section 33: All lands	3/1/2010	2,580.00
			TOTALS:	**48,100.00**

Table 4-2 Ochoa Project State of New Mexico Leases

Serial Number	Township and Range	Sections and Descriptions	New Mexico Approval Date	Acreage
HP-0030	Township 22 south, Range 32 east, NMPM	Section 32	5/24/2010	640.00
HP-0031	Township 22 south, Range 32 east, NMPM	Section 36	5/24/2010	640.00
HP-0031	Township 23 south, Range 32 east, NMPM	Section 1: E2SE4, SE4NE4, lot 1 Section 12: E2E2	5/24/2010	319.95
HP-0032	Township 23 south, Range 32 east, NMPM	Section 3: SW4NW4 Section 4: SE4NE4	5/24/2010	80.00
HP-0033	Township 23 south, Range32 east, NMPM	Section 2: S2, S2N2, lots 1, 2, 3, 4	5/24/2010	638.52
HP-0034	Township 23 south, Range 32 east, NMPM	Section 16: All lands	5/24/2010	640.00
HP-0035	Township 23 south, Range 32 east, NMPM	Section 21: SE4NE4	5/24/2010	40.00
HP-0036	Township 22 south, Range 33 east, NMPM	Section 30: E2, E2W2, lots 1, 2, 3, 4 Section 31: E2, E2W2, lots 1, 2, 3, 4 Section 32: All lands Section 33: All lands	5/24/2010	2,533.44
HP-0037	Township 23 south, Range 33 east, NMPM	Section 2: S2, S2N2, lots 1, 2, 3, 4 Section 3: S2, S2N2, lots 1, 2, 3, 4 Section 10: All lands	5/24/2010	1,917.64
HP-0038	Township 23 south, Range 33 east, NMPM	Section 12: All lands	5/24/2010	640.00
HP-0039	Township 23 south, Range 33 east, NMPM	Section 15: All lands Section 16: All lands Section 17: E2, E2NW4, SW4 Section 18: E2, E2W2, lots 1, 2, 3, 4	5/24/2010	2,471.4
HP-0040	Township 23 south, Range 33 east, NMPM	Section 22: All lands Section 27: All lands Section 33: All lands Section 34: All lands	5/24/2010	2,560.00
HP-0041	Township 23 south, Range 33 east, NMPM	Section 35: All lands Section 36: All lands	5/24/2010	2,554.8
HP-0041	Township 23 south, Range 34 east, NMPM	Section 31: E2, E2W2, lots 1,2,3,4		
HP-0042	Township 24 south, Range 33 east, NMPM	Section 1: S2, S2N2, lots 1,2,3,4 Section 2: S2, S2N2, lots 1,2,3,4 Section 3: S2, S2N2, lots 1,2,3,4	5/24/2010	1,918.6
HP-0042	Township 24 south, Range 34 east, NMPM	Section 6: SE4, S2NE4, E2SW4, SE4NW4, lots 1, 2, 3, 4, 5, 6, 7	5/24/2010	636.24

Serial Number	Township and Range	Sections and Descriptions	New Mexico Approval Date	Acreage
HP-0043	Township 23 south, Range 33 east, NMPM	Section 32: All lands	5/24/2010	640.00
HP-0043	Township 24 south, Range 33 east, NMPM	Section 4: S2, S2N2, lots 1, 2, 3, 4 Section 5: S2, S2N2, lots 1, 2, 3, 4 Section 8: All lands	5/24/2010	1,918.76
HP-0044	Township 23 south, Range 32 east, NMPM	Section 36: All lands	5/24/2010	640.00
HP-0044	Township 23 south, Range 33 east, NMPM	Section 31: E2, E2W2, lots 1, 2, 3, 4	5/24/2010	632.36
HP-0044	Township 24 south, Range 33 east, NMPM	Section 6: SE4, S2NE4, E2SW4, SE4NW4, lots 1, 2, 3, 4, 5, 6, 7 Section 7: E2, E2W2, lots 1, 2, 3, 4	5/24/2010	1268.12
HP-0045	Township 24 south, Range 33 east, NMPM	Section 9: All lands Section 10: All lands Section 15: All lands	5/24/2010	1,920.00
HP-0046	Township 23 south, Range 33 east, NMPM	Section 13: N2 Section 14: N2	5/24/2010	640.00
			TOTALS:	**25,889.83**

Table 4-3 Ochoa Project Pending BLM Leases

Serial Number	Township and Range	Sections and Descriptions	BLM Approval Date	Acreage
124371	Township 22 south, Range33 east, NMPM	Section 29: S2	5/24/2010	320.00
124371	Township 22 south, Range 32 east, NMPM	Section 19: Lots 3-4, E2SW4, SE4 Section 20: S2 Section 21: All lands Section 22: All lands	5/24/2010	1,929.00
124372	Township 22 south, Range 32 east, NMPM	Section 23: All lands Section 24: S2 Section 25: All lands Section 26: All lands Section 27: N2	5/24/2010	2,560.00
124373	Township 22 south, Range 32 east, NMPM	Section 27: S2 Section 31: Lots 1-4, E2W2, E2 Section 34: All lands Section 35: All lands	5/24/2010	2,260.72
124374	Township 22 south, Range 31 east, NMPM	Section 24: E2 Section 25: SW4, E2 Section 26:S2NW4, S2	5/24/2010	1,200.00

Serial Number	Township and Range	Sections and Descriptions	BLM Approval Date	Acreage
124375	Township 22 south, Range 31 east, NMPM	Section 35: All lands	5/24/2010	640.00
124375	Township 23 south, Range 31 east, NMPM	Section 1: Lots 1-4, S2N2, S2 Section 11: N2NE4 Section 12: N2NW4, SE4NW4, E2	5/24/2010	1,159.00
124375	Township 23 south, Range 32 east, NMPM	Section 1: Lots 2-4, SW4NE2, S2NW4,	5/24/2010	240.00
124376	Township 23 south, Range 32 east, NMPM	Section 7: Lots 1-4 E2W2, E2 Section 11: All lands Section 14: All lands Section 15: N2	5/24/2010	2,263.92
124377	Township 23 south, Range 32 east, NMPM	Section 15: S2 Section 17: All lands Section 18: Lots 1-2, E2NW4, E2 Section 20: N2, SE4 Section 21: S2, NW4, W2NE4	5/24/2010	2,492.07
124378	Township 23 south, Range 32 east, NMPM	Section 26: S2 Section 27: S2 Section 28: N2, SE4 Section 34: N2, SE4 Section 35: All lands	5/24/2010	2,240.00
124379	Township 23 south, Range 33 east, NMPM	Section 19: Lots 1-4 E2W2, E2 Section 20: All lands Section 29: All lands Section 30: Lots 1-4 E2W2, E2	5/24/2010	2,543.32
124380	Township 23 south, Range 34 east, NMPM	Section 20: S2, NW4 Section 27: S2, NW4 Section 28: All lands Section 29: S2, NE4	5/24/2010	2,080.00
124381	Township 23 south, Range 34 east, NMPM	Section 30: Lots 1-4 E2W2, E2	5/24/2010	640.00
124381	Township 24 south, Range 32 east, NMPM	Section 1: Lots 1-4, S2N2, S2 Section 12: N2	5/24/2010	960.00
124381	Township 24 south, Range 33 east, NMPM	Section 35: All lands	5/24/2010	633.00
124382	Township 24 south, Range 34 east, NMPM	Section 30: E2, NE4SW4, SE4NW4 Section 31: W2	5/24/2010	720.00
124382	Township 25 south, Range 33 east, NMPM	Section 1: All lands Section 3: All lands	5/24/2010	1,281.00

Serial Number	Township and Range	Sections and Descriptions	BLM Approval Date	Acreage
124383	Township 25 south, Range 33 east, NMPM	Section 10: NE4 Section 11: All lands Section 12: W2, NE4, N2SE4	5/24/2010	1,361.00
124383	Township 25 south, Range 34 east, NMPM	Section 6: W2 Section 7: W2NW4	5/24/2010	398.00
			TOTALS:	**27,921.03**

Figure 4-2 shows the areas held by ICP under BLM prospecting permits in the Ochoa Project area, along with the 13 new prospecting permit applications that are in the final stages of review and approval. These new prospecting permits are located in T22S R31E, T22S R32E, T22S R33E, T23S R31E, T23S R32E, T23S R33E, T23S R34E, T24S R32E, T24S R33E, T24S R34E, T25S R33E, and T25S R34E. ICP will have an exclusive option to lease these tracts from the BLM during the two-year option or extension periods with conversion to preference right leases upon demonstration of a chiefly valuable resource.

Each state mining lease has a term of 10 years with subsequent renewals if, over 3 consecutive years during the term, the average annual production is not below the amount necessary to generate the minimum royalty required. ICP has posted a $25,000 bond for performance and surface or improvement damage with respect to the state mining leases. The next annual rent of approximately $26,000 in the aggregate is due by May 24, 2012, for the 17 state mining leases.

Royalties are payable to the BLM and to the State of New Mexico (at an average rate of 2.25% of gross sales), and to private parties at a rate of $1.00/ton of finished product for the first 1,000,000 tons sold and at $0.50/ton thereafter. There is a 3% net profit royalty that can be reduced to 1.5% net profit with a payment of $9 million, all of which terminates after 25 years thereafter. Total royalties are projected to average $15.5 million per year. Total payments for state and BLM royalties, property taxes and state and federal income taxes are projected to be $5,193.1 million (25% of gross revenues).

ICP currently plans on locating the facilities on leased and BLM land. The final location of facilities will be determined during feasibility studies and according to negotiations with the lease holders, with whom ICP has established and has maintained good relations.

4.3 Environmental Liabilities

The Ochoa Project has not been mined and has no known existing mining-related environmental liabilities. Drill roads and pads are reclaimed after completion of drill holes in accordance with BLM approved methods.

The permitting schedule for the Ochoa Project will be significantly influenced by the National Environmental Policy Act (NEPA) process. NEPA typically requires baseline studies for at least one year followed by a public review and comment period for scoping and development of draft environmental assessment or environmental impact statement. Other anticipated permitting requirements include mine registration, air, underground water, state trust land leases, explosives, and utility location.

Proposed mining projects are typically evaluated for a range of social, economic, cultural, and environmental impacts in response to NEPA and state permitting regulations. The Ochoa Project area is sparsely vegetated. Cattle graze on much of the Ochoa property, and petroleum exploration and development is widespread in the immediate vicinity. A small amount of oil and gas production occurs within the project area, though many of the wells are older and are thought to be experiencing declining production.

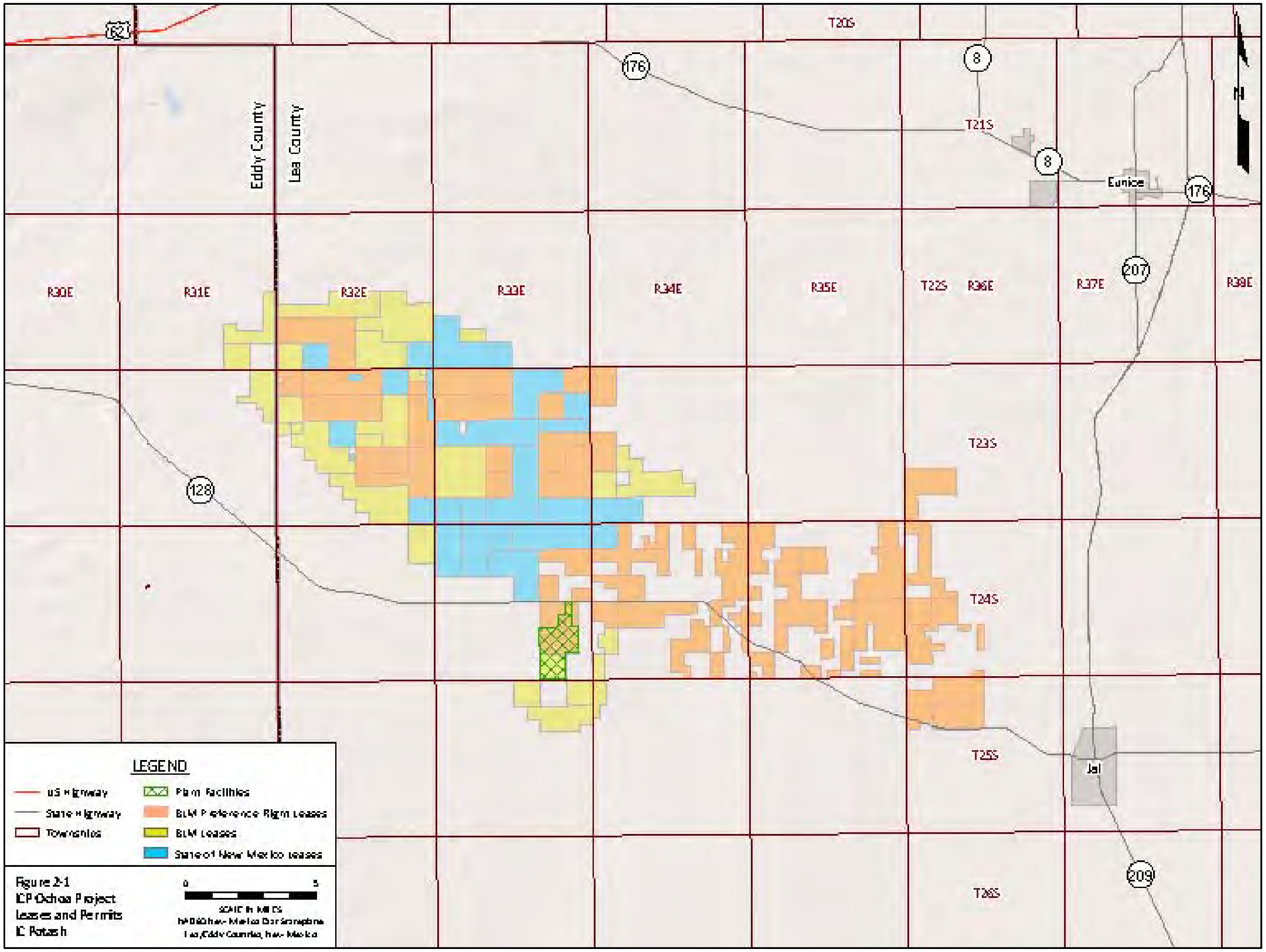


Figure 4-2 Claim Boundary Map

5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

5.1 Accessibility, Infrastructure, and Local Resources

The Ochoa Project is readily accessible via State Highway 128 and an extensive network of gravel roads. The property is traversed by County Road 2, as well as two track roads and primitive jeep roads. Airports are located in Hobbs (Lea County) and Carlsbad (Eddy County). A rail line runs through Jal, 15 mi to the east of the project area, south to El Paso, Texas, and a rail spur connects to the Waste Isolation Pilot Plant (WIPP) site 10 mi to the west.

The project area is located in Lea County in southeast New Mexico, near the border between Lea and Eddy Counties. According to the 2010 census, the population of Lea County is 64,727 and the population of Eddy County is 53,829. The town of Jal, with a population of about 2,000, is the nearest community to the project, just a few miles southeast of ICP's land holdings on State Highway 128. Food, fuel, and limited services are available in Jal, and heavy equipment, industrial supplies, and mining support services are available in Carlsbad and Hobbs, NM and Midland, TX. Experienced labor for construction, mining, and processing operations is available from nearly all of the southeastern New Mexico communities, including Carlsbad, Loving, and Hobbs.

There are active and plugged oil and gas wells within the limits of the project area, along with roads, power lines, and pipelines associated with oilfield development. Existing infrastructure includes a number of small dirt roads for vehicle access to the wells. A high voltage power line is located near the southern edge of the property, and electric power is supplied by Xcel Energy.

5.2 Topography, Elevation, Vegetation, and Climate

The Ochoa Project is located in the Pecos Valley section of the southern Great Plains physiographic province. Terrain is relatively flat with minor arroyos and low-quality, semi-arid rangeland (Figure 5-1). Elevation ranges from 3,100 ft to 3,750 ft above sea level. Vegetation is dominated by mesquite, shinnery oak and coarse grasses. Soil cover is composed of caliche rubble and wind-blown sand. The northern portion of the project is situated in sandy dune country which supports limited plant species.

The climate of the Ochoa Project area is semi-arid with generally mild temperatures. The prevailing winds are from the southeast during the summer months and from the west during the winter. Winter temperatures range from -20^{o}F to 50^{o}F. Summer daytime high temperatures are typically above 90^{o}F with nighttime lows of 70^{o}F. Average annual precipitation is about 13 inches (in), about half of which is associated with thunder storms that occur from June through September. Exploration, mining, and mineral processing can be carried out year-round on the Ochoa property.

Figure 5-1 Typical Terrain and Vegetation of the Ochoa Project

6 HISTORY

The Ochoa Project is a new mineral discovery and deposit. The immediate project area has no mining history.

The Delaware Basin has been explored for hydrocarbons since the early 20th century, but it has not been the subject of any previous exploration for polyhalite. ICP's planned commercial utilization of polyhalite as a raw material for production of SOP and other potassium/ magnesium fertilizers is based on work done in the 1920s to 1950s by the USBM and Potash Corporation of America. Economic production of potash from potassium chloride, langbeinite, and sodium chloride minerals in the Carlsbad area significantly curbed interest in and precluded the use of the polyhalite production process. ICP began preliminary polyhalite exploration in 2008, when they applied for exploration permits and initiated a scoping study. The 2008 scoping study prepared by Mincon indicated that the Ochoa area had good potential for a sizeable polyhalite deposit.

ICP drilled 13 core holes at the Ochoa Project prior to August 2009. The August 2009 PEA completed by Gustavson supported the prospects for polyhalite production from the Ochoa Project. As of September 1, 2011, ICP has completed a total of 20 core holes and has analyzed the chemical composition of polyhalite samples obtained during drilling.

Process test work was performed on Ochoa core samples by Hazen Research throughout the spring and summer of 2011 with direction and support from Rich Chastain and Tom Neuman.

7 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

The Ochoa Project lies at the northeastern margin of the Delaware Basin (Figure 7-1). The Delaware Basin is a structural sub-basin of the large Permian Basin that dominated the region of southeast New Mexico, West Texas, and northern Mexico from 265 Ma to 230 Ma. The Permian Basin is an asymmetrical depression formed on top of Precambrian basement rocks. Marine sediments accumulated in the basin throughout the Paleozoic Era. The slow collision of the North American and South American crustal plates resulted in tectonic subdivision of the Permian Basin into numerous sub-basins, of which the Delaware and Midland basins are the largest (Ward et al. 1986).

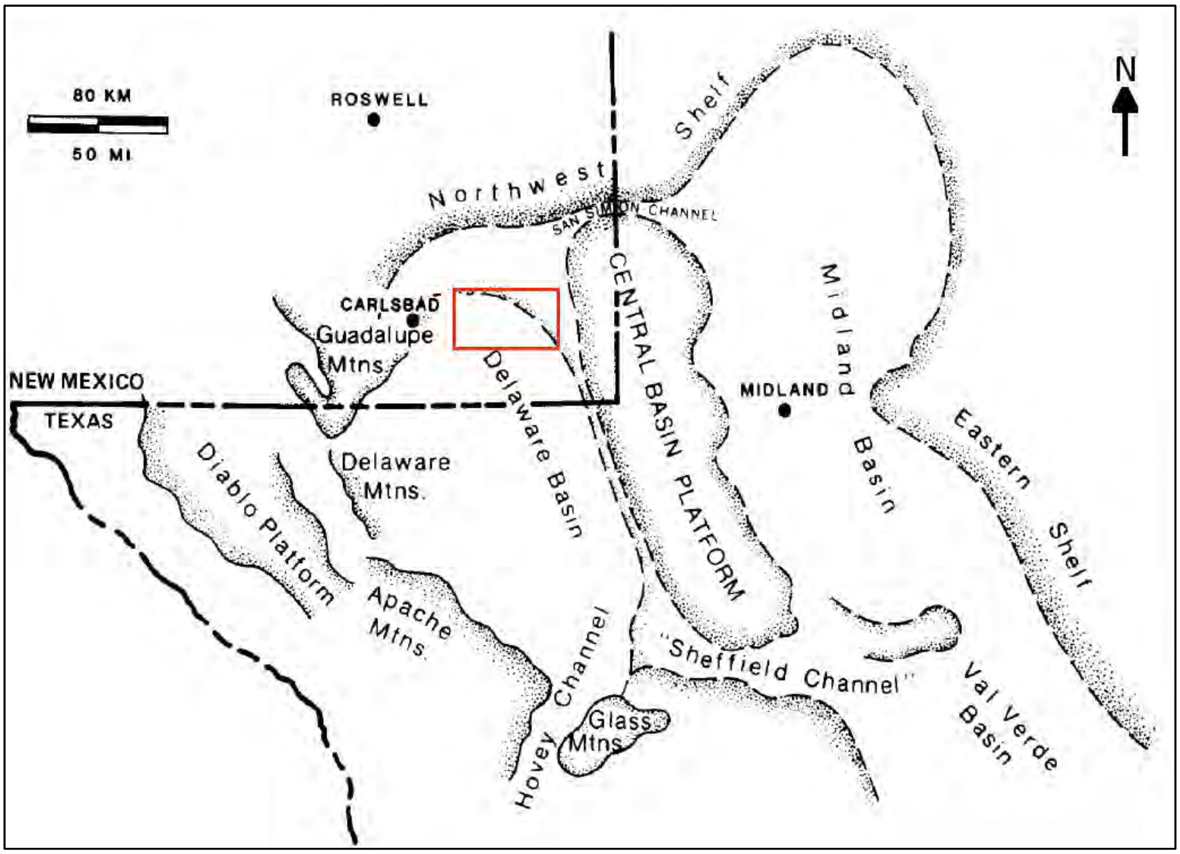


Figure 7-1 Delaware Basin, Ochoa Project Boundary in Red
(Modified from Ward et al. 1988)

GUSTAVSON ASSOCIATES
GEOLOGISTS • ENGINEERS • ECONOMISTS • APPRAISERS

7.2 Local Geology

The sedimentary sequence of the Delaware Basin is composed of deep water siliciclastics, shelf carbonates, marginal marine evaporites, and terrestrial red beds. The deep water siliciclastics and shelf carbonates occur well below the horizon of interest and are not discussed further. Extensive and thick evaporate deposits occur throughout the Late Permian (Ochoan-age) rocks within the basin. Ochoan-age sedimentary deposits, specifically the Castile, Salado, and Rustler Formations (Figure 7-2), are the primary focus of polyhalite exploration. Collectively, the Castile, Salado and Rustler evaporite-bearing formations are over 4,000 ft thick.

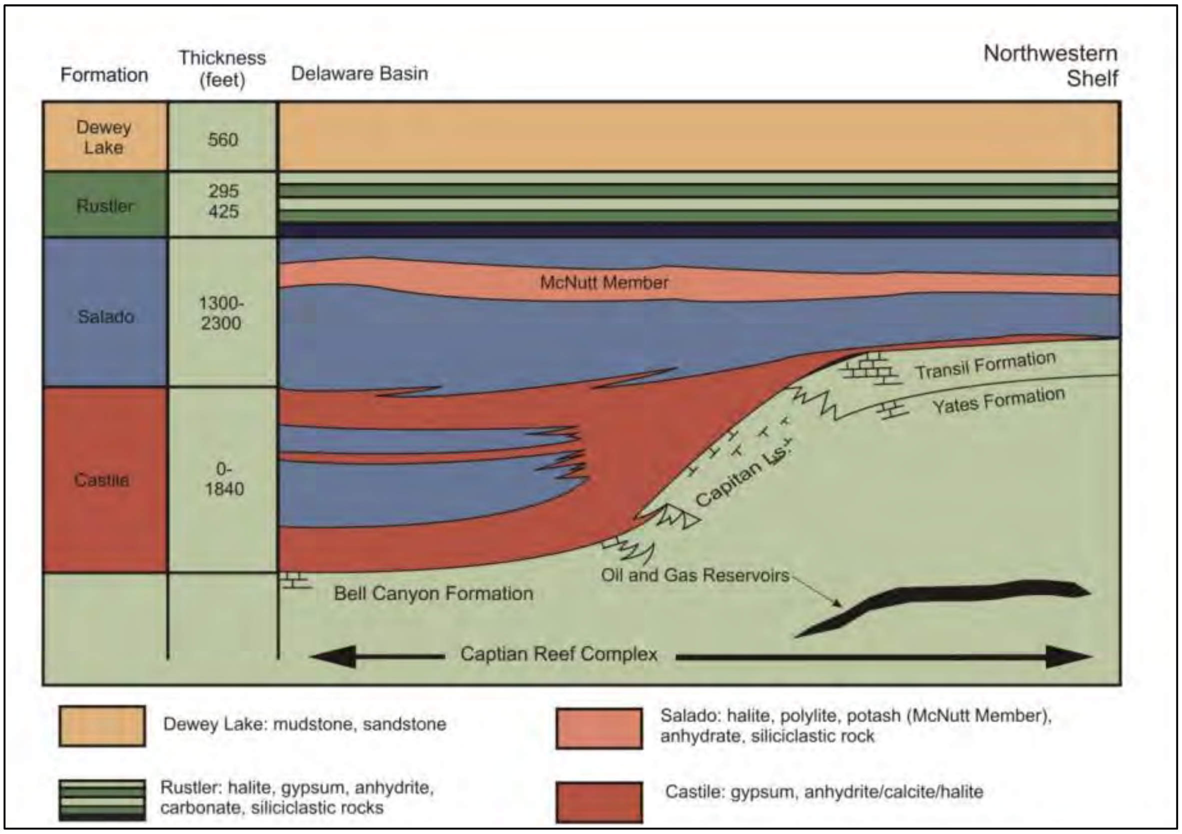


Figure 7-2 Conceptual Cross-Section of the Delaware Basin

7.2.1 Castile Formation

The Castile Formation is the oldest evaporite cycle of the Ochoan series in the Delaware Basin. The Castile Formation is composed of anhydrite, halite, and limestone with anhydrite interbeds.

7.2.2 Salado Formation

The Salado Formation consists of cyclic anhydrite, halite, and clay deposits. Potassium minerals in the Salado Formation occur as interbeds within the anhydrite and halite stratigraphic units. Potash occurs in the form of polyhalite in anhydrite, and as sylvite, langbeinite, or carnallite in halite. The Salado Formation is divided into three units, the upper, lower, and middle, in the northern portion of the Delaware Basin.

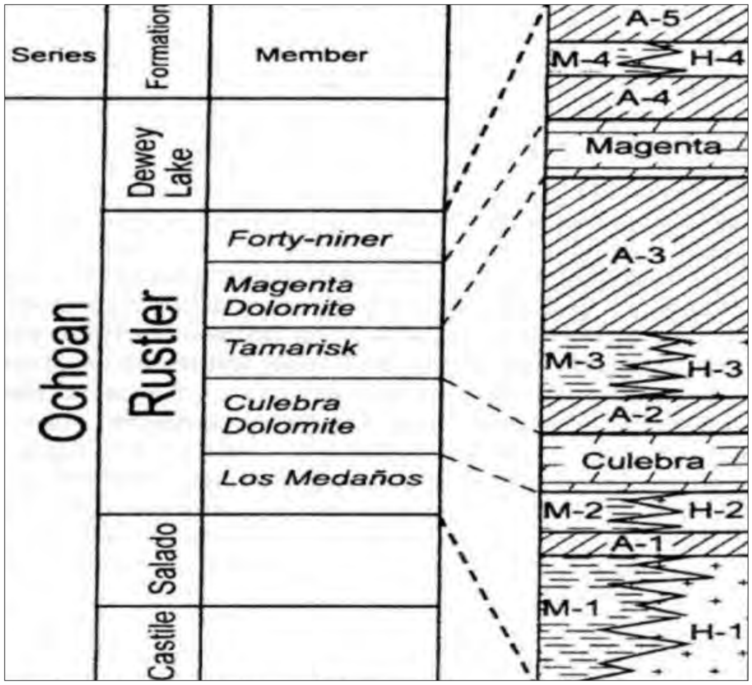
7.2.3 Rustler Formation

The target horizon of ICP's Ochoa Project is the polyhalite found within the Rustler Formation. The Rustler Formation is composed of anhydrite, halite, dolomite, sandy siltstone, and polyhalite (Jones 1972). There are five recognized members of the Rustler Formation, which are, from oldest to youngest, the Lost Medaños, Culebra, Tamarisk, Magenta, and Forty-niner (Figure 7-3). Polyhalite occurs in the Tamarisk Member of the Rustler Formation.

- The Los Medaños Member consists of siliclastics, halitic mudstones, and muddy halite, and sulfate minerals, principally anhydrite (Powers and Holt 1999).
- The Culebra Member consists of pinkish gray dolomite.
- The Tamarisk Member is comprised of three sub-units: a lower basal anhydrite, a middle halite-rich mudstone, and an upper anhydrite. Polyhalite occurs within the lower anhydrite. The thickness of the Tamarisk varies principally as a function of the thickness of the middle halite-rich mudstone unit.
- The Magenta Member is predominantly dolomite with minor amounts of gypsum.
- The Forty-niner Member has a similar general stratigraphy to the Tamarisk. It is made up of a lower and an upper anhydrite with a middle siltstone.

7.2.4 Dewey Lake Formation

The Dewey Lake Formation is composed of mudstone, siltstone, claystone, and interbedded sandstones consistent with typical terrestrial red beds. The formation is divided into upper and lower members. The lower Dewey Lake is characterized by gypsum filled fractures, and the upper Dewey Lake is cemented by carbonate (Beauheim and Holt 1990).



NOTE: Units on the right labeled A- are dominated by anhydrite, those labeled H- are halite dominated, and those labeled M- are mudstone or clay.

Figure 7-3 Ochoan Stratigraphic Mapping Units Defined by Powers

7.3 Property Geology

The geology of the Ochoa Project is characterized by a simple structural setting and conformable stratigraphic sequences. The stratigraphic section of interest, the Rustler Formation, is present in its entirety throughout the project area. In general, the Ochoa property overlies a gentle, symmetrical synform with a northwest-southeast axial orientation. The synform appears to have full closure to the northwest and dips slightly to the southeast. Borns and Shaffer (1985) completed a regional correlation of 276 borehole geophysical logs to identify the horizons of the Ochoan-age rocks in the Delaware Basin. Correlation of the additional geophysical logs carried out by ICP has improved the understanding and resolution of the subsurface geology in the Ochoa Project area. The horizon of interest in the project area is interpreted to have accumulated in a shallow marginal marine setting, specifically a lagoon environment.

7.4 Mineralization

Polyhalite mineralization within the Ochoa Project area occurs within the lower half of the Tamarisk Member of the Rustler Formation. The polyhalite is interpreted to have formed in a paleolagoon of Ochoan age. Polyhalite mineralization occurs throughout a roughly oval shaped area approximately 20 mi in length and approximately 9 mi in width. The mineralized area is characterized by a bed thickness greater than 4 ft across the majority of the area, and a narrow peripheral zone that contains bed thickness from 0 to 4 ft thick.

8 DEPOSIT TYPES

Potash is the collective term for a potassium-bearing, chemical sedimentary mineral deposit that is the result of low temperature chemical processes governed by evaporative concentration of a fluid such as seawater or freshwater. Bedded potash deposits commonly occur in sedimentary basins that have restricted connection to more dilute fluid. Diagenetic processes play an important role in evaporite mineral alteration and the production of potash ore minerals.

Potash mineralization occurs as assemblages of predominantly potassium chloride or predominantly potassium sulfate minerals. These assemblages may be interbedded or adjacent to one another, but rarely occur as a mixed assemblage in a single sedimentary bed. Individual potash mineral deposits can typically be correlated with geophysical logs and mapped over large areas.

Polyhalite is a hydrated sulfate mineral containing potassium, calcium, and magnesium.

Modern occurrences are thought to form through diagenetic alteration of gypsum. Alteration is the result of the chemical reaction of gypsum with increasingly potassium and magnesium concentrated brines, formed in the evaporative facies of a sedimentary basin. Mineralization at Ochoa is interpreted to have formed through identical processes in a marine lagoon setting.

9 EXPLORATION

A reconnaissance area of approximately 1,000 mi^2 was studied in order to identify major geologic features and determine the basic distribution of lithologicic units, including polyhalite mineralization. This work relied on published reports and was supplemented with petroleum data records and well logs obtained from public and commerical sources. A general 'target' geologic framework, from the top of the Rustler Formation down to the top of the Salado Formation, was established. Polyhalite mineralization occurs approximately midway between the two contacts.

ICP has aquired 812 geophysical borehole logs from various exploration sources. Wireline log readings from these boreholes were used to interpret subsurface lithology.

9.1 Subsurface Interpretation

Fifteen petrophysical wireline log markers were defined within the target geologic framework. Six of these are formal lithostratigraphic units that are encountered throughout the study area. The remaining nine markers are associated with individual sedimentary beds within the formal lithostratigraphic units, which exhibit unique petrophysical responses (Table 9-1).

Table 9-1 Summary Petrophysical Markers Defined for Correlation

	Marker	Type of marker	Lithology
1	Top Rustler	Stratigraphic – formation	Anhydrite
2	APH_01	Petrophysical	Siltstone-shale within Forty-niner member
3	APH_02	Petrophysical	
4	Top Magenta	Stratigraphic - member	Dolomite
5	Top Tamarisk	Stratigraphic – member	Anhydrite
6	Halite_U	Petrophysical – unknown origin; appear to be the base of the upper half of the Tamarisk anhydrite and marks the change to a lower zone of anhydritic halite and siltstone	None – reflects division between upper and lower anhydrite zones
7	APH_05	Petrophysical	None – may be a bedding plane feature
8	APH_06	Petrophysical	None – may be a bedding plane feature
9	Top Poly	Petrophysical	Polyhalite, depth of gamma high may occur below depth of density log because anhydrite density is similar to polyhalite density
10	Base Poly	Petrophysical	Transition to underlying anhydrite
11	BPH_01	Petrophyscial	Top shale or anhydritic shale
12	BPH_02	Petrophyscial	Base of shale zone, transition to anhydrite
13	Top Culebra	Stratigraphic - member	Silty dolomite
14	Top Los Medaños	Stratigraphic - member	Siltstone, top of thick siltstone sequence, include 1st anhydrite as part of upper portion of sequence and immediately below siltstone that forms the spike
15	Top Salado	Stratigraphic – formation	Halite

The effective use of marker correlation and mapping of exploration is limited to establishing structural framework, estimating lithostratigraphic volumes, and evaluating physical trends such as changes in elevation and thickness. At this stage of exploration facies analysis is ongoing. Figure 9-1 is an example of wireline borehole logs correlated using the 15 markers.

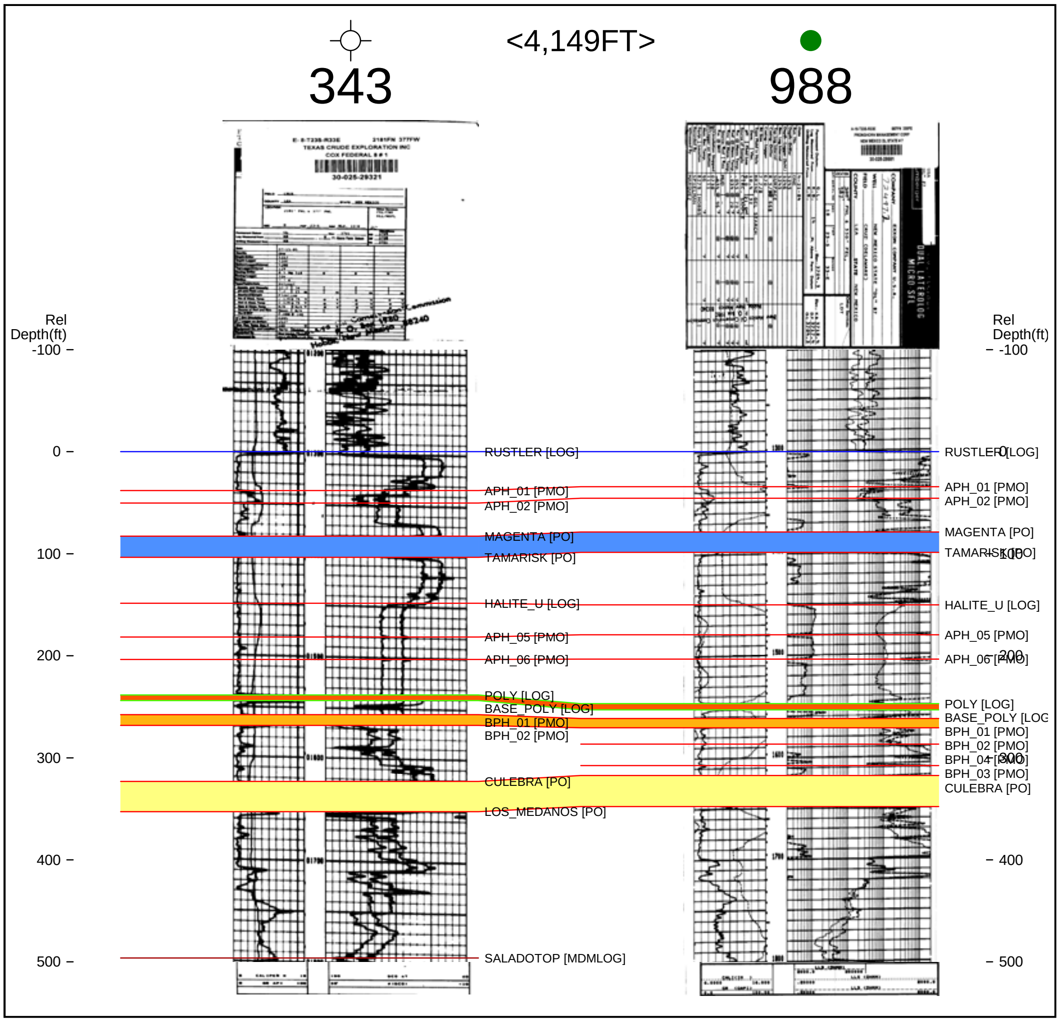


Figure 9-1 Typical Wireline Logs with Marker Horizons

Some of the markers were not present throughout the entire reconassiance area (e.g., Halite_U, APH_05, APH_06, Top Polyhalite, and Base Polyhalite), indicating a limit to the mineralization and presumed delineation of the paleoshoreline. Structural maps with contoured surfaces of the marker bed horizons were created based on the correlated wireline logs.

Previous studies by others have concluded that the current study reconnaissance area is a depocenter within the Delaware Basin. The results of correlating and mapping the subsurface markers of the Rustler Formation support that hypothesis, and suggest the following with regard to the structure of the basin:

- Elongate depression oriented northwest-southeast
- Closed in the northwest and open but restricted in the southeast

- Bounded on the east by a well-defined ridge (50 to 200 ft relief, 2 to 3 mi wide)
- Bounded on the west and north by broad sloping ramp
- No disruptions identified (e.g., sharp elevation changes, sharp isopach variations, or sharp slope changes from marker to marker)
- No significant migration of basin depocenter axis or other framework features including highs, lows, and edges
- Variation in thickness between markers is very consistent, but clearly thin or truncate toward and at the edges of the sub-basin
- No clear evidence of significant faults

The geology of the project area is representative of a depositional basin that has experienced uplift and minor structural deformation. The interpretation of a structurally quiescent depositional basin is supported by strong marker correlation, consistent thicknesses between markers, consistent slope of surfaces within the sub-basin, and the thinning trend and truncation of markers near areas where underlying markers begin to shallow in depth. The present shape and slope of the basin is probably enhanced by post-lithification events in the region, the most important being salt dissolution and subsidence in the Nash Draw to the west and the San Simon Swale to the east.

The locations of two cross sections demonstrating the shape of the subsurface layers are shown in Figure 9-2. The northwest-southeast cross-section (Figure 9-3) is shown looking eastward from the western portion of the property. This section is approximately coincident with the axis of the basin. Figure 9-4 shows a west-east cross-section looking north, and illustrates the symmetry of the basin. These cross sections are based on data from only a few widely spaced wells, which are shown equally, rather than proportionally, spaced. The large distance between wells and very limited vertical variation in beds and markers is difficult to portray in small page size diagrams.

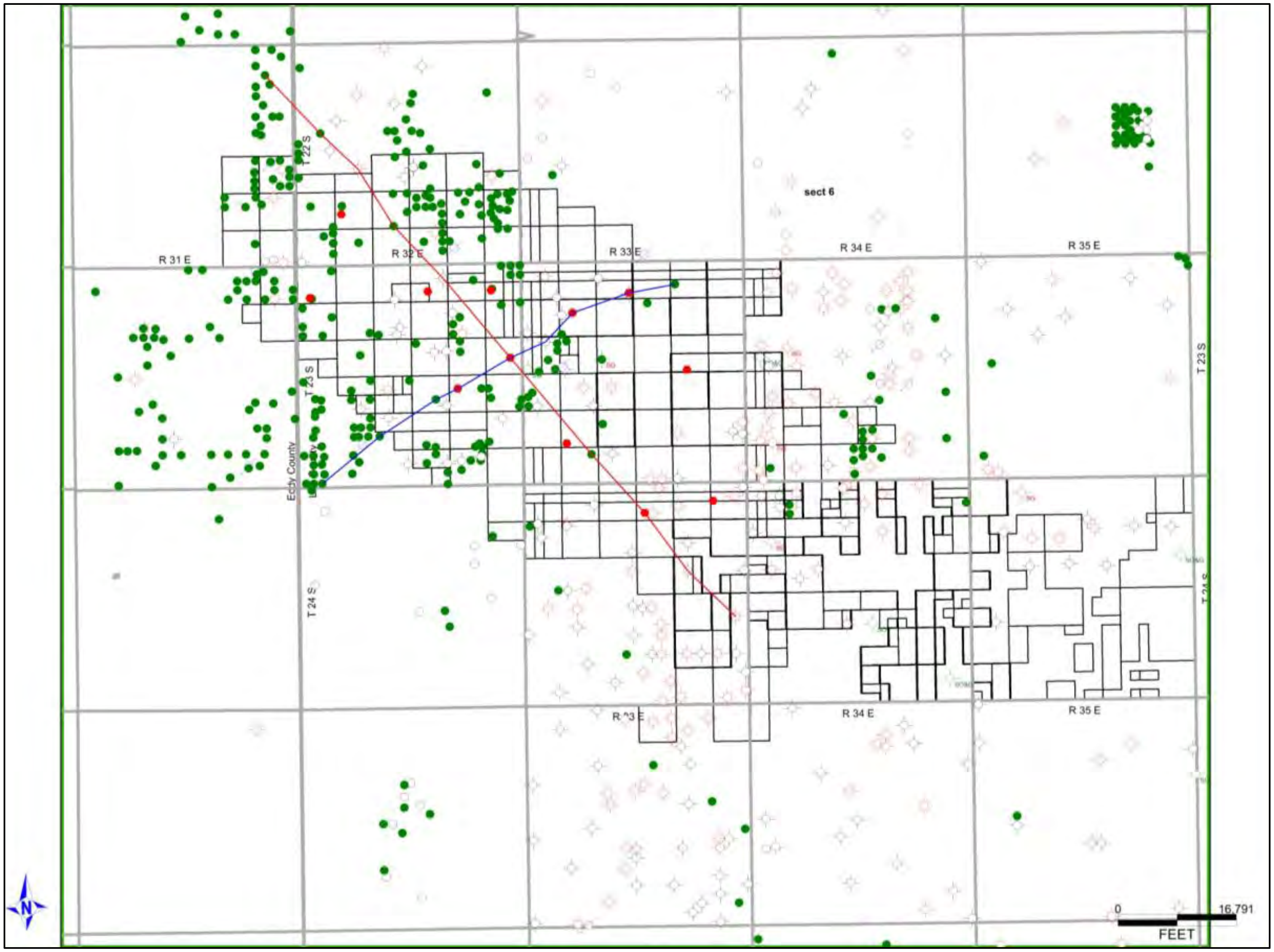


Figure 9-2 Representative Cross Section Alignments

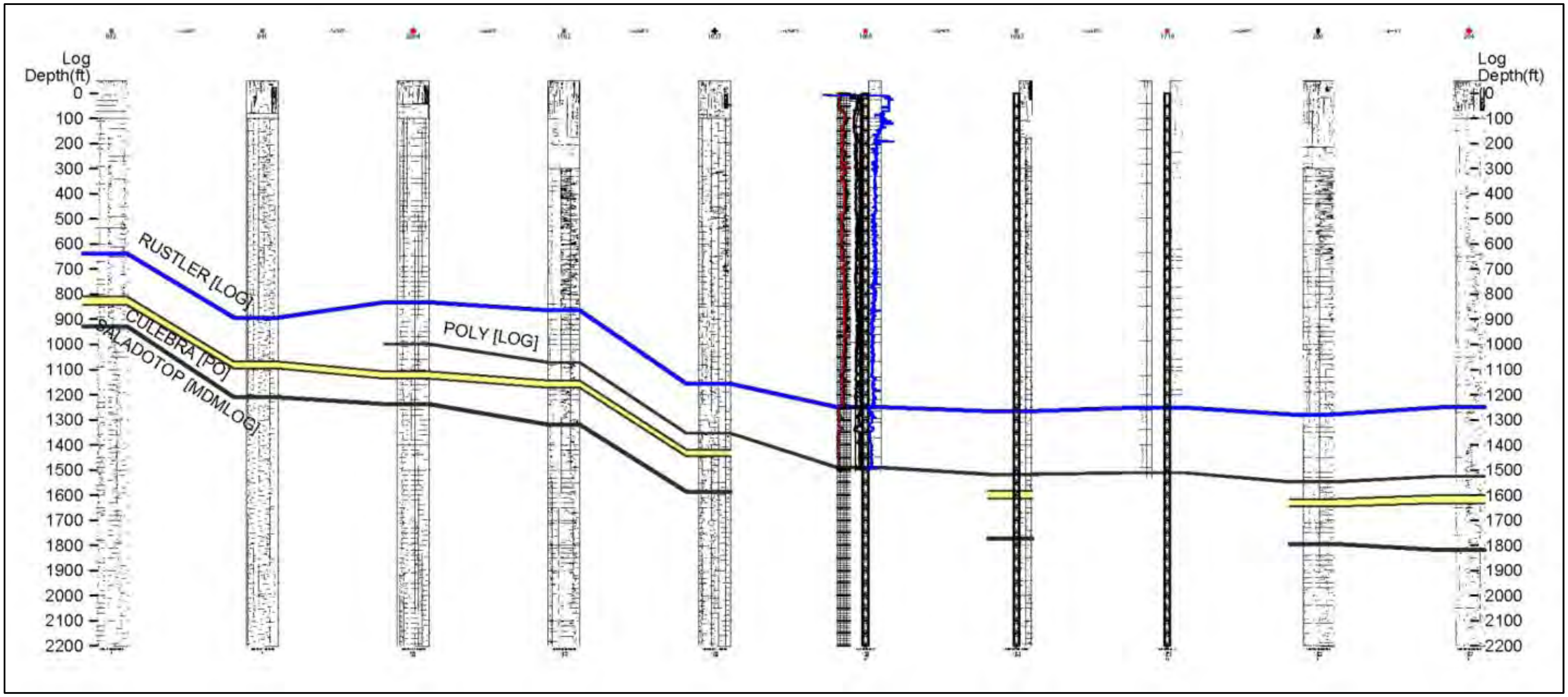


Figure 9-3 Northwest-southeast Cross Section Along Basin Axis (Vertical exaggeration approximately 10x)

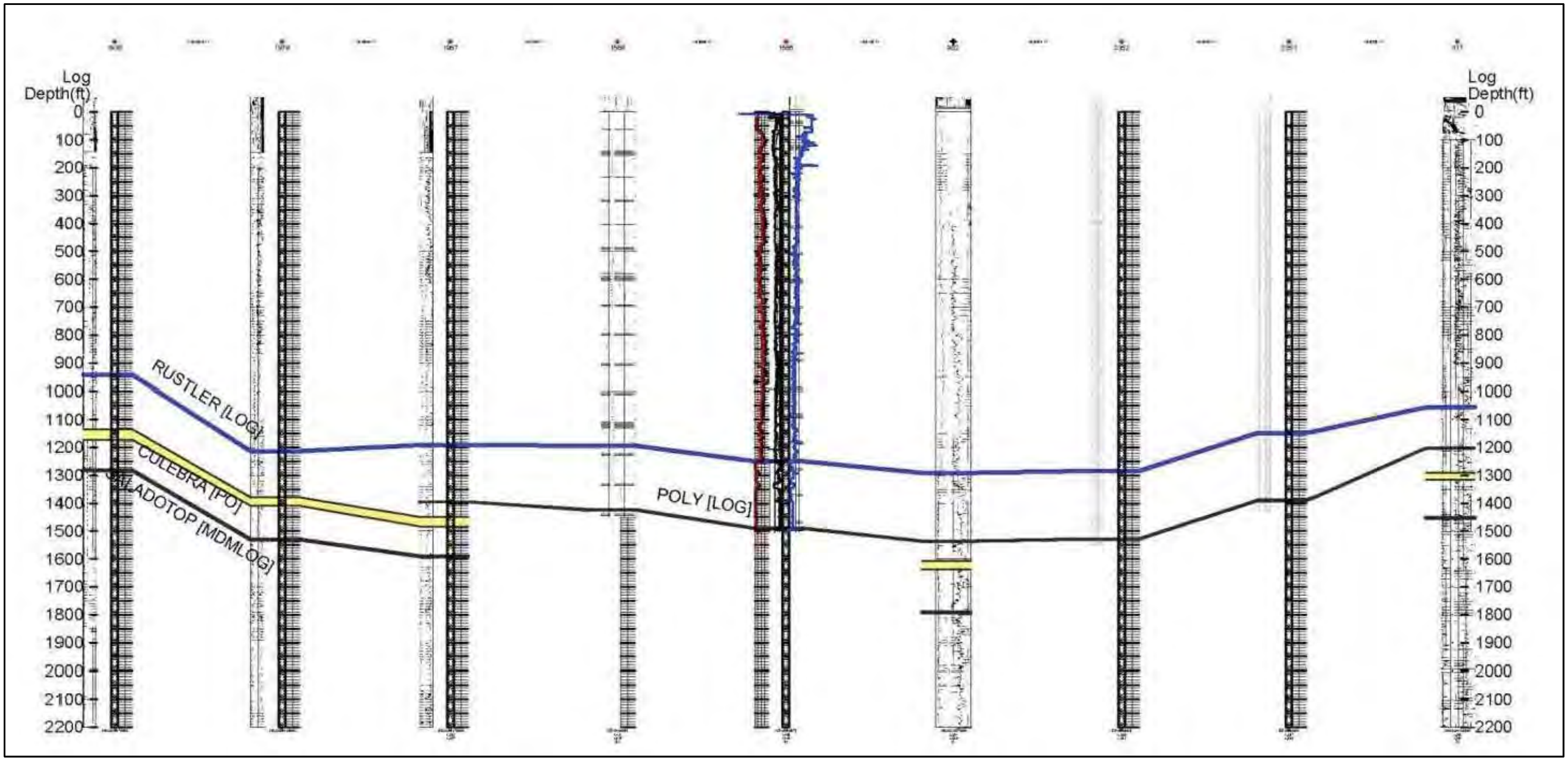


Figure 9-4 West-East Cross Section across AOI (Vertical exaggeration approximately 10x)

10 DRILLING

10.1 Introduction

ICP successfully drilled, cored, logged, plugged and abandoned 20 vertical exploration holes throughout the permit area during a two-phase exploration drilling campaign.

Each drill hole was drilled as an upper portion and a lower portion. The upper portion was drilled using a rotary drill and cased for borehole integrity and aquifer protection. The upper portion contained formations from the ground surface to within ~50-75 ft of the top of the polyhalite mineralized bed. Coring was implemented from this point for the purpose of analytical data collection.

10.2 Procedures and Conditions

Drilling conditions in the Ochoa Project are good due to gently rolling terrain and easy access provided by oil and gas well roads. Pad sites are constructed when needed. No aquifers were encountered during the ICP drilling program.

10.2.1 Rotary Drilling

Rotary drilling was used to advance each hole through the Dewey Lake Formation and into the upper portion of the Rustler Formation. This portion of the drill hole was advanced using a water based gel chemical drilling fluid. Rock chips were collected in 5-ft intervals, washed in water, logged for lithologic description, placed in chip trays, transported to and stored at the core lab in Hobbs, NM. The geologist at the rig assessed cuttings, rig performance, and offset well correlation to identify the approximate depth above the polyhalite mineralization at which to begin core drilling and collection. In exploration Phases 1 and 2, this depth was approximately 20 ft above the polyhalite seam and was delineated by an anhydrite marker bed (i.e., APH_05 and APH_06). In Phase 2B drilling, core was also recovered for roof rock geotechnical analysis, and the core point was moved to roughly 50 to 75 ft above the polyhalite seam.

10.2.2 Diamond Core Drilling

For the target evaporite intervals, a salt saturated drilling fluid was used to minimize dissolution and alteration of water soluble minerals, which were predominantly halite and polyhalite. Use of the salt saturated drilling fluid was initiated prior to drilling to core point. This provided sufficient time to establish stable chemical and rheological properties in the drilling fluid both the active and reserve drilling fluid systems. At the core point, the rotary drilling assembly was removed from the hole and replaced with a 40 ft core barrel and bottom hole assembly. The coring tools were run in the hole and a 40 ft core run was completed. The core barrel and drill string were then tripped out and the core recovered. The process was repeated if a second or third core run was desired.

10.2.3 Wireline Logs

Upon completion of coring, the holes were logged with wireline petrophysical tools. Logs collected during Phase 1 work include total gamma, caliper, and standard electric logs. No density or neutron logs were acquired during Phase 1 exploration. The specific tools used in Phase 1 varied and presentation was not standardized. Phase 2 and 2B holes were logged using a consistent suite of tools, and the logs collected include spectral gamma, laterolog and induction electrical, formation density, and neutron density logs (Table 10-1).

Table 10-1 Summary of Wireline Logs Collected

	Hole ID	Caliper*	Gamma	Spectral Gamma	Sonic	Density	Neutron	Resistivity*	Directional Survey
Phase 1 Drilling Program	ICP-021(001)	x	x	n	x	n	n	n	x
	ICP-022(002)	x	x	n	x	n	n	n	x
	ICP-026(003)	x	x	n	n	n	n	n	x
	ICP-047(004)	x	x	n	x	n	n	n	x
	ICP-043(005)	x	x	n	n	n	n	x	x
	ICP-051(006)	x	x	n	x	n	n	x	x
Phase 2 Drilling Program	ICP-042(007)	x	x	x	x	x	x	x	x
	ICP-045(008)	x	x	x	x	x	x	x	x
	ICP-048(009)	x	x	x	x	x	x	x	x
	ICP-062(010)	x	x	x	x	x	x	x	x
	ICP-063(011)	x	x	p	x	x	p	x	x
	ICP-061(012)	x	x	x	x	x	x	x	x
	ICP-056(013)	x	x	x	x	x	x	x	x
Phase 2B Drilling Program	ICP-046(014)	x	x	x	x	x	x	x	x
	ICP-053(015)	x	x	x	x	x	x	x	x
	ICP-005(016)	x	x	x	x	p	x	x	x
	ICP-078(017)	x	x	x	x	x	x	x	x
	ICP-076(018)	x	x	x	x	x	x	x	x
	ICP-058(019)	x	x	x	x	x	x	x	x
	ICP-059(020)	x	x	x	x	x	x	x	X

**1-arm caliper run in all holes, 3-arm caliper run in Phase 2 and 2B holes; resistivity logs variously included guard, induction, and normal.*

***n** = not run.*

***p** = hole problems prevented complete run.*

10.2.3.1 *Collar Surveys*

ICP commissioned commercial surveying companies to survey the location of each of the 20 drill holes completed. Drill hole collar location information is presented in Table 10-2, and drill hole locations are shown in plan view on Figure 10-1.

Table 10-2 Drill Hole Collar Location Information

Well ID	Drilling Sequence	Phase	Survey Locations in NAD 83 Projection		
			Elevation	Latitude	Longitude
ICP021	001	1	3632.97	32° 19’ 43.2”	103° 34’ 13.9”
ICP022	002	1	3700.71	32° 19’ 16.0”	103° 35’ 48.5”
ICP026	003	1	3690.11	32° 17’ 54.1”	103° 32’ 40.2”
ICP047	004	1	3519.44	32° 19’ 41.9”	103° 43’ 01.5”
ICP043	005	1	3561.29	32° 21’ 39.5”	103° 42’ 08.4”
ICP051	006	1	3747.04	32° 19’ 49.1”	103° 38’ 03.2”
ICP042	007	2	3726.82	32° 18’ 14.9”	103° 37’ 31.7”
ICP045	008	2	3692.37	32° 17’ 31.1”	103° 38’ 59.2”
ICP048	009	2	3677.52	32° 19’ 49.7”	103° 39’ 47.1”
ICP062	010	2	3631.85	32° 14’ 48.1”	103° 31’ 59.0”
ICP063	011	2	3587.33	32° 14’ 32.3”	103° 33’ 52.3”
ICP061	012	2	3627.05	32° 14’ 17.2”	103° 36’ 020.”
ICP056	013	2	3666.93	32° 16’ 11.6”	103° 35’ 59.8”
ICP046	014	2B	3673.47	32° 16’ 38.0”	103° 35’ 02.7”
ICP053	015	2B	3693.52	32° 17’ 23.0”	103° 37’ 29.1”
ICP005	016	2B	3627.10	32° 16’ 07.4”	103° 31’ 45.2”
ICP078	017	2B	3664.45	32° 16’ 04.9”	103° 33’ 43.0”
ICP076	018	2B	3657.16	32° 15’ 10.7”	103° 34’ 54.3”
ICP058	019	2B	3624.10	32° 14’ 19.3”	103° 31’ 25.2”
ICP059	020	2B	3607.76	32° 14’ 21.5”	103° 33’ 06.0”

10.2.3.2 Downhole Surveys

All drill holes are vertical or sub-vertical. Wireline gyroscopic surveys were acquired during the open hole logging procedures.

10.2.3.3 Core Recovery

Core recovery in the polyhalite and anhydrite zones was excellent in terms of length and minimal alteration of the rock by the salt based drilling fluid. Halite zones above and below the polyhalite reacted with the drilling fluid and partially dissolved. The degree of dissolution depended on the salt saturation condition of the drilling fluid. In most cases, the core was under gauge by less than 1 to 2 millimeters (mm). Severe reduction in gauge (e.g., 1 centimeters (cm) radial reduction) occurred when the drilling fluid was not properly conditioned or maintained near salt saturation, or when there was a prolonged coring time caused by slow penetration rate at the anhydrite and polyhalite horizons.

Chemical reaction between the drilling fluid and rock-forming minerals does not appear to be a significant issue. Visual appearance of the surface of the core does not show any noteworthy pitting or efflorescence. The core was not washed or scrubbed to remove drilling fluid, and it is possible that some amount of the halite detected by x-ray diffraction (XRD) was drilling fluid contamination.

In addition to core, drill cuttings were collected at 5-ft intervals from spud to total depth. After drilling and logging operations were complete, all wells were plugged from total depth to ground surface.

Drill hole summary reports were compiled for Phase 1 (6 holes), Phase 2 (7 holes) and Phase 2B (7 holes). These reports contain all field operational records, core description and photographic records, and assay data. The reports are on file in the Hobbs business office. A typical drillhole log example is shown in Figure 10-2.

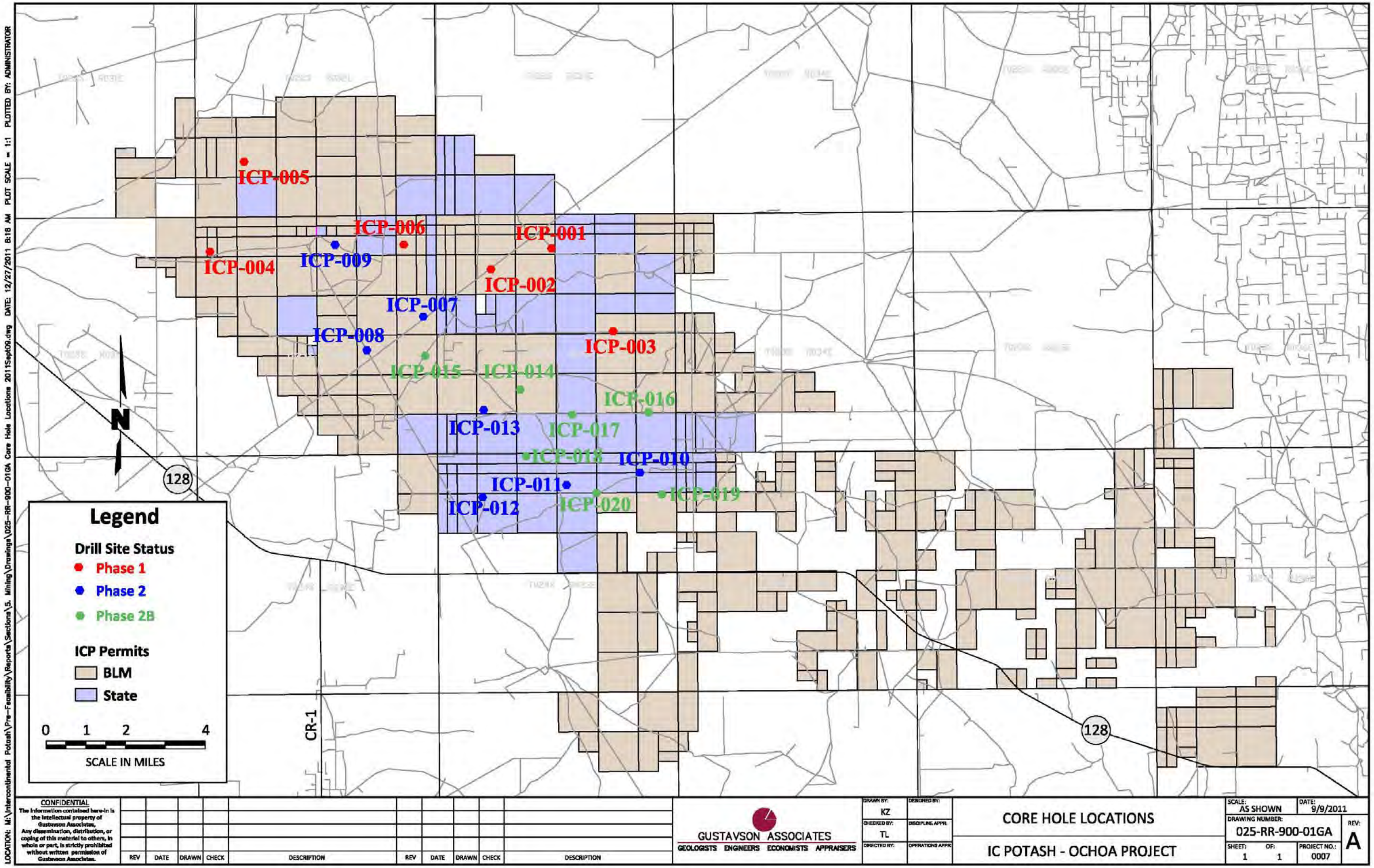


Figure 10-1 ICP Drill Hole Location

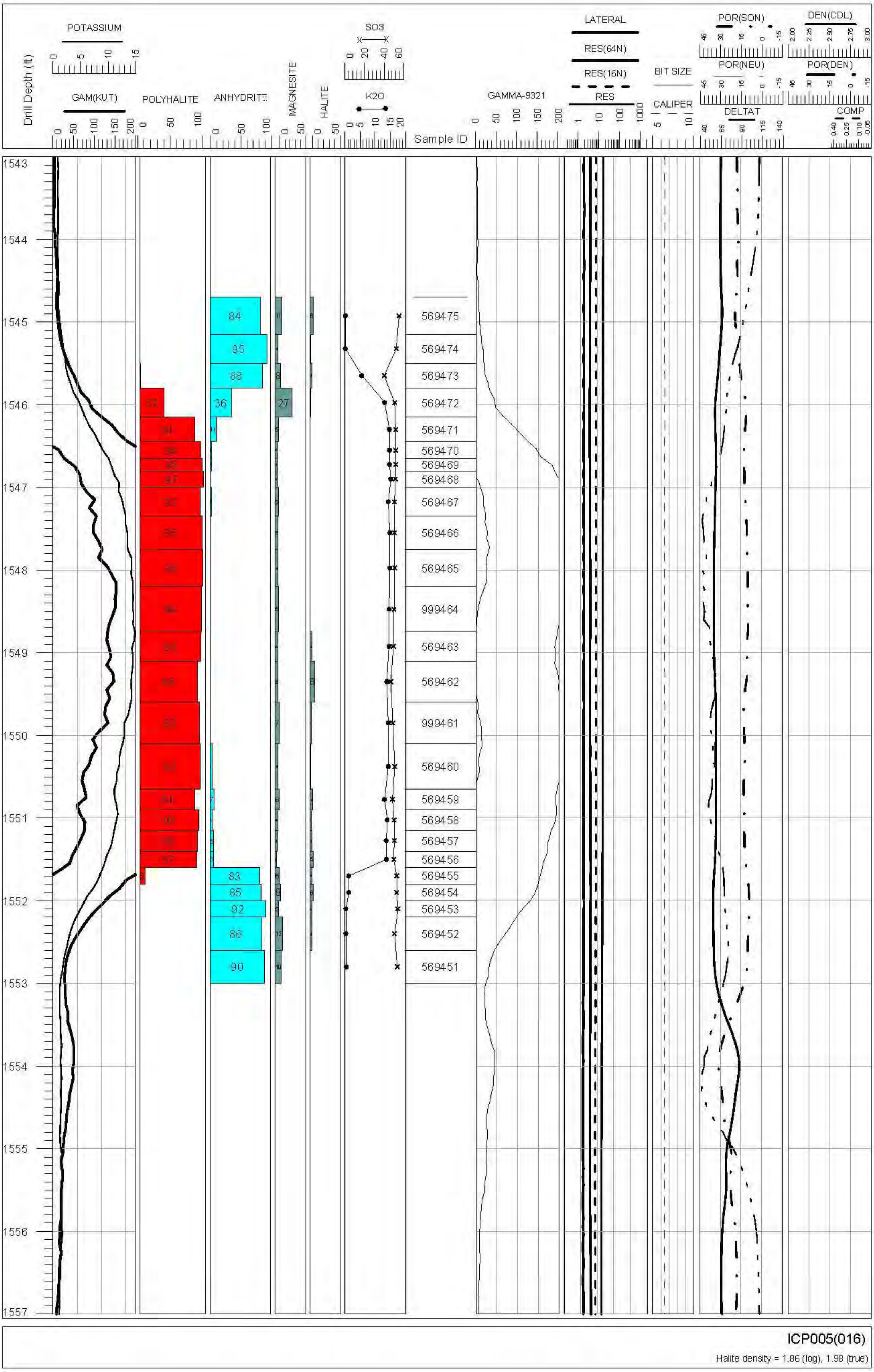


Figure 10-2 Typical Drillhole Log Example

11 SAMPLE PREPARATION, ANALYSES, AND SECURIITY

11.1 Sample Handling and Security

Sodium chloride-saturated drilling fluids were used during coring to ensure minimal alteration of the recovered core. The rate of penetration, revolutions per minute, weight on bit, pump pressure, and strokes per minute were documented as the core was advanced. Upon completion of coring, the drill string was picked up and the indication of the core break observed and noted. The drill string and core barrel were carefully brought to surface. The core barrel was hung vertically in the derrick and the core removed. Core removal was recorded on video to ensure that proper orientation of the core was maintained during transportation from the core barrel to the core trailer.

The core was laid out on a core logging table and fit together to reconstruct the continuous core recovered. If core loss was suspected a spacer was placed in the layout until the core was matched to the petrophysical logs. The core was measured, and percent core recovery was calculated. Initial core loss and broken/rubble core intervals were documented. The core was cleaned with dry rags and marked with driller depths in foot increments and vertical orientation. The marked core was video taped and boxed with bags of rumbled core, foam spacers to reduce movement of core in the boxes, and desiccant packs. The core box tops and bottoms were labeled on two sides with the drill hole name, core run number, box number, and interval contained in the box. The boxes were sealed with security tape and a chain of custody was completed documenting when the core was transported to the core lab. All cores were transported by an ICP company vehicle from the field to the core lab.

When the core arrived at the core lab, the chain of custody was checked to verify all materials were present and in a secured condition. If security had been compromised, an investigation was initiated. The core was depth corrected to get the most accurate depth for geologic modeling and mine planning. The depth correction also verified lost core intervals.

Depth correcting was conducted by comparing the driller depths and wireline log depths of the casing bottom and key lithology changes. The most confident depth was selected for the corrected depth if a discrepancy existed between the driller depth and wireline log depth. Corrected depths were marked in red permanent marker. The core was compared to the final wireline logs to verify or modify the initial core loss intervals documented in the field, as appropriate.

Improved sample handling protocols were instituted in Phase 2B of the project. The whole core was photographed with a Canon EOS Rebel T1i camera mounted on a stationary tri-pod. The core was passed by the camera on a rolling table to keep consistent parameters for all photographs. Each photograph contains an engineer scale, color scale, and a gray scale. The individual photographs were archived and stitched together using computer software to create a single photograph containing well name, lithologic contacts, engineer scale, color and gray scale, and adjusted depths.

The whole core was cut into two halves; one half was then cut into two quarters. One quarter was canted (the outer curved potion of the quarter core was cut off). This eliminated the possibility of sending core altered by the drilling fluid to the lab for analysis. The canted quarters were used as the analytical samples and were cut in 3-in. to 6-in. interval lengths. The samples were assigned a blind number from a sample book which correlates the well name, sample interval, and a sample description to the blind number. The samples were individually vacuum sealed in 6-in. x 10-in., 3-mil poly bags with their respective blind number and sent to the lab. Multiple core runs may have been sent to the lab in a batch, but a single core run was never split between two batches. A chain of custody was completed for each batch of samples sent to the lab, documenting the sample numbers contained in the batch, shipment date, and mode of transfer. A signed copy of the chain of custody was returned to ICP when the package was delivered to the lab.

All retained core was individually vacuum sealed in less than two ft intervals in 6-mil poly tubing with a 1/6 Tyvek® desiccant pack, humidity indicator, and index card with the well name and interval labeled. All vacuum sealed core intervals were replaced in the appropriate core boxes with adjusted depths labeled on two sides, in red marker, and maximum temperature indicators placed on the inside of the boxes. Core boxes were stacked five boxes high on a back shelf for long-term storage after the core is processed.

11.2 Sampling Quality Assurance / Quality Control Program Design

The sampling program utilized duplicate, blank, and standard samples inserted into the sample batches for testing alongside the samples from intervals of interest. This allowed for a check and correction of sample test results, as necessary. Duplicate samples were used to provide a measure of the repeatability of test results, including sample homogeneity and testing procedures. Duplicate samples were assigned a different sample number than their counterpart sample. Blank samples did not contain the material of interest, potassium in this case, and provided a measure of cross-contamination between individual samples as they were prepared and tested. Standard samples have a known composition, which allowed for a comparison between the lab test results and the known composition of the standard. These standards, or standard reference materials (SRM), provide a means of comparison to identify instances and degrees of under- or over-reporting of chemical species in the sample testing results.

An analytical batch consisted of 12 to 20 samples made up of core samples, one or two duplicates, one SRM, and one blank. During Phase 1 exploration, no duplicates were run. SRM consisted of polyhalite, sylvite, langbeinite, or commercial fertilizer; and the blanks were quartz sand. Upon review of the first program, a decision was made that too many standards were being used and the composition of those standards were not well established. The blank (a silicate) was determined to be inappropriate because it was not of similar type to the sample (i.e., sulfate). During Phase 2, SRM was limited to langbeinite, polyhalite, or arcanite (reagent grade K_2SO_4) and reagent grade $CaSO_4$ was used as the blank.

11.3 Sample Preparation and Analysis

During Phase 1 and 2, samples were shipped to two contract labs for preparation and XRD and x-ray fluorescence (XRF) analysis, and to one lab for inductively coupled plasma optical emission spectrometry (OES) and supporting analysis. The results of the different methods of analyses were evaluated, and ICP determined that quantitative XRF and XRD analyses were the most useful in establishing polyhalite grade. A new protocol was established for Phase 2B samples, and this protocol was applied to a new set of Phase 1 and Phase 2 samples in order to standardize all samples and results.

During Phase 2B exploration, ICP standardized the sampling process and began using only XRD and XRF analyses from H&M Analytical Service labs in Allentown, New Jersey. Samples from Phase 1 and Phase 2 were reanalyzed according to this process in order to standardize all analytical data. The entire amount of each sample was crushed with a jaw crusher to <6 mm and then ground in a Retsch RM100 motorized mortar and pestle to a fine powder (-325 mesh) that was suitable for XRD analyses. The following processing methods were used by H&M Analytical Services in processing the core samples received from ICP.

11.3.1 Quantitative XRD

A small amount of each fine powder was placed into a standard sample holder and put into a Panalytical X'pert MPD Pro X-ray diffractometer using copper (Cu) radiation at 40 kilovolts (kV) / 40 milliamperes (MA). Scans were run over the range of 10° – 80° with a step size of 0.0156° and a counting time of 100 seconds per step. Once the diffraction patterns had been collected, crystallographic databases (International Centre for Diffraction Data and Inorganic Crystal Structure Database) were used to identify the minerals present. Finally, quantitative phase analysis was performed with a Rietveld Refinement analysis, which has a typical accuracy of about 1%.

11.3.2 Quantitative and Semi-quantitative XRF

The fluorescence samples were mixed with 20% Paraffin and pressed in a die at 30 tons for 5 minutes to produce a standard 40 mm XRF specimen. Each pellet was then tested on a Bruker S4 Wavelength Dispersive X-ray Fluorescence Spectrometer for elements between sodium (Na) and uranium (U). This analysis uses a spectrometer, a sequential instrument to examine one element at a time using kV settings, filters, collimators and monochromators that are optimized for each element.

Semi-quantitative analysis was then performed using the Fundamental Parameters method, a standardless technique. This analytical method takes into account the fluorescence yield, absorption, and matrix effects to estimate the atomic chemical composition. This technique has an accuracy of about 5% for the major elements.

Full quantitative analyses were performed for sodium (Na), chlorine (Cl), magnesium (Mg), sulfur (S), potassium (K), and calcium (Ca). The remaining trace elements were analyzed by a semiquantitative analysis also based on a Fundamental Parameters method. The results are a hybrid of fully quantitative analysis for the major elements (with error ≈ 1%) and semiquantitative analysis for the trace elements (with errors ≈10%).

Gustavson finds the sample preparation, security and analytical procedures ICP used for the purposes of this report adequate per the standards of NI 43-101.

12 DATA VERIFICATION

Gustavson personnel visited the Ochoa project on April 28 and 29, 2010, and again on October 12, 2010. During these site visits, Gustavson personnel reviewed drilling operations, sample handling and security, core logging protocols, data management, and QA/QC programs. Detailed discussion regarding drilling methods, sample handling and security, and QA/QC programs is provided in previous sections of this report.

Gustavson's review of the ICP exploration program found that ICP geologists map and sample according to accepted, industry-wide techniques in an organized, systematic, and professional manner. Gustavson independently verified exploration data collected prior to September 1, 2011, by checking logs and laboratory data against core samples, field checking survey data, and comparing borehole data reported by ICP to original laboratory certificates. Gustavson finds the quality of data collected to date adequate for use in estimating the Mineral Resource of the Ochoa Project.

13 MINERAL PROCESSING AND METALLURGICAL TESTING

ICP intends to generate potassium and magnesium sulfate liquors using a process that is based on one of the processes proposed by the USBM. The USBM conducted extensive study of potassium sulfate generation processes in the 1930s and 1940s (e.g., Conley and Partridge 1944; Wroth 1930), and the fundamentals underlying those processes are now well understood. Potassium sulfate generation methods were demonstrated on a laboratory scale, and parameters needed to implement the processes on an industrial scale were developed. ICP is currently conducting laboratory-scale mineral processing and metallurgical testing to confirm the process and generate design data needed to design the commercial operation.

The test work described here leaves out specific detail to protect the ICP process and intellectual property.

13.1 Ore Sampling and Test Work

13.1.1 Metallurgical Testing Conclusions

Batch scale test work performed on all six critical operations (comminution, washing, calcination, leaching, crystallization and granulation) proved that the process works technically. Basic engineering was generated to design the process flowsheet and to size equipment for the PFS. The test work and highlights of results undertaken for this study include the following:

13.1.1.1 Comminution Testing

1. Abrasion index- The abrasion index (Ai) was calculated for three different representative samples of Ochoa polyhalite ore. This data, given in Table 13-1, was used to calculate the steel media wear in equipment. The Ochoa polyhalite ore is relatively soft and not abrasive; no future abrasion index testing is planned.

Table 13-1 Abrasion Index of the Three Ochoa Polyhalite Samples

Sample Number	Ai
1	0.0009
2	0.0022
3	0.0026

a. SMC Testing- The SMC (Sag Mill Comminution) test was performed on Ochoa core. The SMC test generates a relationship between input energy (kilowatt per ton [kWH/t]) and the percent of broken product passing a specified sieve size. The results are used to determine the drop-weight index (DWi), which is a measure of the strength of the rock when broken under impact conditions and has the units kWh/m^3.Around 99% of the DWi values lie in the range 0.5 to14.0 kWh/m^3, with soft ores being at the low end of this range and hard ores at the high end. The Ochoa ore had a drop weight index of 2.59 indicating that it is a soft ore. This information was used to calculate power input for grinding the ore. No future SMC testing is expected

b. Rod Mill Work Index (RWi) - The rod mill work index was determined for two representative Ochoa ore samples. The data was used in the design and sizing of the rod mill. Results are shown in Table 13-2 for 14 mesh grind.

Table 13-2 Bonds Rod Mill Work Index at 14 Mesh Grind

Sample	RWi, kWH/st
1	9.5
2	10.4

c. Batch Rod Mill Testing- Three open-circuits and one closed-circuit batch rod mill tests were performed with results shown in Tables 13-3 and 13-4 respectively. The open circuit test was designed to determine if grind time had much effect on the generation of fines. The test showed a large effect, with the one minute grind producing the lowest fines content in the -10 mesh material (about 45% compared to 72% and 79% for the three minute and five minute grinds). The closed circuit test consisted of five cycles with the -10 mesh material removed after each cycle and fresh ore added as make up. Although the test clearly had not reached steady state, the cycle 5 data represents the best estimate available to date of the particle size distribution (psd) to be expected in the process. Future larger scale testing will provide better estimates of the process psd for equipment sizing.

Table 13-3 Size Distribution Data for the 1, 3 and 5 Minute Open-Cycle Grind Tests

Results expressed in percent retained material

Size (mesh)	Feed	1-min Grind (1)	3-min Grind (2)	5-min Grind (3)
+10	99.2	78.1	46.3	21.3
10x100	.8	12.0	15.3	16.8
-100	0	9.9	38.4	61.9

Table 13-4 Size Distribution of the Last Two 1-Minute Closed-Cycle Rod Mill Tests

Results expressed in percent retained material.

Size (mesh)	1-min (4)	1-min (5)
+10	79.8	85.0
10x100	11.9	10.3
-100	8.3	4.7

2. Washing
   a. A sodium chloride brine similar in composition to the recirculating brine to be used in the full scale process was used in the closed cycle rod mill test to evaluate the effectiveness of halite leaching. The results showed that essentially all of the sodium chloride was dissolved and the losses of potassium and magnesium were minimal (as expected based on the USBM work). The composition of the final leach brine from each cycle is shown in Table 13-5. Analysis of the solids yielded an initial sodium concentration of 0.794 wt%, and a final concentration of 0.016 wt% after washing, showing a dramatic decrease in sodium concentration, and thus halite concentration in the ore.

Table 13-5 Closed-Circuit Rod Mill Primary Filtrate Analytical Results

Cycle No.	SG g/cc	Ca (g/L)	K (g/L)	Mg (g/L)	Na (g/L)	S (g/L)
1	1.0495	0.442	1.32	0.440	24.7	1.47
2	1.0463	0.399	1.55	0.503	22.6	1.70
3	1.0455	0.372	1.59	0.498	21.7	1.66
4	1.0273	0.528	1.01	0.330	12.4	1.35
5	1.0468	0.371	1.54	0.495	22.2	1.69

3. Calcination
   a. Thermo-Gravimetric Analysis- Thermo-gravimetric Analysis (TGA) was used to determine the change in weight of the sample when subjected to increasing temperature. This test was used to evaluate the loss of crystal bound water and other weight loss in the polyhalite when subjected to increasing temperatures. Figure 13-1 shows the TGA scan of Ochoa polyhalite. The loss of crystal bound water can clearly be seen at around 300° to 400° C. Equilibrium temperature was reached almost immediately

between the polyhalite sample and the test shell. Leaching test showed that the ideal calcination temperature is 480-520˚C. The mass loss at 525˚C corresponds to another change in the crystal that was later determined to make the polyhalite less soluble through leaching. The dotted line in the figure is a derivative curve which allows the steepest slopes to be seen graphically.

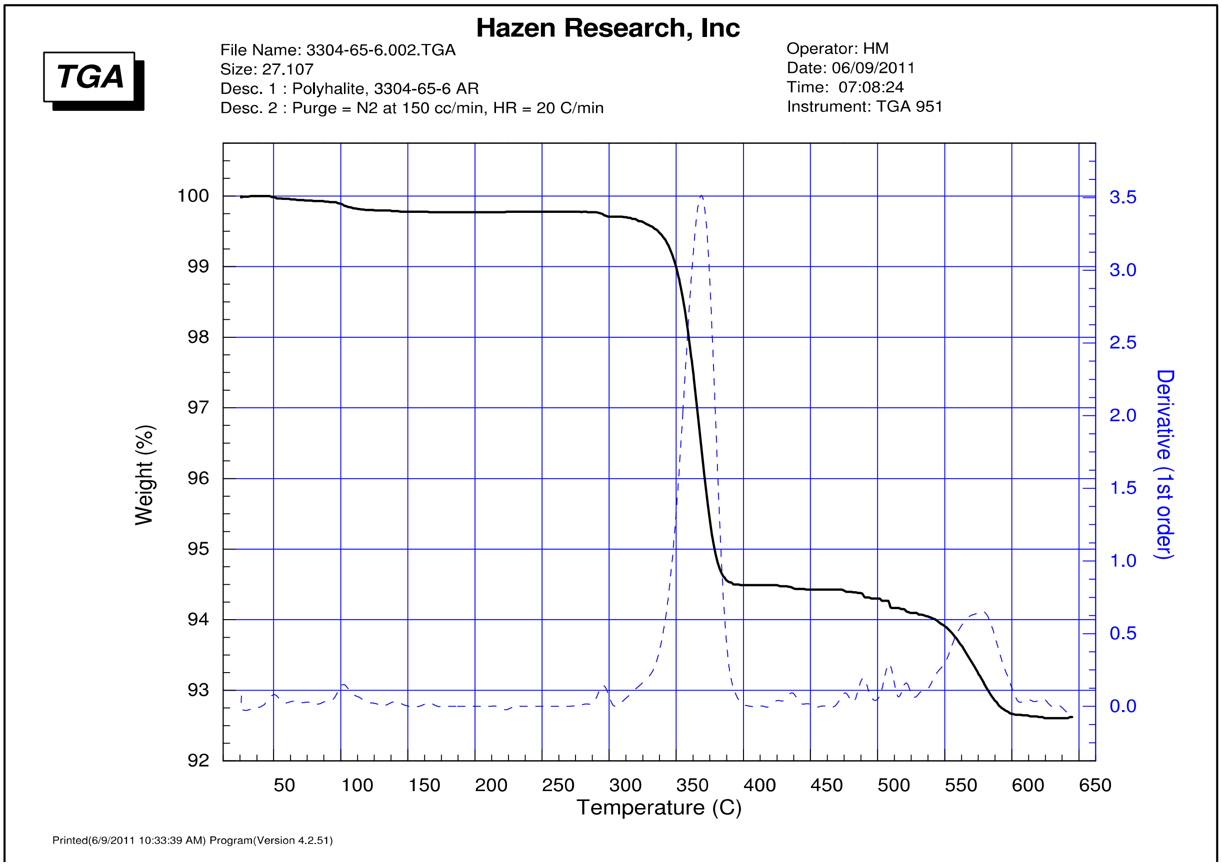


Figure 13-1 Thermo-gravimetric Analysis of Polyhalite

b. Differential Thermal Analysis-Differential Thermal Analysis (DTA) was used in conjunction with TGA to determine transformations that have occurred to the material when subjected to varying temperature. This test was used to investigate the modification of the polyhalite crystal as the temperature is increased. Results are shown in Figure 13-2. The large trough corresponds to the release of the waters of hydration from the polyhalite crystal. While TGA records a change in the mass of the sample, DTA records a difference in temperature between the sample and the shell of the test kiln corresponding to energy used in a kinetic reaction within the samples crystal structure. In the figure, the loss of water is observed at around 300-400˚C, which is similar to the TGA scan.

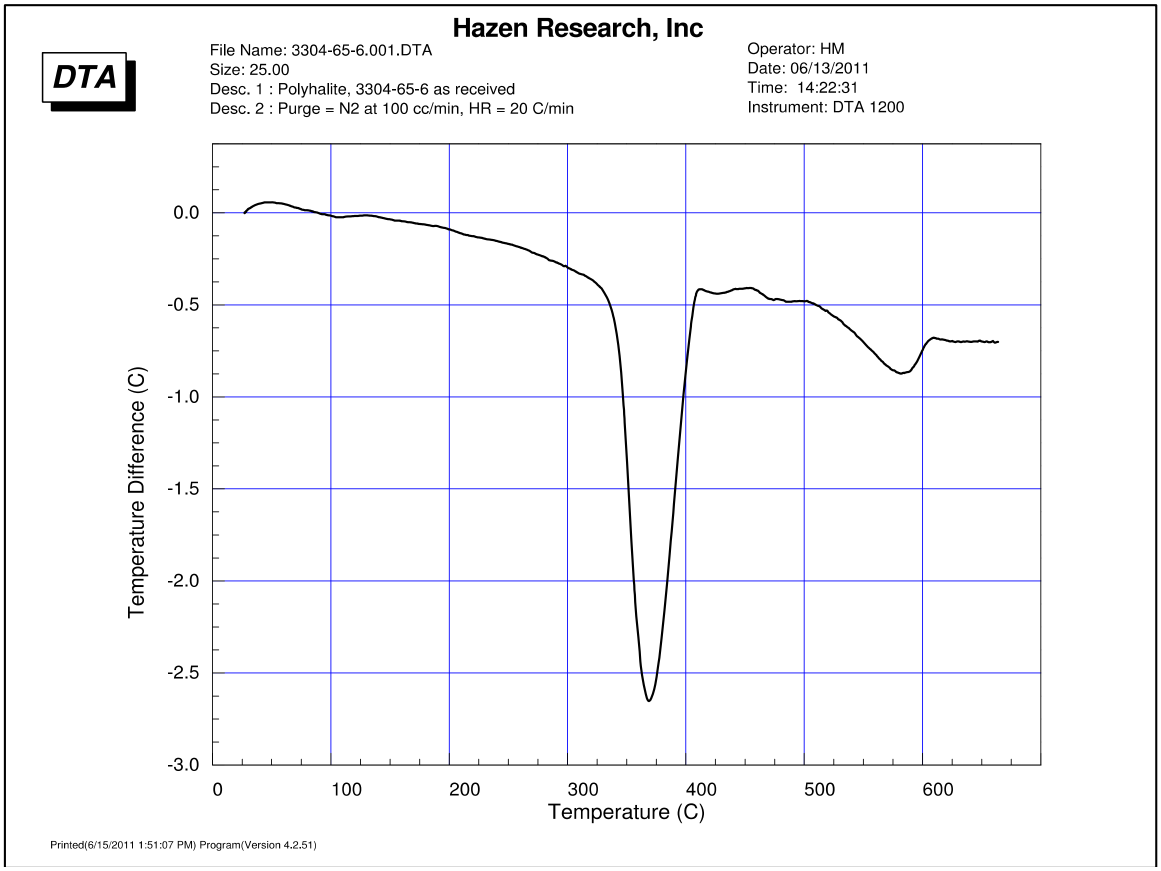


Figure 13-2 Differential Thermal Analysis Scan of Polyhalite

Lab Scale Rotary Kiln- Forty tests were conducted using a laboratory rotary kiln with several varying conditions to calcine polyhalite. The polyhalite samples were calcined in the rotary kiln and then leached to determine the efficiency of the calcination. The solubility of the calcined polyhalite is directly related to the efficiency of the calcination process. Table 13-6 shows the calcination parameters used for the 40 calcination tests. These parameters were in part determined from the USBM work. The 40 calcination tests were then leached to determine the efficiency of the calcination and its effect on solubility. From there, the ideal calcination temperature was observed to be around 500˚C. It was thought that particle size would play a role in the efficiency of the calcination and so several particle sizes were chosen and shown in Figure 13-6. The -10 mesh particles showed the best leaching characteristics after calcination. With the given resonance times, the larger particles were thought to be incompletely calcined which was supported by leach data.

Table 13-6 Calcination Parameters for the 40 Calcination Tests

Calcination Data			
Test Number	**Temperature (°C)**	**Size (mesh)**	**Time (min)**
1	420	10 × 20	10
2	420	10 × 20	30
3	420	6 × 10	10
4	420	6 × 10	30
5	420	4 × 6	10
6	420	4 × 6	30
7	440	10 × 20	10
8	440	10 × 20	30
9	440	6 × 10	10
10	440	6 × 10	30
11	440	4 × 6	10
12	440	4 × 6	30
13	460	30 × 40	10
14	460	30 × 40	30
15	460	10 × 20	10
16	460	10 × 20	30
17	460	10 × 20	35
18	460	10 × 20	50
19	460	6 × 10	10
20	460	6 × 10	30
21	460	4 × 6	10
22	460	4 × 6	30
23	480	30 × 40	30
24	480	10 × 20	15
25	480	10 × 20	35
26	480	6 × 10	35
27	480	4 × 6	35
28	480	4 × 6	35
29	500	30 × 40	30
30	500	10 × 20	35
31	500	6 × 10	35
32	500	4 × 6	35

Calcination Data			
Test Number	Temperature (°C)	Size (mesh)	Time (min)
33	520	30 × 40	30
34	520	10 × 20	35
35	520	6 × 10	35
36	520	4 × 6	35
37	540	30 × 40	30
38	540	10 × 20	35
39	540	6 × 10	35
40	540	4 × 6	35

Extraction Procedure - Samples of calcined polyhalite were added to atmospheric boiling water solutions and boiled for 60 min. This test extracted the soluble solid phases from the calcined polyhalite. The residual solids and liquid were analyzed for respective minerals, elements including, potassium, magnesium, and sulphate. These tests determined to what extent the solids became soluble, thus indicating the effectiveness of the calcination test conditions.

Calcination was most effective under conditions similar to those reported as superior by the USBM.

4. Leaching - Batch leaching tests using water as the solvent showed that strong liquors with high leaching recoveries could not be achieved in single stage leaching. Therefore, basic investigations of the solubility and kinetics of the dissolution of the solids from the single stage leaching tests were conducted. These results were used to predict the performance of a two stage counter current leaching process. The predicted liquor concentration for a process with a greater than 95% leaching efficiency is 7.5 g K_2SO_4/100 g H_2O. Six locked-cycle leaching tests were performed to simulate a two stage counter current leach process. The high evaporation losses associated with such small scale tests made the data very difficult to interpret. However, reinterpretation of the data suggested liquor concentratins of about 6.8 g K_2SO_4/100 g H_2O could be produced with a leaching efficiency of about 95%. This is a little lower than the value predicted by the earlier work. Larger scale testing will provide data for use in the Feasiblity Study.
5. Crystallization and Granulation
   a. Lab Scale Crystallizer- Laboratory scale langbeinite crystallization was performed using HPD's laboratory crystallizers with results shown in table 13-7.

b. Also included in the HPD testing was the conversion of langbeinite to leonite via lab scale reactor. These tests proved that langbeinite crystallization followed by conversion to leonite is feasible offering benefits to the process. The feed brines were created synthetically using leach data from the calcination testing. Three tests were performed on both the langbeinite crystallization and the langbeinite-leonite conversion. Langbeinite has the chemical formula $K_2Mg_2(SO_4)_3$ and leonite has the chemical formula $K_2Mg(SO_4)_2 \bullet 4(H_2O)$. The conversion of langbeinite to leonite takes place in a water solution and removes a magnesium sulfate molecule from langbeinite. Leonite is more readily dissolved in leach brine than langbeinite.

c. Granulation tests were encouraging showing that langbeinite granulation was successful however additional test work to optimize the process is needed for the project Feasibility Study.

d. HPD has built numerous commercial SOP crystallizers and did not feel test work was needed for them to produce data for the PFS. SOP crystallization test work will be performed for the Feasibility Study.

Table 13-7 Langbeinite Crystallization at Various Pressures

Test	Operating Pressure (psia)	Crystal Production (kg)	Magma%
1	11.5	3.1	22.5
2	14.4	2.0	17.0
3	14.4	5.6	31.5

The process chemistry initially developed by USBM was confirmed. The samples used for the process test work are representative of the polyhalite mineralization contained within the mine plan, and the test work performed on those samples successfully demonstrated the process is economically viable. Additional metallurgical test work is needed prior to the Feasibility Study to aid in process design and optimization and equipment selection.

14 MINERAL RESOURCE ESTIMATES

The updated Mineral Resource estimate reported for the Ochoa Project as of November 25, 2011, was completed by Zachary J. Black, E.I.T., Gustavson Staff Geological Engineer, under the supervision of Donald E. Hulse, P.E., VP. The Mineral Resource was updated to include data from seven new core holes drilled during ICP's Phase 2B drilling program. This Mineral Resource estimate is compliant with NI 43-101 Standards of Disclosure for Mineral Projects and CIM Definition Standards.

14.1 Data Used for the Polyhalite Grade Estimation

Gustavson created a 2-dimensional (2D) grid model for estimating mineral resources at the Ochoa Project. Drill hole data, including collar coordinates, sample assay intervals, and composite geophysical logs, were provided by ICP as Microsoft Excel files and as Adobe PDFs. Gustavson updated the project database to include the additional 7 drill holes completed in 2011. The Ochoa Project drill hole database contains lithology, assay, polyhalite thickness, and petrophysical log data from a total of 20 diamond core holes drilled by ICP, as well as petrophysical log data (and interpreted polyhalite thicknesses) from 792 oil and gas wells drilled throughout the area of interest.

The assay and geological data from the 20 ICP drill holes were used to assess the accuracy of the petrophysical markers previously used to identify the top and bottom of the polyhalite seam. Verified petrophysical markers were then used to locate the top and bottom of the polyhalite seam in the 792 oil and gas bore holes.

ICP drill hole locations are arranged in an irregular grid pattern in order to maximize the collection of information with regard to the polyhalite seam within the property boundary. The drill holes are spaced approximately 10,000 ft apart, with a minimum distance of 4,170 ft and a maximum distance of 23,738 ft.

14.2 Thickness Estimation Methodology

14.2.1 Data Preparation

The ICP core holes were sampled on approximate 6-in. intervals. The thickness of the polyhalite seam in the core holes was determined based on assay data, and is represented by the longest continuous set of sample intervals with grades of >10% polyhalite. Thickness values were determined by Upstream and verified by Gustavson.

14.2.2 Statistical Data

Gustavson statistically analyzed the thicknesses determined by Upstream. Special attention was paid to the thickness of the polyhalite seam because it represents the largest data set available for use in resource estimation. The thickness of the polyhalite seam dictates the volume of polyhalite within the property boundary. Histograms, probability plots, and cumulative frequency plots were generated in order to evaluate and describe the distribution of the polyhalite seam with regard to thickness. Table 14-1 below summarizes the relevant descriptive statistics.

Table 14-1 Descriptive Statistics of Polyhalite Thickness (in ft)

Minimum	25th Percentile	Median	75th Percentile	Maximum	Variance	Mean
2.45	4.68	5.23	5.73	6.85	0.60	5.13

Gustavson determined that the distribution of the thickness data is Gaussian (normal). A probability plot (P-plot) comparing a theoretical Gaussian data set to the polyhalite thickness data set is presented as Figure 14-1.

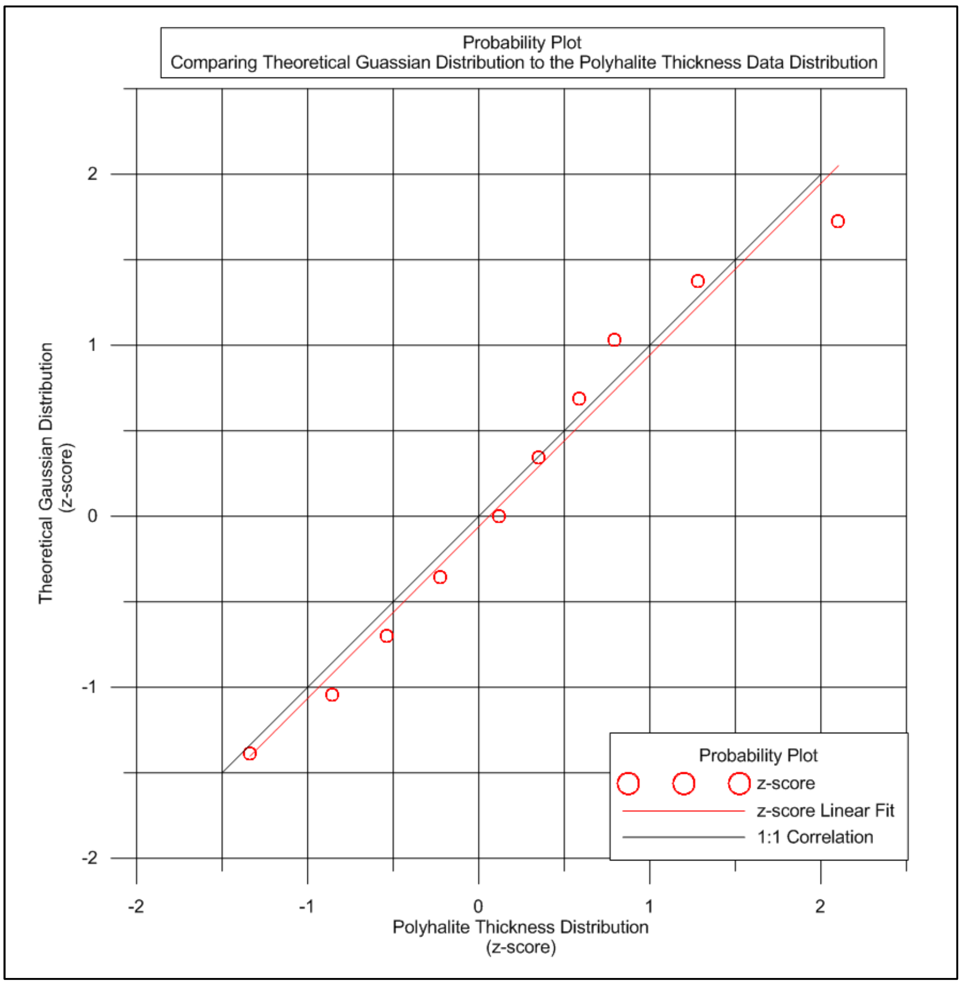


Figure 14-1 P-Plot of Thickness Data Showing Normality

The mean, median, and mode of a normal distribution are all approximately equal, and all are valid measures of the center of the data distribution (measure of central tendency). The mean (5.13 ft) value occurs most frequently, and has the highest probability of occurring.

14.2.3 Variography

Experimental variogram values were computed using the polyhalite thickness data. A spherical variogram was fit to the computed experimental variogram values. The spherical variogram is Gustavson's interpretation of the spatial variability of the polyhalite thickness data, and is used to filter noise resulting from imperfect measurements or lack of data. The nugget, sill, and range defined by the spherical variogram are used in the kriging algorithm during the modeling process. The spherical variogram applied by Gustavson is presented in Figure 14-2.

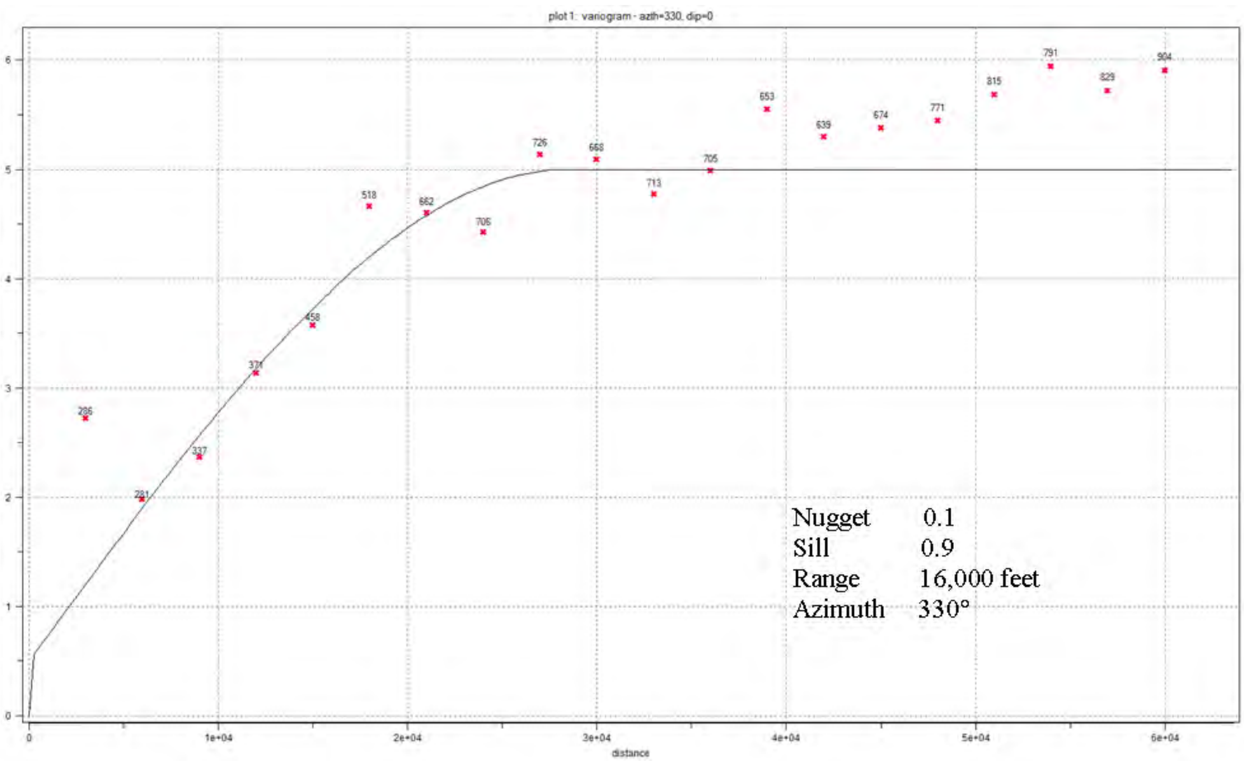


Figure 14-2 Spherical Variogram of Polyhalite Thickness with Normalized Variogram Model Parameters Shown

14.2.4 Sequential Gaussian Simulation

Gustavson used 2D Sequential Gaussian Simulation (SGS) to model the polyhalite thickness with Stanford Geostatistical Modeling Software (SGeMS). SGS is a proven, effective method of modeling normally distributed data. Data from all 812 drill holes were used in the simulation process. A 975,000-ft wide by 1,735,000-ft long grid with nodes on 100-ft centers was defined. SGS uses conditional probability distribution to provide possible values at unsampled locations within the grid. The values are conditional to available data, and are estimated using an ordinary kriging algorithm. The SGS software program builds a Gaussian distribution around the kriged value (the mean of the distribution) at a node on the grid with a variance that matches the kriged variance. The algorithm uses a random number generator to select a probability from the estimated distribution, and assigns the corresponding thickness value to the node. The program proceeds through the grid node by node, taking into account the previously assigned values at the other nodes. After all nodes have been assigned a value, the realization is complete. Fifty realizations were generated by repeating the steps outlined above. Each of these realizations has an equal probability of predicting the actual values at the grid nodes.

14.2.5 Model Validation

The realizations were validated individually to ensure that the sample distribution (Table 14-2) and spatial variability were honored. For all 50 realizations, the median model (M-type), and the average model (E-type), were evaluated to confirm that the measured sample thicknesses were adequately represented in the models. Gustavson chose to report an M-type estimate because it represents the least absolute error and honors the sample distribution (Figure 14-3) and spatial variability. The M-type model represents the median value of all 50 realizations at each point (Figure 14-4). Gustavson reblocked the 100-ft grid centers to a 500-ft grid to correct for volume variance.

Table 14-2 Descriptive Statistics Comparison of Polyhalite Thickness (in ft)

Descriptive Statistics Comparison							
Dataset	**Minimum**	**25th Percentile**	**Median**	**75th Percentile**	**Maximum**	**Variance**	**Mean**
Sample	2.45	4.68	5.23	5.73	6.85	0.60	5.13
Realization 1	0.1	4.69	5.27	5.75	6.85	0.60	5.15
Realization 11	0.1	4.68	5.23	5.69	6.85	0.60	5.12
Realization 21	0.1	4.66	5.24	5.76	6.85	0.65	5.13
Realization 31	0.1	4.68	5.22	5.67	6.85	0.58	5.11
Realization 41	0.1	4.68	5.24	5.71	6.85	0.61	5.13
M-type (100x100)	0.1	4.49	4.96	5.35	6.85	0.47	4.88
M-type (500x500)	0.1	3.92	4.82	5.29	6.33	2.64	4.22

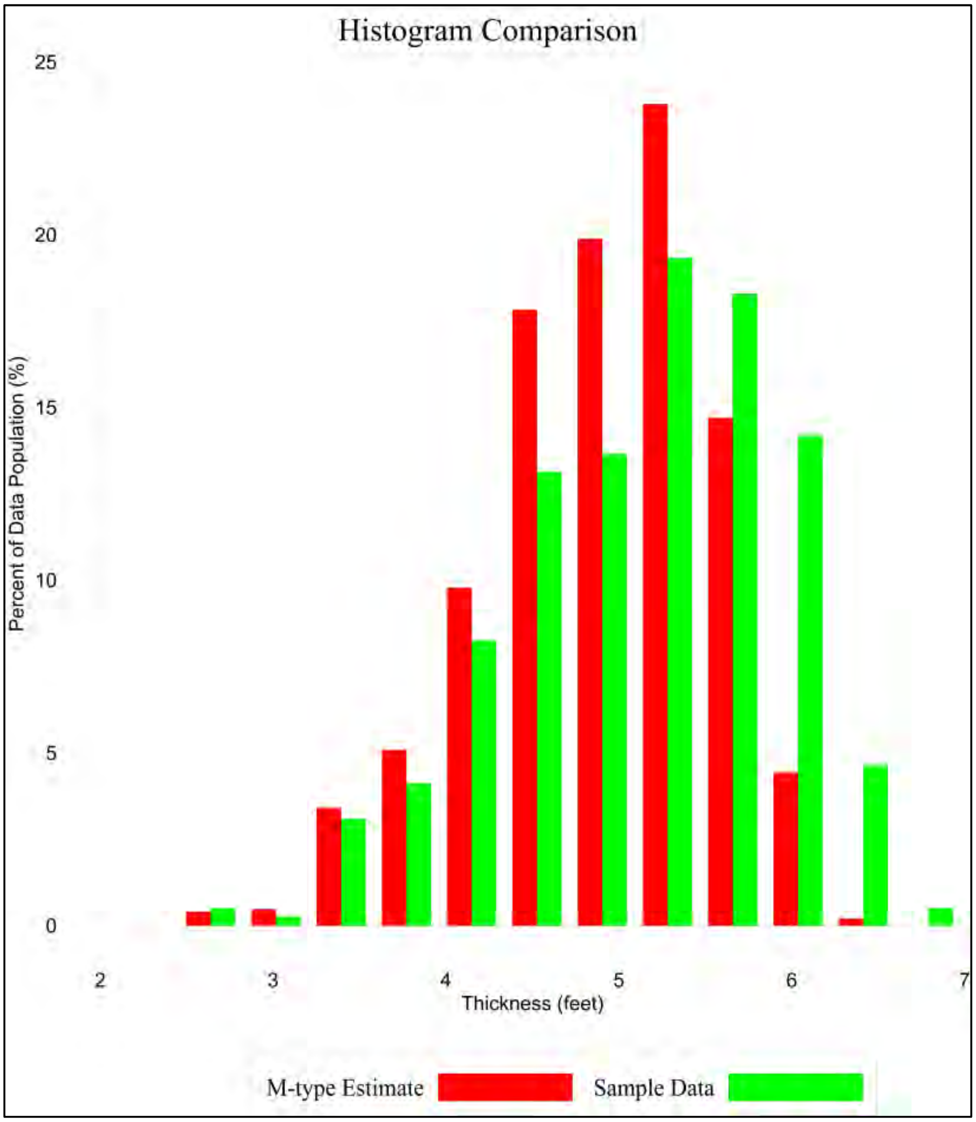


Figure 14-3 Results of M-Type Estimate vs. Sample Data

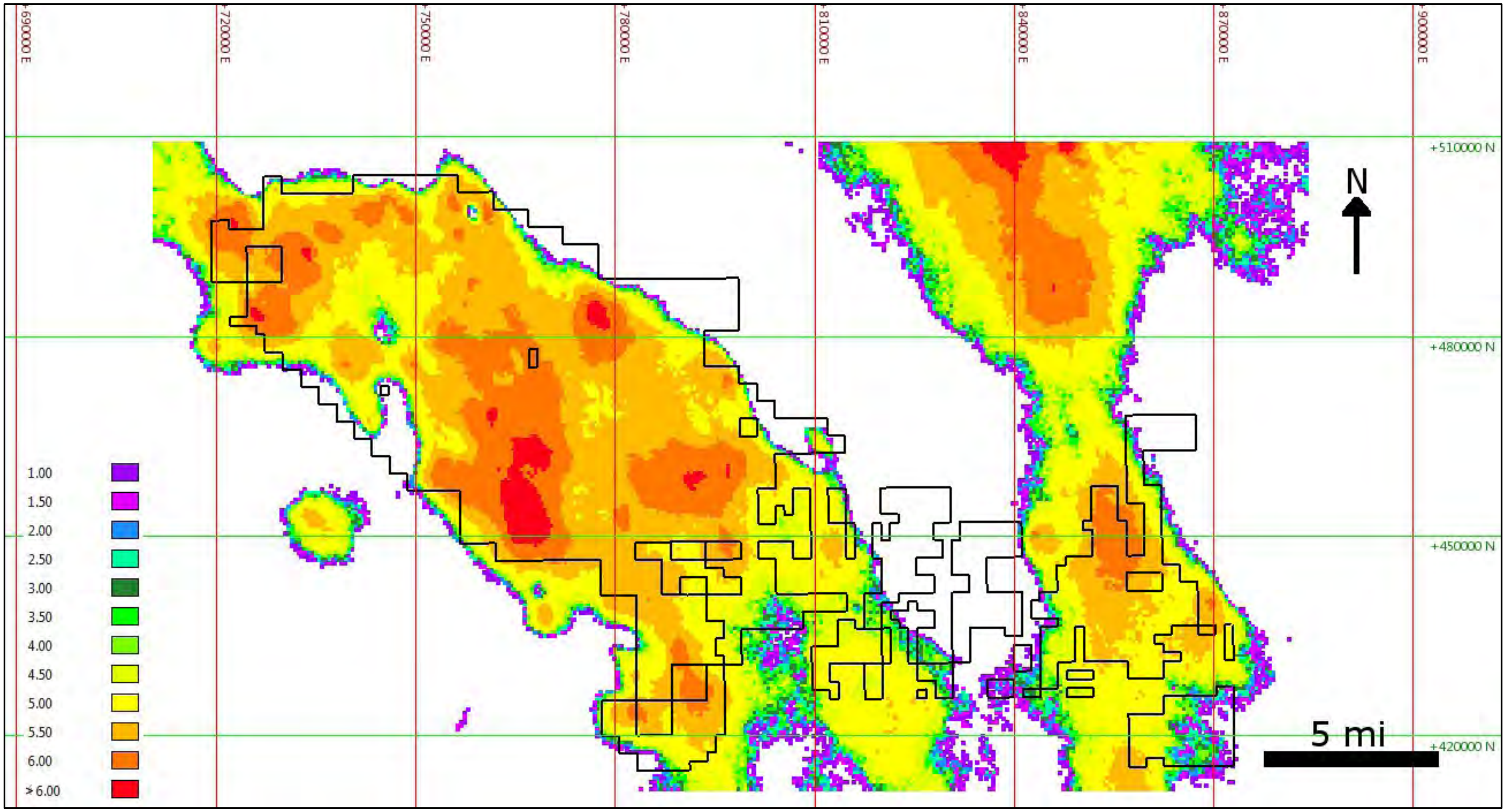


Figure 14-4 Isopach Map of Polyhalite Thickness

14.3 Mineral Grade Estimation

14.3.1 Data Estimated

Grade was estimated for three zone classifications: above the polyhalite seam, within the polyhalite seam, and below the polyhalite seam. The geologic units above and below the polyhalite seam are anhydrite-dominated, though they may contain some percentage of polyhalite. Thickness of the anhydrite-dominated zones is represented by the thickness of sample intervals in core assay tables above and below the identified polyhalite seam. The spatial distribution of the anhydrite-dominated zones with regard to thickness was modeled using the same methods as were used for the polyhalite seam, and also with 50 simulations. The geologic character and general distribution of both anhydrite-dominated zones are assumed to be similar to those of the polyhalite seam.

14.3.2 Statistical Data

Within each of the three zones, Gustavson estimated the grade (percent weight) of polyhalite, anhydrite, halite, and magnesite. The descriptive statistics associated with each zone are summarized in Table 14-3.

Table 14-3 Distribution of Average Grade for ICP Core Holes

Above Polyhalite Seam							
Mineral	**Minimum**	**25th Percentile**	**Median**	**75th Percentile**	**Maximum**	**Variance**	**Mean**
Polyhalite	0	0	0.4	0.8	9.2	4.3	1.1
Anhydrite	72.4	81.1	86.8	88.7	96.6	37.3	85.4
Halite	0	2.5	3.7	7.3	17.9	20.0	5.8
Magnesite	2.3	5.7	6.6	7.9	12.6	6.6	7.1
Within Polyhalite Seam							
Mineral	**Minimum**	**25th Percentile**	**Median**	**75th Percentile**	**Maximum**	**Variance**	**Mean**
Polyhalite	70.9	77.5	80.8	81.6	89.8	24.5	80.4
Anhydrite	1.7	3.9	5.4	9.2	14.5	13.7	6.8
Halite	0.8	1.7	3.1	4.5	6.8	3.1	3.5
Magnesite	4.1	7.1	8.5	10.0	12.6	5.7	8.7

Below Polyhalite Seam							
Mineral	**Minimum**	**25th Percentile**	**Median**	**75th Percentile**	**Maximum**	**Variance**	**Mean**
Polyhalite	0	0.7	1.2	2.1	4.0	1.1	1.5
Below Polyhalite Seam							
Mineral	**Minimum**	**25th Percentile**	**Median**	**75th Percentile**	**Maximum**	**Variance**	**Mean**
Anhydrite	57.0	72.2	77.7	80.4	87.3	52.5	76.6
Halite	0	2.2	2.9	5.0	8.6	5.3	3.8
Magnesite	0	9.9	16.0	19.0	24.1	37.0	15.3

Each of the datasets presented above appears to be normally distributed, though it is difficult to be certain that the datasets are truly normal with only 20 samples (core hole polyhalite composite intercepts). Gustavson analyzed the grade data in relation to unit thickness using selected thickness cut-off values, and found little variation in grade with change in thickness. For each selected thickness cut-off, polyhalite grade is assumed consistent throughout the polyhalite seam.

14.3.3 Sequential Guassian Simulation and Validation

SGS was used to estimate the grade of polyhalite, anhydrite, halite, magnesite, and the remaining minerals within each of the three seams based on the previously defined 975,000-ft wide by 1,735,000-ft long grid with nodes on 500-ft centers. Fifty realizations were generated for each grade estimation.

14.3.4 Model Validation

For each realization, model values were checked against known sample values in close proximity in order to confirm that the predicted (model) values are reasonable. Gustavson chose to use an E-type estimate for reporting, which utilizes the average grade of the 50 realizations to effectively smooth the normal distribution of values and more reasonably represent the likely distribution of grade throughout the deposit (Figure 14-5).

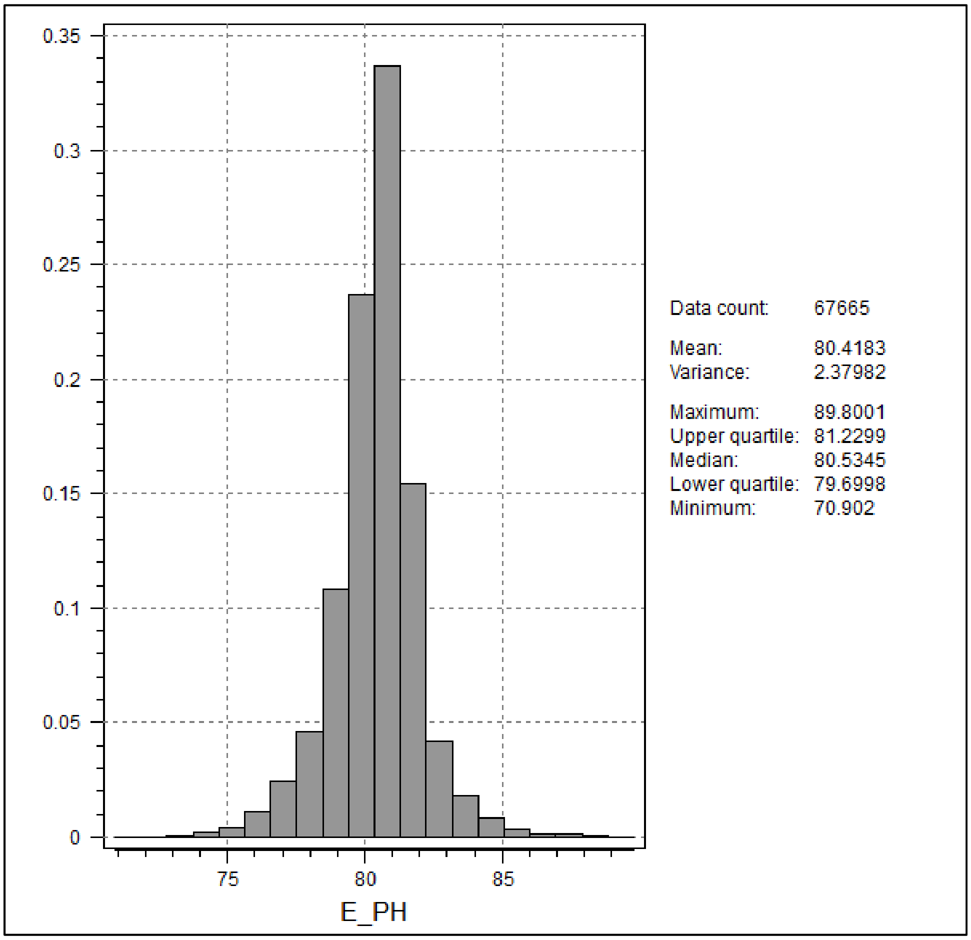


Figure 14-5 Distribution of Average Grade for ICP Core Holes

14.4 Resource Classification

Gustavson classified the mineral resources as Measured, Indicated, and Inferred. The classification of resources is based on the unsampled distance from an ICP sample point. Measured Resources occur within 0.75 mi of an ICP sample location; Indicted Resources occur between a distance of 0.75 and1.5 mi from an ICP sample point; and Resources that occur beyond the 1.5-mi radius but within the property boundaries or within a 3.0-mi radius, whichever is shorter, of an ICP sample point are classified as Inferred. Gustavson believes that this method of resource classification is reasonable and appropriate with specific regard to the Ochoa Project.

14.5 Mineral Resource Tabulation

The Ochoa Project Mineral Resource estimate is summarized in Table 14-4. The mineral resource estimate includes all drill data obtained as of September 1, 2011, and was independently verified by Gustavson. Table 14-4 below is the Mineral Resource contained within the ICP permits and leases displayed in Figure 14-2.

Table 14-4 Mineral Resource Estimate

Conditional Simulation Median Model				
4 ft Minimum Thickness	**Measured**	**Indicated**	**Measured plus Indicated**	**Inferred**
Average Thickness (ft)	5.45	5.30	5.37	5.05
Tons (million)	422	562	984	440
Grade Polyhalite	80.2%	79.9%	80.0%	80.6%
Eq Grade K_2SO_4	22.7%	22.6%	22.7%	22.8%
5 ft Minimum Thickness	**Measured**	**Indicated**	**Measured plus Indicated**	**Inferred**
Average Thickness (ft)	**5.52**	**5.46**	**5.49**	**5.35**
Tons (million)	**390**	**448**	**838**	**269**
Grade Polyhalite	**80%**	**80.2%**	**80.3%**	**80.7%**
Eq Grade K_2SO_4	**22.8%**	**22.7%**	**22.8%**	**22.9%**
6 ft Minimum Thickness	**Measured**	**Indicated**	**Measured plus Indicated**	**Inferred**
Average Thickness (ft)	6.10	60.06	6.09	6.03
Tons (million)	42	21	63	.8
Grade Polyhalite	84.5%	84.4%	84.5%	84.2%
Eq Grade K_2SO_4	24.0%	23.9%	23.9%	23.9%

(1) Mineral resources that are not mineral reserves have not demonstrated economic viability and may be materially affected by environmental, permitting, legal, title, taxation, sociopolitical, marketing, or other relevant issues, and are subject to the findings of a full feasibility study.

(2) The quantity and grade of reported inferred mineral resources in this estimation are uncertain in nature and exploration is insufficient to define these inferred resources as indicated or measured mineral resources and it is uncertain if further exploration will result in upgrading inferred resources to indicated or measured resources.

(3) The mineral resources reported here were estimated according to the CIM standards on Mineral Resources and Reserves, Definitions and Guidelines dated November 27, 2010.

15 MINERAL RESERVES ESTIMATES

Mineral reserves were estimated by Zachary Black and Nicholas Sheremeta of Gustavson according to CIM definitions and based on technical data and information received prior to November 25, 2011. A mine plan was created for a portion of the polyhalite resources as shown in Figure 15-1. The initial mine plan, covers a portion of the resources that have a low concentration of active and abandoned oil and gas wells. There are two areas that have been excluded from the mine plan because of a higher number of existing active and abandoned oil and gas wells that would make mining more difficult and result in lower ore recovery. These areas should be reconsidered in the Feasibility Study. The mineable portion of the mineral resource considers a 90% ore extraction in areas over 1500 ft away from active wells. In areas closer than 1500 ft from active wells, an ore extraction of 60% is used, which will inhibit subsidence. A 200 ft radius pillar will be left around each active well to provided extra stability and eliminate the potential for oil or gas inflow to the mine. Using these design parameters and the proposed production rate there is a Proven and Probable Mineral Reserve of 414 million tons at a polyhalite grade of 83.98% polyhalite, sufficient to last the mine for approximately 93 years of production. A more detailed mine plan was created for inclusion in the 40 year economic model, as shown in Figure 15-2.

The cutoff grade for the Mineral Reserve estimate is based on a proposed 40 year mine plan with an average sale price of $623 per ton of finished product. The proposed finished product is expected to be approximately 568,000 tons of SOP and 275,000 tons of langbeinite per year. The sale price is based on the forecasted prices that were included within the marketing study that was done for the Ochoa Project. At this sale price the minimum cutoff grade is 16% polyhalite, well below the 70% polyhalite value included in the mine plan. The cutoff grade is based on the forecasted sale price and the estimated operating costs. Table 15-1 shows the calculated cutoff grade based on a sale price of $623 per ton of SOP.

Table 15-1 Calculated Cutoff

Economic Cutoff @		**$623**
Cost Center		
Mining	$/ore ton	**$6.91**
Processing	$/ore ton	**$24.72**
G&A	$/ore ton	**$3.54**
Recoveries	ton	**82%**
Royalties	$/ton of finished product	**$10**
total cost	ore/ton	**$35.17**
Finished Product Selling Price	ton	**$623**
Cutoff Grade	% Polyhalite	**15% (Calculated)** **70% (Applied)**

A minimum mining thickness of 5 ft was used to estimate the Mineral Reserves, based on the operating height of the proposed mining equipment. In areas where the polyhalite is less than 5 ft in thickness, the ore is diluted in the mine model with waste material (anhydrite) above and below the polyhalite bed. Dilution was also added to the modeled polyhalite thickness to incorporate uncertainty in ore selectivity. A minimum dilution of 0.2 ft of material both above and below the polyhalite seam was added. Table 15-2 shows the contained and recovered polyhalite and diluted grade within both the 40 year mine plan and the entire proposed mine plan.

Table 15-2 Proven and ProbableMineral Reserves

Reserves Within 40 Year Mine Plan				
	Total Ore Tons	**Recovery Factor**	**Recovered Ore Tons**	**Diluted Grade Percent Polyhalite**
Proven	76,950,000	84.29%	64,861,000	80.14%
Probable	93,632,000	79.69%	74,613,000	78.78%
Total Proven & Probable	**170,582,000**	**81.76%**	**139,474,000**	**79.39%**
Remaining Reserves Within Proposed Mine Plan				
Proven	115,709,000	84.62%	97,911,000	76.51%
Probable	128,163,000	83.44%	106,935,000	75.33%
Total Proven & Probable	**243,872,000**	**84.00%**	**204,846,000**	**75.89%**
Total Proven and Probable Reserves Within Entire Proposed Mine Plan				
	414,454,000	**83.08%**	**344,320,000**	**77.33%**

The Mineral Reserve estimate presented above considers mining, processing, infrastructure and permitting requirements as described in more detail in the reaminder of this report. No material factors are known or believed to exist that might impact this reserve estimate.

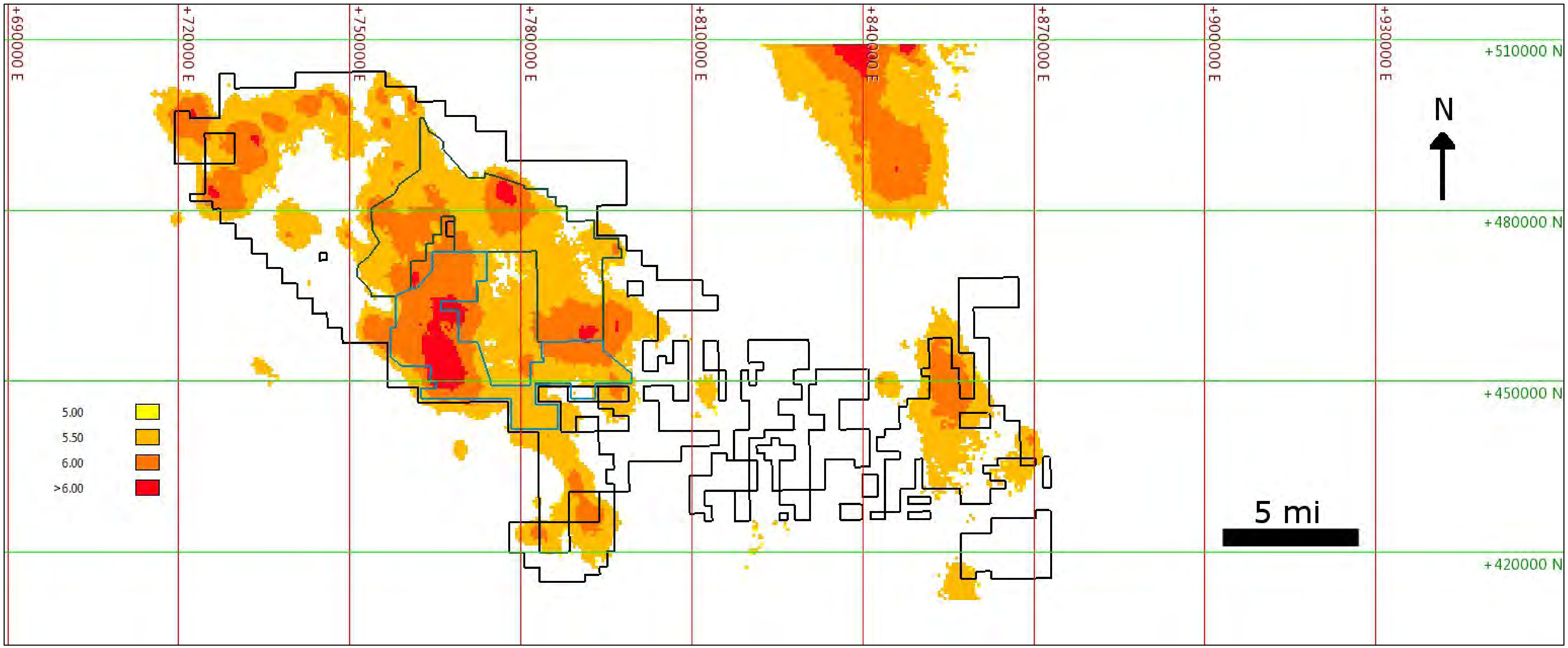


Figure 15-1 Polyhalite Thickness

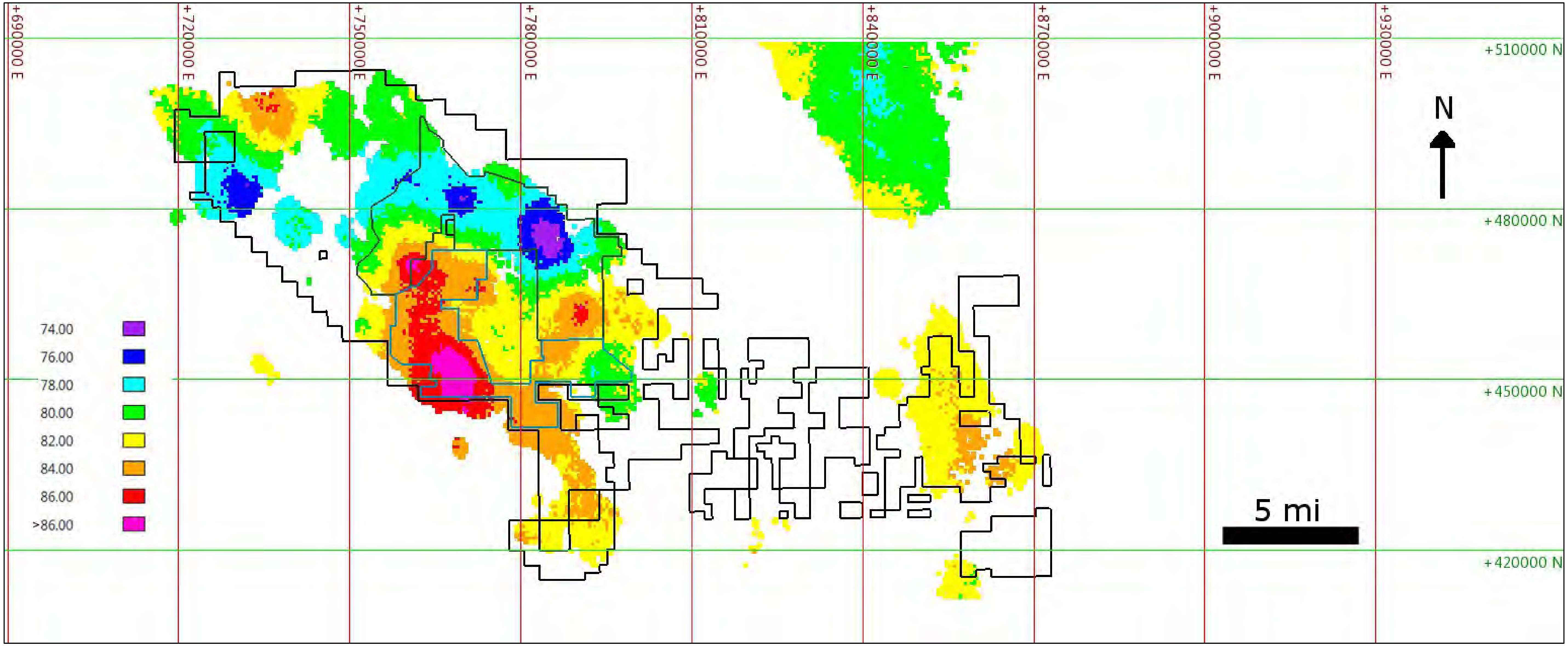


Figure 15-2 Polyhalite Grade

16 MINING METHODS

16.1 Room and Pillar Plan

Mining will be performed using conventional room and pillar methods, similar to other mines in the Carlsbad mining district. The polyhalite bed varies in depth within the proposed mine area from 1,180 ft to 1,740 ft bgs with a thickness range of 4.5 to 6.5 ft. Although there are no known natural sources of gas within the mining horizon, ICP has elected to follow the rules and regulations of a category III gassy mine under MSHA 30 CFR because there are active and abandoned gas wells in the immediate area. All mine and ventilation plans will follow the rules and regulation pertaining to a category III mine.

The mining method selected for the extraction of polyhalite will be room and pillar retreat in a herringbone pattern. An extraction rate of 90% is planned for most portions of the mine; however, in areas of the mine that are within 1,500 ft of an active gas or oil well, only 60% of the polyhalite will be extracted in order to safeguard the stability of the active well and minimize ground subsidence in areas around the wells. Additionally, a 200 ft radius around all active and abandoned wells will not be mined or disturbed leaving a strong pillar to eliminate the potential for oil or gas intrusion into the mine.

The mine will be divided into separate production panels that are approximately 525 ft in width. The length of a production panel can extend up to 2 mi and will vary throughout the mine in order to maximize extraction. The entire mine will be developed and mined by using Joy 12-HM27 or equivalent continuous miners. Once a production panel has been completely developed, mining will progress in a retreating manner away from mined out areas; which will minimize the need for support pillars and increase the mining extraction rate up to 90% of total polyhalite within the panel. Like the adjacent mines in the region, the rooms in each panel are expected to slowly close through plastic deformation or crushing of the pillars and deformation of the overlying strata. A 60-ft thick layer of halite lies directly above the polyhalite bed, and the halite is expected to plastically deform. Laboratory tests have been carried out to determine the strength and geotechnical properties of the materials that are expected to be encountered within the mining horizon of the mine.

Figure 16-1 shows the general proposed layout for the mine and facilities.

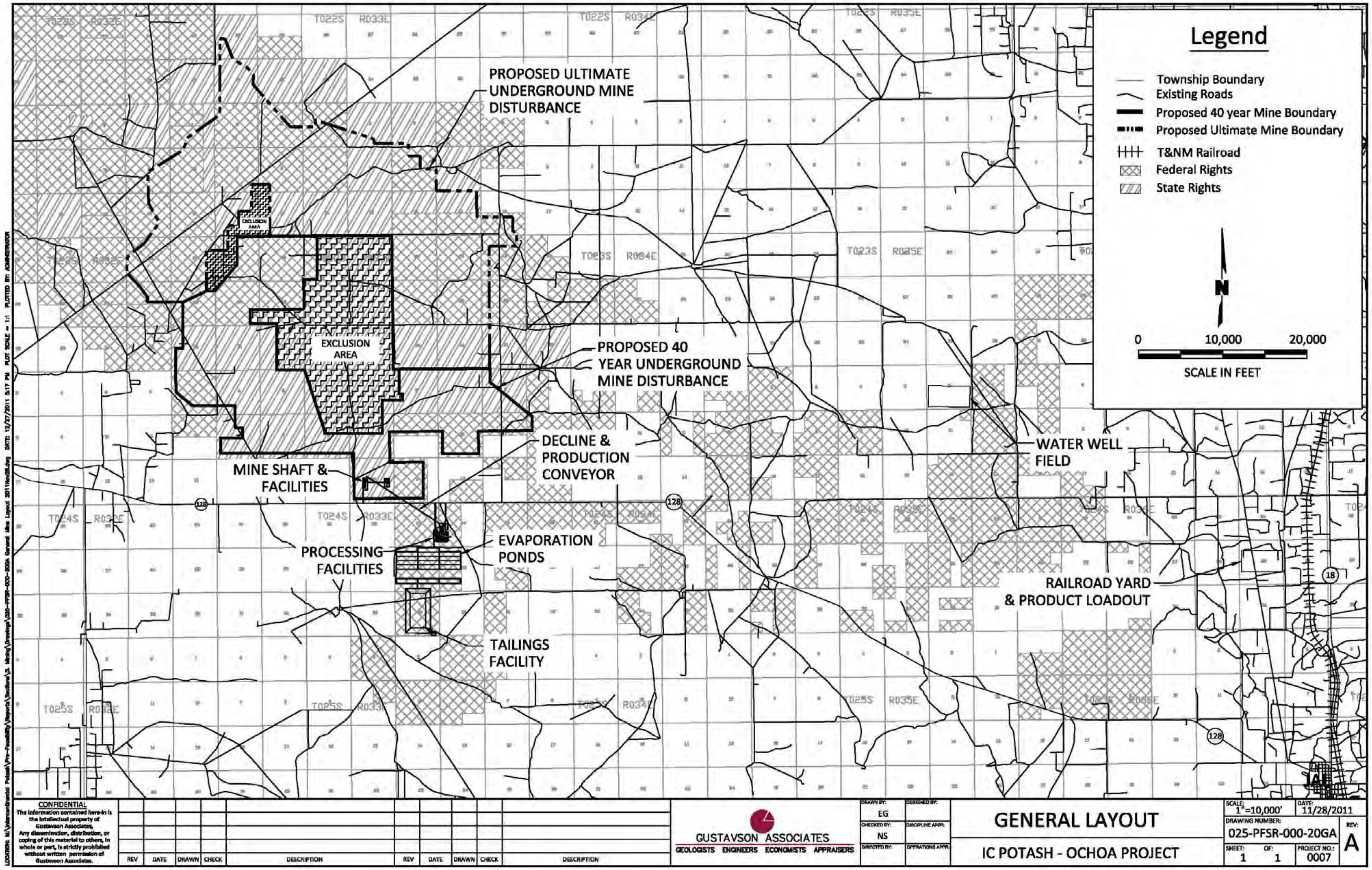


Figure 16-1 General Site Layout

16.1.1 Underground Mine Plan

The polyhalite bed undulates in elevation throughout the planned mine area at slopes generally less than 5%. There are two areas that have been excluded from the mine plan due to the higher concentration of active oil and gas wells and a number of planned wells. The area excluded from the south end of the mine essentially divides the mine into two separate areas that can be mined independently of each other. The need to exclude this area from the mine plan should be revisited for the Feasibility Study. A detailed mine plan of the first 40 years has been laid out and is shown in Figure 16-2. Mining begins in the western portion of the mine because this area has the thickest and highest grade polyhalite. The underground shops, offices, warehouses, and infrastructure will be located near the bottom of the decline. The man and utility shaft will be located approximately 425 ft southwest from the bottom of the decline. A 1,500 ft barrier pillar around the shaft is designed to protect the shaft, decline, and underground development. The main access drifts and underground facilities are the only excavations occurring within the barrier pillar. Figure 16-3 shows the development of the initial underground infrastructure.

The main drifts (mains) will head due north from the shop and shaft area in order to access the production panels. Mains will consist of two separate drifts that are driven parallel to each other. Each main drift will be 27 ft wide and 8 ft in height. The drifts will be separated by a 75 ft pillar with cross cuts connecting the two drifts approximately every 75 ft. The drifts will act as the intake and return air ventilation pathways. One drift will carry fresh air from the shaft and the other one will carry exhaust air to the decline where it will be vented to the surface. Figure 16-4 shows a detailed plan view of the drifts. A 500 ft wide barrier pillar is designed along each side of the mains to ensure that rock around these drifts remains stable. These barrier pillars will be recovered as crews retreat permanently out of these portions of the mine.

Production panels will be developed and mined directly north of the main drifts as development advances towards the western portion of the mine. Once the main drifts reach the western portion of the mine, the mains will extend to the northwest with production panels developed from both sides of the mains. In order to access the eastern portion of the mine, a main drift will extend first due east from the initial main drift where production panels will be developed from the main drift to the north, and then turn east between the mine plan boundary and the exclusion area. Once development reaches the eastern portion of the mine a main drift will be developed going north with development panels branching off from both sides of the main drift. Figure 16-2 shows how drifts are developed over time.

Production panels will be developed and mined with a single continuous miner. Each production panel will be developed at right angles to the main heading, as illustrated in Figure 16-4. The production panel will have parallel drifts down the center of the panel that will be 27 ft wide and 6 ft in height in order to provide access to the production rooms. The parallel drifts in the production panels will be 32 ft apart and will have cross cuts connecting them to each other.

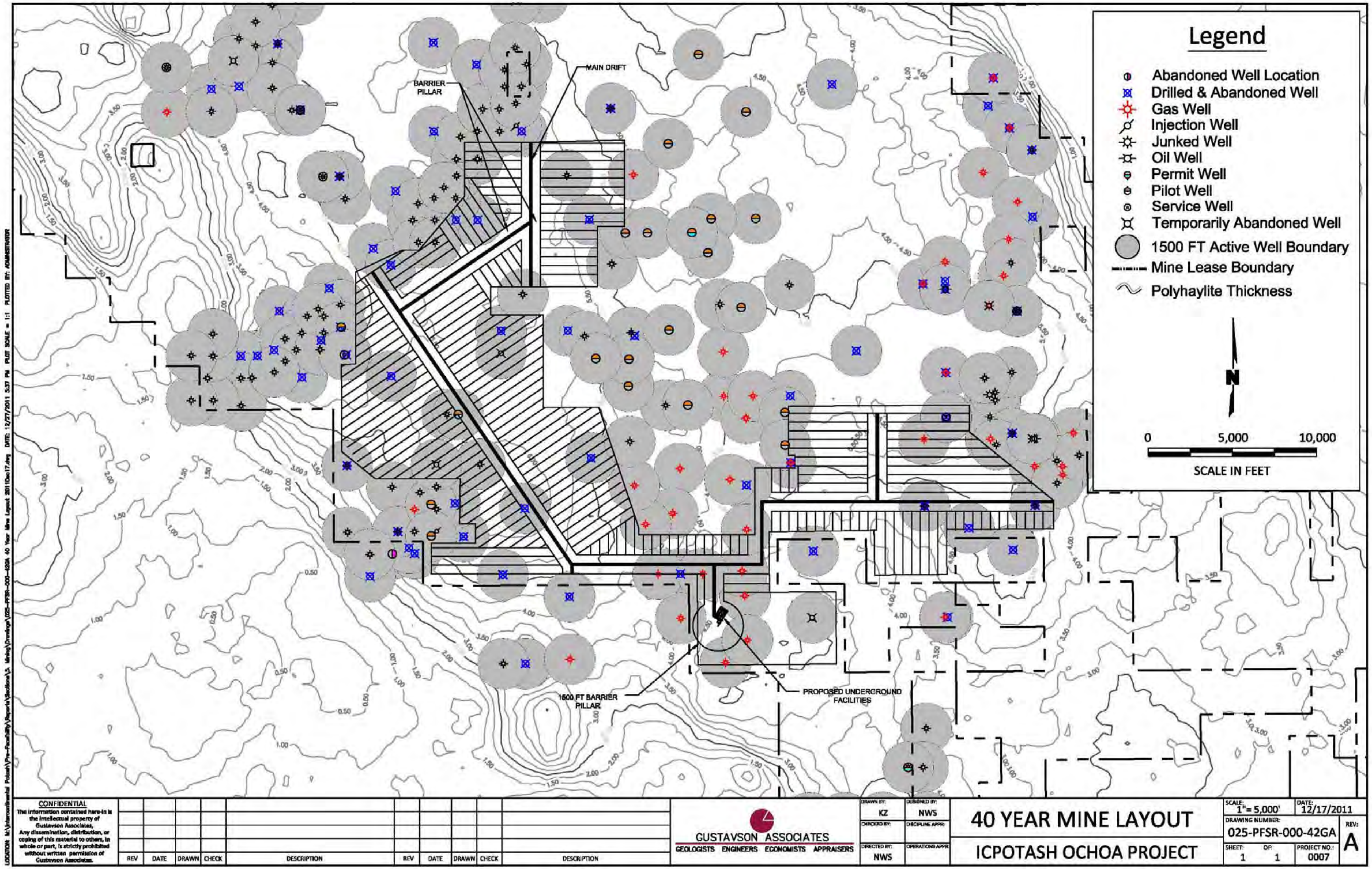


Figure 16-2 40 Year Detailed Mine Plan

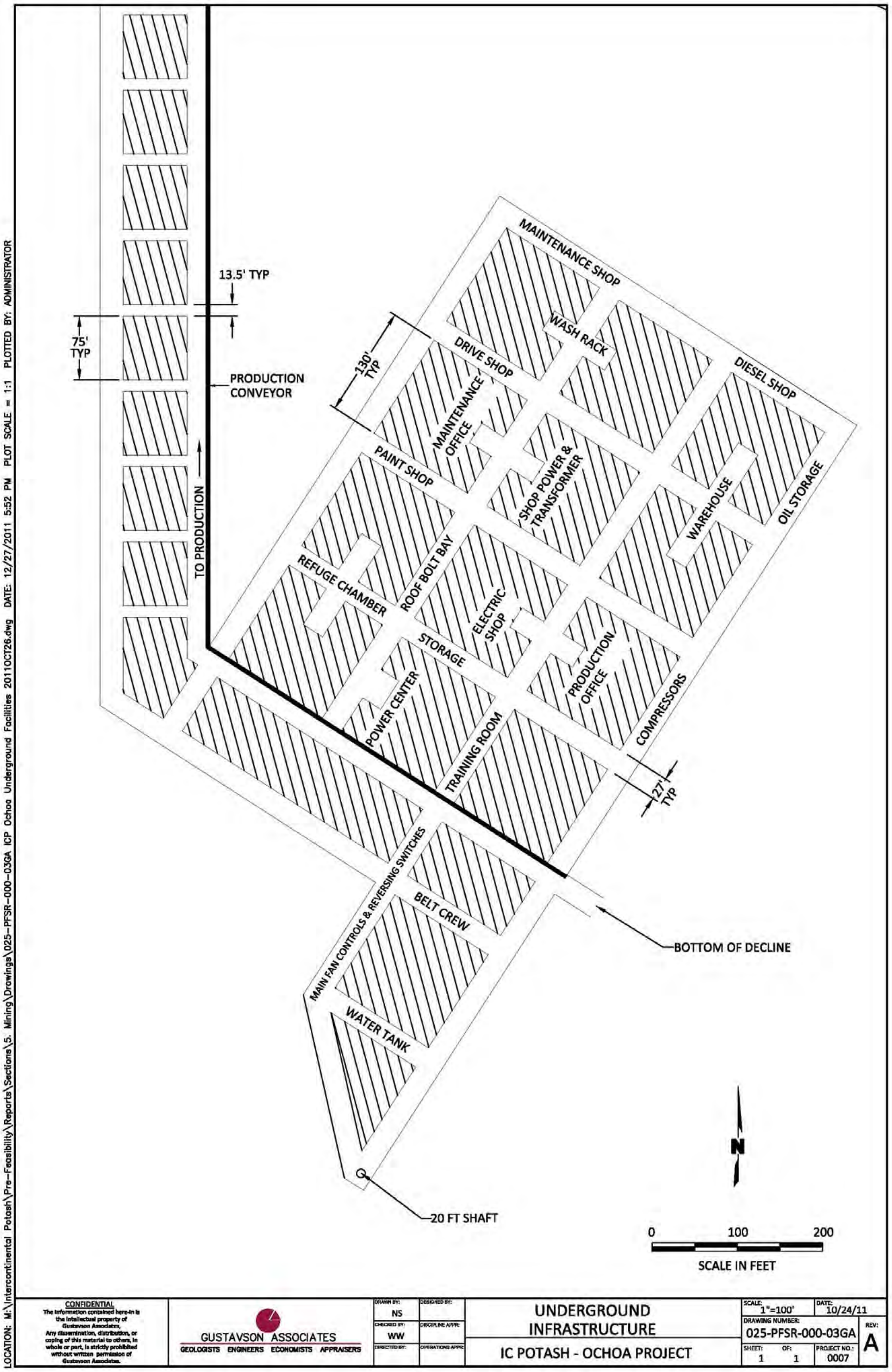


Figure 16-3 Proposed Underground Infrastructure

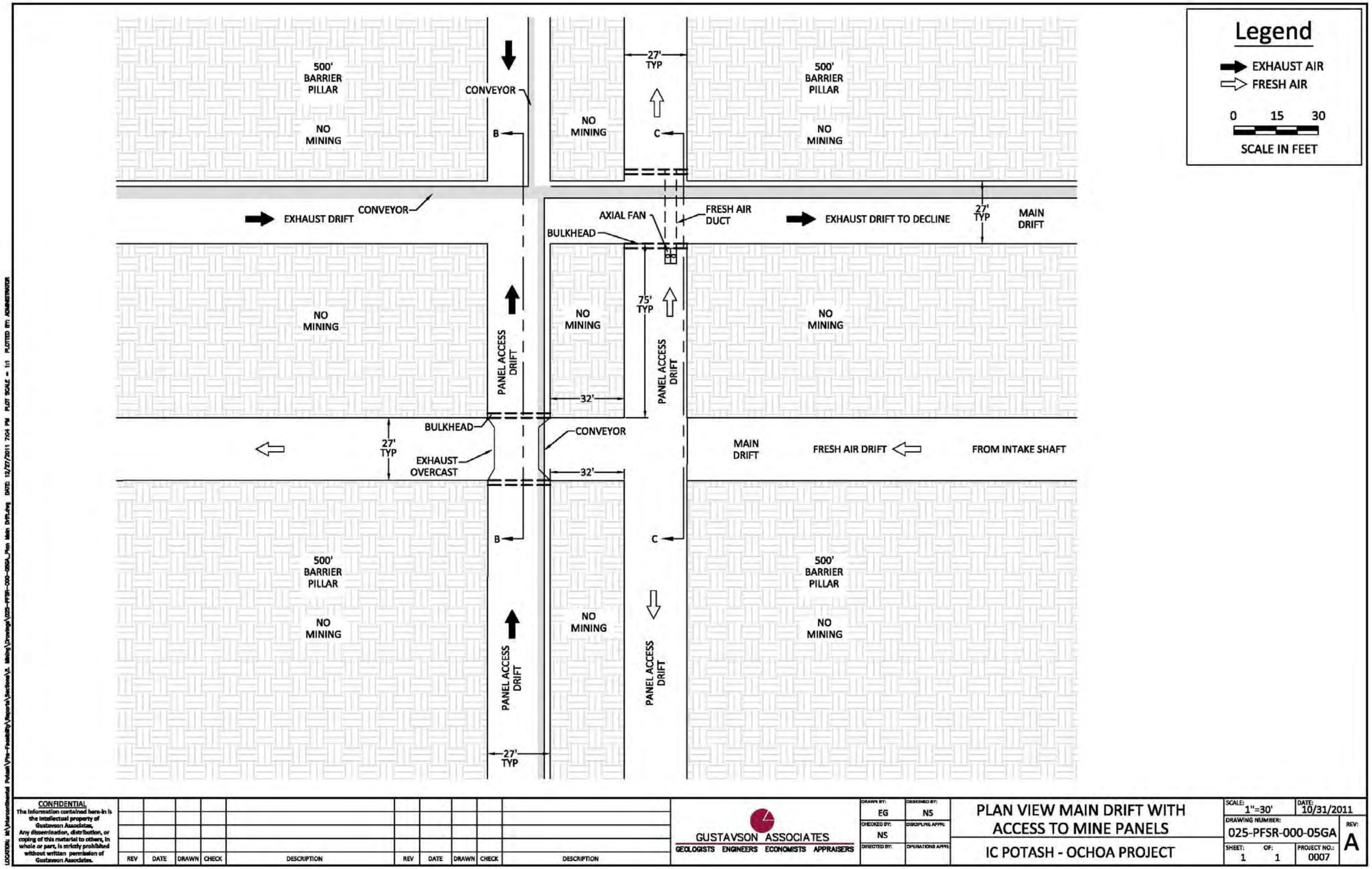


Figure 16-4 Main Drift

The panel development drifts will be driven to their end before production rooms are mined, retreating from panel end, back to the barrier pillar, providing workers with a strong safe working environment.

Ore extraction is 90% in areas where there are no active oil and gas wells. The mining rooms in these panels will be approximately 40 ft in width which consists of three full passes of the continuous miner, and 250 ft in length. The short length of the room allows for the miner to mine the room quickly, and proceed to the next room without the need for any bolting of the back. The room height will be 6 ft, which represents the 5 ft or more of polyhalite that is mined as ore and 1 ft of anhydrite that will be mined as waste from the back and gobbed into previously mined out rooms. In order for the shuttle cars to access the previously mined out rooms to gob the anhydrite, the rooms will be separated by an 8 ft pillar with cross cuts. The pillars in the 90% extraction areas are designed to deform and collapse, closing off the mined out room and causing subsidence on the ground surface. Figure 16-5 shows a plan of a production panel targeting 90% extraction, see Section 16.1.4 for calculations.

Only 60% of the polyhalite will be extracted within a 1,500 ft radius of the well in areas of the mine having active oil and gas wells. This 60% extraction provides sufficient strength that the back will not collapse and it will prevent surface subsidence. In areas that have 60% ore extraction, the mined rooms will be 27 ft in width and extend to 250 ft in length, as shown in Figure 16-6. The 27 ft width of the room will enable to continuous miner to mine the room with 2 full passes. Mined rooms will be separated by 22 ft wide pillars that have a 13.5 ft cross cut between rooms every 116 ft These pillars are designed such that they will not crush over time, will support the back, and will prevent subsidence from occurring on the surface.

Each production panel will be equipped with a conveyor that will be extended as the production panel drifts are developed and shortened as the panel retreats from panel end towards the mains. The equipment in each production panel will include a continuous miner, two shuttle cars, a feeder breaker and the conveyor that will feed material to the main conveyors in the main drifts. The shuttle cars will take material from the continuous miner and dump it into the feeder breaker in the panel drift. The feeder breaker will be connected to the takeaway conveyor, will crush the polyhalite to a minus 4 in. size, and feed the crushed polyhalite to the conveyor belt.

As mining retreats toward the main drifts, sections of the conveyor in the production drift will be taken out and moved to a production panel that is in development. The feeder breaker will be moved closer to the mains as mining rooms are completed and the conveyor is shortened.

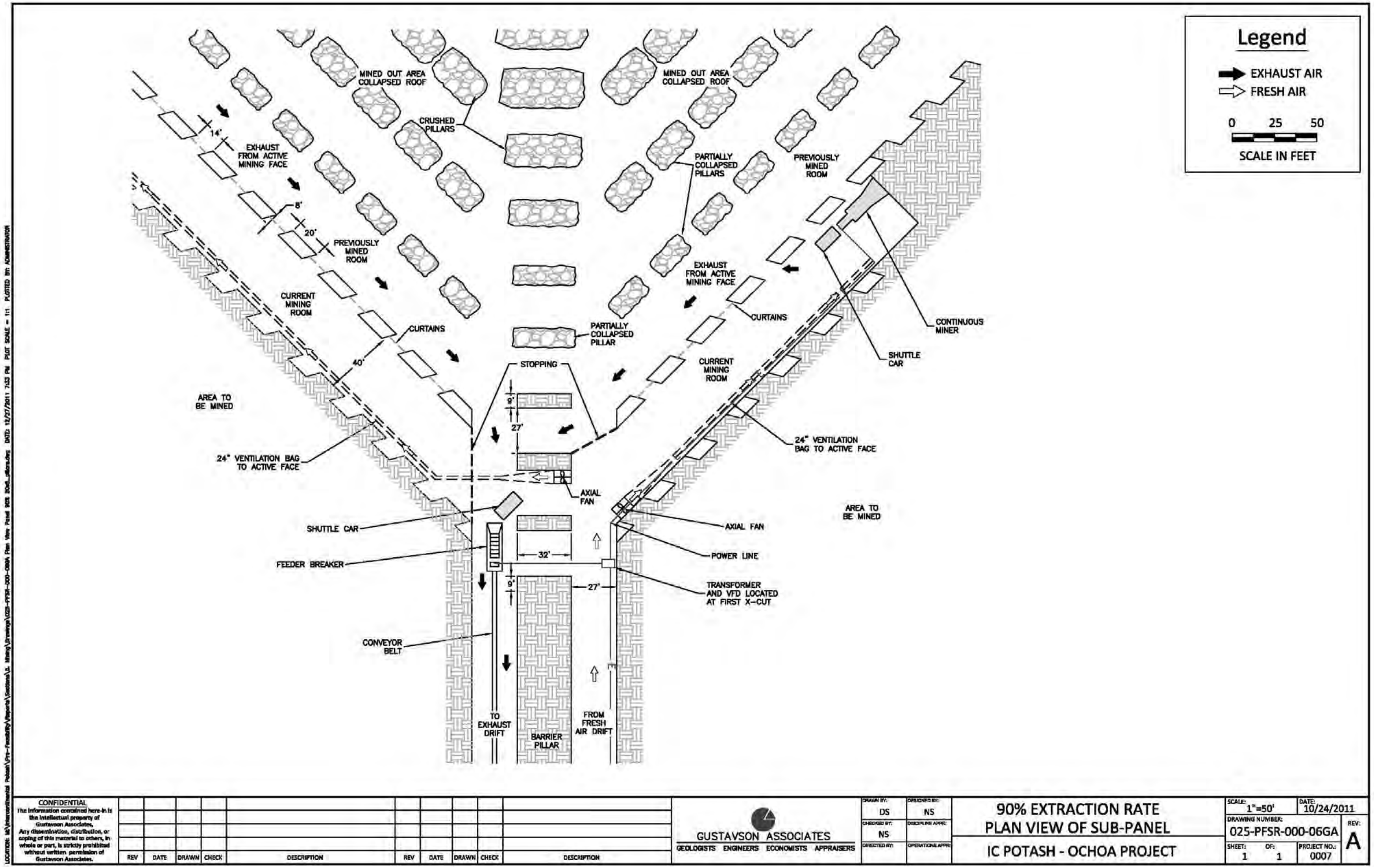


Figure 16-5 90% Extraction Rate

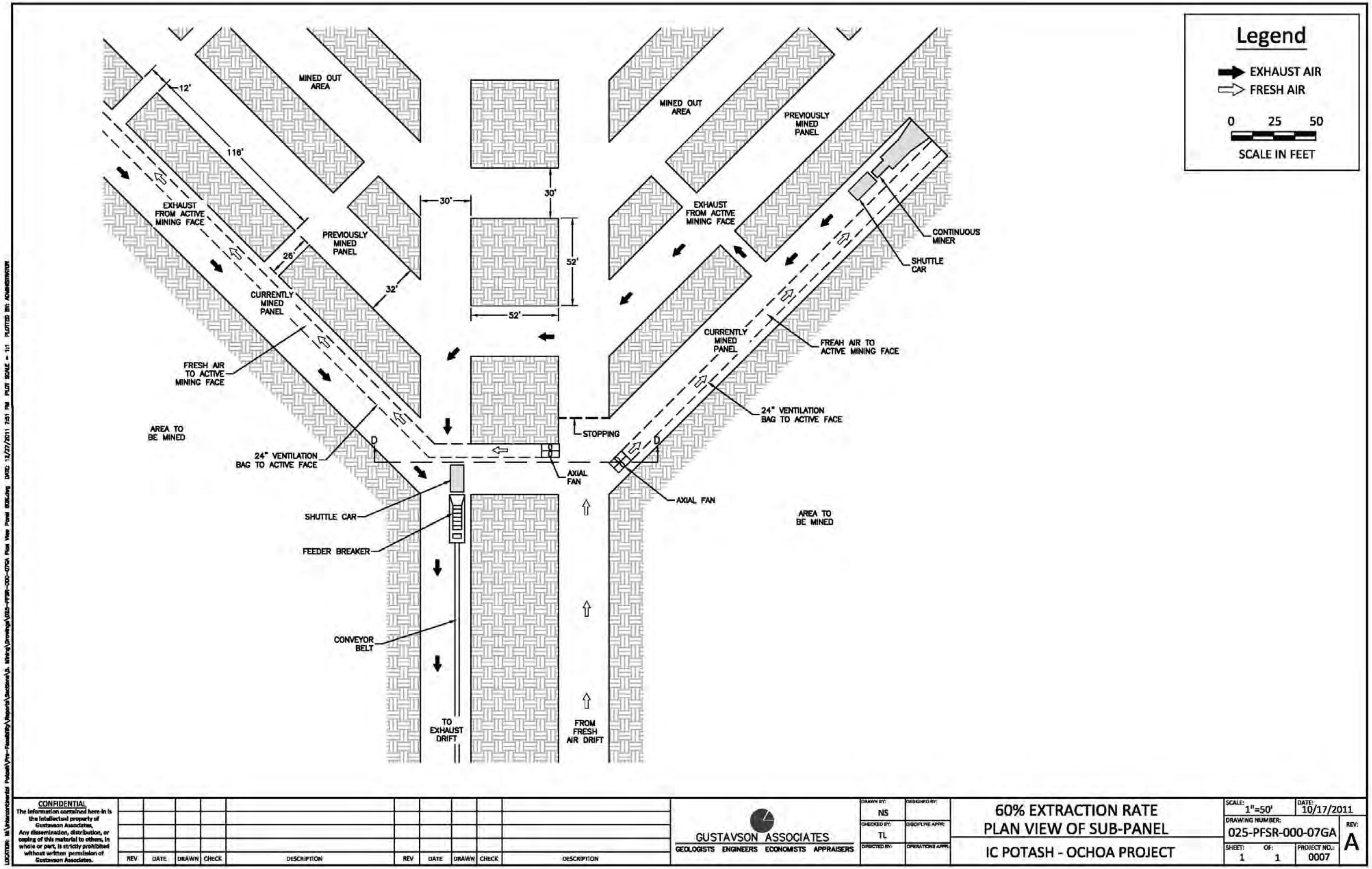


Figure 16-6 60% Extraction Rate

The continuous miner will make two separate passes when mining the polyhalite in both the production areas and the development areas, as shown in Figure 16-7. For safety reasons, personnel will not be permitted into areas of the mine where the anhydrite has not been removed from the back. For this reason the continuous miner will only be able to advance 20 ft at a time before it will have to reverse and remove the anhydrite from the back

In development headings, the anhydrite will be stored in cross cuts until it can be placed on the conveyor at scheduled times and transported to the surface. After the anhydrite has been removed from the back, a rock bolter will install rock bolts in order to further strengthen the back.

16.1.2 Waste Dumps

There will be two sites dedicated for development waste rock dumps. One is located near the shaft (as seen in Figure 16-8) and will be designated for waste rock and for waste salt. The second location is near the decline portal and will be dedicated for waste anhydrite.

Mined waste rock will be brought to the surface during the development stages of the mine via conveyors. Ore and waste will be campaigned using the same conveyors. There will be both rock waste from excavating the decline and shaft, and salt waste from initial mine development. The waste rock stockpile for the decline excavation is located by the processing facility in T24S, R33E Section 24. Waste rock stockpile for excavating the shaft, and the salt waste pile for developing underground shops will both be located near the shaft in T24S, R33E, Section 15. All waste stockpiles will be graded and lined with linear low-density polyethylene (LLDPE) liner.

A lined dry stack tailings facility will be created large enough to handle all waste produced by the plant. The dry stack tailing facility is located in T24S, R 33E, Sections 26 and 35. Plant waste will consist of either a dry tailing or a brine that needs to be evaporated. Dry tails from the plant will be transported to the tailings facility by the use of haul trucks. Waste brine will be pumped over land in a pipeline to a series of evaporation ponds. The evaporation ponds are located in T24S, R33E, Sections 25 and 26.

Waste brine sent to the evaporation ponds will be allowed to evaporate over time (Figure 16-9). When enough waste material has accumulated at the bottom of the ponds, the waste will be harvested with scrapers or loaders and hauled to the dry stack tailings facility. The tailings facility will be graded to allow any moisture to drain towards collection ponds where any water will be evaporated. The dry stack tailings facility will have a LLDPE liner underneath to prevent brine from seeping into the ground.

16.1.3 Annual Mine Plans

Figures 16-10 to 16-14 show the extent of the underground mine at years 1, 2, 5, 10, and 40.

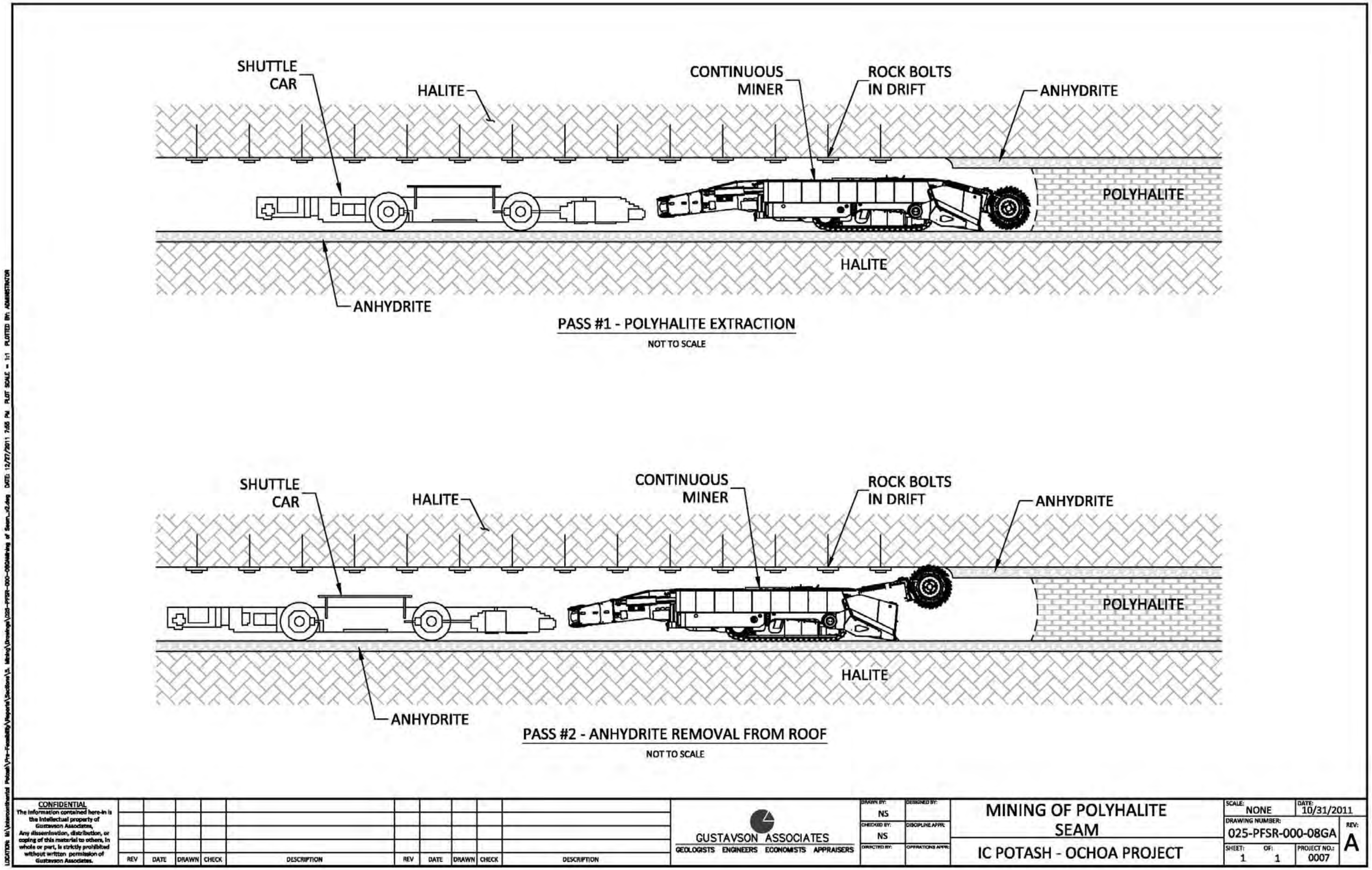


Figure 16-7 Continuous Miner Taking Two Passes

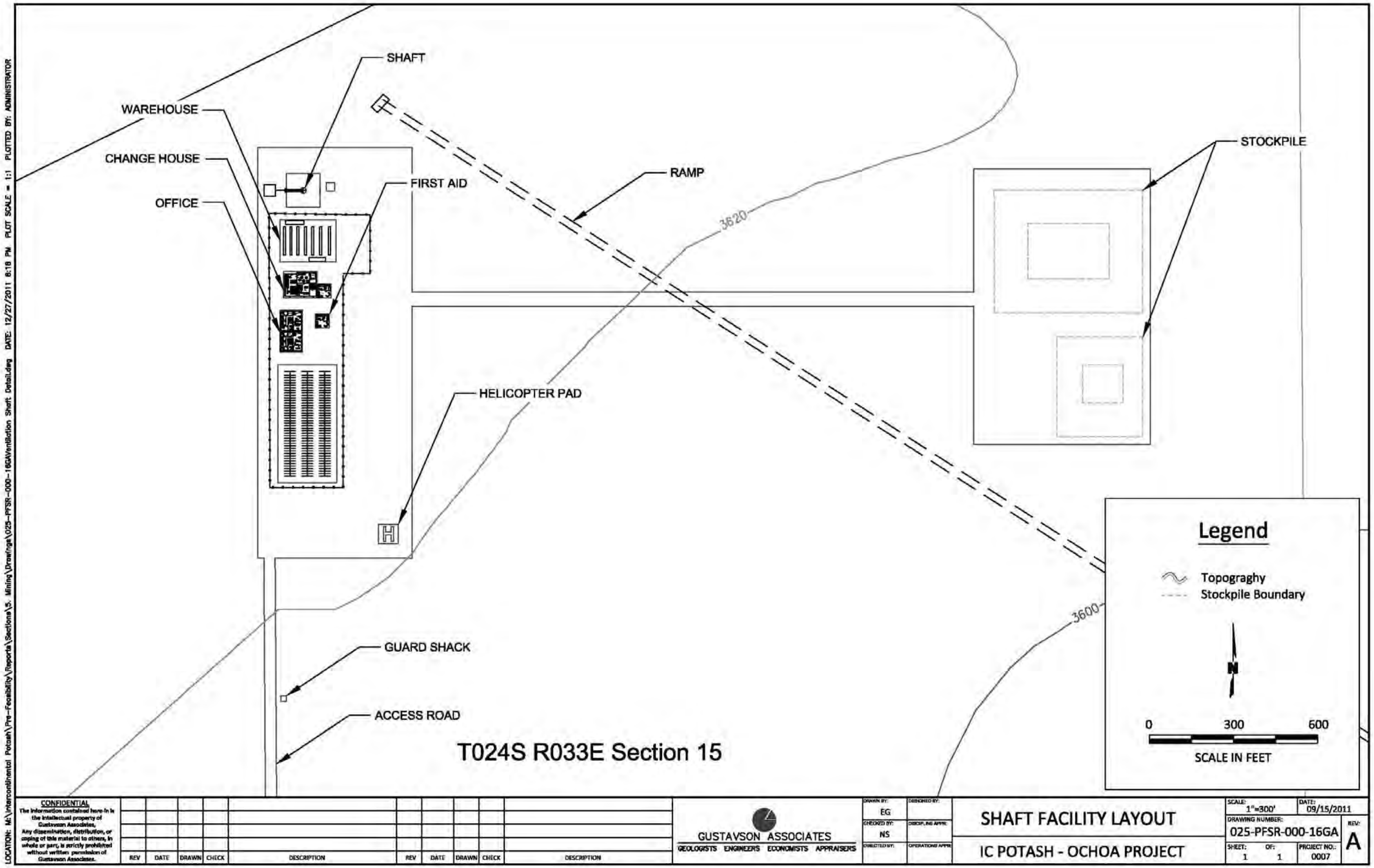


Figure 16-8 Shaft Facility Layout

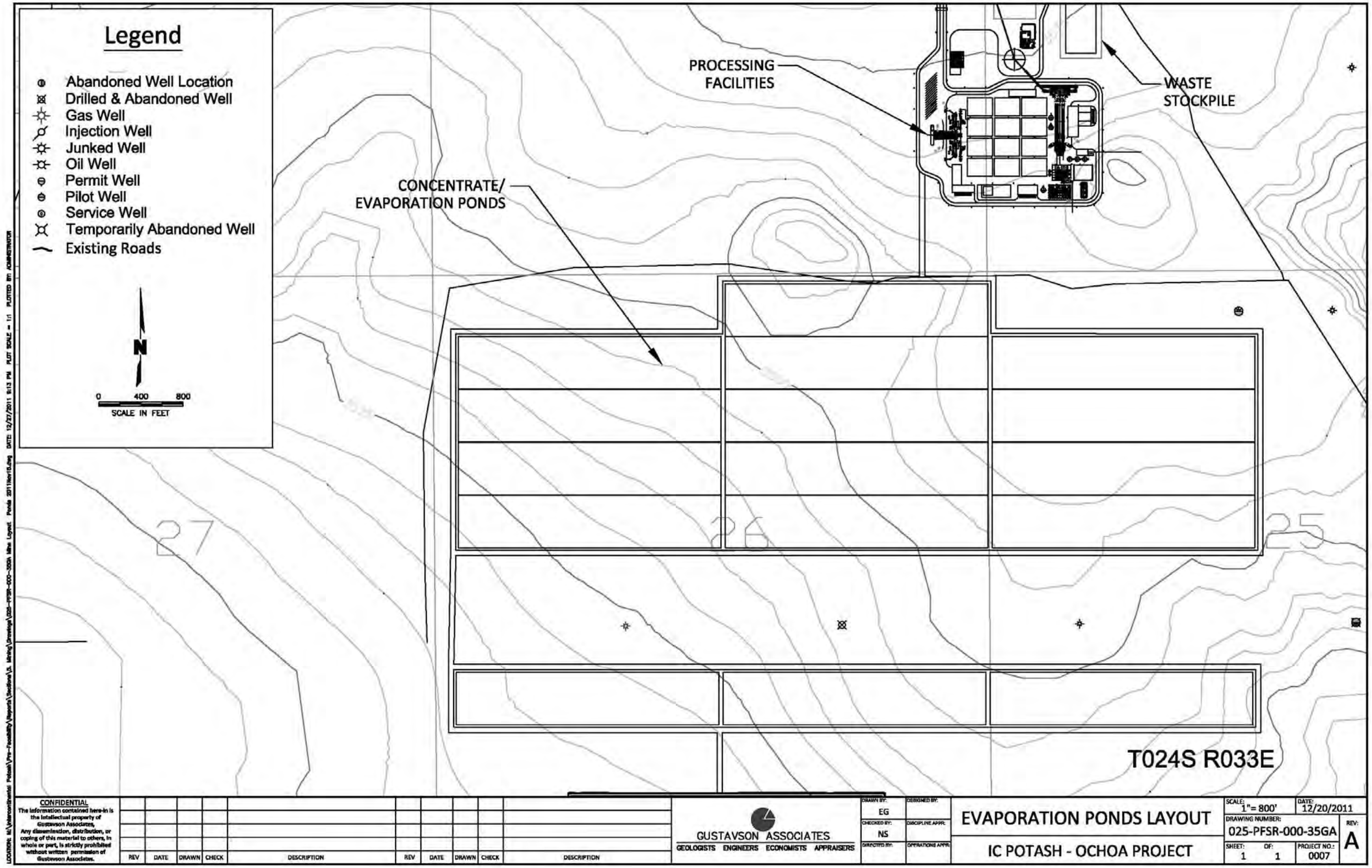


Figure 16-9 Evaporation Ponds Layout

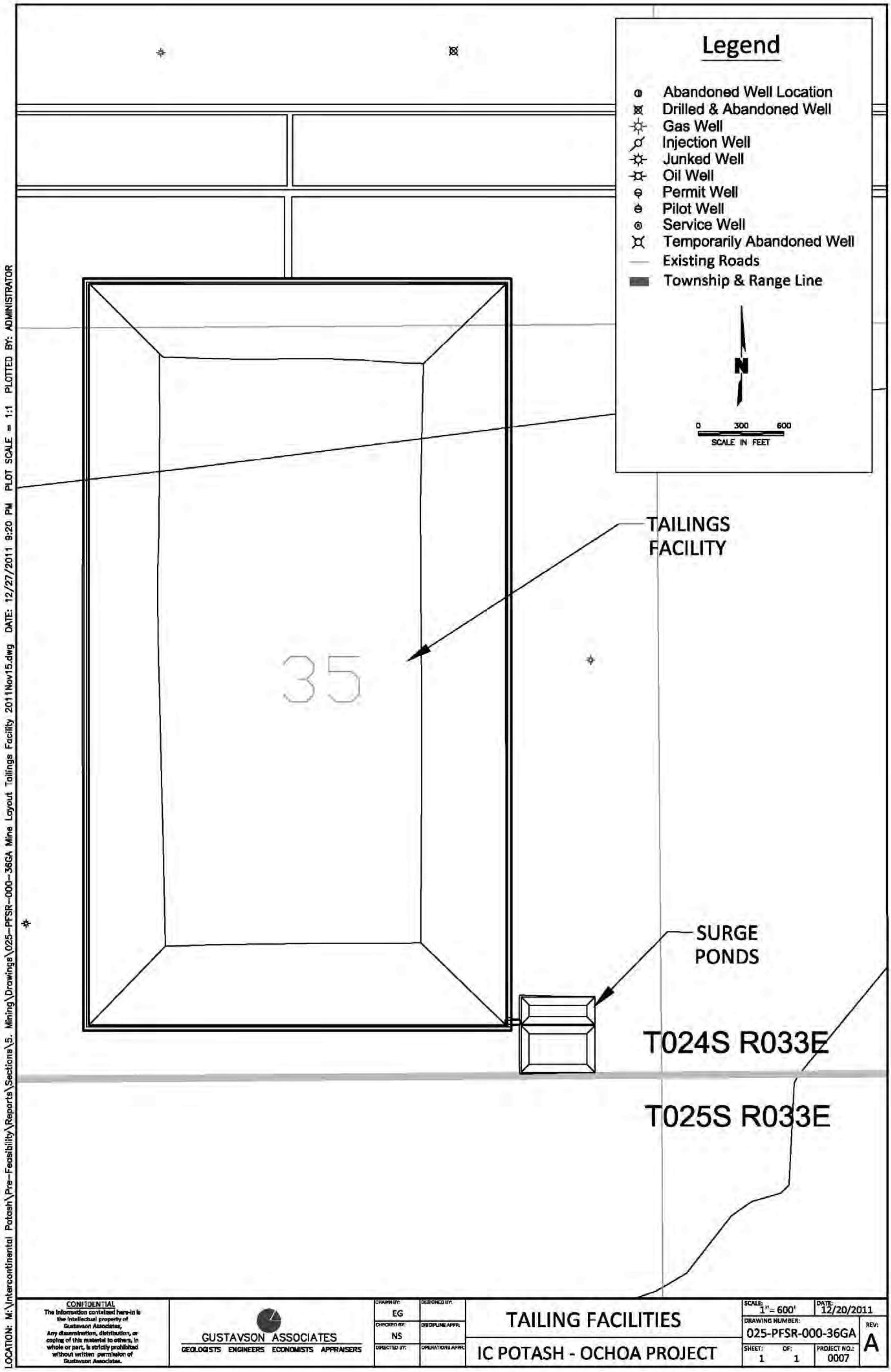


Figure 16-10 Tailings Facilities

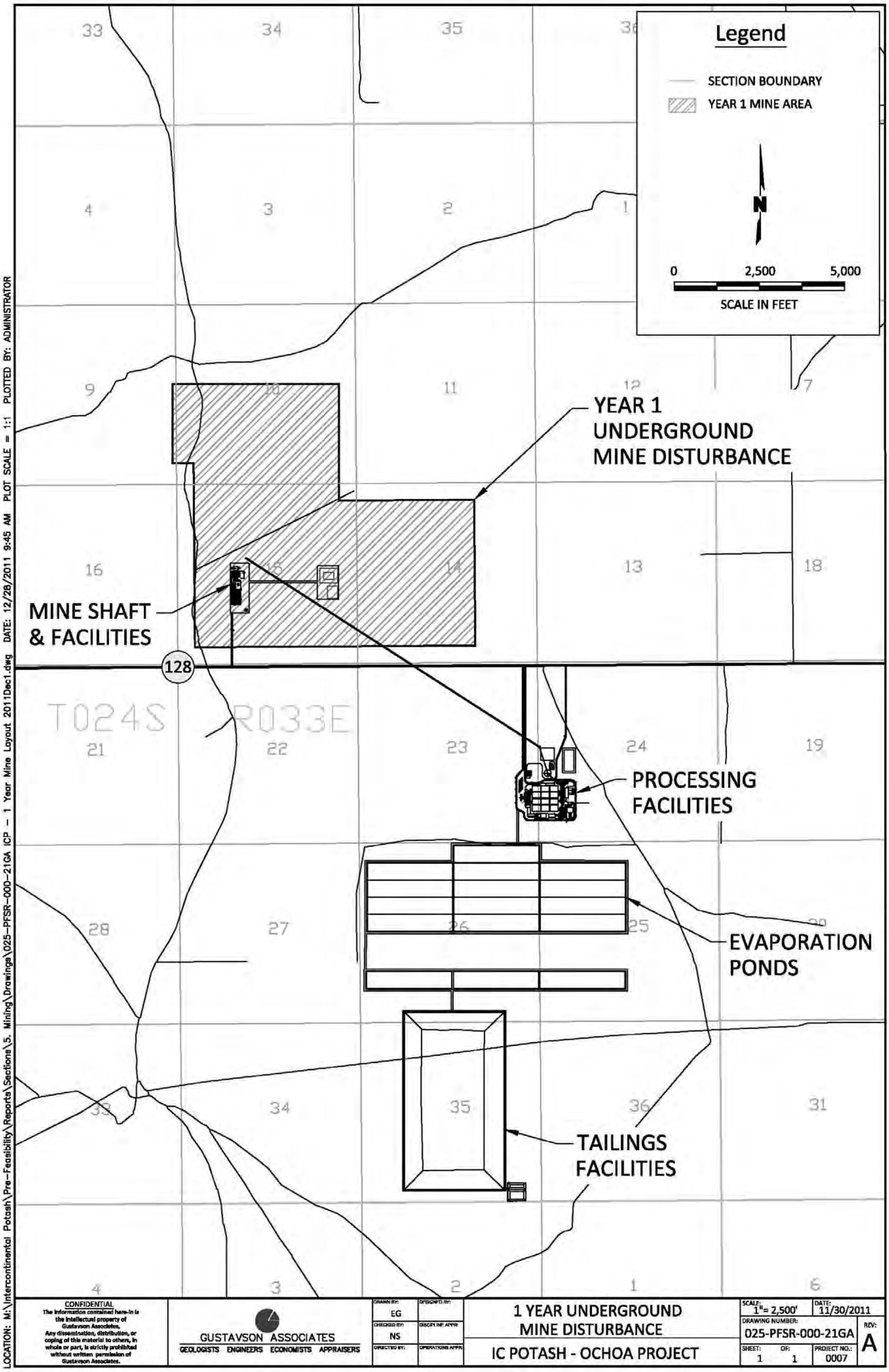


Figure 16-11 1 Year Underground Mine Disturbance

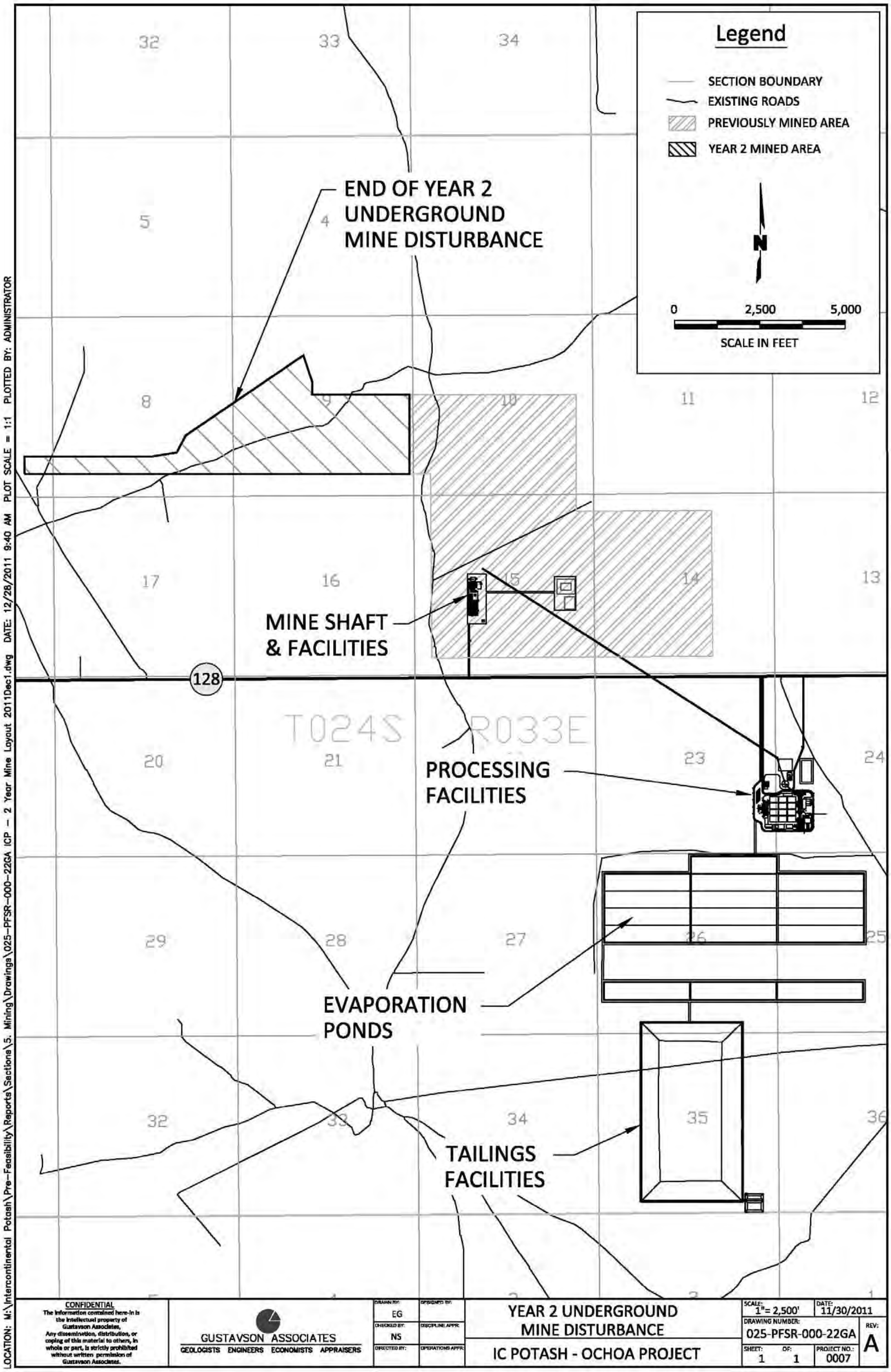


Figure 16-12 2 Year Underground Mine Disturbance

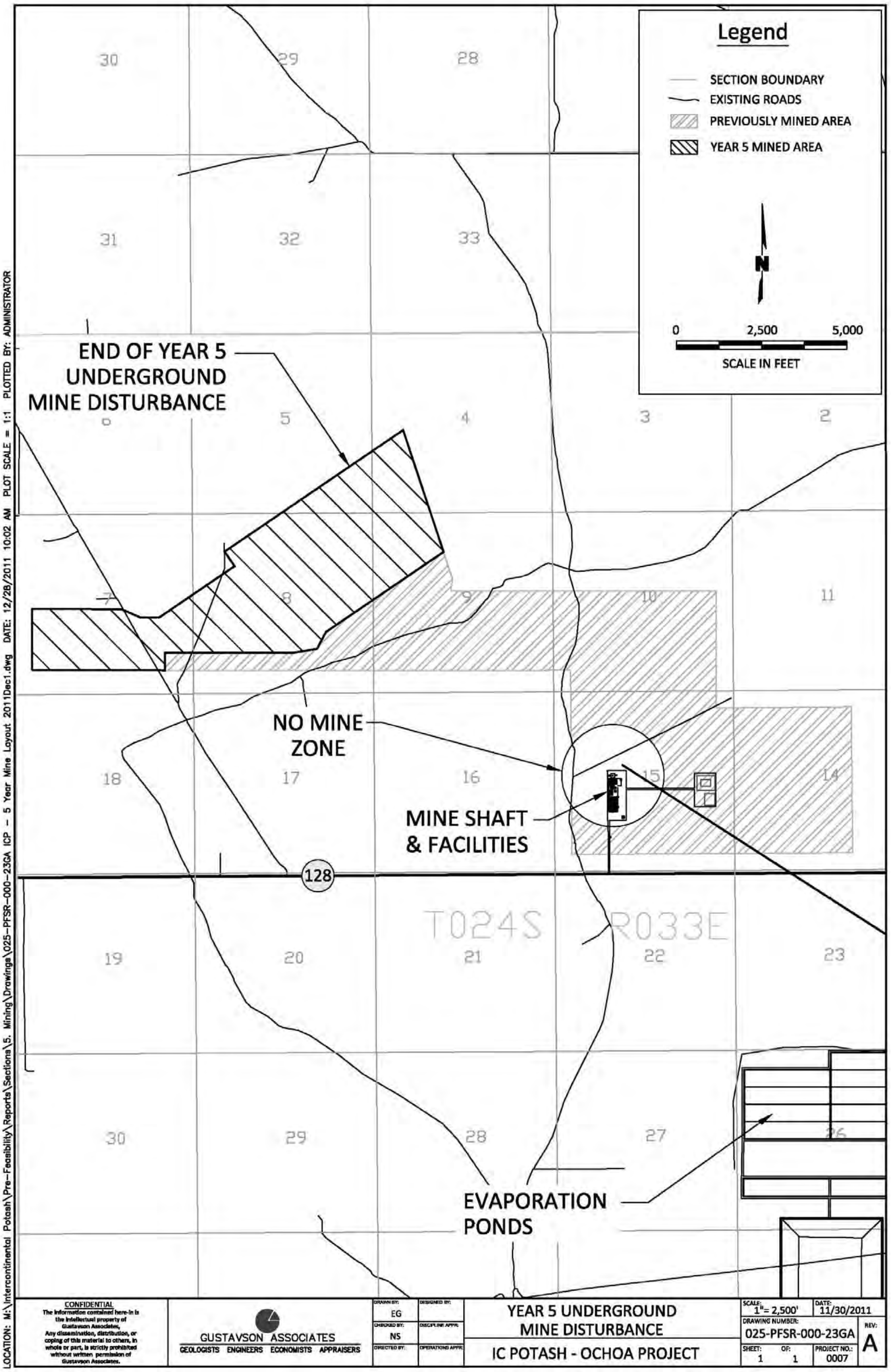


Figure 16-13 5 Year Underground Mine Disturbance

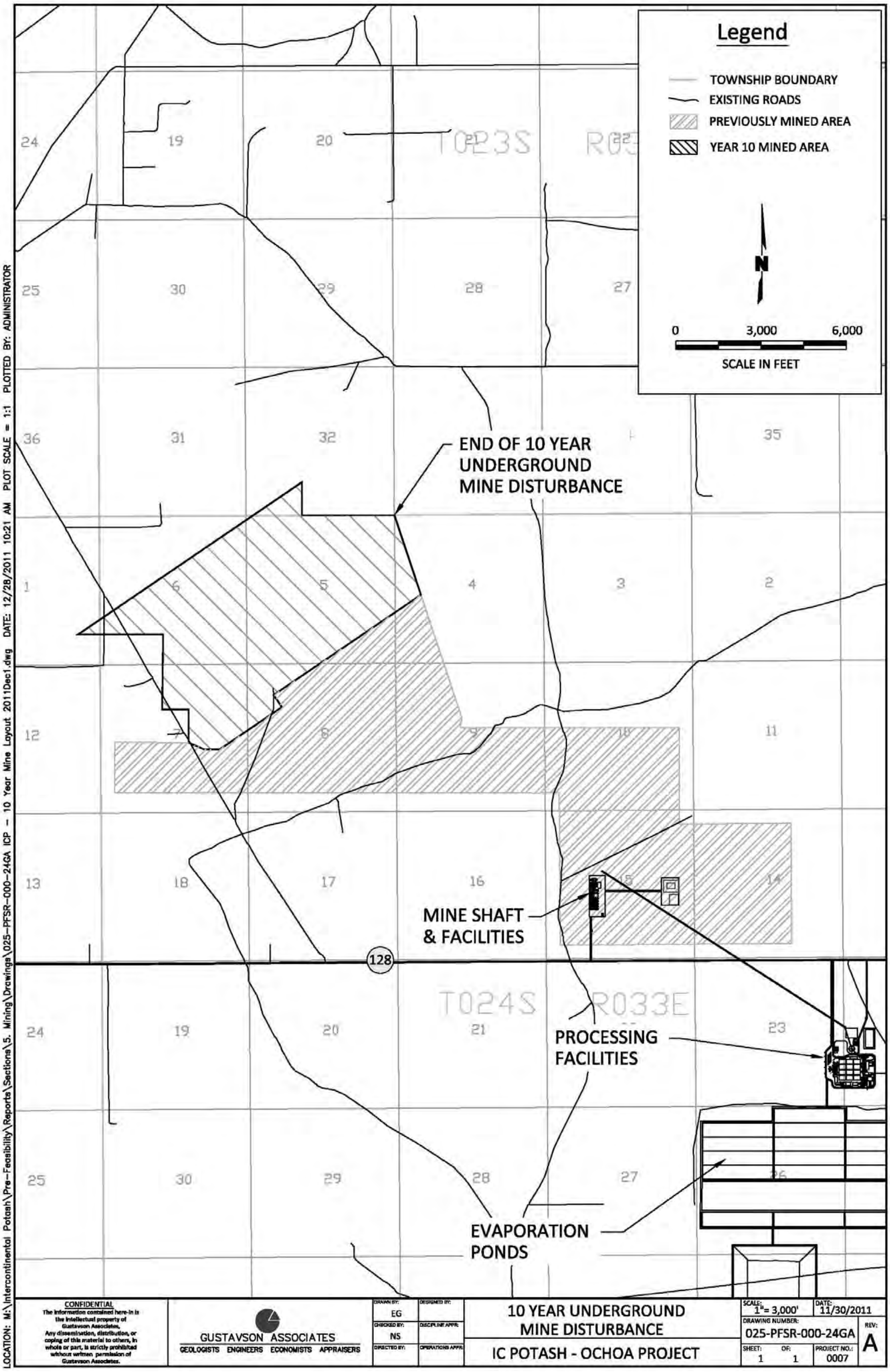


Figure 16-14 10 Year Underground Mine Disturbance

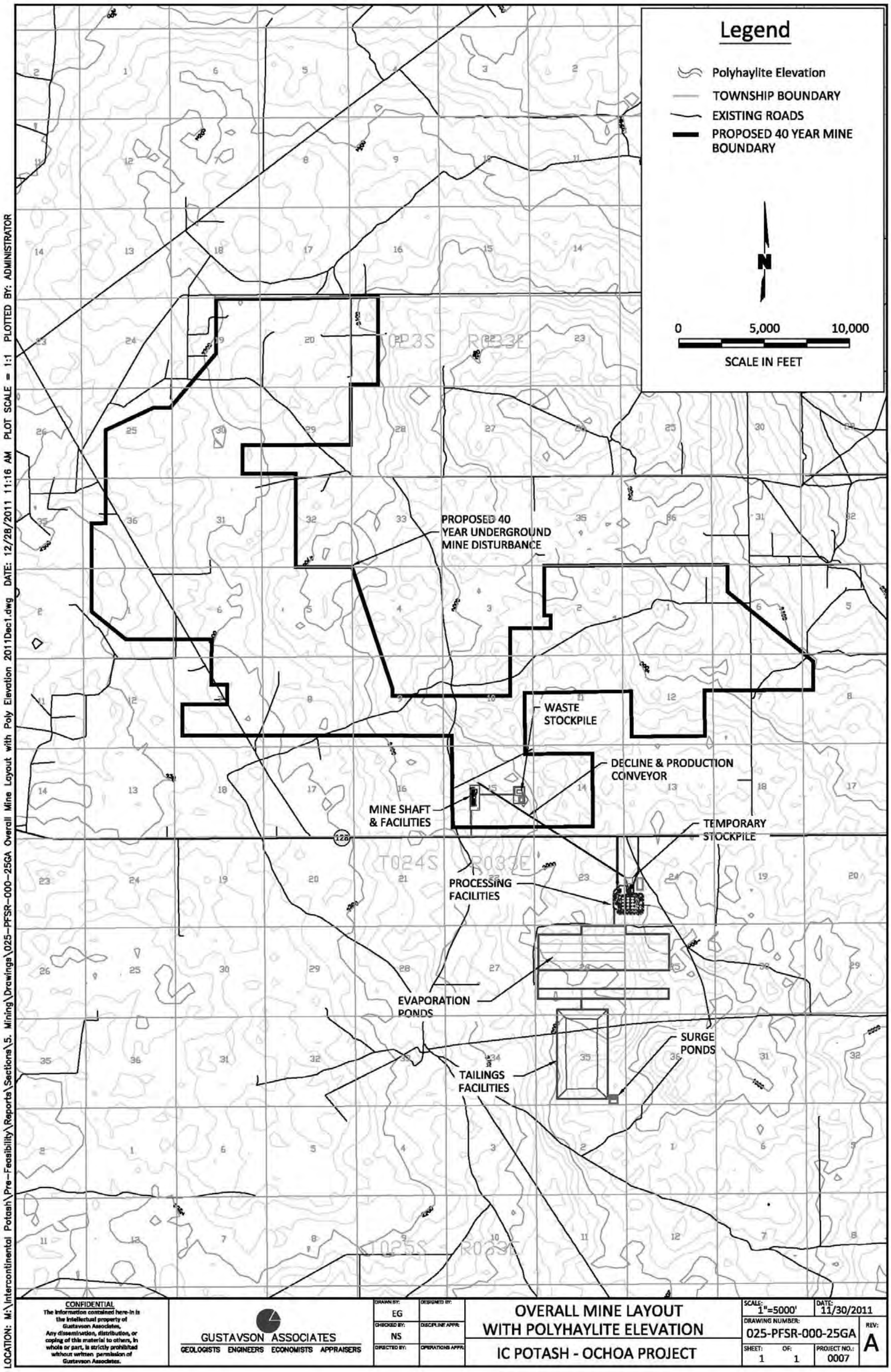


Figure 16-15 40 Year Underground Mine Disturbance Showing Polyhalite Elevation

16.1.4 Pillar Design

Pillar design calculations for this study are based on methods and formulas described in Rock Mechanics in Salt Mining, M.L. Jeremic, Chapter 12, Mining of Moderately Thick Deposits. The Ochoa mine will be a room and pillar mine laid out in a herringbone pattern, which provides a more stable ground condition when mining is completed in a retreat fashion with continuous miners. This method of mining is the standard method used in other potash mines in the vicinity of the project.

Different pillars will be used for the different ore extraction rates. As previously described, a 90% ore extraction is used for areas where subsidence is not a concern, and 60% extraction rate around oil and gas wells and in other important areas of the mine such as main drifts and development areas that will need to be accessed throughout the life of the mine. In areas having a 90% extraction rate, the pillars between rooms will be designed to yield and will collapse over time as mining retreats towards the main drifts and haulage ways. Once mined, these areas of the mine will not be accessed again.

In areas of 60% ore extraction, the pillars are designed so they will not yield and will support the ground above them indefinitely. Due to the plastic characteristics of the halite back, the halite may, over very long time periods, flow into the openings. In the areas that will need constant access for the entire life of mine, maintenance may be necessary to deal with the plasticity of the halite in high stress areas adjacent to mined out panels. The back and floor in these areas will need to be monitored over time in order to determine if additional maintenance is necessary to maintain access.

A factor of safety greater than 1 is used for pillars that will bear the load above them and a factor of safety less than 1 shows that the pillar has been designed to yield. In general a factor of safety of greater than 1.6 should be used when designing long-term supporting pillars, 1.3 for intermediate-term supporting pillars, and 1.1 for temporary pillars.

The data used for the calculations in this study are shown in Table 16-1.

Table 16-1 Data Used for Pillar Design

Assumptions Used for Pillar Calculations	
Overburden Depth	1,500 ft
Density of Overburden	175 pcf.
Pillar Height (with anhydrite)	6 ft
Pillar Material	Polyhalite
Polyhalite Compressive Strength	8,000 psi

Pounds per cubic ft (pcf)
Pounds per square inch (psi)

16.1.4.1 Yielding pillars in 90% extraction areas

The mine will target a 90% extraction rate in most mining panels. In order to achieve this rate of extraction, the pillars designed will be yielding and will collapse soon after the room is mined.

The ultimate strength of the pillar is based upon the compressive strength of the polyhalite and the slenderness ratio which is the height of the pillar divided by the width of the pillar. Calculations for the ultimate strength of the pillar are shown in Table 16-2.

Table 16-2 Calculations Used to find Ultimate Pillar Strength

Assumptions used to find Ultimate Pillar Strength	
Ultimate Pillar Strength	$\sigma_p = \sigma_c(W/H)^{\wedge 0.5}$
σ_c = Material Compressive Strength	8,000 psi
W = Width of Pillar	8'
H = Height of Pillar (with anhydrite)	6'
Ultimate Pillar Strength	= 8,000 psi * (8'/6')$^{\wedge 0.5}$ = 9237.5 psi

The final design of the pillar will also depend on the size and type of equipment that will be used. Continuous miners with cutting head diameters of 52 in. and a width of 13.5 ft will be the proposed pieces of extracting equipment. Ultimate room size will be dependent upon the ultimate pillar strength, as the stronger the pillar, the larger the room can be. The average pillar load will be necessary to determine the maximum width of the room, based upon tributary area of loading. The area that the pillar supports is all of the area between the pillar and the midpoint of the next pillar. In this case, the length of the pillar that is being used is 20 ft and the space between pillars is 13.5 ft which is one full pass of the continuous miner. The calculations used for finding the average load a pillar can withstand can be found in Table 16-3 below.

Table 16-3 Calculations Used for Average Load a Pillar can Withstand

Calculations Used for Average Load a Pillar can Withstand	
Average Pillar Load	$\sigma_v = \gamma h * 1/(1-R_e)/144$
γ = weight of overburden	175 pcf
h = height of overburden	1,500 ft
Re = Recovery Factor	90% = 0.9
Average pillar load	= 175 pcf * 1500 ft * 1/(1-.9)/144in^2/ft^2 = 18,229 psi

By keeping the width and length of the pillar as well as the pillar spacing constant it is possible to determine the room width needed to extract 90% of the polyhalite. The calculations used for determining the room width can be found in Table 16-4 below.

Table 16-4 Calculations Used to Determine the Room Width for 90% Extraction

Calculations Used to Determine the Room Width for 90% Extraction	
Width of Room	W_r=((W*L)*(σ_v*144)/(γ*h))/(L_r+L)-W
W= Width of Pillar	8 ft
L = Length of pillar	20 ft
σ_v= Average Pillar Load	18,229 psi
γ = weight of overburden	175 pcf
h = height of overburden	1,500 ft
L_r = space between pillars	13.5 ft
Room width	= ((8'*20')*(18,229psi*144 in^2/ft^2)/(175pcf *1,500'))/(13.5'+20')–8' = 40'

This room width is approximately three full passes of the continuous miner. Room width varies based on the design of the pillar.

The pillars that were designed in the 90% extraction areas will yield, with a factor of safety of 0.5. The low factor of safety is necessary to ensure that the pillars will collapse in a relatively short amount of time after the room is completed and not punch through the weak halite back. The table of calculations used to determine factor of safety can be found below in Table 16-5.

Table 16-5 Calculations Used to Determine Factor of Safety

Calculations Used to Determine Factor of Safety	
Factor of Safety	$F_s = \sigma_p / \sigma_v$
σ_v= Average Pillar Load	18,229 psi
σ_p = Ultimate Pillar Strength	9,238 psi
Factor of Safety	= 9,238 psi / 18,229 psi = 0.5

16.1.4.2 Non yielding bearing pillars in 60% extraction areas

Polyhalite extraction will be 60% within a 1,500 ft radius of the well in areas around active oil and gas wells. These pillars are designed as load bearing pillars and will not fail because ground subsidence is not permitted in these areas. The same formulas that were used to design the 90% extraction rate pillars apply to the design of these non-yielding pillars. The targeted room width for these areas is 27 ft, which is approximately two full passes with the continuous miner. The length of the pillars will be 116 ft in length with 13.5 ft spacing between the pillars. Using these assumptions, the width of the room pillar will need to be approximately 22 ft, which is a slenderness ratio of 0.272 assuming the pillar height is 6 ft. Refer to Table 16-6 for calculations to determine ultimate pillar strength in 60% extraction areas.

Table 16-6 Calculations for Ultimate Pillar Strength in 60% Extraction Areas

Calculations Used to Find Ultimate Pillar Strength in 60% Extraction Areas	
Ultimate Pillar Strength	$\sigma_p = \sigma_c(W/H)^{0.5}$
σ_c = Material Compressive Strength	8,000 psi
W = Width of Pillar	22'
H = Height of Pillar	6'
Ultimate Pillar Strength	= 8,000 psi * $(22'/6')^{0.5}$ = 15,339 psi

The same formula to determine the average pillar load as above is used to determine the average pillar load for extracting only 60% of the material. The overburden depth and density stay the same; the only change is the recovery factor changing from 90% to 60%. Leaving 30% more of the material decreases the pillar load substantially in comparison to the 90% extraction rate, which is expected. Table 16-7 below shows the calculations used to determine average load in 60% extraction areas.

Table 16-7 Calculations Used for Average Load in 60% Extraction Areas

Calculations Used for Average Load in 60% Extraction Areas	
Average Pillar Load	$\sigma_v = \gamma h * 1/(1-R_e)/144$
γ = weight of overburden	175 pcf
h = height of overburden	1,500 ft
Re = Recovery Factor	60% = 0.6
Average pillar load	= 175 pcf * 1500 ft * 1/(1-.6)/144in^2/ft^2 = 4,557 psi

Room width is determined by using the same calculations. This room width is ideal for 2 passes of the continuous miner. Table 16-8 shows the assumptions used to determine room width for 60% extraction.

Table 16-8 Calculations used to determine room width for 60% extraction

Calculations used to determine the room width for 60% extraction	
Width of Room	W_r=((W*L)*(σ_V*144)/(γ*h))/(L_r+L)-W
W= Width of Pillar	22 ft
L = Length of pillar	120 ft
σ_V= Average Pillar Load	4,557 psi
γ = weight of overburden	175 pcf
h = height of overburden	1,500 ft
L_r = space between pillars	13.5 ft
Room width	= ((22'*116')*(4,557psi*144 in^2/ft^2)/(175pcf *1,500'))/(13.5'+116')–22' = 27ft

The factor of safety is 3.4 for 60% extraction, which is substantially larger than the 1.6 factor of safety that should be used for long term load bearing pillars. Pillars may not fail with extraction greater than 60%, however, the relatively weak halite above has a low compressive strength. Additional testing of halite is recommended to better understand its geotechnical characteristics.

16.1.4.3 Main Drift Pillars

Pillars around the main drifts will be designed to bear the weight of the overburden over the life of the mine. The mains will be 27 ft in width in order to provide adequate room for equipment, ventilation, and personnel. A 27 ft wide drift will also allow the continuous miner to build the drift with two full passes. On both sides of the main drift, a 500 ft barrier pillar will exist between the main drifts and the mining areas. Barrier pillars of this size are common practice around main drifts and development areas where openings must stay open for the entire life of mine. The height of the mains is 8 ft and it needs to be maintained throughout the drifts in order to accommodate conveying, ventilation, and mining equipment.

Based on the slenderness ratio, the calculated ultimate stress for a pillar of this size is 24,495 psi which is greater than the laboratory results of 23,015 psi. For the design of the main drift pillar the laboratory results were used in order to determine the factor of safety.

The average pillar load is calculated to be 2,734 psi. Using the laboratory ultimate pillar stress, the factor of safety for the pillars formed between the main drifts and the cross cuts is 8.4. This design is extremely conservative, and will be adequate for the entire mine life.

16.1.5 Back Support

It is essential that the back remains safe from collapsing and sagging in areas where the opening needs to remain open for long periods of time. When material is removed and an opening is created underground, loads immediately above the opening are redistributed towards the pillars. The redistribution of load creates a de-stressed area immediately above the opening called a pressure arch where material is not being supported.

The size of the de-stressed zone is dependent upon the material property and the bedding of the strata. The back will begin to either sag or collapse from the lack of support; therefore it will need to be supported with rock bolts in order to prevent this from happening. The rock bolt size and pattern will need to be determined based on additional laboratory tests done on the back material.

The floor (sill) will have the tendency to heave over time as the loads from the pillars are transferred to the sill. Like the back, the areas directly below the opening do not support any load, and as the loads from the pillar are transferred to the sill, this will cause the sill to heave in the areas that do not support load.

The de-stressed zone in the back and the passive zone in the sill are related and based upon the width of the room. If over time there are large amounts of heave and sag, then it will be necessary to make the room narrower in order to minimize these problems.

16.1.6 Mining Equipment

16.1.6.1 Gassy Mine Methods

The Ochoa mine will follow the 30 CFR 57.22305 and 30 CFR 57.22308, regulations for gassy mines. The continuous miners will be equipped with methane monitors that will give warning at 1.0 % methane, automatically de-energize electrical equipment and prevent from starting at levels of 1.5% and higher methane, automatically de-energize equipment if a sensor is interrupted and finally the sensing units will be positioned at a location that is most effective for measuring methane levels. Procedurally, equipment will not be operated in atmospheres containing 1.0 % or more methane levels

16.1.6.2 Permanent Shaft Equipment

The hoist and headframe will remain as part of the permanent equipment. The muck buckets and the Galloway stage will be removed.

To accommodate the hoisting of men and materials, a cage and counterweight will be installed along with the necessary shaft steel sets and timber guides. The cage will be fitted with a broken rope safety device as required by law. The chutes and deck doors used for sinking will be removed and the collar area will be adapted with a steel structure to accommodate the cage.

The sheaves used in conjunction with the Galloway stage will be removed and the hoist sheaves relocated to their permanent position to accommodate the cage and counterweight.

16.1.6.3 Permanent Decline Equipment

The decline will be driven using the conveyor to remove the muck as it is generated by the roadheader and the conveyor will be extended as the decline progresses. It will therefore not require a great deal of modification to prepare the conveyor for a production format. The conveyor will be 48 in wide and consist of three sections.

16.1.6.4 Production Equipment

Production equipment will be a combination of mobile and conveying equipment. Each continuous miner will be supported by two shuttle cars, a rock bolter, and a feeder breaker which will crush the polyhalite and feed it to the conveyor. A mining crew will consist of three people (continuous miner/bolter operator and two shuttle car operators).

Production cycles were calculated based on two 10-hour shifts, 7 days a week to determine the number of mining crews that will be necessary to produce a sufficient quantity of polyhalite to feed the plant on a daily basis. Based on these calculations it will be necessary to have six mining crews operating to meet demand from the plant. Table 16-9 and 16-10 below lists the quantity and equipment needed for initial production and additional equipment necessary for full production. The tables include extra equipment to allow for maintenance and rebuilds.

Table 16-9 Initial Mine Equipment

Quantity	Description
2 ea	Continuous miners – Joy 12HM
4 ea	Shuttle cars
2 ea	Rock bolters
2 ea	Feeder Breaker
1 ea	Main Collection Conveyor
2 ea	Panel Conveyor

Table 16-10 Additional Mine Equipment

Quantity	Description
5 ea	Continuous miners – Joy 12HM
10 ea	Shuttle cars
4 ea	Rock bolters
5 ea	Feeder Breaker
2 ea	Panel Conveyor
1 ea	Surface Conveyor

16.1.7 Support Equipment

Support equipment will consist of both underground equipment and surface equipment in order to deliver polyhalite from the active face to the processing facility and to manage tailings and waste on the surface. The largest piece of underground support equipment will be the ventilation fans. Two 200-horsepower (HP) fans will be necessary to provide the primary ventilation for the mine. Additional underground support equipment include: rescue cars, mine transport cars to move the crews to and from the active faces, and a lube/service vehicle to assist in maintenance in the mine. Finally, generators are necessary in the case of a main power outage to maintain lighting and ventilation to the mine.

Surface support equipment include: front end loaders for moving material and reclaiming the ore stock pile, a scraper to reclaim the evaporation ponds as well as to maintain the roads, haul trucks are necessary to transport reclaimed waste from the evaporation ponds and the plant to the tailings facility, a water truck to keep dust down on the surface and a service truck is necessary for field maintenance. Mine support equipment is summarized in Tables 16-11 and 16-12.

Table 16-11 Initial Support Equipment

Quantity	Description
1 ea	Lube/Service Truck
4 ea	Transport Car
2 ea	Rescue Car
2 ea	200 HP Ventilation Fan
2 ea	Front End Loader
1 ea	Generator Set
1 ea	Service Truck

Table 16-12 Additional Support Equipments

Quantity	Description
1 ea	Water Truck
2 ea	Haul Truck
1 ea	Scraper/Reclaimer

16.2 Preproduction Development

16.2.1 Shaft Construction Equipment

The hoist, headframe, and compressors will not only be used in the sinking of the shaft but will remain as permanent equipment servicing the shaft. The hoist will be a double drum model of approximately 600 HP. The hoist will not require any modification for shaft sinking. The headframe will be 80 or 90 ft high and will be modified for shaft sinking as follows:

- Muck bucket dump chutes will be installed.
- Hoist sheave wheels will be relocated to accommodate the shaft sinking arrangement.
- Additional sheaves will be installed to accommodate the Galloway work deck.
- Sheaves to raise and lower the Galloway work deck on wire ropes will be installed.
- Safety doors operated by compressed air cylinders will be installed at the collar level as required for shaft sinking.
- The drill and blast cycle will use hand held drills for drilling and cryderman muckers for mucking.
- Concrete will be placed using concrete buckets.

16.2.2 Decline Construction Equipment

The principal excavation equipment for the decline development will be a Sandvik MR 360 Roadheader or equivalent rather than using drill and blast methods. The back will be supported using rock bolts, mesh, and shotcrete.

The product of the roadheader will be transferred from the roadheader to an extensible loading section of conveyor and subsequently transported to the surface using a 48 in belt conveyor.

Installation of rock bolts will be the task of an Atlas Copco MC Roof Bolter or equivalent which will also carry an arm to handle wire mesh.

The wire mesh will be reinforced with shotcrete that will be delivered from a Normet Spraymek concrete sprayer with a hydraulic boom. Shotcrete material will be transported using a Normet transmixer.

16.2.3 Development

Mine development will begin immediately after the shaft reaches the mining horizon. The sinking hoist will be utilized for delivering the first continuous miner, two shuttle cars, feeder breaker and rock bolter down to the mining horizon. The continuous miner and feeder breaker will begin the mining operations by developing underground maintenance shops, warehouses, offices, etc. During these operations, the polyhalite, anhydrite and waste mined by the continuous miner will be transferred separately onto the feeder breaker by the shuttle cars, reduced by the feeder breaker, sized down to minus 4 in and removed through the shaft by the hoist and construction muck buckets.

The polyhalite, anhydrite and waste removed from the mine during the mine development phase will be stockpiled on the surface into three separate stockpiles, which will be located adjacent to the shaft. The polyhalite will be further used in the SOP and langbeinite production, while the anhydrite and waste will be used in future construction work.

After completion of the decline, the rest of the mining equipment will be delivered down to the mining horizon via the decline. The run of mine (ROM) belt conveying system will be installed along the decline wall and the full scale mining operations will begin. As the development of the main drift will progress, the main drift collecting belt conveyor will be installed. This conveyor will transfer the crushed ore onto the ROM conveyor. The ROM conveyor will deliver the polyhalite from the mine to a stockpile loadout tripper conveyor. This stockpile will be located close to the decline portal at the process plant site and hold approximately 7 days' worth of mined and crushed polyhalite.

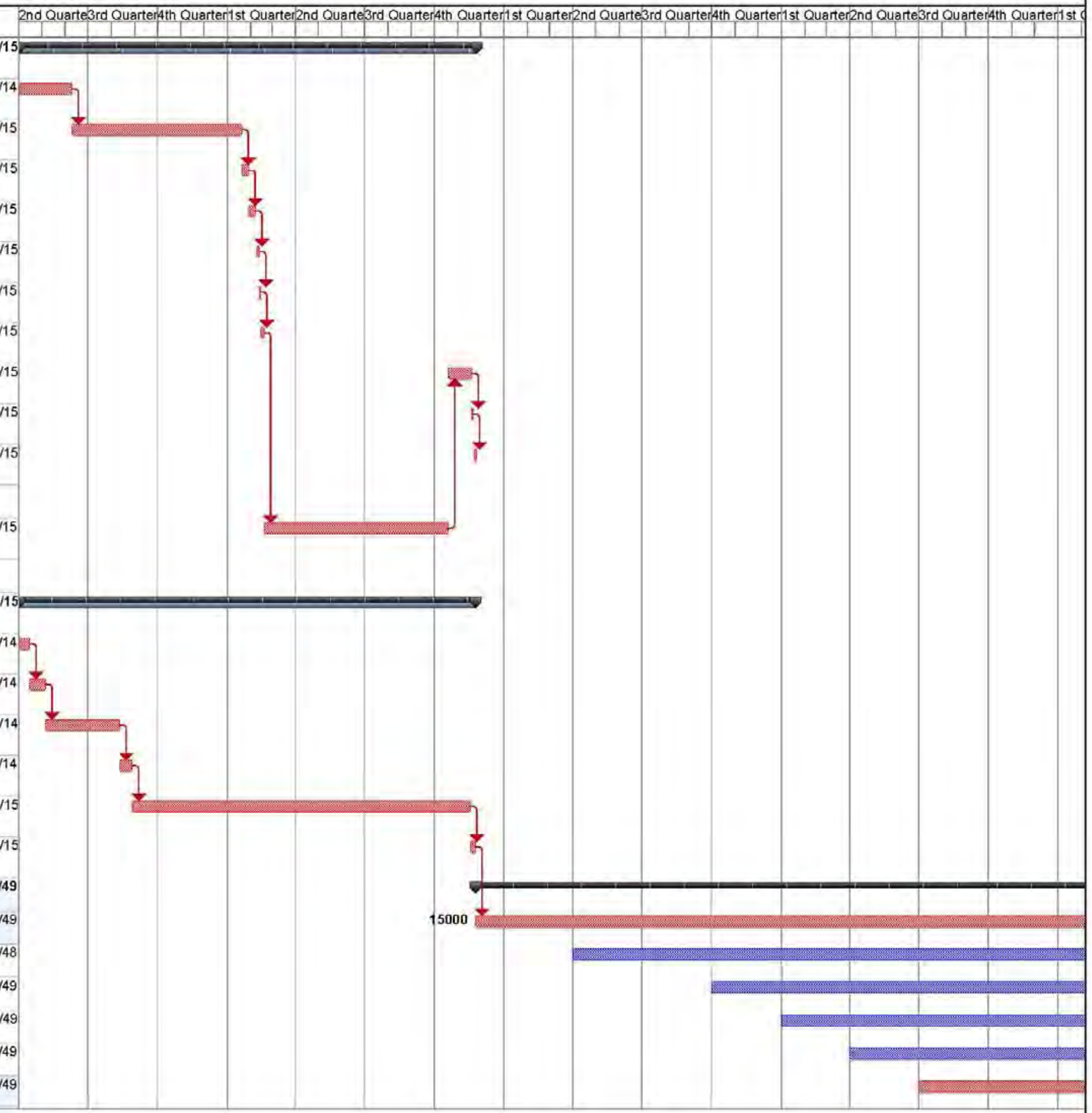
16.3 Production Schedule

Mine production will begin as soon as the production decline is complete and decline conveyor is installed. Production will begin with the use of one continuous miner (miner) developing the main drift until it reaches where the first production panel will be located. It is anticipated that decline will be complete approximately 4 months prior to when the production plant will begin initial production. This will allow the mine to produce at a slower initial rate and it will allow a temporary stockpile of approximately 325,000 tons to be constructed on the surface while the processing plant construction is being finished. The production plant will ramp up to full production over an 18 month period, which allows for additional mining equipment to be purchased over a 19 month period. The first mining machine will develop the main drift by itself for four months. Once the processing plant is running a second machine and related equipment will begin mining panels. The third mining machine and related equipment begins production 6 months later. The fourth mining crew comes on line 3 months later, followed by the fifth mining crew after another three months. The final mining crew will begin production 6 months after the 5th crew begins. All crews will work in developing main drifts as well as working in production panels based on the needs of the plant and the detailed mining plan. Figure 16-16 shows the time to sink the shaft, drive the decline, perform initial mine development, and ramp up to full production.

Two different production rates were calculated based on which activity the miner is engaged. While developing drifts, it is calculated that a miner running 20 hours a day based on two – 10 hour shifts will produce approximately 1,050 tons per day of polyhalite. A miner in a production room is calculated to produce approximately 1,940 tons per day of polyhalite. Overall, it is anticipated that at full production, the processing plant will consume approximately 3.25 million tons per year of polyhalite ore. Underground production will vary between 9,000 to 10,000 tons per day of polyhalite ore based on the grade of the polyhalite that is being mined at the time. With six mining crews at full production, there will be enough capacity to meet the needs of the processing plant.

Intercontinental Potash - Ochoa Mine
Construction Schedule

ID	Task Name	Duration	Start	Finish
1	**SHAFT CONSTRUCTION & ASSOCIATED DEVELOPMENT**	**86.8 wks**	**Tue 4/1/14**	**Wed 11/25/15**
2	Hoist, Headframe Inst'n & Shaft to 25 ft	10 wks	Tue 4/1/14	Mon 6/9/14
3	Sink Shaft 25 to 1600 ft @ 7 ft per day	32 wks	Tue 6/10/14	Mon 1/19/15
4	Shaft Station	1.4 wks	Tue 1/20/15	Wed 1/28/15
5	Construct Loading pocket	1.4 wks	Thu 1/29/15	Fri 2/6/15
6	Install Station Steel	0.6 wks	Mon 2/9/15	Wed 2/11/15
7	Lower Roadheader & LHD's	0.3 wks	Thu 2/12/15	Fri 2/13/15
8	Install Electrical & Vent Requn'ts for Dev	0.6 wks	Fri 2/13/15	Wed 2/18/15
9	Furnish Shaft with Steel Sets & Guides	4.6 wks	Mon 10/19/15	Thu 11/19/15
10	Install Cage & Counter-Weight	0.3 wks	Thu 11/19/15	Fri 11/20/15
11	Convert from Sinking to Men & Mater Handling	0.6 wks	Mon 11/23/15	Wed 11/25/15
12				
13	**INITIAL DEVELOPMENT FROM SHAFT**	35 wks	Wed 2/18/15	Mon 10/19/15
14				
15	**DECLINE CONSTRUCTION**	**86.5 wks**	**Tue 4/1/14**	**Tue 11/24/15**
16	Mobilization	2 wks	Tue 4/1/14	Mon 4/14/14
17	Portal Excavation 0 to 342 ft	3 wks	Tue 4/15/14	Mon 5/5/14
18	Portal Concrete to 0 to 342 ft	14 wks	Tue 5/6/14	Mon 8/11/14
19	Conveyor Installation - Initial Section	2.5 wks	Tue 8/12/14	Thu 8/28/14
20	Decline from 342 to 10,039 Plus Parking Areas @ 24 ft /day	64 wks	Thu 8/28/14	Tue 11/17/15
21	Estab Contin Miner, Prod'n Conveyor etc	1 wk	Tue 11/17/15	Tue 11/24/15
22	**PRODUCTION MINING**	**1780.5 wks**	**Tue 11/24/15**	**Fri 12/31/49**
23	Machine A	1780.3 wks	Tue 11/24/15	Fri 12/31/49
24	Machine B	1700 wks	Fri 4/1/16	Fri 10/23/48
25	Machine C	1700 wks	Sat 10/1/16	Mon 4/26/49
26	Machine D	1722 wks	Sun 1/1/17	Tue 12/28/49
27	Machine E	1709.2 wks	Sat 4/1/17	Thu 12/30/49
28	Machine F	1696 wks	Sat 7/1/17	Fri 12/31/49



Page 1

Figure 16-16 Construction Schedule

16.3.1 Production Schedule Parameters

The mine production schedule is based on a 7 day per week schedule, with two 10 hour shifts per day. There are four crews planned to cover the rotating schedule. Within the 10 hour shift, down time is included for travelling to and from the face, lunch, inspection and training, and miscellaneous down time. Table 16-13 shows typical daily schedule parameters and hours scheduled.

Table 16-13 Mine Schedule Parameters

Mine Schedule	
Crews	4
Shifts/day	2
Hours/shift	10 hour
Lunch.	30 min
Travel to and from the Face	30 min
Inspect & Train	30 min
Miscellaneous Down Time	30 min
Total Productive Hours/Day	**16.6**

The quantity of the equipment necessary for full production is based upon the requirements from the processing plant and the cycle times for the continuous miners and shuttle car to haul material. The continuous miner will be utilized approximately 74% of the available time. The time that it is not being utilized, the miner is waiting for material to be cleared out of the way and for back control. It is expected that the miner will be available 85% of the time. With proper maintenance and re-builds of the miner, it is expected that this availability rate is achievable. In the cases where equipment does break-down, there is sufficient spare equipment capacity available to meet the production requirements.

16.3.2 Load and Haul Parameters

Mined polyhalite will be removed from the mine by the main conveyor system. The underground conveyor system will be composed of three different sections. The first section will be the panel conveying. This will consist of a 42 in. conveyor that will be placed in each production panel. A feeder breaker will crush the raw polyhalite ore from the continuous miner into minus 4 in. pieces and then transport it to the panel conveyor. The panel conveyor will then transport the material to the main drift where the material will be transferred onto a 48 in. conveyor running in the main drift. This main drift conveyor will be the second section of the system, and will collect polyhalite from all of the production panel conveyors and transport it to the bottom of the decline. At the bottom of the decline, material will be transported from the main drift conveyor onto the third conveyor of the system, a 48 in. conveyor that will transport the material through the decline to the surface.

Once the polyhalite has reached the portal, it will be transported onto a 48 in. overland conveyor. The overland conveyor will transfer the polyhalite approximately 385 ft to a 436 ft long stockpile feed conveyor that will then dump the polyhalite onto a clear span covered stockpile (Figure 16-17); the stockpile has 50,000 ton (net 7 days of storage) capacity. ROM polyhalite will be passed through a small hopper onto a 307 ft long surge bin feed conveyor that goes to a surge bin used in the processing plant.

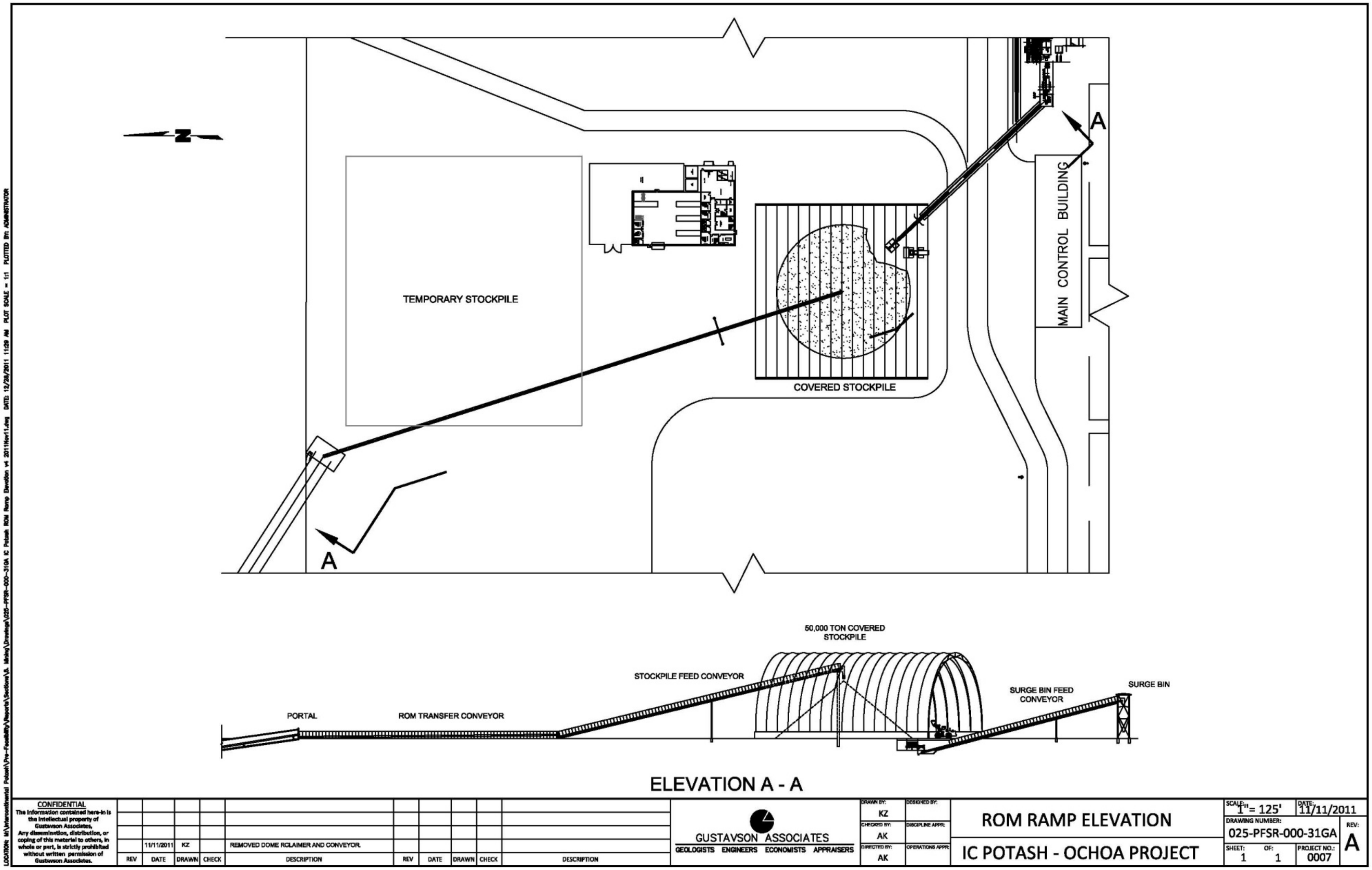
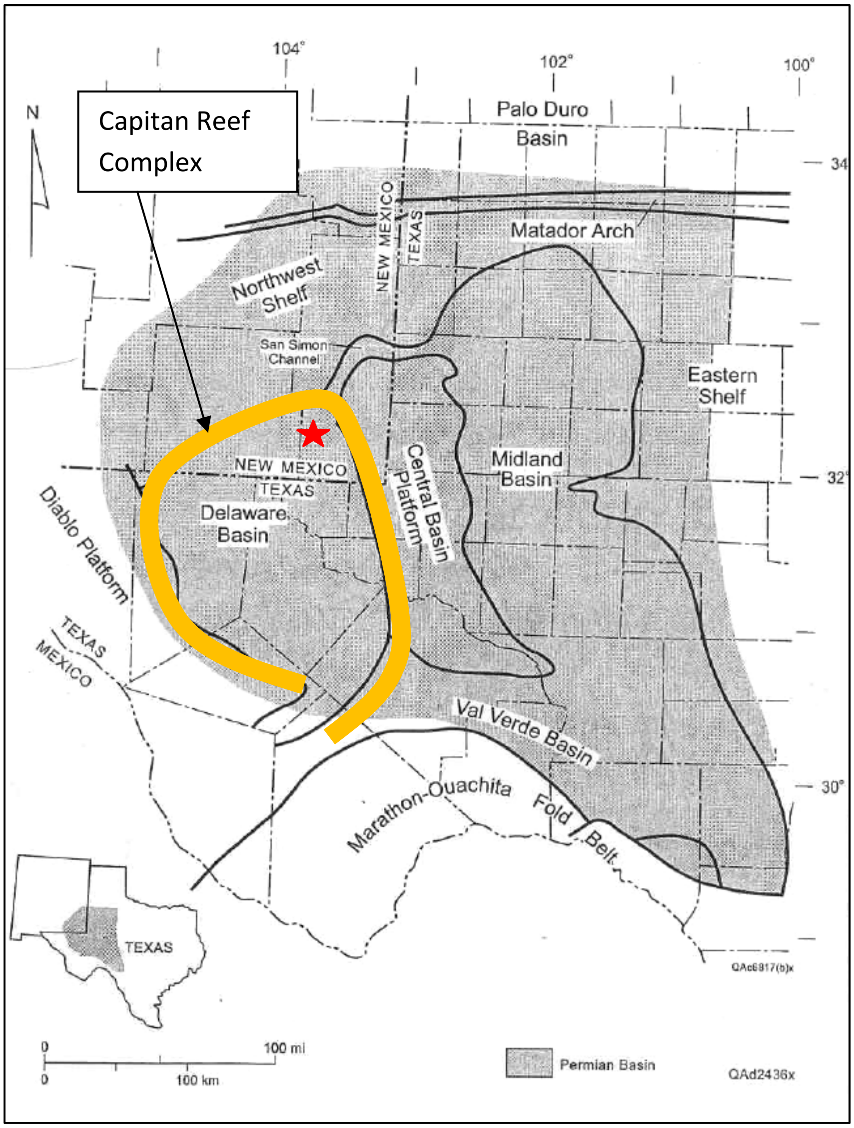


Figure 16-17 ROM Ramp Elevation

16.4 Co-Production with Gas and Oil

The area of the proposed mine is within a geologic province known as the Delaware Basin, which is part of the Permian Basin (Figure 16-18). The Delaware Basin extends from southeastern New Mexico south into Texas. The Delaware Basin is a prolific oil and gas producing area.



From Broadhead et al, 2004 and Standen et. al, 2009.

Figure 16-18 Map of the Permian Basin Showing the Delaware Basin and other Sub-basins

(Star marks the approximate location of the mining lease hold)

Oil and gas production has been important in the Permian Basin since the 1920s. The Delaware Basin is considered a mature area with respect to oil and gas production. There are currently more than eight producing horizons intervals in the mine area and several more established in the basin (Figure 16-19). The depths of wells in the immediate area of the proposed mine range from 5,000 ft to 17,649 ft and production horizons exist from depths of 5,000 ft to 13,000 ft for oil and associated gas and 13,000 ft to 16,000 ft for gas and associated liquids.

Production is informally divided into shallow oil and deep pressured gas. The shallow oil play is primarily oil and associated gas from members of the Permian age Delaware Mountain Group including the Cherry Canyon and the Brushy Canyon formations (Figure 16-19). The Delaware Mountain Group consists of alternating limestone and sandstone deposited basinward of the Permian age Capitan reef complex that ringed the northern margins of the Delaware Basin in Permian time (Figure 16-18 and Figure 16-20). Illustrated also in Figure16-20 is the evaporate strata that includes the proposed mine horizon. The Castile evaporite filled in the paleogeographic relief of the Delaware Basin basinward of the reef. The overlying Rustler and Salado formations continued to fill the basin as the basin dried up.

The Dewey Lake and Santa Rosa formations were deposited after the series of evaporates (Figure 16-19). These fluvial sandstones were deposits formed in streams and rivers. These formations are known as fresh-water aquifers in the area.

The Bone Spring Formation overlies an angular unconformity (Figure 16-20). The unconformity consists of erosion of Early Permian age and older rocks that have been gently folded in this area. Erosion then removed some of the strata prior to deposition of the Bone Spring Formation (Figure 16-20). Production below this unconformity is considered deep pressured gas. Gas and associated liquids are produced in the basin from reservoir rocks as old as Late Ordovician (Figure 16-19).

The underlying Permian age Bone Spring Formation is also a productive oil reservoir in the area. The depositional setting for this formation is similar to the Delaware Mountain Group as it was deposited basinward to a prior continental shelf as alternating limestone and sandstone as seen in Figures 16-19, 16-20, and 16-21.

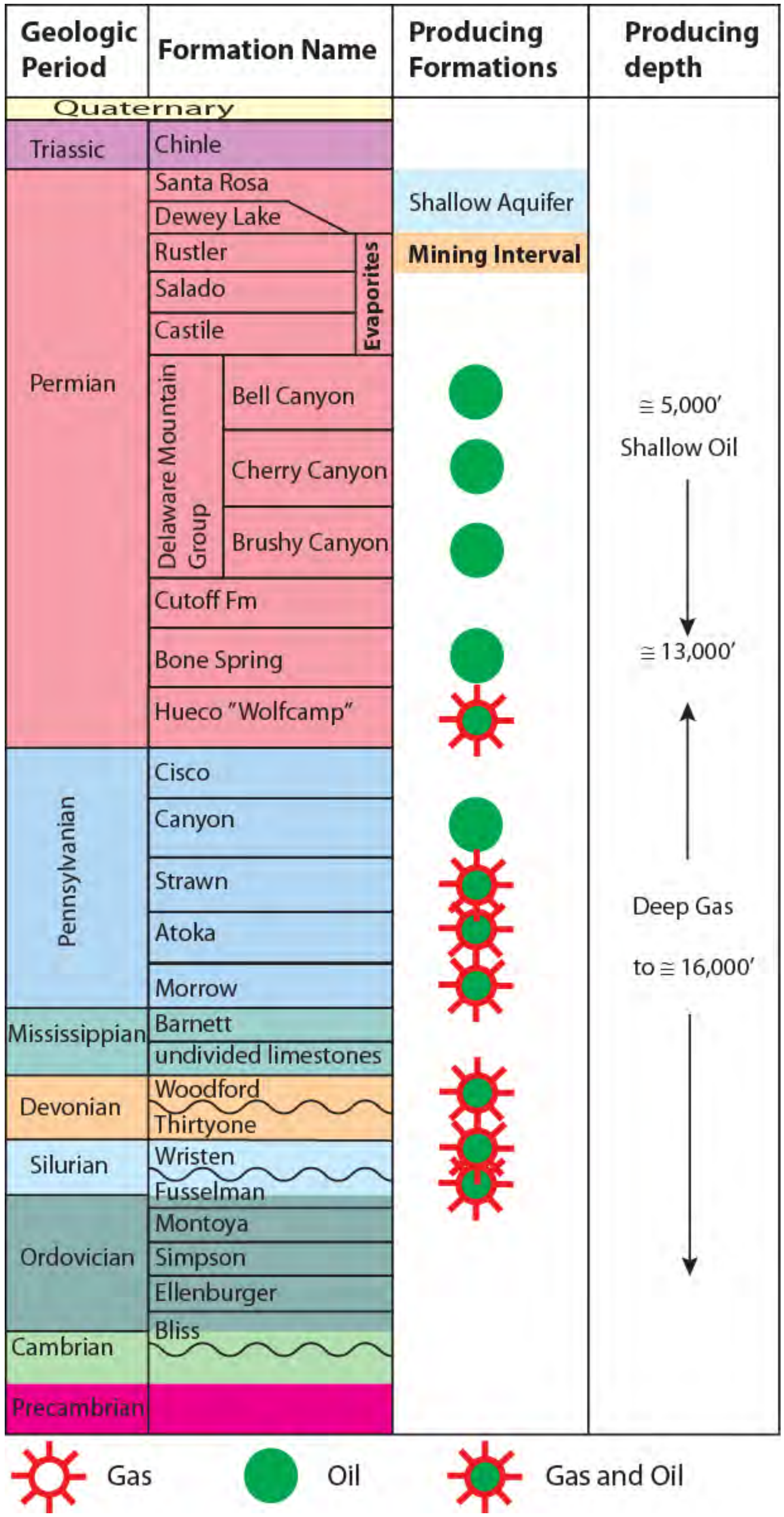


Figure 16-19 Stratigraphic Column for the Delaware Basin Showing Oil and Gas Reservoir Horizons

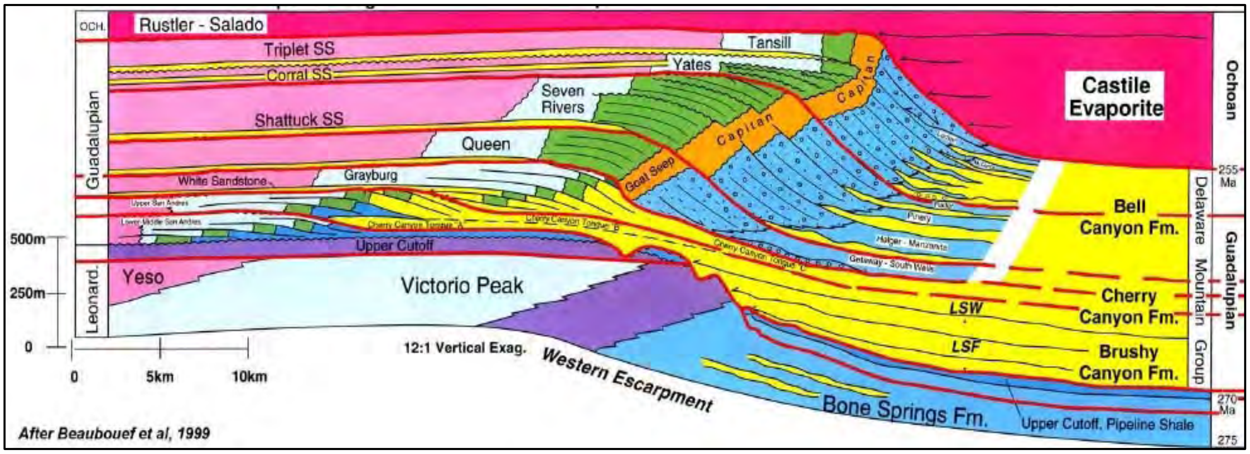


Figure 16-20 Illustrative Cross Section of Depositional Units Associated with the Delaware Basin.

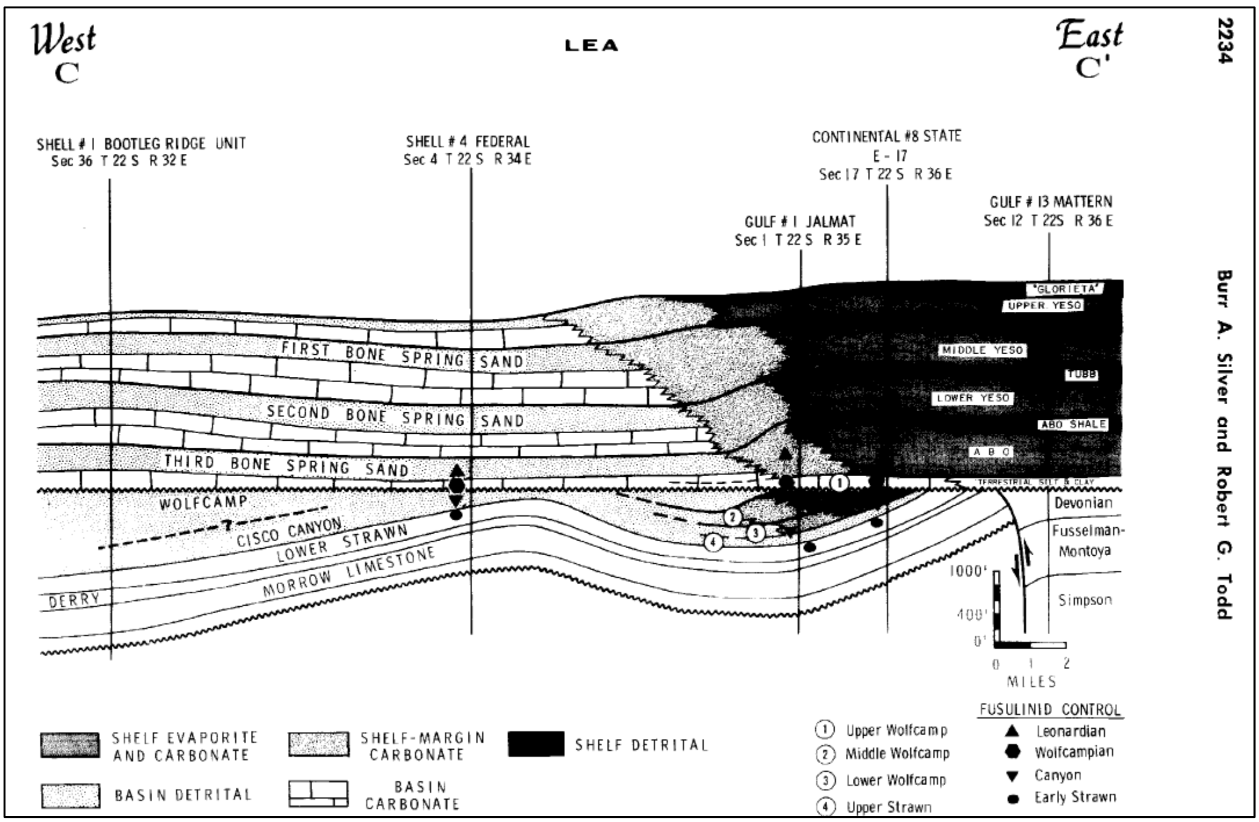


Figure 16-21 Cross Section of Depositional Setting for the Bone Spring Formation and Older Strata

Hydrocarbon traps in the area are primarily stratigraphic traps. Stratigraphic traps are where porous reservoir rocks pinch out into or are encased in non-porous rocks. Two examples are reservoir rocks below the unconformity that are tilted and then cut and sealed by the unconformity, and reservoir rocks that were deposited as discrete sand bodies in the basin and later surrounded by shale (Figure 16-22). Production from these types of traps may follow linear trends that trace either where the reservoir subcrops under the unconformity or the shape and orientation of the geometry of the sandstone body.

The gentle folding of the pre-early Permian age rocks also created anticlinal structures that have trapped gas in Early Permian age and older reservoir rocks.

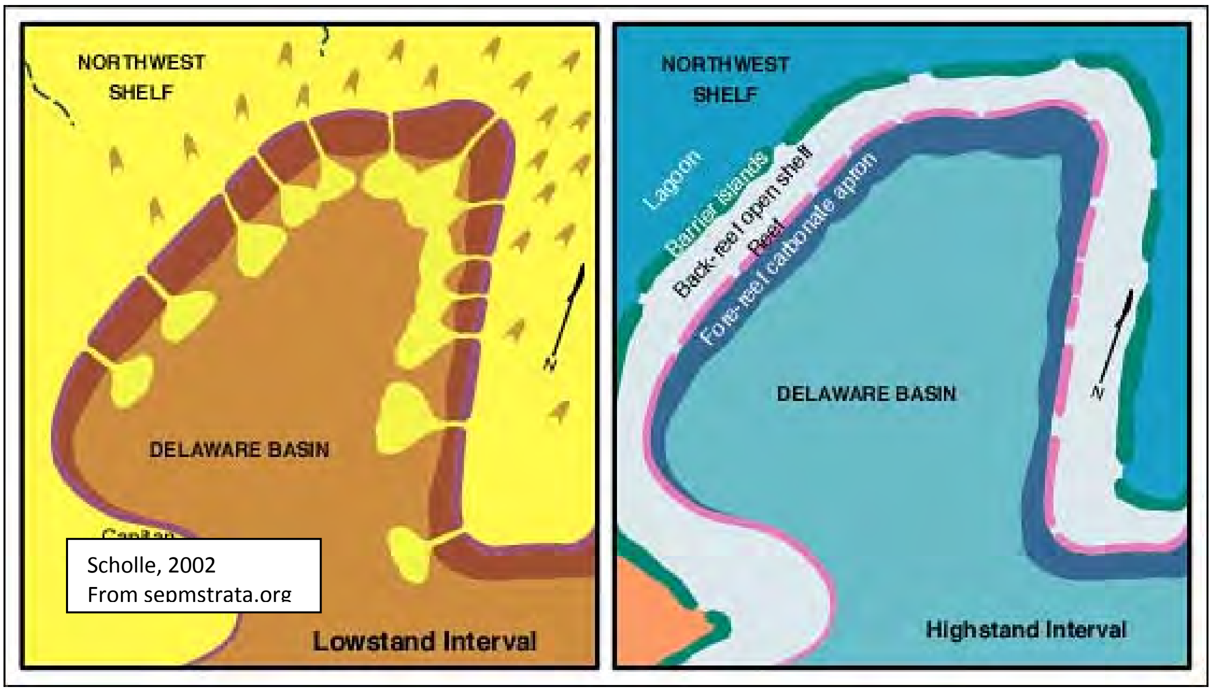


Figure 16-22 The Permian Age Configuration of the Delaware Basin

Illustrating the alternating deposition of sandstone during sea level lowstands and limestone and other carbonates during sea level highstands.

The Delaware Basin is currently attracting renewed interest for exploration and development potential in the areas of enhanced oil recovery using horizontal drilling and the identification and establishment of unconventional plays such as shale gas and shale oil. Thus there currently are old and abandoned wells in the mine area, producing oil wells and producing gas wells, approved permits for new wells, and expected continued permitting and drilling for new plays. The map in Figure 16-23 shows the known wells and permits and their status as of September 1, 2011.

These hydrocarbon operations need to be considered as mining is planned and as mining proceeds. Since the mine life is considered to be more than 40 years, the potential of many additional producing and abandoned wells is considered.

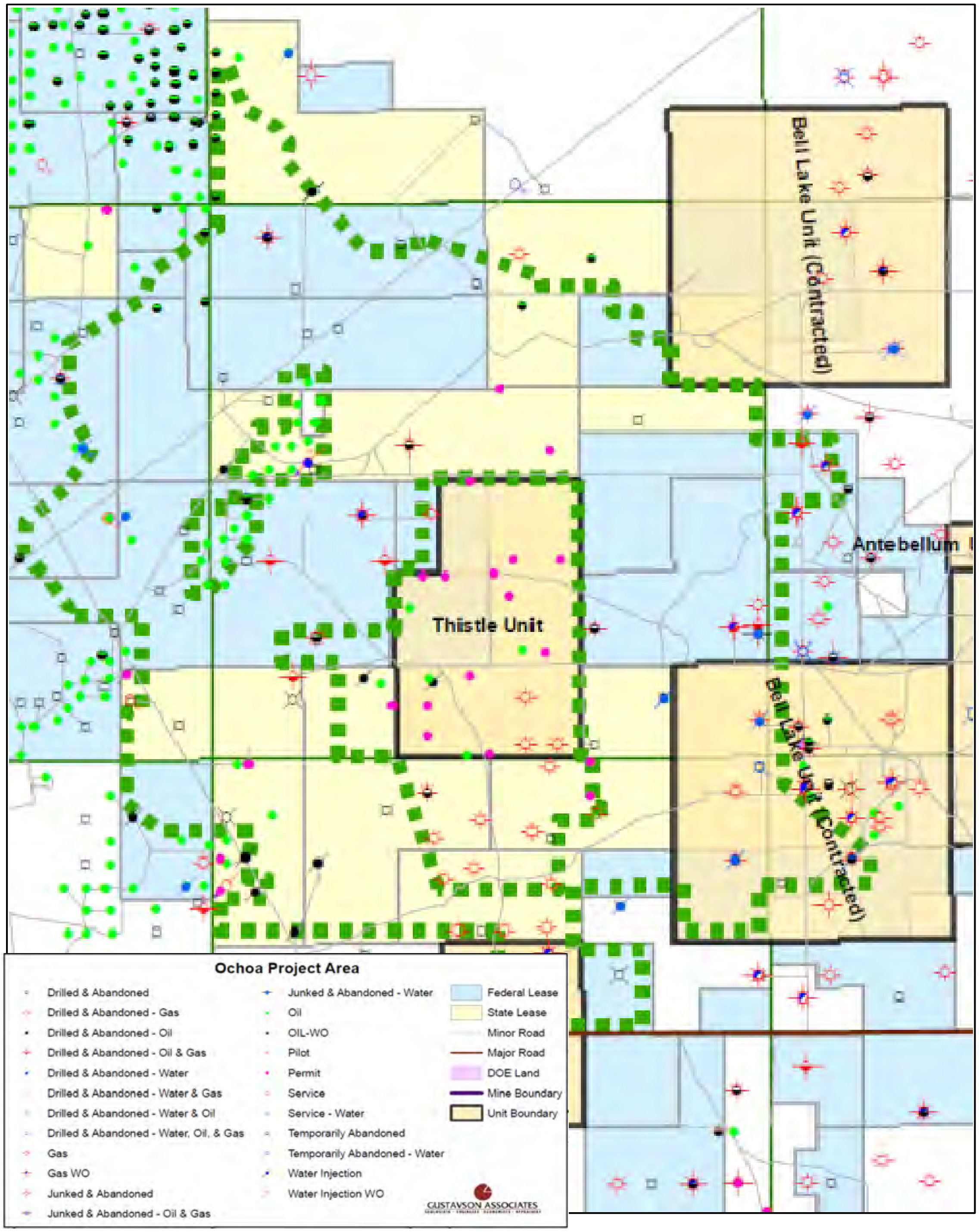


Figure 16-23 Wells and Permits Within or Adjacent to the Proposed Mine Outline

16.4.1 Existing Wells

Existing wells in the area of the proposed mine will be avoided during mining operations and operations will be planned to eliminate subsidence around these wells so that the integrity of the well is not compromised. This is important to avoid the potential of hydrocarbons leaking into the mine or the abandoned mine, hydrocarbons leaking into the aquifers, hydrocarbons leaking to the surface, and water from the aquifers leaking into the mine. The second consideration is the potential for future hydrocarbon exploration after mining has been completed. The general mining operation is expected to cover four sections or 2,560 ac every 12 years or so. This means that activity of the hydrocarbon wells needs to be monitored. A list of wells within the proposed mine area must be maintained and frequently updated in order to plan ahead for the necessary treatment of the wells that will be encountered during a specific time period. During some mining time periods, no wells will need to be considered; during other mining time periods several wells will need to be addressed. A variety of conditions of the wells are expected and thus a variety of approaches to the wells will be considered. These range from no remediation to the extreme of complete re-plugging and re-abandonment and will depend on the circumstances of the individual well. The extreme case is thought to be a rare possibility.

In T24S R33E Sections 9, 10, and 15 will be crossed by the decline. There are gas wells present in these sections that are producing from the deep gas reservoirs; three deep producers and a shallow drilled and abandoned (D&A) in Section 9; three deep gas producers in Section 10; and three deep gas producers and one deep permit currently in Section 15. The basic information for these wells is shown in Table 16-14. The decline route should be able to avoid these wells easily since they are widely spaced and have been taken into account during planning.

The proposed first sections to be mined are Sections 5, 6, 7, and 8 in T24S R33E. The wells currently in these sections are listed on Table 16-15. The owners and operators of the hydrocarbon leases are shown on a map in Figure 16-24.

Table 16-14 Wells in Sections with Proposed Decline Route

API Number	Operator Current Name	Well No.	Depth Total driller	Class Initial Name	Formation at TD name	Formation Producing Name	Elevation Reference Value	Surface Latitude	Surface Longitude	Status
Mine Ramp Route T24S R33E 15										
30025332380000	MURCHISON O&G INC	3	13920	DEVELOPMENT WELL	STRAWN	WOLFCAMP	3632	32.21208	-103.562	GAS
30025332990000	ENRON OIL & GAS CO	4	14803	DEVELOPMENT WELL	ATOKA	WOLFCAMP	3635	32.22296	-103.558	GAS
30025332990001	ENRON OIL & GAS CO	4	15534	NEW FIELD WILDCAT DEEPENING	MORROW	ATOKA	3635	32.22296	-103.558	GAS-WO
30025332990002	ENRON OIL & GAS CO	4	15534	DEVELOPMENT RECOMPLETION	MORROW	ATOKA	3635	32.22296	-103.558	GAS-WO
30025346870000	MURCHISON O&G INC	7	13841	DEVELOPMENT WELL	WOLFCAMP	WOLFCAMP	3630	32.21572	-103.558	GAS
30025398080000	DEVON ENERGY PROD	1		NEW FIELD WILDCAT				32.302	-103.557	Permit
Three producing deep gas wells and one permit										
Mine Ramp Route continued T24S R33E 10										
30025335650000	ENRON OIL & GAS CO	1	15560	SHALLOWER POOL WILDCAT	MORROW CL.	WOLFCAMP	3617	32.227	-103.558	GAS
30025343970000	ENRON OIL & GAS CO	2	13660	DEVELOPMENT WELL	WOLFCAMP	WOLFCAMP LOV.	3610	32.23379	-103.558	GAS
30025347240000	EOG RESOURCES INC	3	13850	DEVELOPMENT WELL	WOLFCAMP	WOLFCAMP	3633	32.226	-103.566	GAS
Three producing deep gas wells										
Mine Ramp Route continued T24S R33E 9										
30025289920000	HARPER OIL COMPANY	1	5400	SHALLOWER POOL WILDCAT	DELAWARE		3625	32.22661	-103.57	D&A
30025341650000	MURCHISON O&G INC	1	13891	DEVELOPMENT WELL	WOLFCAMP	WOLFCAMP	3638	32.22661	-103.575	GAS
30025344410000	ENRON OIL & GAS CO	2	13950	DEVELOPMENT WELL	WOLFCAMP	WOLFCAMP	3598	32.23652	-103.572	GAS
30025350680000	MURCHISON O&G INC	3	13600	DEVELOPMENT WELL	WOLFCAMP	WOLFCAMP	3605	32.23475	-103.577	GAS
Three producing deep gas wells and one shallow D&A										
western 1/4 of this section should be available for mining										

Table 16-15 Table of Wells in the Proposed first Four Sections to be Mined

API Number	Operator Current Name	Well No.	Depth Total driller	Class Initial Name	Formation at TD name	Formation Producing Name	Elevation Reference Value	Surface Latitude	Surface Longitude	Status
Mining Section T24S R33E 8										
30025083700000	SUNRAY DX OIL CO	1	5210	NEW FIELD WILDCAT	OLDS		3636	32.23749	-103.6	D&A-O
One shallow D&A well										
Mining Section T24S R33E 7										
30025083680000	FASKEN DAVID	2	5076	NEW FIELD WILDCAT	FORD/SD		3578	32.23294	-103.612	D&A-O
30025083690000	RILEY GEORGE	1	5165	NEW FIELD WILDCAT	UNKNOWN		3586	32.2266	-103.604	D&A-O
30025243470000	INGRAM TOM L	1	5203	DEVELOPMENT WELL	DELAWARE	DELAWARE	3590	32.23747	-103.617	OIL
30025244320000	CONOCO INCORPORATED	WI-I	5204	DEVELOPMENT WELL	DELAWARE		3603	32.23385	-103.617	WIWO
30025246340000	INGRAHAM T	1	5121	DEVELOPMENT WELL	LAMAR/LM/		3636	32.23839	-103.614	D&A-O
30025398820000	MARBOB ENERGY CORP	1H		DEVELOPMENT WELL				32.23825	-103.618	Permit
30025398830000	MARBOB ENERGY CORP	2H		DEVELOPMENT WELL				32.23308	-103.618	Permit
One producing shallow oil well, three shallow D&A, one shallow water injection, two active deep oil horizontal permits										
Mining Section T24S R33E 6										
30025243030000	HONDO DRLG CO	1	5160	DEVELOPMENT WELL	DELAWARE		3598	32.2411	-103.617	OIL
30025243670000	CONTINENTAL OIL CO	13	8597	DEVELOPMENT WELL	BONE SPRING		3612	32.24825	-103.502	J&A
30025243810000	HONDO DRLG CO	2	5170	DEVELOPMENT WELL	DELAWARE		3606	32.24473	-103.617	TA
30025244000000	CONTINENTAL OIL CO	13X	8910	DEVELOPMENT WELL	BONE SPRING		3614	32.24825	-103.503	TA
30025336330000	PERKER&PARSLEY DEV	1	12500	DEEPER POOL WILDCAT	BONE SPRING	BONE SPRING	3647	32.24474	-103.609	OIL
30025367310000	POGO PRODUCING CO	1	9200	DEVELOPMENT WELL	BONE SPRING	BRUSHY CAN	3664	32.25291	-103.615	OIL
30025369520000	KAISER-FRANCIS OIL	21	8900	DEVELOPMENT WELL	BONE SPRING	BRUSHY CAN	3609	32.24735	-103.509	OIL
30025401830000	CIMAREX ENERGY OF CO	2		PILOT HOLE				32.2529	-103.613	Permit
30025401830100	CIMAREX ENERGY OF CO	2		DEVELOPMENT REDRILL				32.2529	-103.613	Permit
Four producing shallow oil wells, one shallow J&A/TA, one TA (temporarily abandoned), one horizontal permit										
Mining Section T24S R33E 5										
30025346740000	CONCHO RESOURCES INC	1	13900	DEVELOPMENT WELL	MISSISSIPPIAN		3675	32.24565	-103.587	D&A
One deep D&A										
Plugged?	Permit	Outside Mine?		Permit outside mine?						

GUSTAVSON ASSOCIATES
GEOLOGISTS · ENGINEERS · ECONOMISTS · APPRAISERS

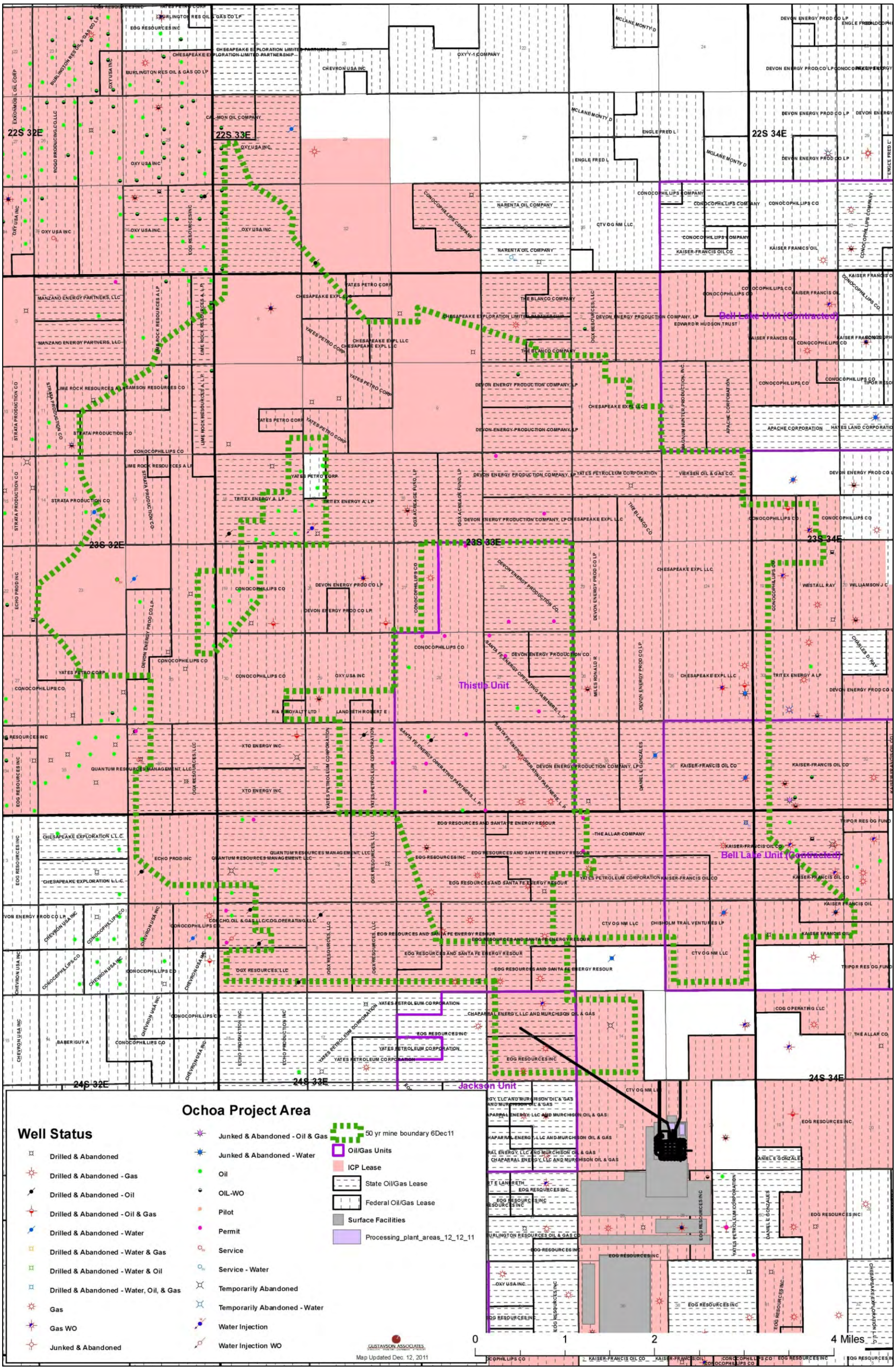


Figure 16-24 Owners and Operators of Hydrocarbons

16.4.2 Approaches to Wells in the Mine Path

There are several approaches to deal with wells in the path of mining operations that will be suggested here. These vary from accepting the well as is and treating it as the mine plan prescribes to the extreme of opening an abandoned well and re-plugging it. Within these end points would be the approach of buying out the production and taking on the abandonment process to ensure integrity. This could move the well from the producing category, where the mine plan leaves a large undisturbed perimeter around the well, to the abandoned category, where mining occurs closer to the well. Another approach that will not specifically be discussed would be to encourage legislative changes that would require that the entire evaporate interval be plugged.

The appropriate approach will depend on the individual well and the history and information available for that well. Many wells are old and have been abandoned for decades. Many have no records concerning drilling, casing, and plugging operations. Records may not be available for wells plugged before the state required data. It may not be possible to ascertain where cement plugs were placed or even if they were placed and the condition of the old casing and cement could be unknown.

The approaches discussed here consider the many circumstances that may be encountered with the hydrocarbon wells in the area but may not address unforeseen or unusual circumstances. These approaches may change with the lifetime of the mining operation and may need to be modified depending on the results of the application of these approaches.

16.4.2.1 Abandoned wells

Current regulations require the plugging of a well to permanently confine any oil, gas, and/or water to the separate strata where they originated. In addition, multiple plugs have been used, traditionally in the Bell Canyon Formation and the Rustler Formation and sometimes also the Salado Salt Formation. Wells are also currently required to set a cement plug from the surface to 50-ft. Required practices may have changed somewhat over the years and some wells have no plug and abandon (P&A) records on file.

If inspection of state files for P&A reports, drilling reports, casing plans, state inspections, and other documents does not satisfy that the well in question was correctly abandoned, then the well may require additional work. This work would include location of the well and the removal of the cap welded to the casing, if present. Then the 50-ft surface plug, if present, would be drilled out and a gas detector fixed to the casing. If no hydrocarbons were then detected in the well it could be re-plugged and re-abandoned.

The most difficult and extensive case, and likely the rarest, is if hydrocarbons were detected, then all plugs (cement and iron bridge plugs) would be drilled out. Wireline tools would be used to test the casing and the cement behind casing and could include a casing integrity log and cement bond log or a combination tool such as Schlumberger's UltraSonic Imager logging tool or a similar combination tool. These tests will show the thickness and condition of the casing and test the seal quality of the cement that is between the casing and the rock. Remedial work might be necessary to perforate the casing and squeeze new cement between the casing and the rock. The well would then be re-plugged (plugging through the entire evaporite zone should be considered) and re-abandoned with confidence in the integrity of the hole. The Schlumberger UltraSonic Imager logging tool currently runs from $16,000 to $20,000 per well (Figure 16-25). Costs would depend on the depth of the well and the work necessary for that well. Since this scenario is not common, the costs are difficult to estimate but would not be expected to run more than $100,000.

Permission of the owner of the well would be required for these operations. Determination has not been made if this approach is permissible by state or federal regulation for an entity other than the holder of the hydrocarbon lease to perform the described remediation. Coordination with the BLM and the State of New Mexico would be useful for this maximum treatment case.

16.4.3 Accommodations for Future Exploration and Production of Hydrocarbons

The Delaware Basin is receiving renewed attention from oil and gas companies as an area where modern technology can be applied to increase production from old wells in conventional plays, discover and produce more efficiently from new wells in conventional plays, and explore for and establish production from potential unconventional plays. The conventional plays in the Delaware Basin have traditionally been stratigraphic traps, where the reservoir is discontinuous and trapping occurs where porous rock is encased in nonporous rock as shown in the conventional stratigraphic gas accumulation in (Figure 16-26). Structural traps are known to exist in pre-Early Permian strata but are not as common in this area of the basin. Operators are starting to drill horizontal wells and lateral legs in stratigraphically trapped reservoirs in this basin. This approach exposes more of the wellbore to the reservoir thus increasing recovery and production. Other conventional plays have been recognized in the area of the mine but production has not been significant from these to date.

Figure 16-25 Schlumberger UltraSonic Imager Tool and Images

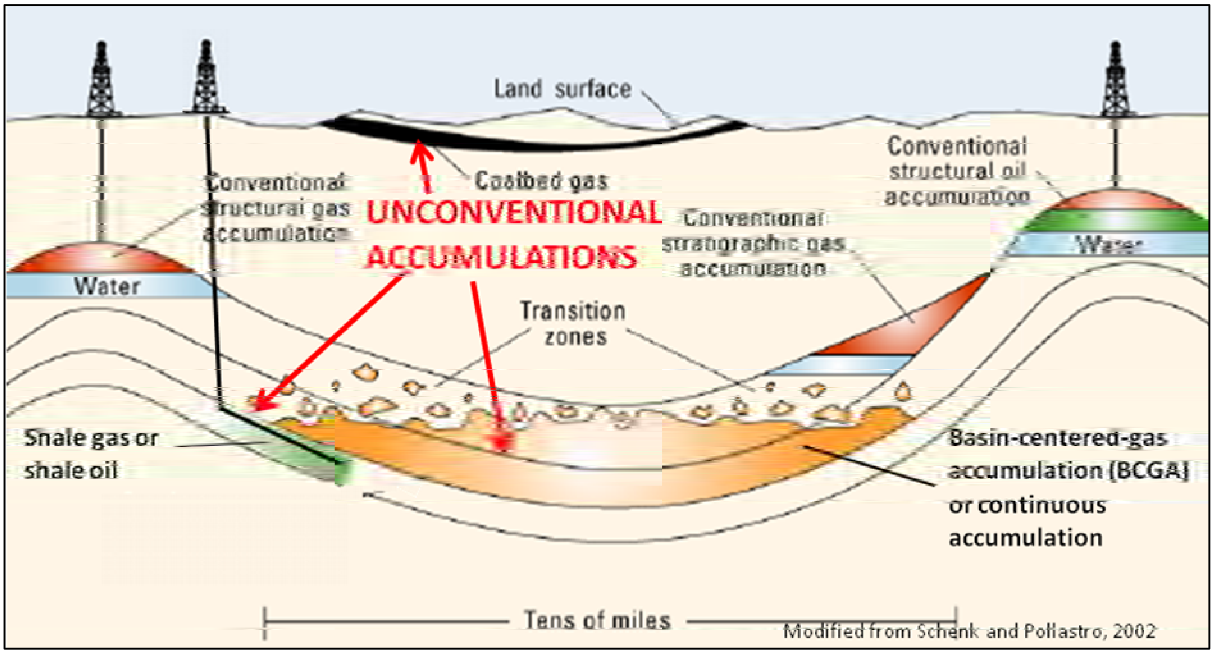


Figure 16-26 Conventional and Unconventional Hydrocarbons

Unconventional shale gas and shale oil plays are also being investigated in the basin. There are several shales that are present in the basin and others that are extensions of or equivalent in age to established shale plays in Texas. These include the Avalon shale, unnamed shale intervals in the Wolfcamp, Barnett Shale equivalent, and extension of the Woodford Shale from Texas. Oil from these shales would be produced from wells with horizontal or lateral portions that would stay within the shale reservoir strata and be artificially fractured to enhance production.

In the Bakken shale oil play in North Dakota and Montana the surface projection of the termination of the horizontal or lateral section of the well can be as much as 2-mi distance from the surface location. This hydrocarbon exploration technology allows for the mining operation to potentially preserve areas for future drilling that could be widely spaced, for instance, a quarter section every 2 mi in any direction. In order to use this type of preserved area, the hydrocarbon exploration company would have to secure the drilling site lease and leases continuously to the bottom-hole location and, which would be possible since much of the mineral rights in the area of the mine are either Federal or State. This pattern of drilling is seen at the Waste Isolation Pilot Plant (WIPP) adjacent to the north western area of the mining leasehold to reach hydrocarbon targets under the WIPP area where hydrocarbon drilling from the surface area is prohibited.

An alternative or complimentary approach to leaving areas for future hydrocarbon wells is to leave 200 ft radius pillars within the mined area as outlined by the mine plan. The drilling of directional wells from a single surface location is common practice in many oil and gas producing areas of the U.S. and might be possible in this area. The current spacing rules call for one well per pool per 40 ac (¼ ¼ section). Exploration and development plans on BLM land may be documented by an annual submission by the operator. These can be found in public documents but not usually for several months after they are submitted.

16.4.4 Unitization of Oil and Gas Exploration and Production

There are several exploration/production units present in the area of the mining leasehold and the Thistle Unit is located within the mine outline (Figure 16-23). Unitization is the joint operation of all or some portion of a producing reservoir. This status serves to unite multiple spacing units and/or leases so as to minimize surface disturbance, enable exploration of a large area with a common reservoir, optimize well locations for efficient production, operate the area as a single lease, share costs and risk, extend leases, and relieve the rule of federal limitations on a single entity from owning more than 246,080 ac within a state. There are three basic types of Federal Units: 1) exploratory units-not coalbed methane (CBM), 2) development units, and 3) secondary recovery units. Unitization is based on the 1920 mineral leasing act and is an agreement between the BLM and the operator. The Unit Operating Agreement is between the operator and the working interest owners. Various obligations, requirements, and responsibilities are attached to these agreements making for a complex situation.

On one hand, the unit might be avoided entirely so as to simplify the necessity to develop an approach to the wells included in the unit. On the other hand, if the complexity can be overcome then the exploration and development efficiencies built into the unit agreement might concentrate the drilling and thus allow mining in areas that will not be drilled. Further investigation would be necessary if avoidance was not the choice.

16.5 Subsidence

Subsidence is expected during Ochoa Project operations in areas of 90% material extraction rates with the room and pillar mining technique. Subsidence depth is expected to be approximately 4 ft, depending on the thickness of the evaporate seam removed. There is no subsidence anticipated in areas of 60% extraction rates; however, ICP will monitor for subsidence in these areas. ICP will install at least five monitoring stations; one at each active well and others where ICP feels necessary. Monitoring stations will be surveyed prior to active mining and will be used as a baseline. During operations, monitoring stations will be surveyed once every five years and the results compared to the baseline survey. If subsidence is detected in the 60% extraction area, monitoring frequency may be increased.

17 RECOVERY METHODS

17.1 Process Description

There are several unit processing steps involved in the processing of polyhalites. These include crushing and grinding, washing, calcination, leaching, crystallization, langbeinite decomposition and granulation. ICP undertook a systematic process development program with Hazen Research and HPD to develop the optimum process conditions for each unit operation at several testing facilities.

The process described here leaves out specific detail to protect intellectual property. A layout of the processing plant is shown in Figure 17-1.

17.2 Production Rate and Products

The Ochoa mine and material handling system is designed for a throughput of 402 tons of ore per hour. The entire mine and process flow is depicted in Figure 17-2.

17.3 Crushing and Grinding

Run-of-mine polyhalite ore will be reclaimed from the surface storage area and delivered to a surge bin at the head of the process. The ROM ore (3-inch minus) will be metered from the surge bin at a nominal rate of 402 short tons per hour (TPH) by an apron feeder that will deliver the ore to a single-deck vibrating screen. The 1-inch minus fraction of the ore will pass through the screen onto a collection belt conveyor. Oversize ore will be fed to a single, low-speed sizer where it will be reduced to an approximately 1-inch minus product in open circuit. Sized ore will be collected on the same belt conveyor, which will feed a bucket elevator to deliver the crushed polyhalite ore to the rod mill.

17.3.1 Milling/Sodium Chloride Washing

Fed by the bucket elevator, a 14 ft dia by 21 ft long rod mill will reduce the 1-inch minus ore to a 10-mesh minus (Tyler Screen, 0.0661-inch/1680μm opening) product in a closed-circuit, wet milling operation. Mill process water will be fed into the milling operation to assist in the comminution and to dissolve sodium chloride, which exists as a minor component in the ore. The milled ore slurry will be pumped to a head tank that will feed six stacked vibrating screens. Underflow slurry from the screens will be collected and pumped to a cluster of eight hydrocyclones. Screen oversize (estimated at 5%) will be cycled back to the rod mill.

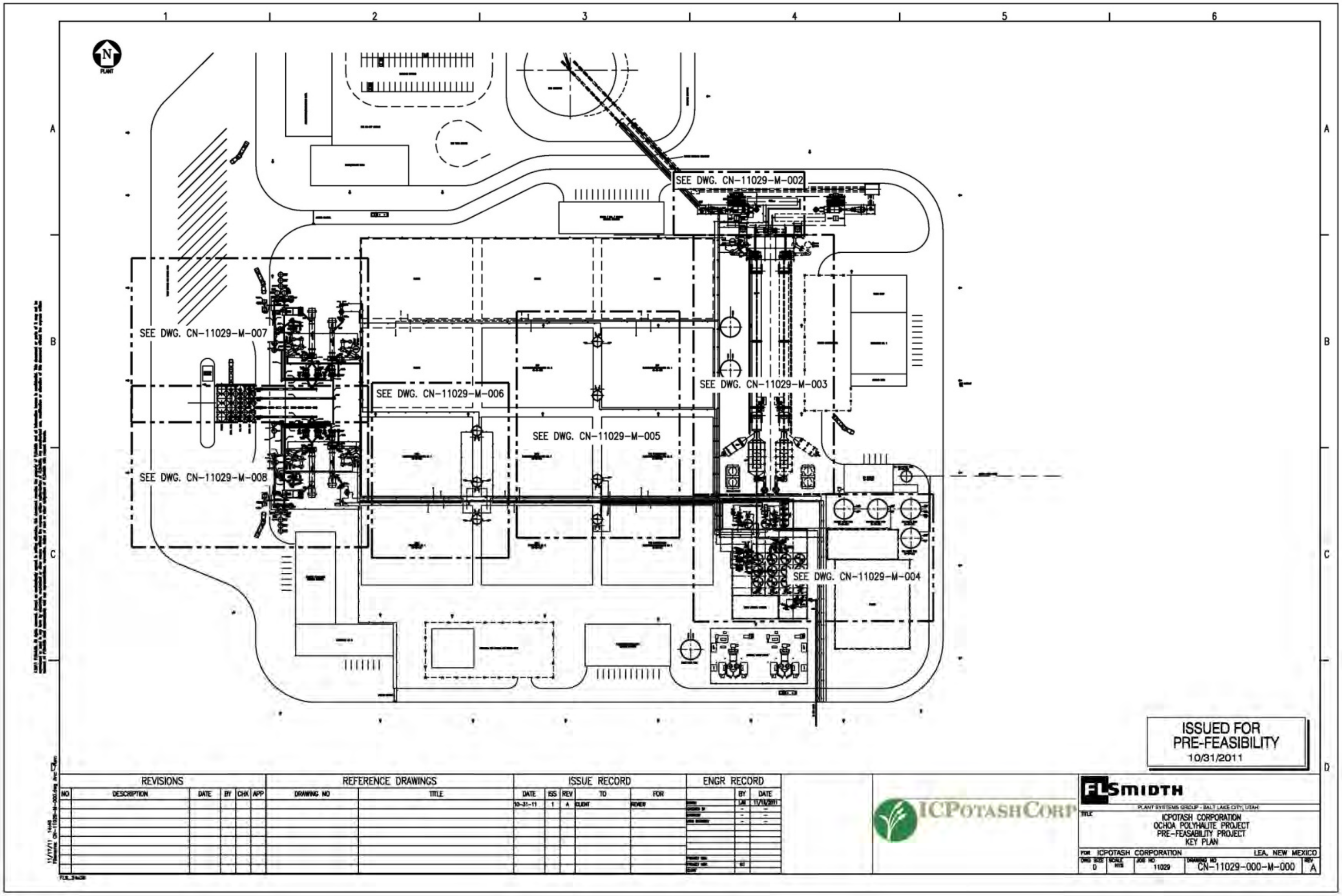


Figure 17-1 Processing Plant Layout

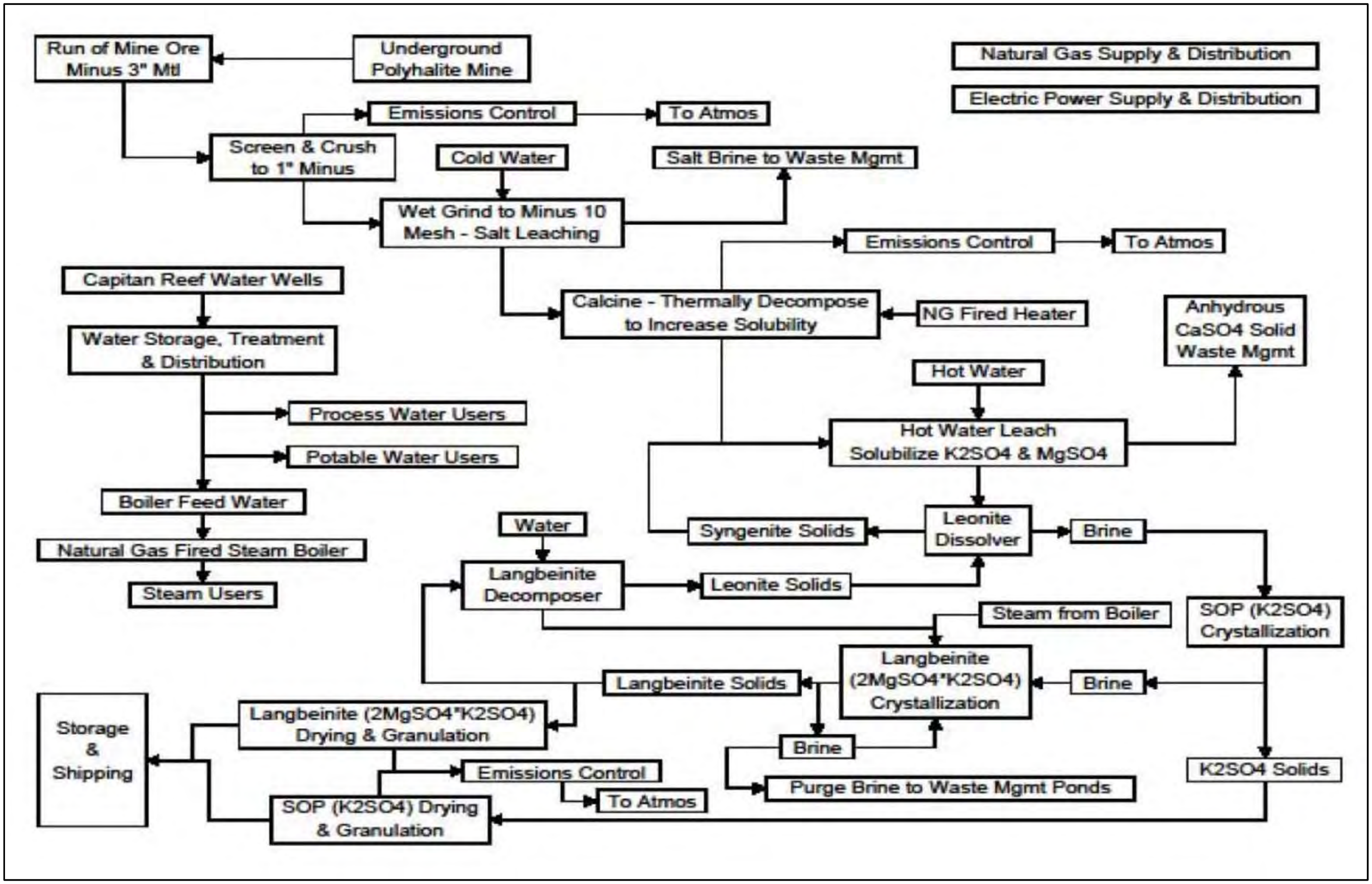


Figure 17-2 General Process Flow

Underflow from the hydrocyclones will be fed to a 112 square meter (4.2m wide by 26.7m long) vacuum belt filter. On the first section of the belt filter, the excess moisture will be removed from the cake. On the second section, the cake will be rinsed with process water to remove additional sodium chloride. The final section of the vacuum filter belt will reduce the free moisture in the cake to approximately 6%. Liquid liberated by both the hydrocyclones and the vacuum belt filter will be recycled back to the brine bleed tank. Here a portion of the mill water (at approximately 20% sodium chloride) will bleed off and be replaced with raw Capitan Reef water to the mill in sufficient quantity to maintain the returning mill water concentration at approximately 20% sodium chloride; this bleed stream will discharge to the concentrate pond. The cake from the belt vacuum filter will be transferred to the kiln feed screw via a belt conveyor.

17.4 Calcination

The second major step in surface processing is calcination of the ore. The goal of the calcination step is to convert the slightly and slowly soluble polyhalite into a rapidly soluble form.

Washed, milled polyhalite cake will be fed to a counter-current rotary kiln/calciner via screw conveyor.

The first section of the kiln will act as a dryer to drive off the 6% moisture in the ground ore. The second section of the kiln will drive the milled ore to calcination temperature. The final section of the kiln will hold the polyhalite ore at those temperatures for approximately 15 min at 480 to 520ºC to break the polyhalite crystal, which will drive off the two waters of hydration.

At higher calcination temperatures, the solubility of polyhalite is reduced and recovery of potassium is adversely affected. At calcination temperatures lower than 480°C, the material does not dissolve as easily. The, calciner must be controlled to this temperature band. Heat from the discharged calcined ore will be recovered in water-cooled heat-exchanger units to reduce the potential for flashing on being fed to the already boiling leaching vessels. Flashing is the immediate and violent vaporization of the liquid media into which the ore will be introduced for leaching. The heated water will be cooled via cooling tower and recycled through the heat-exchanger units.

17.5 Leaching

Calcined ore will be fed to the first of three (20 ft dia × 21 ft tall) agitated mix tanks that make up stage 1 of a two-stage counter-current leaching system. The ore will be pulped with the weak brine produced from stage 2 in tank 1A. Slurry will cascade from tank 1A to tank 1B to tank 1C, and will spend approximately 10 min in each of the three tanks. An atmospheric boiling temperature of 210°F (99°C) will be maintained in each of the tanks using steam spargers. The slurry discharged from tank 1C will be pumped to a cluster of eight hydrocyclones, each of which will feed one of three 54 in. × 70 in. centrifuges. Liquid liberated by both the hydrocyclones and the centrifuges will be designated as the leach brine, and will combine with dissolved leonite (from a separate process) to form augmented leach brine prior to being sent to one of two pre-concentration evaporation/crystallization mechanical vapor recompression (MVR) units, which will operate to concentrate the brine prior to SOP precipitation.

Cake collected from the stage 1 centrifuges will be fed via screw conveyor to the first of nine agitated mix tanks (also 20 ft dia × 21 ft tall) that will make up stage 2 of the leaching system. The cake will be pulped in tank 2A with the addition of 210°F (99°C) condensate returning from the crystallization/evaporation units. Slurry will cascade from tank 2A to tank 2B to tank 2C, and will spend approximately 10 min in each of the three tanks. Heat near the atmospheric boiling point will be maintained in each of the tanks using steam spargers. The slurry will discharge from tank 2C and will be pumped to tank 2D. Slurry will cascade from tank 2D to tank 2E to tank 2F, and will spend approximately 10 min in each of the three tanks. The slurry will discharge from tank 2F and will be pumped to tank 2G. Slurry will cascade from tank 2G to tank 2H to tank 2J, and will spend approximately 10 min in each of the three tanks. The slurry will discharge from tank 2J and will be pumped to a cluster of eight hydrocyclones, which will feed one of two 54 in. × 70 in. centrifuges. Liquid liberated by both the hydrocyclones and the centrifuges will be designated as weak brine, and will be sent to the stage 1 tank 1A. Cake from the stage 2 centrifuges will consist of anhydrite ($CaSO_4$), gypsum ($2CaSO_4 \cdot 2H_2O$), and trace amounts of other solids. The cake will be transferred via screw conveyors to haul trucks that will carry the tailings to the gypsum-stacking/tailings disposal area.

17.5.1 Crystallization

Leach brine will be concentrated by evaporation to produce SOP feed brine. This brine will then be used to produce product crystals by further evaporation of water in three stages: (1) precipitation of potassium sulfate for the SOP product, (2) precipitation of langbeinite both as product and for conversion to leonite, and (3) decomposition of langbeinite to produce leonite for use in augmenting of the leach brine.

All evaporators/ crystallizers will use MVR technology to recapture and to supply the energy required for evaporation. Generated steam will be required for startup, and for small amounts of makup energy in some units.

The first two pre-concentration evaporators (units designated as Pre-Con MVRs No. 1 and No. 2) will be arranged in parallel. These evaporators will concentrate the augmented leach brine (discussed later) to produce SOP feed brine.

The SOP feed brine will be pumped to two SOP evaporative crystallizers (units designated as SOP MVRs No. 1 and No. 2) that will be operated in parallel to selectively precipitate SOP. The SOP crystal slurry will be pumped to an array of hydrocyclones to increase the concentration of SOP crystal in the brine to a level suitable for feeding to centrifuges. The underflow of the hydrocyclones will be fed by gravity to 54 in. × 70 in. screen bowl centrifuges. The liquid liberated by both the hydrocyclones and centrifuges will be designated as the SOP mother liquor and will be pumped to the langbeinite brine distribution tank. The solids will be sent to the SOP product dryer.

SOP mother liquor will be pumped from the langbeinite brine distribution tank to two langbeinite evaporative crystallizers (designated as langbeinite MVRs No. 1 and No. 2) that will be operating in parallel to selectively precipitate langbeinite. Two OSLO crystallizers (designated as units No. 1 and No. 2) will be used to further grow the langbeinite crystals. Crystal slurry will be pumped to the slurry splitter tank. Depending on langbeinite production requirements, a portion of the langbeinite crystal slurry will be pumped to a head tank gravity-feeding 54 in. × 70 in. centrifuges. Liquid liberated by the centrifuges will be designated as langbeinite spent liquor. A portion will be sent to the disposal pond system to act as a purge stream and the remainder will be sent to the langbeinite brine distribution tank for recycling. The solids will be sent to the langbeinite product dryer.

The remainder of the langbeinite crystal slurry will be pumped to a cluster of thirty hydrocyclones, which will be connected to one of two 54 in. × 70 in. solid bowl centrifuges. Liquid liberated by the hydrocyclones and centrifuges will be designated as langbeinite spent liquor and will be mixed with the langbeinite mother liquor produced from the product centrifuges described above. Solids will be conveyed to the langbeinite decomposer, where process water will be added to drive the decomposition. Magnesium sulfate and a small amount of potassium sulfate will be leached from the langbeinite and will produce a slurry of leonite crystals ($K_2Mg(SO_4)^2 \cdot 4H_2O$) in a magnesium sulfate–rich brine. The crystal slurry will be pumped to one of two 54 in. × 70 in. centrifuges. Liquid liberated by the hydrocyclones and centrifuges will be designated as leonite mother liquor. A portion of the leonite mother liquor will be returned to the langbeinite decomposer to control solids density, and the remainder will be sent to the langbeinite brine distribution tank for recycling. Leonite solids will be conveyed to the leonite dissolver tank where they will be combined with the leach brine and dissolved to produce the augmented leach brine.

17.6 Granulation

The SOP crystal will be processed through a rotary dryer to 330°F (165.6°C). Upon exiting the dryer, the crystal will be screened through a vibrating screen to produce soluble and midsize SOP. Oversize will be roll-crushed and recycled through the screen. The soluble fraction will be split between storage for shipment to a loadout facility located in Jal, NM, and storage for augmenting the langbeinite granule product. The midsize SOP crystal will be used as the base for granulation.

Granular SOP production will originate with the milling of a portion of the midsize crystal to produce fines in the event they are not present in sufficient quantity from the initial screening (fines are used to fill the voids in the SOP granule, generating a compact, tight granule). The fines will be combined with the remainder of the midsize crystal in a paddle mixer. Also added to the paddle mixer will be a 2% starch solution, a metered feed of recycled granules, and a metered feed of the air-pollution scrubber effluent. The resulting mixture will feed the wet granules into the granule dryer, which will dry the granules to 240°F (115.6°C) and will produce the final granule product. The dried granules will be screened and the undersize will be stored to be blended back in at the paddle mixer. The oversize will be crushed and also stored for blending back into the product. The screened material meeting market specifications will be stored in day bins for shipment to the rail loadout at Jal

The langbeinite crystal will be processed though a rotary dryer at a temperature of 330°F (165.6°C). Upon exiting the dryer, the crystal will be screened through a vibrating screen. Oversize will be roll crushed, will be combined with the undersize and stored for recycling. No langbeinite soluble product will be produced. The midsize crystal will be used as the base for granulation.

Granular langbeinite production will also begin with the milling of agglomerates from the screening to produce fines. Fines will be combined with the remainder of the dryer discharge in a paddle mixer. Also added to the paddle mixer will be a 2% starch solution, a metered feed of recycled granules, and a metered feed of the air-pollution scrubber effluent. The resulting mixture will be fed to a drum granulator, where granules of the desired SGN will be produced. The drum granulator will feed the wet granules to the granule dryer, which will dry the granules at a temperature of 240°F (115.6°C) and will produce the final granule product. The dried granules will be screened, and the undersize will be stored to be blended back in at the paddle mixer. The oversize granules will be crushed and stored for blending back into the product. The material meeting market specifications will be stored in day bins for shipment to the rail loadout at Jal.

Each of the three products (soluble SOP, granular SOP, and granular langbeinite) will be stored for shipment to the rail loadout at Jal in separate day bins. While the product will not be screened at the plant, a protective coat of de-dusting oil (typically, Shell 266 wax petrolatum) will be applied during the truck loading to control product dust during handling. Trucks will be weighed on certified scales at the plant to produce bills of lading, which are required for shipment over public roads to the loadout at Jal.

At Jal, both SOP and langbeinite products will be screened to eliminate any undersize or oversize product. At the loadout operator’s discretion, a “polish” coat of de-dusting oil will be applied to further eliminate dust generation. Off-specification material will be returned to the plant for storage and recycling.

17.7 Air Pollution Control

Exhaust gases from the calcining kiln and each of the four product dryers require the application of air-pollution control prior to discharging into the atmosphere. In addition, fugitive dust generated by crushing, screening, and material handling must be captured and made inert.

For each of the rotary dryers and the calcining kiln, the exhaust will be captured by a negative-pressure hood, channeling the dirty exhaust through dry cyclones to remove the heavier particles, which will be cycled back into the product stream. The somewhat less-dirty exhaust will enter a quench chamber where water sprayers saturate the exhaust volume, cooling and wetting the dry particles. The exhaust will then be diverted through a compound venturi chamber in which all solid particles will be impinged onto water droplets. The saturated vapor will next be routed through a "wet elbow," forcing the vapor through a standing water bath. The vapor will exit the elbow and will be processed through a wet separator prior to being discharged up a stack. The dirty water will be diverted to a settling tank and filtered prior to being combined with fresh process water, and returned to the quench chamber and compound venturi chamber for use. A portion of the filtered effluent will be bled off and sent to the next down-stream APC unit for further concentration, prior to ultimately being sent to the concentrate pond for disposal.

Fugitive dust will be processed in the same way as the kiln and dryer exhaust gases, but without the heat component. Crushing, screening, and material-handling transfer points are the main sources of dust generation, from which negative-pressure hoods will pick up the dust. The dust will be transferred via fans and flexible or rigid ductwork to the quench chamber. From this point forward, processing of the dust will be identical to the system described previously. One system will be required for the SOP fugitive dust, and a second system for the langbeinite fugitive dust. Fugitive-dust control elsewhere in the process will be handled with water sprays/misting.

17.7.1 Air Pollution Control Design Basis

17.7.1.1 Introduction

Air-pollution control in New Mexico and Utah for potassium sulfate drying has been achieved historically with wet venturi scrubbers. Langbeinite product drying air-pollution control in New Mexico has also been achieved with wet venturi scrubbers. A typical particle size distribution for polyhalite kilns, potassium sulfate product drying, and langbeinite product drying is presented in Table 17 1.

Table 17-1 Particle Size Distribution

Kiln and Dryer Exhaust Particle Size Distribution	
Size (Microns)	**Cumulative (weight %)**
0.12	2.58
0.27	2.62
0.56	2.70
0.95	2.80
1.7	3.07
4.3	3.96
7.3	5.17
9.0	14.17
11.0	16.23
12.5	18.15
16.5	20.88
20.0	26.66
27.0	39.59
37.0	62.79
43.0	76.17
50.0	88.73
60.0	97.73
70.0	100.00

The New Mexico Air Quality Control Regulation (NMAQCR 501) for new dryers in plants producing potassium sulfate and/or langbeinite is a stack flue gas particulate grain loading of 0.1 grain per dry standard cubic foot (grain/ft^3). Fugitive dust collected from potassium sulfate and/or langbeinite production facilities and discharge through a stack is 0.04 grain/ft^3. These regulation limits must be adjusted to assure that the federal Prevention of Significant Deterioration (PSD), regulation is adhered to. The federal PSD increments are dictated by ambient air background particulate concentrations and the class distinction of the locale where the plant is to be built. The lowest NMAQCR for new potash plants (NMAQCR 501) is 0.04 grain/ft^3. The 0.04 grain/ft^3 regulation can easily be met with a wet venturi scrubber at moderate pressure drops (30 in. water column [WC]). Compound venturis tested around 2005 produced stack flue gas particulate grain loading as low as 0.004 grain/ft^3 at moderate pressure drops (18 in. WC) on a langbeinite dryer at full load. Based on test work conducted with simple venturis and compound venturi scrubbers, with the flue gas particle-size distribution determined by cascade impactor test results shown in Table 17-1, a conservative comparison of a simple venturi performance against a compound venturi is presented in Figure 17-3. In each case the venturi or compound venturi is preceded by a dry cyclonic separator. Each scrubber is operated at normal liquid to gas ratios (15 to 20 gallons per 1,000 actual cubic ft). In Figure 17-3, venturi throat pressure drops (in in. WC) required for limiting the scrubber outlet particulate concentration to the values on the x axis are shown. This assumes the use of a properly designed wet cyclonic separator following the venturi or compound venturi.

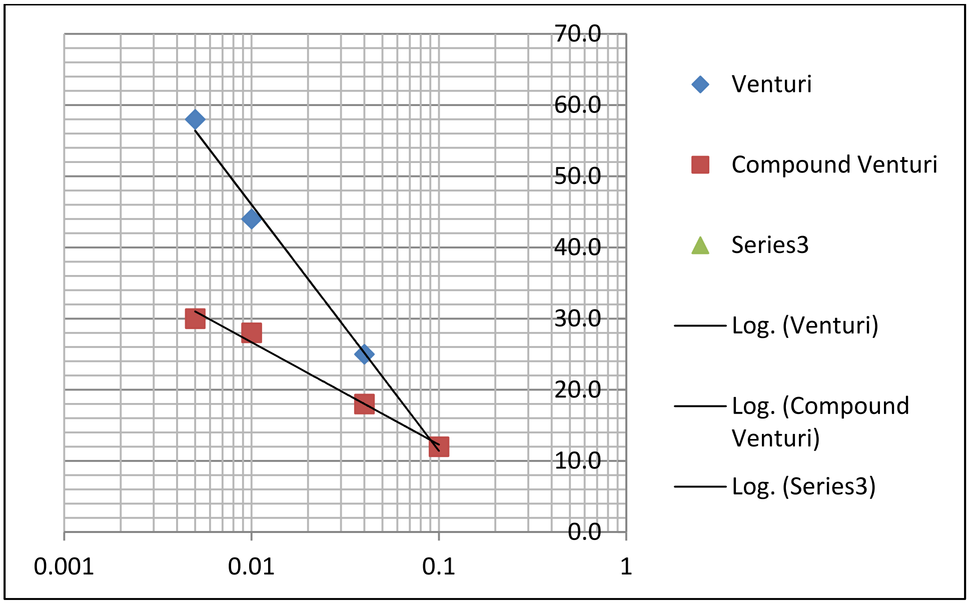


Figure 17-3 Comparison of Simple Venturi vs. Compound Venturi Scrubber Performance

Dispersion modeling to satisfy the federal PSD regulations will determine what flue gas particulate concentration will yield a downwind particulate concentration below the PSD increment. The use of compound venturis allows compliance with the federal PSD regulation with a moderate pressure drop wet scrubber control device. Alternative pollution control systems like baghouses, have proven vulnerable to failure due to humidity from rainfall events and the hydroscopic nature of the potash particulates. The failure of a single bag requires either a shutdown of the entire plant or the installation of duplicate baghouse dust -control units throughout the plant.

17.7.1.2 Polyhalite Decomposition Kiln, Potassium Sulfate/Langbeinite Product Dryers, Potassium Sulfate/Langbeinite Granulator Dryer Flue Gas and Fugitive Dust Exhaust Air-pollution Control Wet Scrubber Design Basis

The flue gas flow rates are based on a polyhalite decomposition kiln handling 400 TPH of leached sodium chloride–free polyhalite at 4.0% by weight moisture as calculated by the FLSmidth pyrotechnical division. This kiln flue gas mass rate, including air exhaust from the product discharge cooler, and its composition and temperature were then used in a wet scrubber heat and material balance.

The potassium sulfate and langbeinite product dryers will have capacities of 110 TPH. Overall heat and material balances have been computed for the product dryer operating within normal temperature ranges and at a feed moisture content of 6.5% by weight.

The potassium sulfate and langbeinite granulator dryers will each have a capacity of 200 TPH at 8.0% moisture. Overall heat and material balances have been computed for the granulator dryers operating within normal temperature ranges and with a feed moisture content of 8.0% by weight.

17.7.1.3 Air-pollution Control Scrubber Unit Descriptions

Kiln Flue Gas Air-pollution Scrubber

Hot flue gas exhaust from the polyhalite decomposition kilns will be routed to an air-pollution scrubber consisting of a quench chamber, a compound venturi, and a wet cyclonic separator. The flue gas exhaust from the kiln's six dry cyclonic separators will be routed at 287,478 actual cubic ft per minute (ACFM) and 285°F to a quench chamber. The hot flue gas will be contacted by 150 gpm of recycle liquor through a coarse spray nozzle in the inlet sleeve atop the quench chamber to lower the temperature from 285°F to 180°F. Flue gas exiting the inlet sleeve atop the quench chamber will then enter the quench chamber, where 52 gpm of fine spray droplets produced by pneumatic atomizers operating at a gauge pressure of 65 pounds per square inch (psig) will contact the gas. The quenched kiln flue gas will then be saturated at 151°F. The saturated flue gas will exit the quench chamber and enter a compound venturi, where it will be contacted by 1,000 gpm of recycle scrubber liquor. The pressure drop in the compound venturi will be 30 in. WC (76.2 centimeters [cm] WC). The secondary scrubbing action in the two opposing venturis in the compound venturi will give an increase in performance that exceeds a conventional venturi. The exhaust gas exiting the compound venturi will enter a wet cyclonic separator and then a wet exhaust fan and the final stack. The particulate concentration in the final scrubbed granulator dryer exhaust should be below 0.005 grain/ft^3.

Potassium Sulfate Product Dryer Air-pollution Scrubber

The potassium sulfate crystal product dryer will be a rotary unit 10 ft dia × 70 ft long with a capacity of 110 TPH of solids with 6.5% by weight moisture. The product dryer will be equipped with a ceramic-lined fire box heated a natural gas burner rated at 40 million British thermal units [BTU] each.

The normal firing rate will be near 36 million BTU per hour (BTU/hr). Gases entering the dryer will be near 2000°F. The potassium sulfate product will be heated to just above 330°F. In the drying of the potassium sulfate product, 43.3 TPH of water will be vaporized in the dryer. The particulate-laden exhaust gases will exit the product dryer at 375°F and enter a pair of dry cyclonic separators, where over 75% of the particulate will be recovered and recombined with the dryer discharge solids in the main discharge screw. Product from the dryer will total 109.7 TPH of dry solids but can vary up to 110 TPH. The combined potassium sulfate product will discharge at 330°F into a screw that will feed a heavy-duty bucket elevator. The exhaust will exit the dry cyclonic separators at 45,726 ACFM and 370°F and enter a sleeve atop a quench chamber, where it will be contacted by 100 gpm of recycle liquor, reducing the gas temperature to 280°F. The flue gas will then exit the entry sleeve and enter the quench chamber, where it will be contacted by 12.2 gpm of fine spray water at 50 psig. The saturated dryer flue gas will exit the quench chamber at 148°F and enter a compound venturi scrubber. The pressure drop in the compound venturi will be 30 in. WC (76.2 cm WC). The secondary scrubbing action in the two opposing venturis in the compound venturi will give an increase in performance that exceeds a conventional venturi. The exhaust from the compound venturi scrubber cyclonic separator 146 °F and have a particulate concentration of less than 0.005 grain/ft^3. The compound venturi will contact the exhaust gases with 1,000 gpm of recycle liquor pumped from the recycle tank.

Langbeinite Product Dryer and Air-pollution Scrubber

The langbeinite crystal product dryer will be a rotary unit 10 ft dia × 70 ft long with a capacity of 110 TPH of solids with 6.5% by weight moisture. The product dryer will be equipped with burners (at 40 million BTU per burner) and a ceramic-lined fire box. The normal firing rate will be nearly 36 million BTU/hr. Gases entering the dryer will be near 2,000°F. The potassium sulfate product will be heated to just above 330°F. In the drying of the potassium sulfate product, 43.3 TPH of water will be vaporized in the dryer. The particulate-laden exhaust gases will exit the product dryer at 375°F and enter a pair of dry cyclonic separators, where over 75% of the particulate will be recovered and recombined with the dryer discharge solids in the main discharge screw. Product from the dryer will total 109.7 TPH of dry solids but can vary up to 110 TPH. The combined potassium sulfate product will then discharge at 330°F into a screw that will feed a heavy-duty bucket elevator. The exhaust will exit the dry cyclonic separators at 45,726 ACFM and 370°F and enter a sleeve atop a quench chamber, where it will be contacted with 100 gpm of recycle liquor, reducing the gas temperature to 280°F. The flue gas will then exit the entry sleeve and enter the quench chamber, where it will be contacted by 12.2 gpm of fine spray water at 50 psig. The saturated dryer flue gas will exit the quench chamber at 148°F and enter a compound venturi scrubber. The pressure drop in the compound venturi will be 30 in. WC (76.2 cm WC). The secondary scrubbing action in the two opposing venturis in the compound venturi will give an increase in performance that exceeds a conventional venturi. The exhaust from the compound venturi scrubber cyclonic separator 146°F and have a particulate concentration of less than 0.005 grain/ft^3. The compound venturi will contact the exhaust gases with 1,000 gpm of recycle liquor pumped from the recycle tank.

Potassium Sulfate Granulator Dryer Flue Gas and Granulator Drum Exhaust Air-pollution Scrubbers

The potassium sulfate granulator dryer will be a rotary unit 14 ft dia by 140 ft long with a capacity of 200 TPH of solids with 8.0% by weight moisture. The product dryer will be equipped with burners (at 40 million BTU per burner) and a ceramic-lined fire box. The normal firing rate will be nearly 22 million BTU/hr. Gases entering the dryer will be near 1,400°F. The potassium sulfate product will be heated to just above 240°F. In the drying of the potassium sulfate granules, 16.9 TPH of water will be vaporized in the dryer. The particulate-laden exhaust gases will exit the product dryer at 260°F and enter a pair of dry cyclonic separators, where over 75% of the particulate will be recovered and recombined with the dryer discharge solids in the main discharge screw. Product from the dryer will total 109.7 TPH of dry solids but can vary up to 300 TPH. At 86,474 ACFM and 241°F, the potassium sulfate granulator dryer flue gas exhaust and the exhaust from the granulation drum will enter a sleeve atop the quench chamber. Inside the entry sleeve, 150 gpm of recycle liquor will be sprayed through a coarse spray nozzle, contacting the combined exhausts and reducing the temperature to 180°F. The potassium sulfate granulator dryer flue gas in the sleeve will then discharge into the quench chamber, where it will be contacted by 22 gpm of fine spray water at 60 psig. The flue gas exiting the quench chamber will be saturated at 143°F. The saturated potassium sulfate flue gas will be discharged into a compound venturi, where the quenched gas will be contacted by 1,000 gpm of recycle liquor. The pressure drop in the compound venturi will be 30 in. WC (76.2 cm WC). The secondary scrubbing action in the two opposing venturis in the compound venturi will give an increase in performance that exceeds a conventional venturi. The exhaust gas exiting the compound venturi will enter a wet cyclonic separator and then an exhaust fan. The wet exhaust fan will then discharge into the final stack. The particulate concentration in the final scrubbed granulator dryer exhaust should be below 0.005 grain/ft^3.

Potassium Sulfate Granulator Fugitive Air-pollution Scrubber

The fugitive dust generated in processing equipment in the potassium sulfate granulation plant will be collected by vent receptacles on the equipment by a network of ducts routed to a central plenum. The particulate-laden exhaust air from the plenum will enter a pair of dry cyclonic separators, where over 50% of the particulate will be recovered and routed to the recycle bin in the granulator circuit. The overflow exhaust from the dry cyclonic separators will be routed to a quench chamber at 58,090 ACFM and 178°F. This exhaust air will enter a sleeve atop a quench chamber, where 100 gpm of recycle liquor will be sprayed to contact the gas and reduce its temperature to 150°F. The flue gas will then exit the entry sleeve and enter the quench chamber, where it will be contacted by 8.7 gpm of fine spray water at 60 psig. The saturated exhaust air will then exit the quench chamber at 80°F and enter a compound venturi scrubber. The pressure drop in the compound venturi will be 30 in. WC (76.2 cm WC). The secondary scrubbing action in the two opposing venturis in the compound venturi will give an increase in performance that exceeds a conventional venturi. The exhaust from the compound venturi scrubber cyclonic separator 80°F and have a particulate concentration of less than 0.005 grain/ft^3. The compound venturi will contact the exhaust air with 1,000 gpm of recycle liquor pumped from the recycle tank.

Langbeinite Granulator Dryer Flue Gas and Granulator Drum Exhaust Air-pollution Scrubber

The langbeinite granulator dryer will be a rotary unit 14 ft dia × 140 ft long with a capacity of 200 TPH of solids with 8.0% by weight moisture. The product dryer will be equipped with burners (at 40 million BTU per burner) and a ceramic-lined fire box. The normal firing rate will be nearly 22 million BTU/hr. Gases entering the dryer will be near 1,400°F. The potassium sulfate product will be heated to just above 240°F. In the drying of the potassium sulfate granules, 16.9 TPH of water will be vaporized in the dryer. The particulate-laden exhaust gases will exit the product dryer at 260°F and enter a pair of dry cyclonic separators, where over 75% of the particulate will be recovered and recombined with the dryer discharge solids in the main discharge screw. Product from the dryer will total 109.7 TPH of dry solids but can vary up to 300 TPH. The langbeinite granulator dyer flue gas exhaust and the exhaust from the granulation drum will enter a sleeve atop the quench chamber at 86,474 ACFM and 241°F. Inside the entry sleeve, 150 gpm of recycle liquor will be sprayed through a coarse spray nozzle, contacting the combined exhaust gases and reducing the temperature to 180°F. The potassium sulfate granulator dryer flue gas in the sleeve atop the quench chamber will then discharge into the quench chamber, where it will be contacted by 22 gpm of fine spray water at 60 psig. The flue gas exiting the quench chamber will be saturated at 143°F. The saturated potassium sulfate flue gas will then be discharged into a compound venturi, where the quenched gas will be contacted by 1,000 gpm of recycle liquor. The pressure drop in the compound venturi will be 30 in. WC (76.2 cm WC). The secondary scrubbing action in the two opposing venturis in the compound venturi will give an increase in performance that exceeds a conventional venturi. The exhaust gas exiting the compound venturi will enter a wet cyclonic separator and then an exhaust fan. The wet exhaust fan will discharge into the final stack. The particulate concentration in the final scrubbed granulator dryer exhaust should be below 0.005 grain/ft^3.

Langbeinite Granulator Fugitive Air-pollution Scrubber

The fugitive dust generated in processing equipment in the potassium sulfate granulation plant will be collected by vent receptacles on the equipment by a network of ducts routed to a central plenum. The particulate-laden exhaust air from the plenum will enter a pair of dry cyclonic separators, where over 50% of the particulate will be recovered and routed to the recycle bin in the granulator circuit. The overflow exhaust from the dry cyclonic separators (58,090 ACFM at 178°F) will be routed to a quench chamber. This exhaust air will enter a sleeve atop a quench chamber, where 100 gpm of recycle liquor will be sprayed to contact the exhaust air and reduce its temperature to 150°F. The flue gas will then exit the entry sleeve and enter the quench chamber, where it will be contacted by 8.7 gpm of fine spray water at 60 psig. The saturated exhaust air will exit the quench chamber at 80°F. The saturated exhaust air will then enter a compound venturi scrubber. The pressure drop in the compound venturi will be 30 in. WC (76.2 cm WC). The secondary scrubbing action in the two opposing venturis in the compound venturi will give an increase in performance that exceeds a conventional venturi. The exhaust from the compound venturi scrubber cyclonic separator 80°F and have a particulate concentration of less than 0.005 grain/ft^3. The compound venturi will contact the exhaust air with 1,000 gpm of recycle liquor pumped from the recycle tank.

18 PROJECT INFRASTRUCTURE

18.1 Facilities

18.1.1 Office Building

There will be two separate office and change house locations. One will service the mine and will be located by the shaft while the one that will service the processing plant will be located near the portal of the decline. In order to keep initial capital lower, the offices and change house located near the shaft will be temporary trailers at the beginning of the project while the project is ramping up. The temporary facilities will be replaced with permanent facilities as the operation reaches full capacity. The office and dry facilities at each location will be designed to accommodate the appropriate staff and administration.

The office and administrative buildings will include offices, toilet facilities, and lunch room as shown in figure 18-1.

18.1.2 Warehouse and Laboratory

Two warehouses and one laboratory are planned for the project. One warehouse will be located at the shaft location and will be used to support the mining operation of the project. A second warehouse and laboratory will be located within the plant site and will support the processing operation. The laboratory will contain sample prep equipment, x-ray defractometer, and an Inductively Coupled Plasma instrument. A fenced-in yard area will be located immediately adjacent to each warehouse to be used as a laydown area.

18.1.3 Truck Shop & Maintenance

The truck shop will consist of two large bays and a single wash bay with sufficient work space to conduct maintenance on the semi-trailer trucks and front-end loaders. The truck maintenance shop will be located within the processing facility site.

18.1.4 Process Building

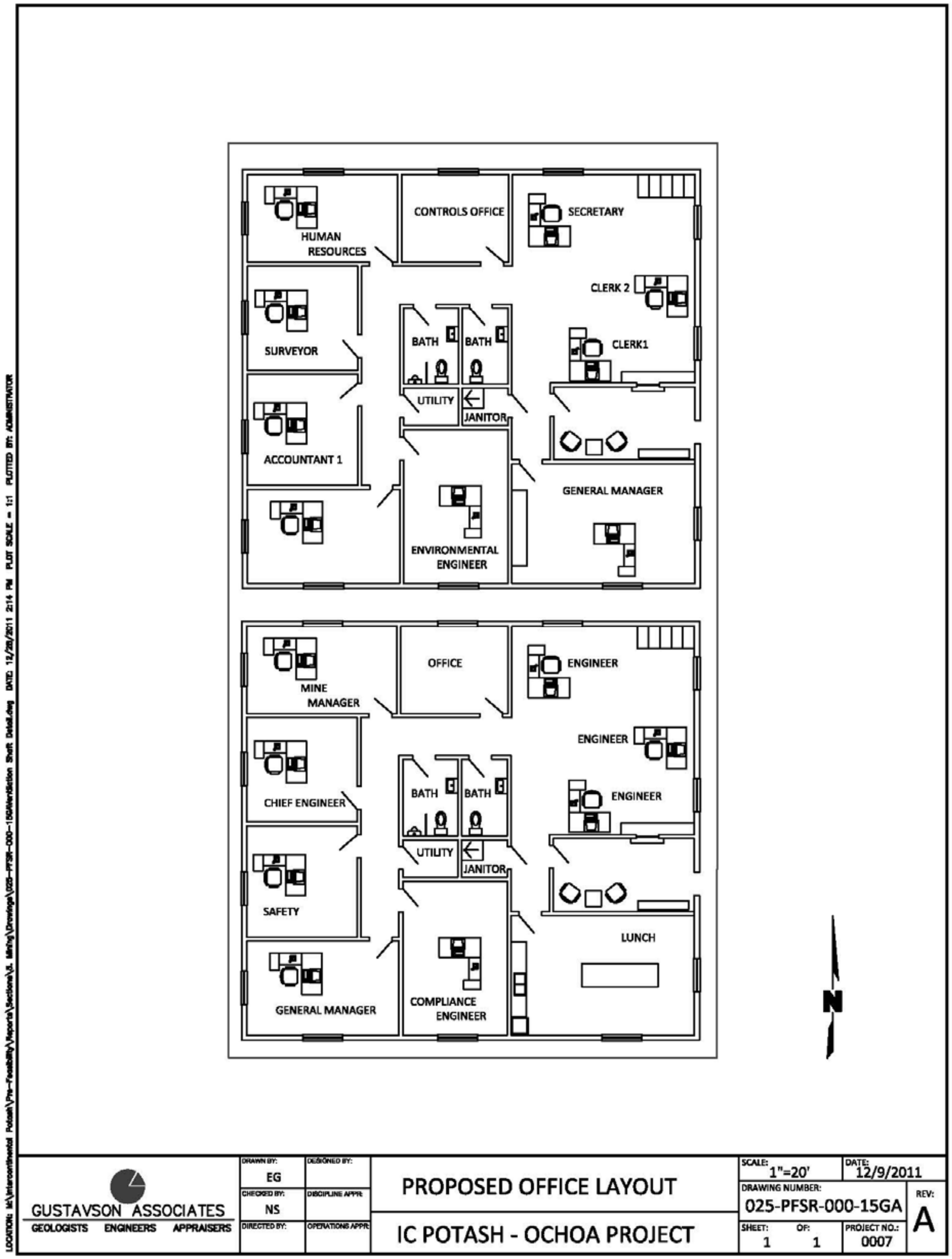


Figure 18-1 Office Building

18.2 Roads

Temporary and permanent roads will be constructed to support the Ochoa Project. Temporary access roads will be constructed with an average 50-ft wide running surface and a total average road disturbance width of 70 ft. Roads will be constructed using standard construction practices and to minimize surface disturbance, erosion, visual contrast, and to facilitate reclamation. Roads will be constructed following Best Management Practices (BMP) and BLM road requirements as described in the BLM Road Manual 9113 (BLM 1985). Temporary access roads will be reclaimed as soon as they are no longer needed. Temporary road reclamation will include re-grading and reseeding the road area with a BLM approved seed mix.

Access roads during operation will be 2-way, 2 lane gravel roads. Each lane will be 20 ft wide for a total of 40 ft running surface. Road shoulders will be between 3 and 5 ft wide.

Cattle guards will be installed on gravel and other access roads, where necessary. Cattle guards will be constructed to a load rating appropriate for anticipated truck traffic. Grid length will not be less than 8 ft and the width will not be less than 14 ft. A 16 ft minimum wire gate will be installed on one side of the cattle guard unless otherwise requested by the surface user.

Borrow ditches will be cut to obtain material to form a crowned road bed. The road bed will have a gravel road base for the running surface. Culverts would be placed to allow pre-existing drainage patterns to prevail. Topsoil will be re-spread over the borrow ditch areas up to the running surface after completion of grading.

18.3 Security

The guard house at the main gate to the mine site will be manned around the clock. Standard security measures and operating procedures will be followed to ensure the security of the site. The perimeter of the mine site will be fenced with 3-strand barbed wire to keep grazing cattle out.

18.4 Septic Systems

Four septic systems are currently planned on the Ochoa property: one for the mine area, one for the warehouse / laboratory, third system for the process plant area and a final one at the Jal loadout. Portable toilets will be placed at the mining,crushing areas, and other areas where necessary.

18.5 Water

Surface water management facilities will be constructed to minimize adverse impacts of runoff from the Ochoa Project site to downstream receiving areas. Controls will ensure that non-point sources of suspended solids and other potential surface water contaminants are contained and not released from the project area.

As there are no perennial drainages within the Ochoa Project site, control systems will be limited to management of surface water resulting from rainfall events. Rainfall runoff and run-on will be managed by constructing protective berms around all disturbed areas and surface facilities at the mine site, and at the rail loadout in Jal.

Berms will be 5 ft high, with the exception of berms in areas down gradient of notable slopes. Berm height will be 7 ft in these areas. In all cases, berms will be constructed with 3H:1V side slopes, and a top width of 3 ft. Berms will be seeded with a BLM approved seed mixture and mulched or covered with erosion control blanket as necessary to prevent soil loss from wind erosion.

Collection ponds will be constructed immediately adjacent to the southeastern side of the dry stack tailings facility. Combined, the ponds will provide containment of the 100-year, 24-hour storm event.

To further minimize runoff and mass movement of sediments, stockpiles (except the waste rock from mine excavation) will be revegetated and lined as appropriate.

A reverse osmosis water treatment system will be installed to deliver potable water to the office, warehouse, and process plant.

Fire water will be supplied to the office, warehouse/laboratory, truck shop, and process plant from a water storage tank located near the gate of the mine. Diesel driven pumps will deliver fire water via underground piping to fire hydrants located next to the various buildings.

18.6 Power

Electric power will be supplied by Xcel Energy. Current power transmission will be adequate for project construction but a new 45 mi long 230kV transmission line from an Xcel station to the Ochoa Project site will be constructed. Project electric power requirements are 120 megawatts (MW) of connected load with an average of 92 MW for routine facility operation. Table 18-1 shows the equipment usage for the mine and processing facility.

Table 18-1 Total Ochoa Project Power Requirements

Total Mine Power Summary			
Process	**Connected HP**	**Avg Load HP**	**Avg kWh**
Mining Equipment	19,050	10,466	7,808
Reverse Osmosis Plant	4,125	3,300	2,462
Primary & Secondary Crushing	3,780	2,781	2,075
Pre-Halite Poly Leach	4,360	3,303	2,464
Kilns	3,020	2,265	1,690
Leach Circuit	3,500	2,765	2,063
Leach Tails Debrine	2,700	2,035	1,518
Tails Washing Thickeners	900	703	524
MVR Crystallizer	81,600	80,800	60,277
Boiler	40	32	24
Salt Storage	250	170	127
Salt Sizing & Debrine	2,270	1,702	1,269
Langbeinite DTB Converters	450	353	263
K_2SO_4 Product Filter	1,700	1,360	1,015
K_2SO_4 Product Dryer	800	620	463
Langbeinite Product Filter	1,700	1,360	1,015
Langbeinite Product Dryer	800	620	463
SOP Granulator Feed Prep	1,960	1,504	1,122
SOP Granulator & Screens	1,810	1,363	1,016
Langbeinite Granulator Feed Prep	1,960	1,504	1,122
Langbeinite Granulator & Screens	1,810	1,363	1,016
Warehouse Conveyors	260	160	119
Fugitive & Granulator Scrubbers	1,140	912	680
Product Dryer Scrubber	520	416	310
Kiln Scrubbers	1,240	992	740
Cooling Tower	500	400	298
Total	**142,245**	**123,246**	**91,942**

Transmission lines will be constructed in accordance with the standards outlined in "Suggested Practices for Avian Protection on Powerlines" (APLIC 2005). A dropdown substation is planned on the Ochoa Project site.

Electricity requirements, above ground and underground, will follow MSHA rules and regulations. Figures 18-2 and 18-3 show a one line electrical drawing for the mine.

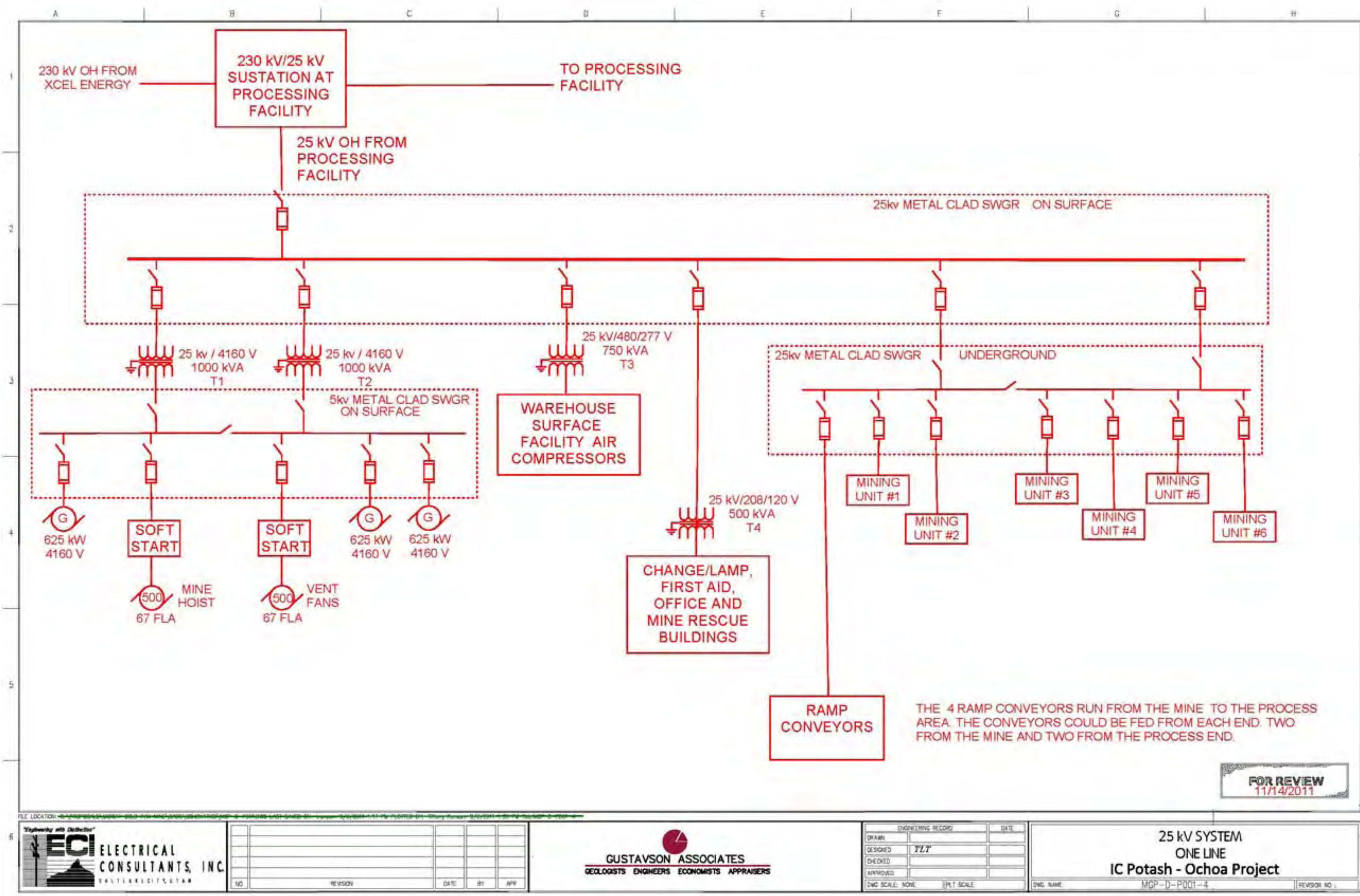


Figure 18-2 One Line Drawing

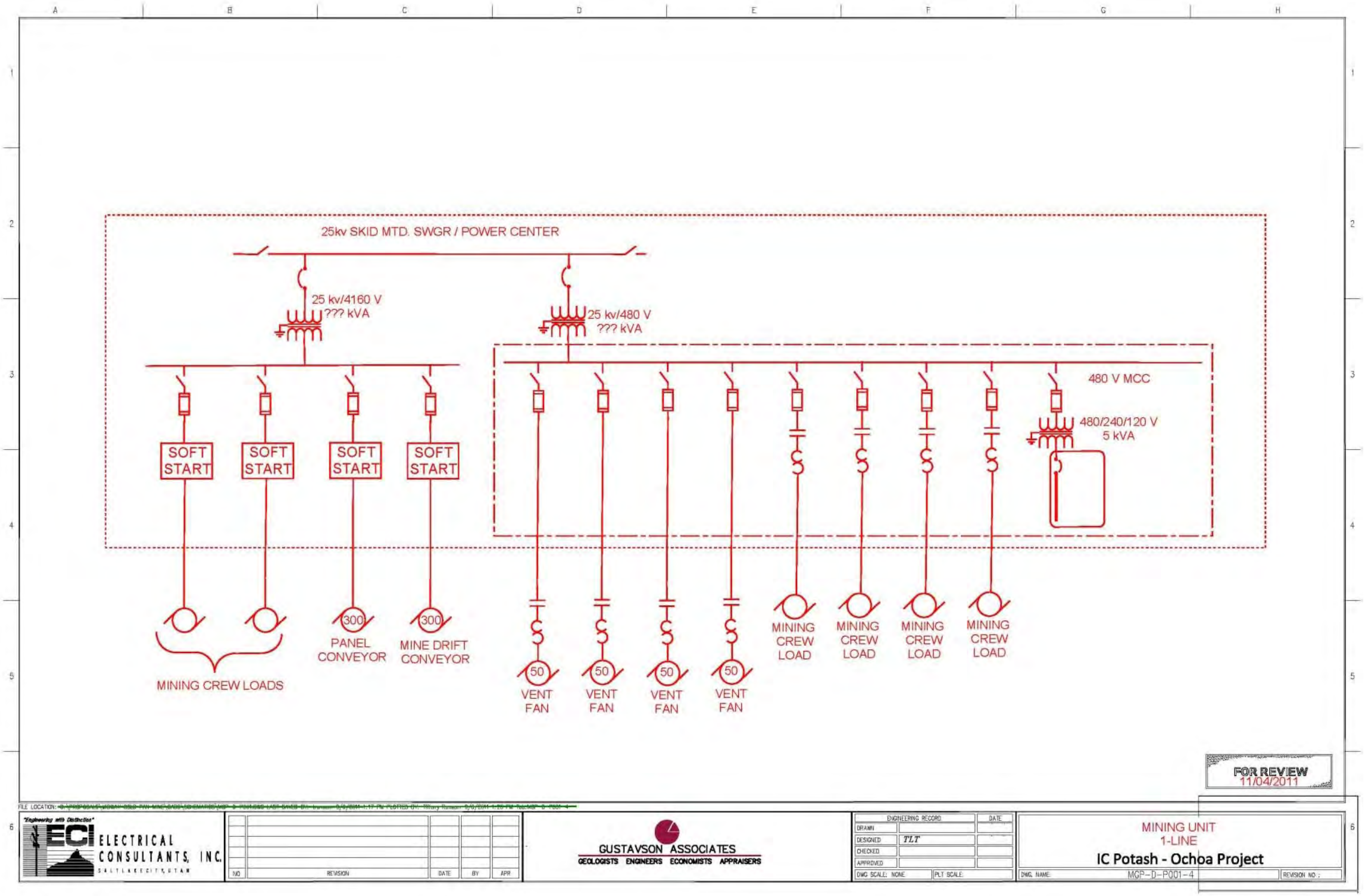


Figure 18-3 One Line Drawing

18.7 Fuel Depot

Diesel will be purchased in bulk and stored on site at a refueling station. Diesel will be stored in a tank with capacity of 10,000 gal, and a fuel truck will be used to refill the support equipment. All mine production equipment is electrically powered. Most vehicles on the mine site will run on diesel; eliminating the need for gasoline, which will be purchased at gas stations in Hobbs or Jal. Light duty diesel trucks will refill at the fuel station. All buildings will be heated with electricity or propane delivered from and stored in tanks located on the project site.

18.8 Communications

Communications will be comprised of separate systems including: optical fiber, telephone and an underground mine communication system (presumably a leaky feeder system). The separate systems will run independently. In the case of one type of communication being lost, the others will still be available for use.

18.9 Product Storage and Loading Facilities

Finished product will be trucked to a rail loadout facility 22 mi northeast of the plant just north of the city of Jal. The loadout facility will store all finished product and all sales either truck or rail will be processed and shipped at this location. As part of the loadout facility, a new rail spur and sidings will be built as well as storage domes and silos for the finished products. A rail car washout facility will be installed for cleaning the cars before loading the product. Rail and truck scales will be furnished to monitore weight of rail cars and trucks to ensure that vehicles are properly loaded and to produce certified bills of lading. Figure 18-4 shows the layout of the proposed loadout facility.

All three products (granular SOP, soluble SOP, and langbeinite) will be delivered from the process plant to the storage facilities by highway trucks equipped with bottom-dump trailers along existing state roads. The enclosed trailers will carry approximately 25 tons of product which is the legal limit for New Mexico highways. Different finished products cannot mix with each other; therefore, truck trailers will be dedicated to one product only, and when there is a need for a trailer to carry a different product, the trailer will be thoroughly cleaned to prevent cross contamination. Upon arrival to the product loadout and storage facility, the truck will proceed to and dump into the proper receiving hopper in order to keep products separated.

18.9.1.1 Product Storage and Handling

Each of the products (granular SOP, soluble SOP, and langbeinite) will be stored separately. The granular SOP and langbeinite will be stored in domes and the soluble SOP will be stored in silos. Each storage dome and silo will be capable of storing 1.5 months' worth of product. The proposed storage site will be designed to allow for increased storage capacity in the future.

Upon arrival to the loadout and storage facility the product will be unloaded from the truck into a dedicated receiving hopper and transferred by reclaim vibratory feeders onto the supply belt conveyors that will deliver the product into the dedicated dome or silo. The receiving hoppers will be equipped with a dust collection system to minimize dust during truck unloading processes. The dust collected will be returned into the receiving hopper.

Each storage dome will be equipped with a product distribution conveyor to ensure even product placement around the dome and reclamation system. The distribution conveyor will be mounted on the center column inside the dome. This conveyor will receive the product from the completely enclosed supply conveyor through a chute. The central column will slowly rotate around its vertical axis and the distribution conveyor will rotate with it, thus delivering and placing the product evenly around the dome's walls. The screw-type reclaim system will be mounted to the same column and will rotate with it. The product reclaimed by the screw reclaimer will be moved inside the central column and where it will be transferred by a vibratory feeder onto a collection conveyor. There will be several conical vibratory dischargers mounted beneath each dome's floor along the center line of the collection conveyor. These vibratory dischargers will be used to transfer the product inside the dome onto the collection conveyor in the case that primary screw conveyor malfunctions. All feeders and collection conveyors will be located under the dome floor in an underground tunnel. Connections between chutes, feeders, and conveyor skirt boards will be dust tight. All storage domes will be equipped with dust collectors. The arrangement of all equipment is designed so that if expansion is necessary in the future, it can occur seamlessly

Because there will be a significant smaller amount of soluble SOP produced, it will be stored in silos rather than domes. Initially, silos will be sized to hold 1.5 months' worth of soluble SOP. The storage area for soluble SOP will be designed to allow for expanded storage capacity if needed in the future. The storage silos will be skirted and equipped with conical bottoms with vibratory dischargers in order to reclaim product out of the silos. After exiting the silo, the product will be transported by a vibratory feeder onto a collection belt conveyor. The collection conveyor will be totally enclosed, installed above ground and long enough to allow for future expansion. Each silo will be equipped with a dust collector for dust control.

In the granular SOP and langbeinite circuit, the collection conveyor will transfer the product onto a screen-feed conveyor, which will deliver it to a vibrating screen. The screen will remove the fines from the product. The fines will be transferred into an enclosed 30-ton-capacity bin equipped with a vibratory bin discharger and weigh belt feeder. When the bin is filled to capacity, an empty truck used to transport the respective material will be loaded with the fines and returned to the process plant for re-granulation. The granular SOP or langbeinite that is not screened out will be transferred onto the train-loading conveyor, where the product will be sprayed with a protective coating to prevent degradation of the product if the operator feels it is necessary.

The freshly coated product will be delivered to the automatic train-loading station. The train-loading station will be capable of loading up to 3,000 TPH into the rail cars, which will be more than sufficient to accommodate the design demand. This train loading station is capable of continuous load or point loading depending on the type of car that needs to be loaded. Rail cars that are equipped with a long continuous slot in the roof, will be loaded continuously while the train is moving, thus reducing the time required for loading the train. Rail cars that are equipped with multiple hatches in the roof instead of one long slot will need to be point loaded and will not be able to move continuously. Point loading will require that the loading operator be aware of the number of hatches in the roof of each car in order to ensure balanced loading of the car and it does not exceed weight. In the case of continuous loaded cars, the loading station will automatically control the weight of the material delivered into each rail car so that overloading does not occur.

The soluble SOP will utilize the same train-loading station to load rail cars. The only difference is that the soluble SOP will not need to be screened for fines or need touch up oil. Product will be fed directly from the storage silo into the train-loading station. Figure 18-5 through 18-7 depicts flow sheets of each material as it progresses through the loadout facility.

The product loading station will also allow trucks to be loaded. In this case, the loading station operator will control the weight of the product to be transferred into the truck. The empty trucks will be weighed before entering the loadout system and after product is loaded so that a certified Bill of Lading can be produced.

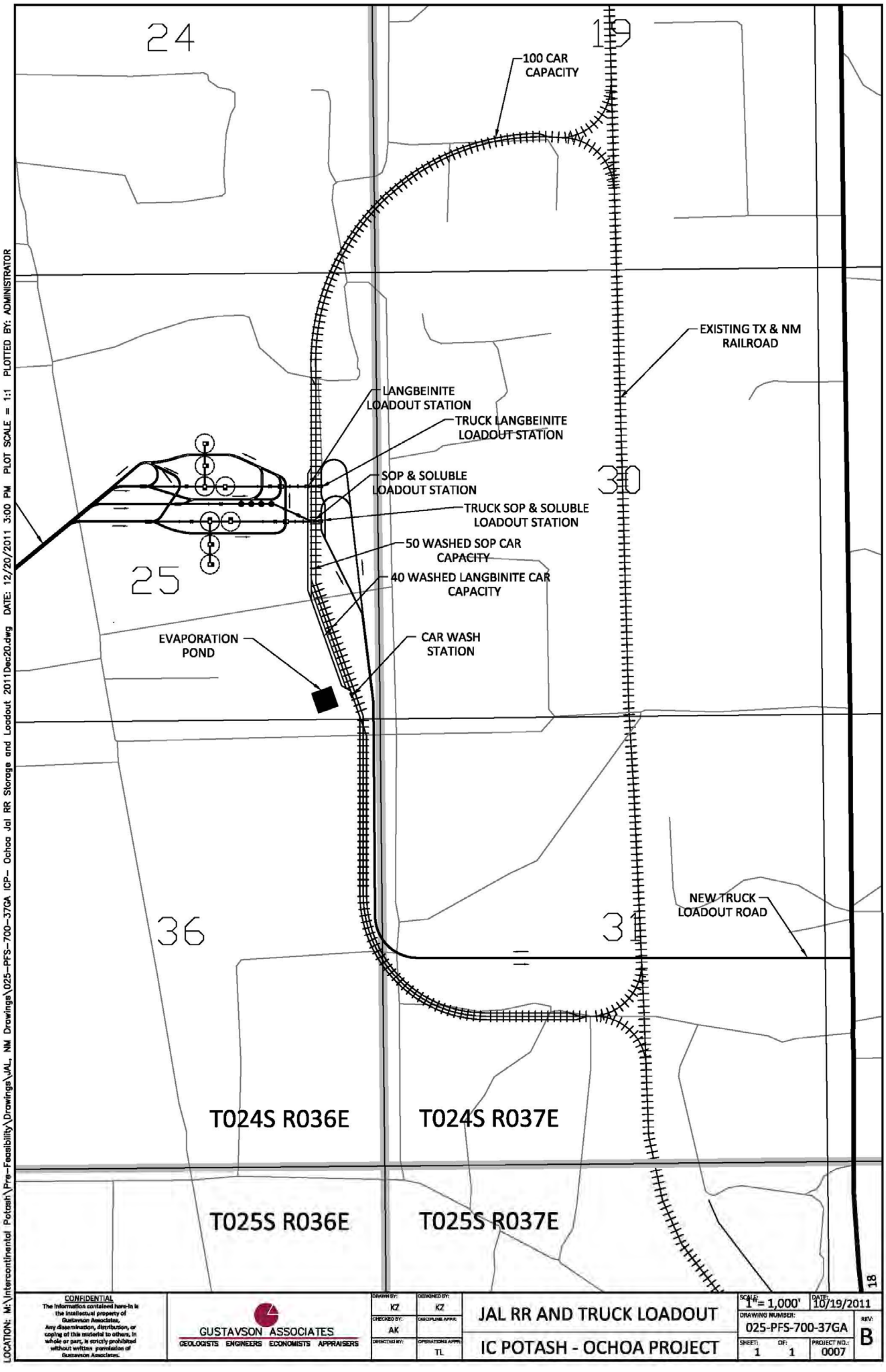


Figure 18-4 Jal RR and Truck Loadout

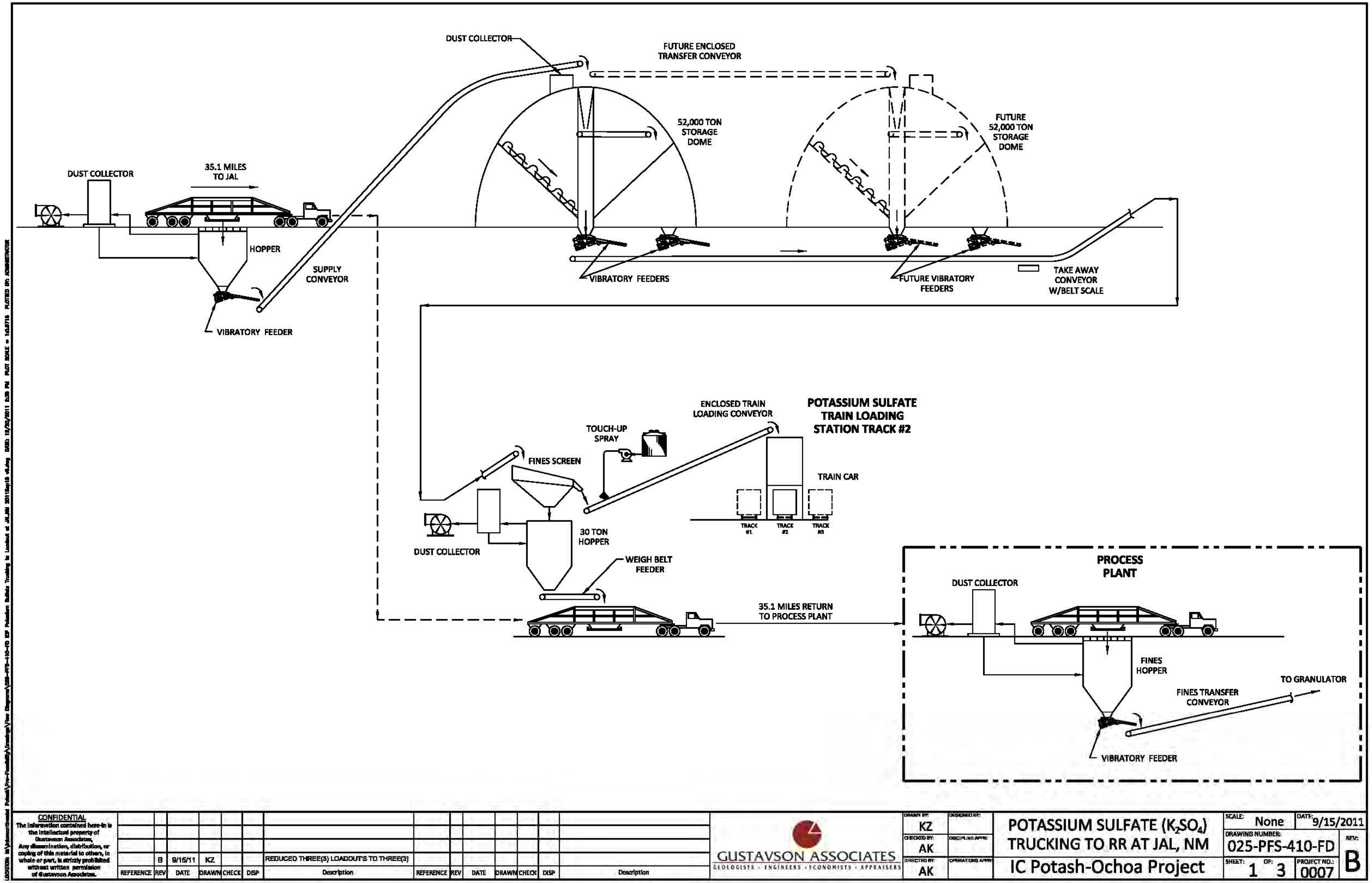


Figure 18-5 Potassium Sulfate Trucking to RR

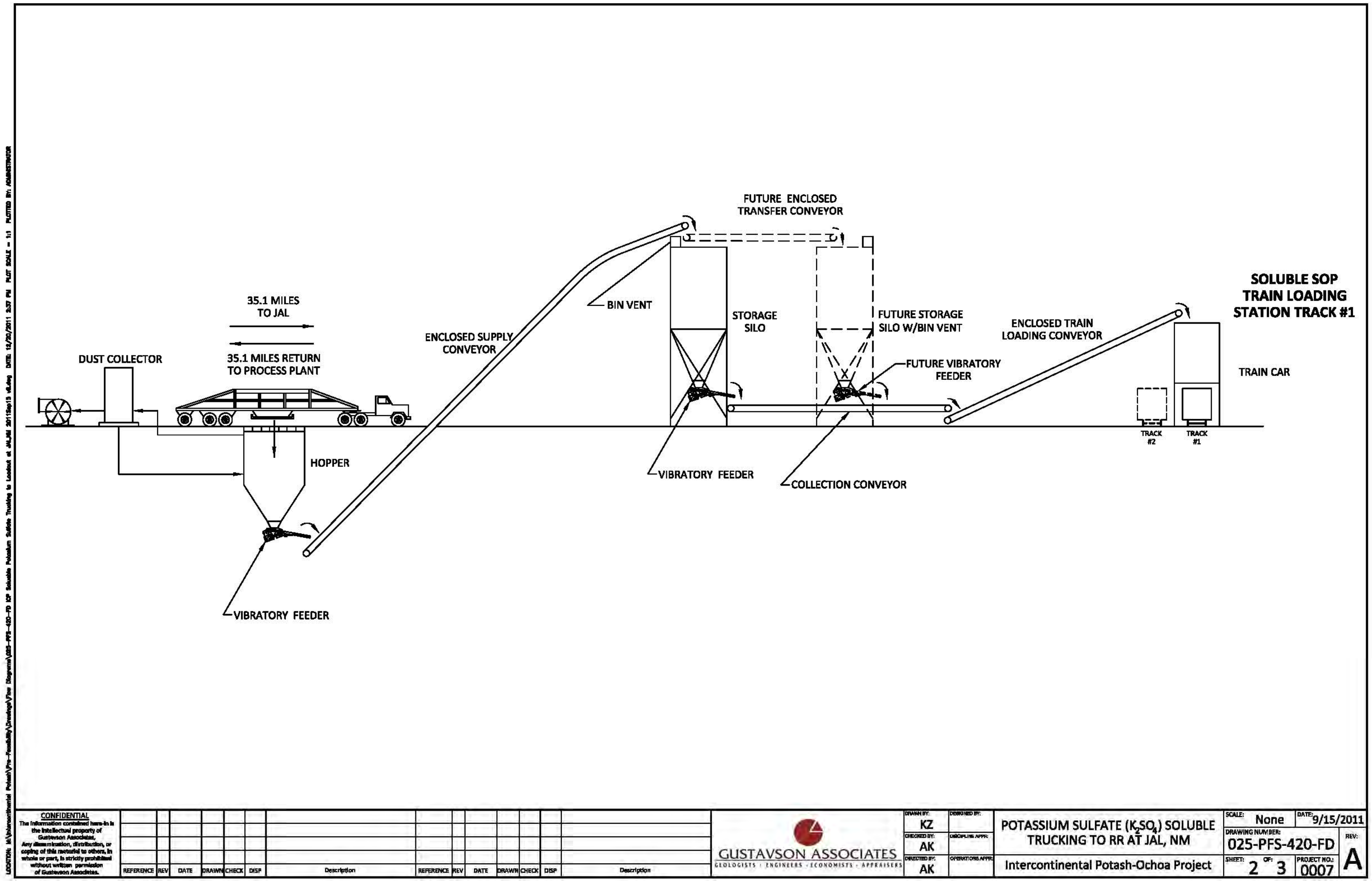


Figure 18-6 Potassium Sulfate Soluble Trucking to RR

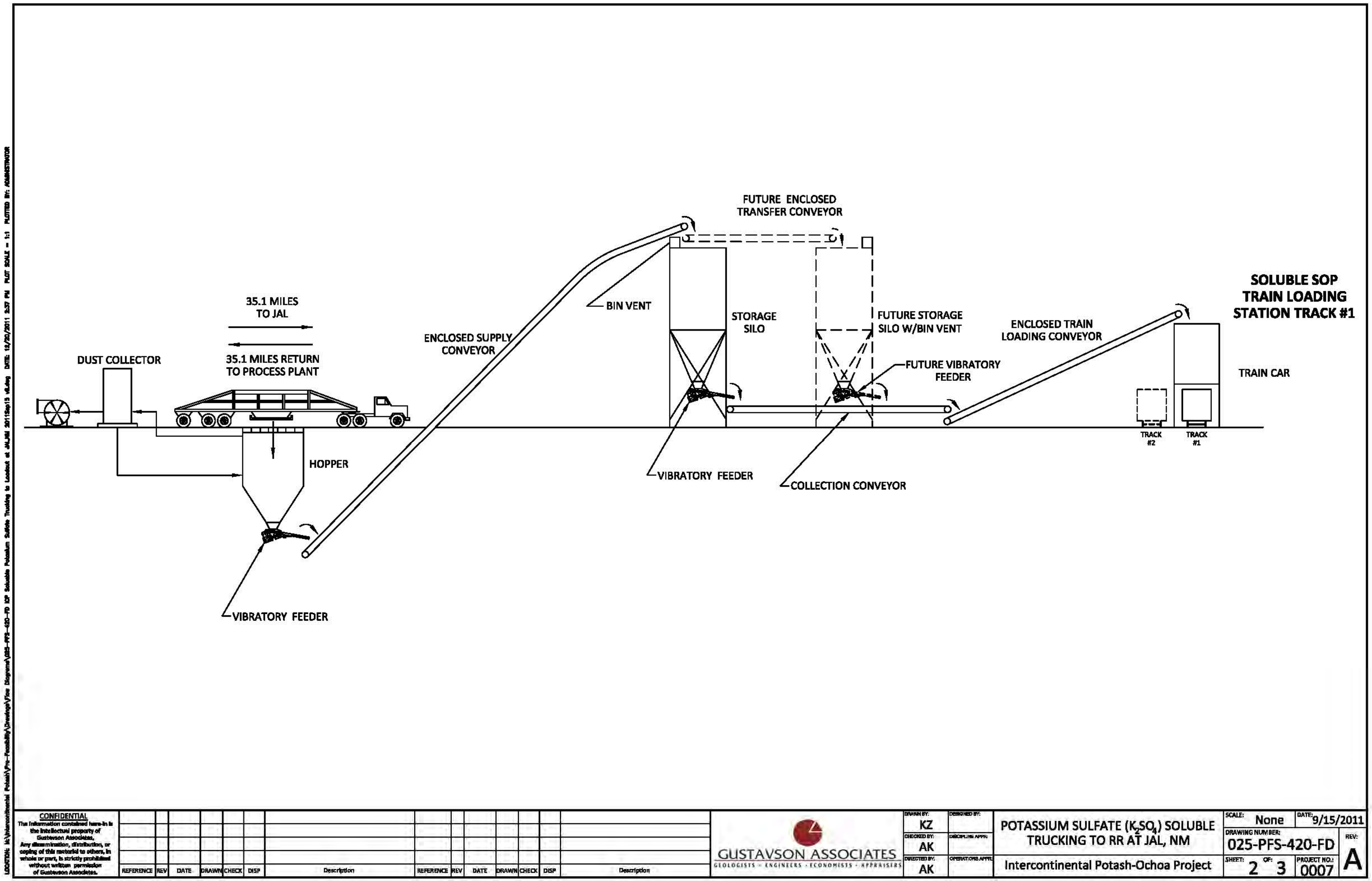


Figure 18-7 Langbeinite Trucking to RR

19 MARKET STUDIES AND CONTRACTS

19.1 Introduction

Chemical fertilizers have played a major role in the dramatic increase of agricultural production over the past 40 years. Better yielding seed varieties, more effective use of soil and water resources, mechanization, and the development of disease resistant crop varieties are frequently cited as the main forces underlying the famous "Green Revolution." This has all but abolished famine in most of the world and resulted in some historically food deficient countries (such as China and India) becoming exporters of food. Higher crop yields inevitably soak up large amounts of nutrients from the soil in quantities that cannot be replaced by so-called "natural" organic fertilizers. Keeping food production ahead of an ever expanding population has and will inevitably continue in the future, requiring increased chemical fertilizer use, especially in developing areas of the world.

One important aspect of future fertilizer use will be an increased awareness of the adverse effects of imbalanced and over-use of fertilizer nutrients. Just like the human body, plants require precise amounts of the essential nutrients in a specific ratio. For example, application of nitrogen fertilizer without the proper amount of phosphorous and potassium fertilizers will ultimately restrict the plant's ability to utilize all the nitrogen applied. Increased efficiency in fertilizer use will not only protect the environment, but will play an important part in maintaining the economics of food production within large sectors of the developing world.

In order to survive, plants, like all living creatures, require a balanced supply of three basic nutrient elements: nitrogen, phosphorous, and potassium. All of these elements are available to some extent in manures and crop residues: however, their concentration is quite low. Also, the chemical form of some of these essential nutrients in many organic sources, cannot be immediately utilized by plants. Finally, application of organic fertilizers, especially animal manures, in the quantities required to support profitable crop yields can create serious environmental problems. Chemical fertilizers provide farmers with an efficient and cost effective source of the essential nutrients in the concentrations and ratios necessary for modern agricultural production.

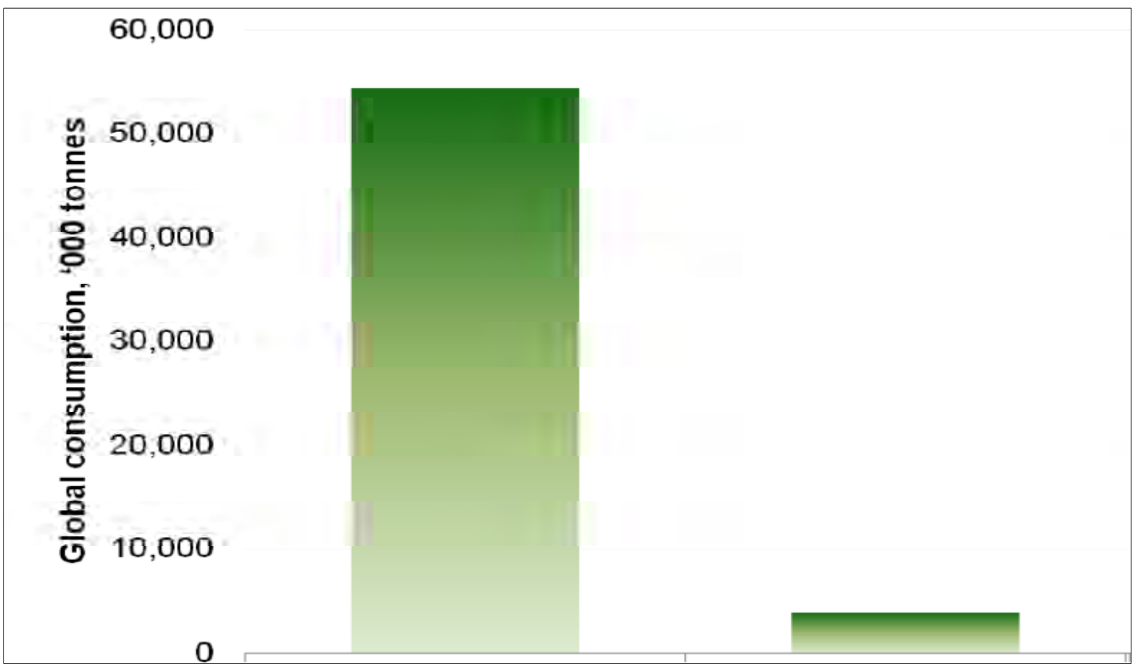
Of the three fertilizer nutrients, nitrogen fertilizers are most commonly derived from anhydrous ammonia. Most ammonia today is made by a chemical process that uses natural gas or other low-cost sources of hydrocarbon to convert the inert nitrogen gas in the atmosphere to the chemically active compound, anhydrous ammonia. Since reserves of natural gas are relatively common throughout the world, ammonia production facilities are widespread and many countries have some indigenous nitrogen fertilizer production.

Phosphorous and potassium fertilizers, on the other hand, are obtained from deposits of phosphate rock or potash bearing minerals or brines. Thus, commercially viable sources of the basic raw materials for phosphate and potassium fertilizers are limited to relatively few geographic regions.

19.2 Potash Products

Agricultural fertilizers account for approximately 94% of potash use. Various industrial uses account for the rest of consumption. The potassium content of potash is usually expressed in terms of potassium oxide (K_2O) content. For example, KCl contains a minimum of 60% K_2O while SOP has a minimum nutrient content of 50% K_2O.

The major fertilizer forms of potash are potassium chloride, which represents about 95% of the potash used in agriculture, and the non-chloride forms potassium sulfate, potassium magnesium sulfate and potassium nitrate. The two sulfate forms of potash, SOP and SOPM, account for almost all non-chloride potash fertilizer use. Of these two SOP forms, potassium sulfate accounts for about 5% to 6% of global potash fertilizer consumption. The relative consumption of potassium chloride in comparison to potassium sulfate in terms of global consumption of potash is shown in Figure 19-1, based on Total Potash Consumption in 2007.



Courtesy CRU Strategies **Potassium Chloride** **Potassium Sulfate**

Figure 19-1 Relative Position of Potassium Chloride and Potassium Sulfate

Potassium chloride (muriate of potash or MOP) is by far the most abundant potash salt in terms of mineral occurrence, availability, commercial importance, and consumption. It is also a lower cost source of potassium fertilizer. Potassium sulfate, because of its greater cost of production, has historically been priced higher than MOP. Consequently, MOP has become the potassium fertilizer of choice for most farmers around the world. In some situations however, SOP is the preferred potash fertilizer and growers will readily pay the higher price for SOP.

19.2.1 SOP Consumption Forecast

In the detailed study of the SOP market prepared for ICP by CRU Strategies, CRU provided a projection of the long-term outlook for SOP demand. The CRU projection of SOP demand over the period from 2010 to 2025 is presented in Table 19-1, below. CRU is forecasting a healthy growth over the next 15 years with global consumption of SOP anticipated to grow by 1.3 million tons (1.2 million tonnes) to a total of approximately 5.5 million tons (5 million tonnes) by the end of the 15 year forecast period. As with most fertilizer markets, the majority of this growth is expected to take place in developing countries, where the combination of population pressures and rising income levels will increase the demand for high value crops, and consequently also for fertilizers. This trend is especially apparent in Asia, which CRU expects will consume 2.8 tons (2.5 million tonnes) of SOP or slightly more than 50% of global consumption in 2025. By contrast, consumption in developed regions, such as North America and Europe, will either decline or show only very modest growth as a result of efficiency improvements in fertilizer use coupled with declining demand for compound Nitrogen, Phosphorous, Potassium (NPK) fertilizers in Europe.

Table 19-1 Forecast of Regional Consumption of Potassium Sulfate 2010-2025

Thousands Short Tons (Thousands Metric Tonnes K_2SO_4 Product)					
	2010	**2015**	**2020**	**2025**	**CAGR '10- '25**
Europe	1,095.7 (994)	1102.3 (1,000)	1,047.2 (950)	992.1 (900)	-0.7%
East Europe/FSU former Soviet Union	47.4 (43)	77.2 (70)	104.7 (95)	132.3 (120)	7.1%
North America	420 (381)	413.4 (375)	424.4 (385)	435.4 (395)	0.2%
Latin America	224.9 (204)	270.1 (245)	330.7 (300)	185.8 (350)	1.3%
Africa	260.1 (236)	292.1 (265)	314.2 (285)	336.2 (305)	1.7%
Mid East	237 (215)	292.1 (265)	314.2 (285)	330.7 (300)	2.2%
Asia	1,850.8 (1,679)	1,995.2 (1,810)	2,370 (2,150)	2,755.8 (2,500)	2.7%
Oceania	61.7 (56)	88.2 (80)	99.2 (90)	110.2 (100)	3.9%
Total World	**4,197.6 (3,808)**	**4,530.5 (4,110)**	**5,004.5 (4,540)**	**5,478.5 (4,970)**	**1.8%**

Data: CRU Strategies

The outlook for regional consumption of SOP from 2010 to 2025 is illustrated graphically in Figure 19-2.

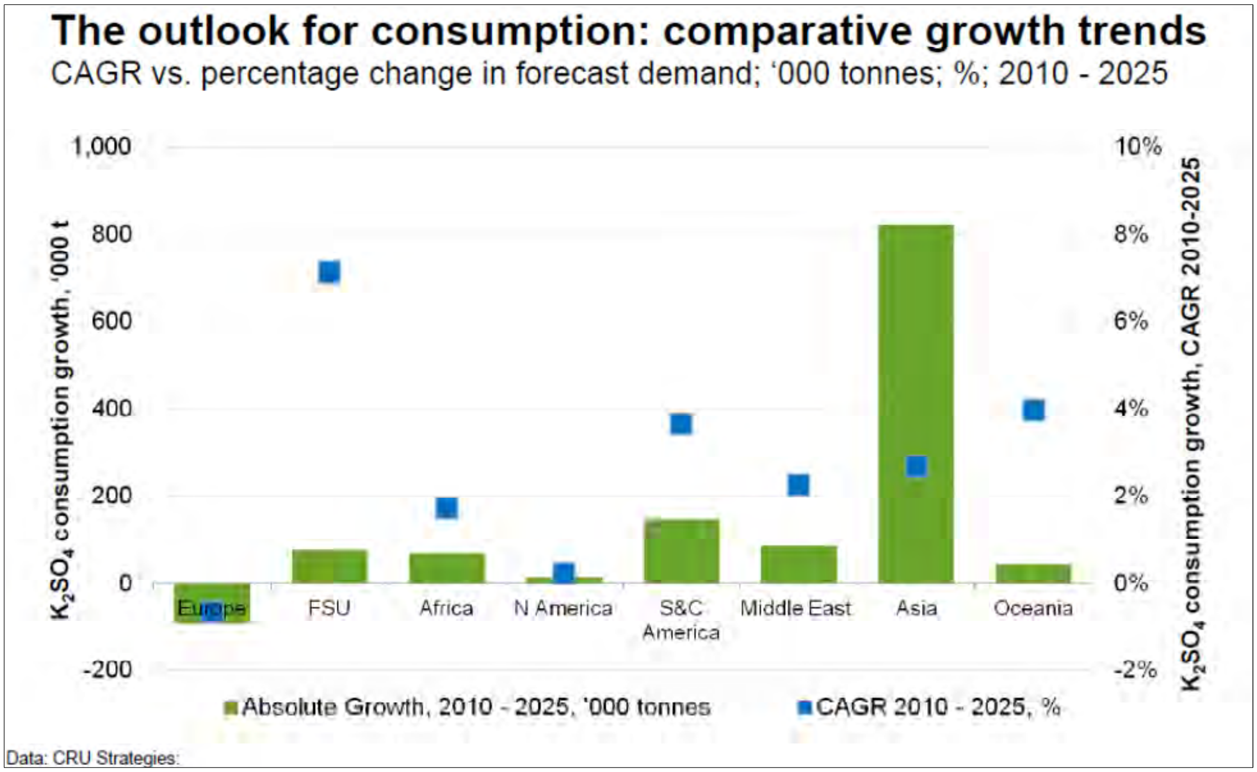


Figure 19-2 Outlook for Regional Consumption of SOP from 2010 to 2025

19.3 Potash Trade - SOP

19.3.1 Country Partner Arrangements

Global trade in SOP amounted to 2.4 million tons (2.2 million tonnes) of product in 2010, an increase of 23% from the beginning of the decade (Figure 19-3). The fact that 60% of all SOP produced during the year entered international trade shows what an important role the international market plays in its distribution. From an export perspective, producers in 18 different countries reported exports ranging from a low of a few thousand tons (tonnes) to nearly one million tons (tonnes). Some of the more prominent trends are described below in greater detail.

The majority of SOP is traded intra-regionally within Europe, or sent from European producers to consumers in Asia and the Americas (19-4). In 2010, the region accounted for three quarters of global exports, with German and Belgian exports amounting to 1.5 million tons (1.4 million tonnes). This represents a 9% increase over the corresponding tonnage in 2000, when exports from these two countries were just short of 1.4 million tons (1.3 million tonnes) of product.

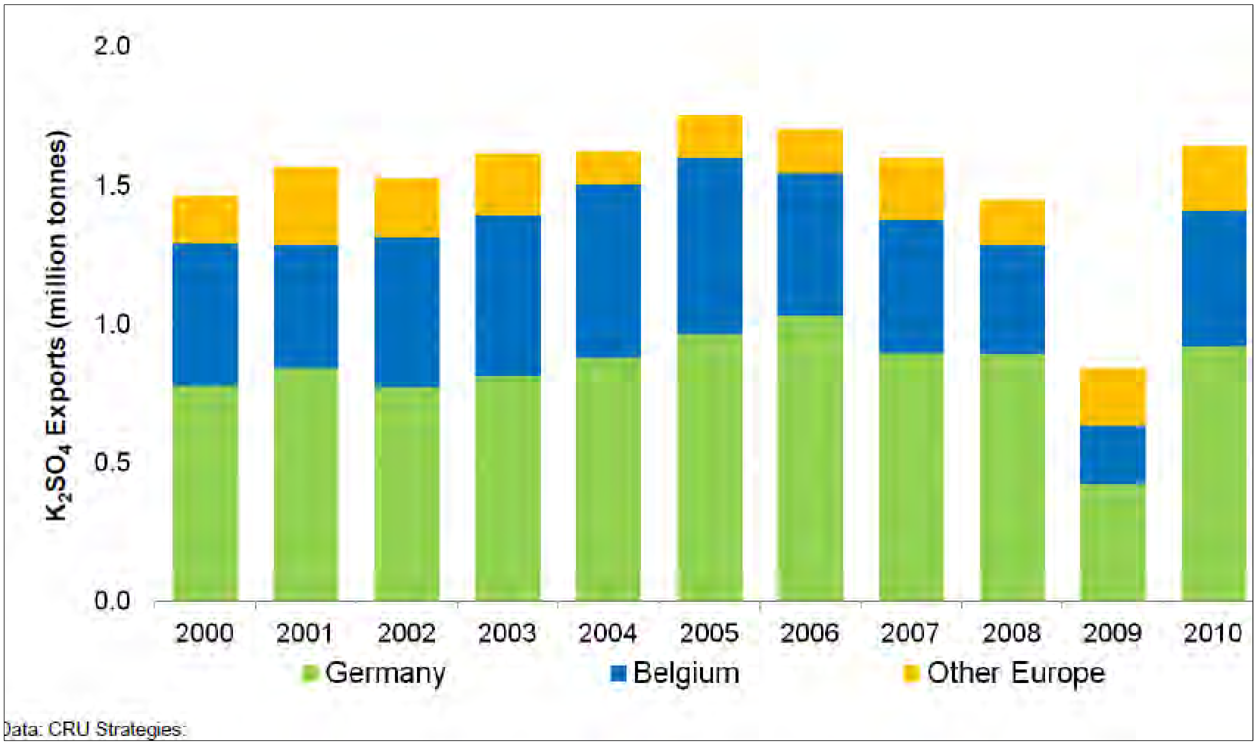


Figure 19-3 European Exports of Sulfate of Potash – 2000 - 2010

Germany's export share was estimated at roughly 992,000 tons (900,000 tonnes) of product in 2010, of which a third was sold mainly to NPK factories in Belgium and Norway. An additional 276,000 tons (250,000 tonnes) were exported to other European countries, of which France, Italy, Netherlands, and Greece each took more than 22,000 tons (20,000 tonnes) of product. Exports outside Europe were mainly to the Asian and Middle Eastern markets, with China, India, and Iran each importing 44,000-72,000 tons (40,000–65,000 tonnes) of product. The United States was Germany's sixth largest export destination in 2010, with 45,000 tons (41,000 tonnes) of imports.

Belgium's exports have been between one half and two thirds of Germany's in any one year. The country's largest export partner has been Iran, which took 21% of its total SOP exports in 2010. The remainder is accounted for by intra-regional trade (43% of total), Latin America (15%), Africa and Asia (jointly 15%). Belgian exports to the United States have been negligible in recent years.

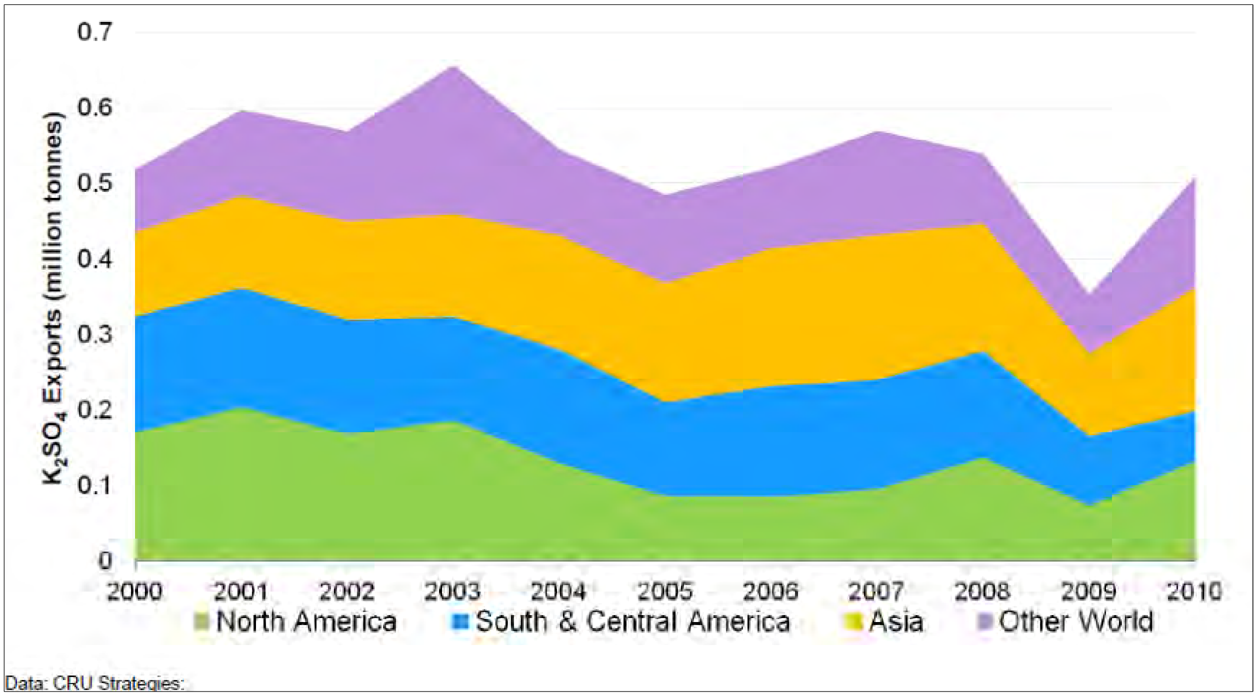


Figure 19-4 Global Exports of SOP (Excluding Europe) – 2000 – 2010

Exports from other regions are comparatively small, jointly accounting for 25% of the total volume of SOP exports in 2010. The most important of these were located in North and South America as well as Asia. In South and Central America exports have fallen by 57% since 2000, to a total of 73,000 tons (66,000 tonnes) in 2010. This is the result of lower SOP production volumes at SQM's Atacama de Salar operation in the north of Chile. A similar trend is evident for North American exports, where weak international demand, particularly from Mexico and Canada, resulted in a 38,000 ton (34,000 tonne) reduction in exports between 2000 and 2010.

SOP trade in Asia is dominated by the Taiwanese and Korean producers, which together accounted for 85% of the regional total. Chinese exports, which had been growing until

2007 (eventually peaking at 65,000 tons [59,000 tonnes]), have subsequently fallen to close to zero as result of the high export tax that was introduced for various fertilizer products in 2007.

Importing countries, by contrast, are far less concentrated, with over 130 countries reporting imports of SOP. The countries of Europe are the largest importers of SOP, accounting for 45% of the total SOP trade in 2010. Trends in each of the major regions are illustrated in Figure 19-5, below.

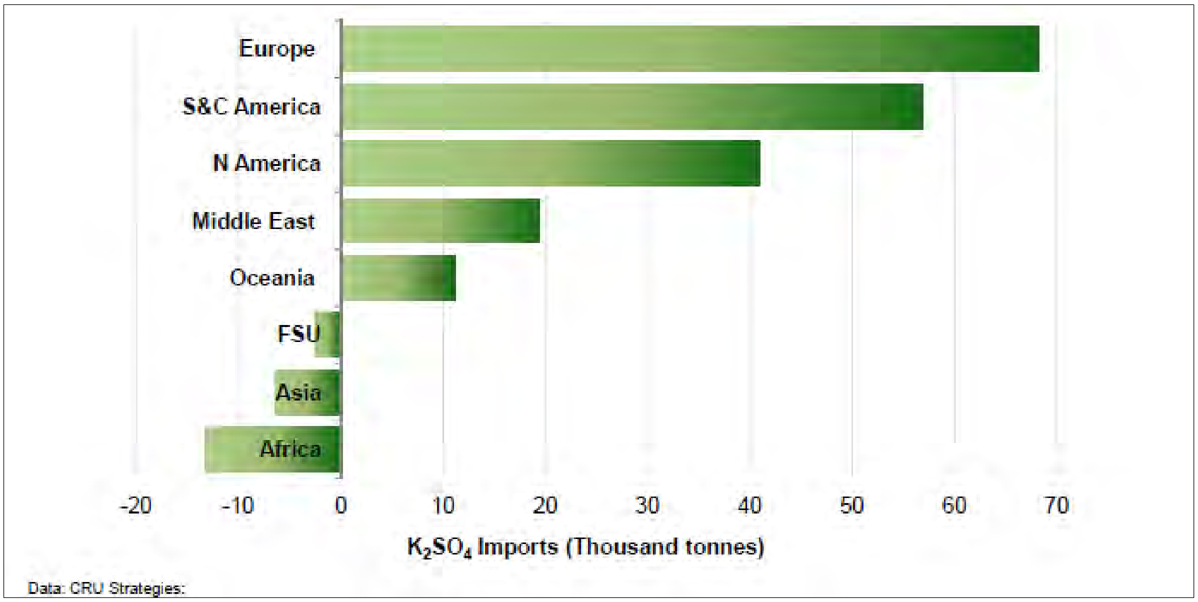


Figure 19-5 Change in SOP Trade 2000-2010

The top five European SOP importers in 2010 were Belgium, Norway, France, Italy, and the Netherlands, which jointly accounted for a third of all global trade. Much of the product imported into Belgium and Norway was probably re-exported in the form of NPK compounds while the SOP imported into France, Italy, and the Netherlands was used domestically on fruits, vegetables, and potatoes.

Outside Europe, imports grew in North America, South and Central America, the Middle East, and Oceania between 2000 and 2010. Much of this growth occurred in the Americas, where imports were 110,000 tons (100,000 tonnes) higher than at the beginning of the decade. South and Central American SOP imports totaled 218,000 tons (198,000 tonnes) in 2010, which was 62,000 tons (56,000 tonnes) higher than a decade ago. Although the overall trend in imports into Latin America has been positive, the total amount imported in 2010 is still somewhat lower than the peak of 264,000 tons (239,000 tonnes) reached in 2004. A combination of demand destruction due to soaring MOP prices and the financial crisis in 2008/2009, caused imports to fall to a low of just 82,000 tons (74,000 tonnes), 70% lower than the previous peak. Since then however, renewed demand for potash fertilizers, especially in the six largest South and Central American fertilizer consuming countries – Brazil, Costa Rica, Ecuador, Mexico, Peru, and Venezuela – has led to a recovery in SOP trade in the region.

In North America imports have grown by 44,000 ton (40,000 tonnes) between 2000 and 2010. Here again, after peaking in the early part of the decade, imports fell by 42% between 2002 and 2008. The principal reason behind this was the ramping-up of domestic capacity at the Great Salt Lake. Between 2003 and 2004, Great Salt Lake Mineral's domestic sales increased by approximately 110,000 tons (100,000 tonnes), which corresponded with a 12% decline of imports. The negative trend continued, more-or-less, consistently through to 2008, when GSL SOP list price hit US$1,100 per ton ($1,000 per tonne), making imported material more competitive. As a result, imports have since recovered to around 132,000 tons (120,000 tonnes) in 2010.

SOP trade in the Middle East has been relatively volatile over the past decade primarily because the variation in imports by Iran. The country is an important consumer of SOP in the Middle Eastern market, accounting for 66% to 89% of the region's total imports during a normal year. However, Iran's imports collapsed in 2002 and then again in 2005 as result of the Iranian importer's decision to cut back on purchases during those years in order to deplete its inventories.

In Oceania, the arid weather conditions prevalent in Queensland and Western Australia have historically been the main driver of demand for imported SOP. Given the increasing number of droughts in these areas in the past decade, it is not surprising that imports to Oceania have grown in recent years. The cyclical peak was achieved in 2008, when regional imports totaled 76,000 tons (69,000 tonnes). Although they have since fallen, mostly as a result of the effects of the global financial crisis, regional imports in 2010 were still 25% higher than they were at the beginning of the decade.

Imports across the remaining regions, Asia, Africa and the former Soviet Union, fell between 2000 and 2010 for a variety of reasons: In Asia, import growth in India, Pakistan and Turkey was cancelled out by significant reductions in Chinese and Japanese imports. In the short to medium term, further reductions are expected in Asia as SDIC-Luobupo continues to ramp up its capacity in the next several years. Imports into Eastern Europe and Africa have together fallen by 16,500 tons (15,000 tonnes) between 2000 and 2010. The decline in Africa is probably the result of higher rates of domestic production, especially in Egypt, where small-scale Mannheim production has been started.

19.3.2 The Position of ICP in International Trade

The following will outline the position of the U.S. and ICP in the international market for SOP. Some comments about organization, logistics and specific target markets will be included.

Because potassium-magnesium sulfate compounds play a significant part in some of the markets that will be of importance to ICP, information about the export trade in potassium-magnesium sulfate also will be included here. The focus of the discussion in this section will be on those markets that will be primary targets for ICP, namely, Canada, Latin America, certain countries in Asia and Oceania. Although the countries of Europe remain the largest consumers of SOP and are also large users of potassium-magnesium sulfate products, the European market may be difficult for ICP to penetrate both because of logistics and the presence within the region of K+S

Kali in Germany and Tessenderlo in Belgium, two of the largest producers of SOP in the world. By the same token, markets in the Middle East and some of those in Africa may also be difficult for ICP to compete because of their proximity to Europe or for political reasons. For example, trade with Iran, the largest consumer of SOP in the Middle East, is not likely for a U.S. company in the foreseeable future because of sanctions on trade imposed by the United Nations and the U.S. government. Similarly, sales by ICP to Egypt and Morocco will be difficult because of freight considerations and the historic ties these countries have with European suppliers. This is not to say that ICP will forever be excluded from any or all of these markets; however, it will be a more productive approach for ICP to focus initially on those markets where it has some advantages over its competition and where it is most likely to rapidly gain a significant market share.

The premium price of SOP over that of potassium chloride is a factor limiting its acceptance in some of ICP's potential export markets; for example, India's, government fertilizer subsidy program does not support SOP making the SOP price prohibitive for most Indian farmers.

By the time SOP reaches the grower, its cost may well be two or three times the price of the product at the producing point as a result of transportation and other logistical costs. Since farmers in many of the countries in Latin America, the Caribbean and Asia are not wealthy, the delivered price of SOP as opposed to the cost of MOP is definitely a factor limiting the use of SOP in these areas. As a result of its relative high cost, especially in regions subject to heavy rainfall, farmers will apply MOP to chloride sensitive crops early in the hopes that rainfall will leach out the chloride before its presence can impact the crop, Even though the farmers are fully aware of the agronomic benefits of SOP

Because soils on which high yielding crops like canola, citrus, oil palm, high starch potatoes and sugar beets are grown tend to be lacking in secondary nutrients such as sulfur and magnesium, potassium-magnesium sulfate products, e.g. langbeinite (K-Mag ®), have found good markets in diverse places like Canada, Mexico, Colombia and Japan. In many cases, the fact that these products are chloride ion free is also a plus. Since potassium-magnesium sulfate products are generally priced well below SOP, some growers may opt to purchase potassium-magnesium sulfate products as opposed to SOP, especially if they also need supplemental magnesium fertilizer. The primary competition for potassium-magnesium type products is magnesium sulfate in the form of kieserite or Epsom salts in combination with SOP or MOP depending on the crop and/or soil.

In summary, in order for ICP to maximize its market potential in its primary target markets, the company should offer as broad a product line as possible. This would include both SOP and potassium-magnesium sulfate products and perhaps a magnesium sulfate product as well. The fact that ICP will produce magnesium sulfate as a co-product with its SOP should offer the opportunity to broaden its product line to include valuable fertilizer materials other than SOP.

Regardless of the products ICP ultimately offers to the domestic and international market, it will be necessary for ICP to proceed carefully, establish realistic sales objectives for each market and then develop a specific strategy to achieve these objectives.

19.3.3 International Market Overview

When assessing the prospect for international sales, a primary source of information is the reporting tonnages of potash materials (both SOP and SOPM) moving from producing countries to importing countries and changes in these tonnages from year to year.

In 2008, world trade in potash reached a total of 48.7 million tons (44.2 million tonnes) of potash products. Of this total, exports of SOP and SOPM amounted to 2.5 million tons (2.3 million tonnes) and 623,000 tons (564,000 tonnes) or about 5.2% and 1.3% of total potash trade respectively. Reflecting the impact of the global economic crisis that struck in 2008, trade in potash declined precipitously in 2009 to a total of about 23.3 million tons (21.1 million tonnes) with exports of SOP dropping to about 1.4 million tons (1.3 million tonnes) 6% of world potash trade and exports of SOPM to about 471,000 tons (427,000 tonnes) 7% of world trade. The degeneration in potash trade during 2009 is considered to be an anomaly and not an indication of a permanent change in the market demand for SOP and SOPM products. This is further supported by the rebound in export trade in 2010 to pre-2005 levels, as seen in Figure 19-3. Therefore, information from the year 2008 will be used as the basis for the discussions of specific markets in this section of the report.

Although exports of both SOP and SOPM were lower in 2009 than in 2008, it is important to note that both products actually increased their share of the potash export market with SOP representing about 6% of total potash trade and SOPM materials almost 2%. The relative market strength of these potash products during one of the worst economic downturns since the 1930s is an indication of the value placed on these non-chloride forms of potash for those crops and soils that are adversely impacted by the chloride ion in potassium chloride.

On a regional basis, trade in SOP declined across the board in 2009 with the exception of a modest increase in imports of SOP in to North America. Among the region's most attractive to ICP (North America, South America and Asia), North America actually experienced a 32% increase, while the group was off by 40%. This group represents 31% of all export off take, and is expected to return to pre-2009 levels or more during 2011 – 2015.

Table 19-2 Sulfate of Potash Imports by Region

Sulfate of Potash Imports by Region		
Thousands Tons (Thousands Tonnes) Potash Product		
	2008	**2009**
North America	84.9 (77)	112.4 (102)
Latin America	281.11 (255)	94.8 (86)
Asia	421.1 (382)	264.6 (240)
Oceania	77.2 (70)	35.3 (32)
Africa	231.5 (210)	163.1 (148)
Middle East	392.4 (356)	297.6 (270)
Europe	1,034 (938)	421.1 (382)
CIS	4.4 (4)	2.2 (2)
Misc. Unidentified	9.9 (9)	0
Total	**2,536.4 (2,301)**	**1,391.1 (1,262)**

Source: Fertecon, IFA

Although a much smaller market, trade in potassium-magnesium sulfate products fared better than SOP over the 2008 – 2009 period (Table 19-3). Regional imports (North and South America and Asia) of these materials declined modestly by only about 13% year over year. What is most significant about the data in Table 19-2 are two things. First, the largest market for SOPM products is Latin America with Asia being the number four consumer and North America being number three. These are all key target markets for ICP. The second important point is that the drop in imports of SOPM by Latin America in 2009 was only about 10%, while imports by Asian countries, another important potential market for ICP, actually increased by 8%. This was in a year when overall potash demand was off by more than 50% and demand for SOP was off by 45%.

Table 19-3 SOPM Imports by Region

Potassium-Magnesium Sulfate Imports by Region		
Thousands Tons (Thousands Tonnes) SOPM Product Basis 22% K2O		
	2008	**2009**
North America	79.4 (72)	49.6 (45)
Latin America	240.3 (218)	215 (195)
Asia	69.4 (63)	75 (68)
Oceania	37.5 (34)	0
Africa	4.4 (4)	0
Middle East	0	0
Europe	185.2 (168)	100.3 (91)
CIS	4.4 (4)	0
Misc. Unidentified	1.1 (1)	30.9 (28)
Total	**621.7 (564)**	**470.7 (427)**

Source: Fertecon, IFA

Finally, there is no doubt that ICP will face some stiff competition as it enters the market. K+S and GSL will not give up their market positions easily and Intrepid and Mosaic can be expected to fight hard to maintain sales of their potassium magnesium sulfate products. Nevertheless, with low production costs and high quality products, ICP can overcome its competitors and achieve the level of market penetration it desires. Finally, one must always keep in mind that the major competitor for all SOP producers is the availability in the market of abundant quantities of low cost MOP.

19.3.4 ICP International Sales Organization

ICP will need to have a marketing department to secure contracts for its products, which initially will consist of a senior manager, a manager- assistant and a documentation and logistic specialist. The senior manager would be experienced in dealing in the international market, particularly with the potash markets in Central and South America since these markets will be the primary international outlets for ICP's SOP, SOPM, and magnesium sulfate products. The team will also need to have experience with the potash markets in Asia would also be helpful as Asia will represent a region where ICP will be marketing a significant quantity of materials.

Finally, although it should be possible for ICP to handle sales to some international markets by dealing directly with the one or two companies that have a major share of the market in their country; it is very likely that ICP will market a substantial amount of its product in the international market using the services of sales agents. In general, these sales agents would be independent business people who have extensive contacts and business relationships in the fertilizer industry in their country. The sales agent would be responsible for representing ICP to fertilizer producers and distributors in their region, developing and administering sales of ICP products and, in many cases, for assisting buyers in finding financing for purchases of ICP products and coordinating the delivery of the products after purchase.

19.3.5 Supply Routes and Distribution

By way of background, most farmers and growers do not buy SOP as such. Rather, SOP reaches these users most often as a component of a balanced fertilizer blend containing specific amounts of nitrogen, phosphorous and potassium along with secondary nutrients such as magnesium and sulfur and possibly microelements, e.g. zinc, boron, iron, etc. These fertilizer blends are formulated to meet specific crop and soil nutrient requirements. In most cases, there are only certain crops grown in areas served by a fertilizer dealer. So the dealer will normally have on hand the formulations most suited for the area he serves.

Therefore, there is no need for a new producer of SOP such as ICP to spend a lot of time and effort reaching out to farmers and growers to tell them about the advantages of SOP for certain crops and soils. These consumers already know the advantages of SOP. Rather, the marketing target has to be principally the distributors and regional suppliers that actually buy SOP as such.

Figure 19-6 is an outline of the principal channels of distribution from the Ochoa mine for ICP products.

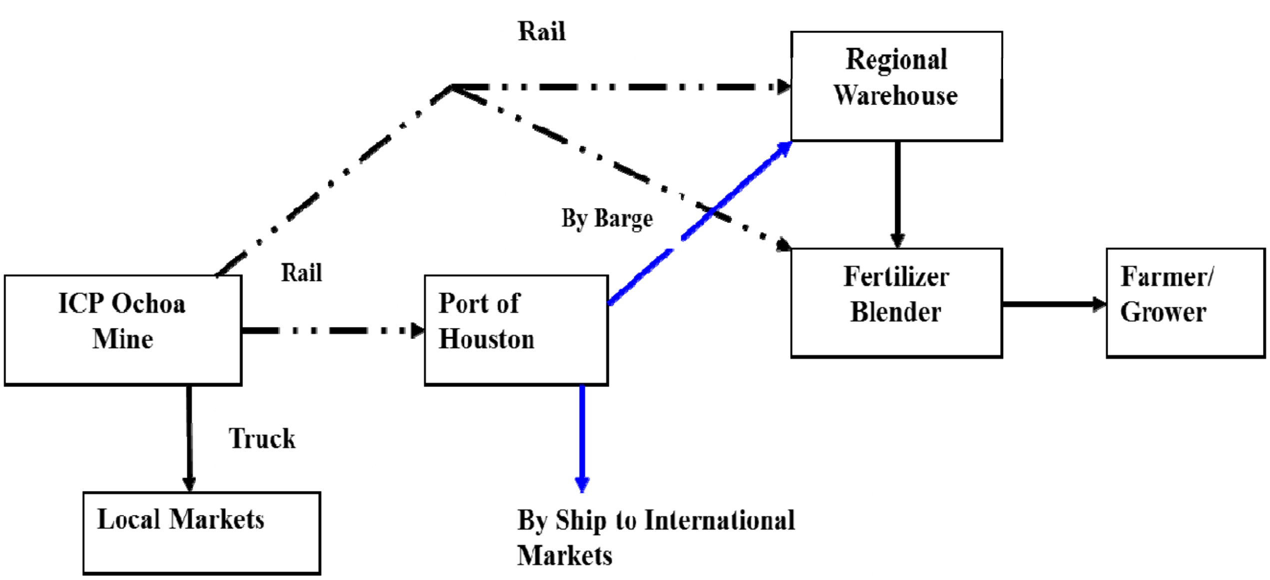


Figure 19-6 Distribution Routes for ICP Products

GUSTAVSON ASSOCIATES

Because the ICP mine and processing operation will be located in southeast New Mexico, well away from any export port or domestic market region, most of ICP's product will have to be shipped from the mine by trucks to a railcar loadout station near the town of Jal. Other alternatives would be to ship directly to the buyer's receiving location or, alternatively, if the buyer's facility is located on a major river, to the port of Houston, loaded on barges and then transported via the inland waterway system to the buyer.

In order to be most economic, rail shipments, whether to the domestic market or to a port for export will be made in multiple car units. The day of the single car rail shipment is mostly a thing of the past. The covered hopper cars used for fertilizers generally carry 100 tons of product. In order to obtain economic freight rates, commitments by ICP to the railroads to make shipments of as few as 8 to 10 cars to as many 100 cars at a time to a single destination will be required.

In the case of most shipments to the international market, the SOP would be shipped in multiple car lots by rail to the port of Houston where it would be loaded onto vessels for transport overseas. Since the individual export shipments of finished product are not likely to be of a size to fill more than one or two typical holds of a ship, very likely intermediate storage at the port will not be required and rail cars will be loaded directly onto the ship when the vessel arrives, also reducing the chances of product degradation from multiple handling.

One exception to exporting through the port of Houston would be for product going to Mexico. In this case, the SOP would most likely be transported directly be rail or by truck to customers in Mexico. The ability to service the market in Mexico from a location in the U.S. close to the border is a major competitive advantage that ICP will enjoy.

In addition to providing attractive outlets for ICP's products, the international market offers the further advantage of offsetting in part the very seasonal nature of the U.S. domestic market. Since the timing of growing seasons may be different in other parts of the world and significant transit time is usually required to move fertilizer products from the U.S. to an overseas location, sales to the international market can relieve inventory pressures during periods when demand in the domestic market is dormant. On the opposite side of the equation, the international market is competitive and participation requires a somewhat different approach and skill set than selling to buyers in the U.S.

In summary, the international market is likely to be as important a sales outlet for ICP as the domestic market. However, successfully obtaining and maintaining a share of the international market for SOP and related fertilizer materials will require persistence and a high degree of expertise.

19.4 Potash Trade - SOPM

World production of SOPM amounts to some 1.3-1.4 million tons (1.2-1.3 million tonnes) per year which, in terms of its magnesium content, is equivalent to 882,000 tons (800,000 tonnes) per year kieserite. There are three groups of producers – in the United States, Germany and China – and they supply most of this product to their own regional markets in the Americas, Europe and China. The total capacity for SOPM in 2010 was 2.6 million tons (2.4 million tonnes) per year (Table 19-4) which was roughly double the estimated level of production. The surplus capacity was in the United States and China.

Table 19-4 Nameplate Production Capacity for SOPM

Nameplate Production Capacity for SOPM				
Country	**Company**	**Location**	**Capacity ('000 tpy [tonnes per year])**	**Raw Material**
GERMANY	K+S Kali	Wintershall	276 (250)	Kieserite + K_2SO_4
U.S.A.	Mosaic	Carlsbad NM	1400 (1270)	Langbeinite ore
	Intrepid	Hobbs NM	250 (227)	Langbeinite ore
CHINA	CITIC-Gouan	W.Taijinaier Lake QH	165 (150)#	Natural Brine
	Qinghai Lianyu	E. Taijinaier Lake QH	165 (150)	Natural Brine
	Qinghai Gaoduan	E. Taijinaier Lake QH	165 (150)	Natural Brine
	Bindi Potash	Lenghu Lake QH	220 (200)	Natural Brine
	Yaret Chem. Ind.	Manasi Lake XJ	110 (100)	Natural Brine
	SDIC-Luobupo	Lop Nor XJ	110 (100)	Natural Brine

Data: CRU Fertilizers

Some comments about the producers of SOPM are given in the following paragraphs.

19.4.1 United States

SOPM is produced in the United States by the two potash companies that have mines in New Mexico. These producers mine langbeinite ore and wash it to remove the salt (NaCl) and obtain a langbeinite concentrate that is a marketable product. Mosaic, the larger of the two producers, has capacity for 1.4 million tons (1.3 million tonnes) per year SOPM, which it markets as *K-Mag*®, and Intrepid, which started production in 2005, has capacity for 276,000 tons (250,000 tonnes) per year, marketed as *Trio*®. In a normal year their combined output is estimated to have been about 992,000 tons (900,000 tonnes) per year of SOPM, of which 55% is sold in the United States and Canada, 30% in Latin America, some in Europe and the rest in Asia/Pacific markets.

19.4.2 Germany

At K+S Kali's Wintershall potash refinery, some of its output of SOP and kieserite powder is mixed in a 60:40 ratio and passed through a drum granulator to make *Kalimagnesia®* fertilizer. The annual output is estimated to be 276,000 tons (250,000 tonnes) per year, of which 95% is sold to European countries, including the German home market.

19.4.3 China

There are six active producers of SOPM in China. All but one small operation is based on brine from salt lakes in the northwest of the country. The first production of SOPM in China was in 2005, when CITIC-Gouan commissioned the solar evaporation and refinery complex at West (Xi) Taijinaier Salt Lake, in Qinghai Province. CITIC-Gouan planned to build up sales and to expand its capacity at West Taijinaier to 1.1 million tons (1.0 million tonnes) per year. More investors from the private sector followed CITIC-Gouan in developing other salt lake resources in Qinghai and Xinjiang to recover SOPM. In addition, the state-backed SDIC-Luobupo Potash started up a commercial-scale pilot plant at the site of its SOP operation to prove a process for making SOPM.

All of these companies have sought to market SOPM as a specialty fertilizer to growers of higher-value fruit and vegetables within China. Although priced more cheaply than the main potash fertilizers, the low K_2O content of SOPM has meant that the unit cost of its K_2O has been relatively high. However, the relatively high cost of the potassium nutrient is offset by the value of the other nutrients, i.e. magnesium and sulfur. The marketing campaign for SOPM coincided with a period of very high prices for potash, and sales of SOPM failed to take off. The new producers also found that they did not have access to the cheap rail tariffs that are available to the main potash producers in northwest China and so have had to pay the full freight charges to the markets areas in southern and eastern China. As a result of these negative factors, there has been a move away from producing SOPM in China:

- CITIC-Gouan has abandoned its expansion project and will close down the SOPM operation at West Taijinaier in 2011.
- CITIC-Gouan's JV with Qinghai Lianyu will develop SOP production to replace SOPM at East Taijinaier in 2012.
- Xinjiang Yaret has already converted half of its 220,000 tons (200,000 tonnes) per year SOPM capacity to make 44,000 tons (40,000 tonnes) per year K_2SO_4, and plans to convert the rest in 2011.

This appears to leave Qinghai Bindi and Qinghai Gaoduan as the only regular producers of SOPM in China, plus the first stage of the Luobupo SOPM project. However, the construction of the 1.1 million tons (1.0 million tonnes) per year SOPM capacity at Luobupo is reported to have been delayed beyond 2012 status. Nevertheless, given that Luobupo Potash has the backing of the SDIC and is contributing to the industrialization of Xinjiang region, it is likely that this project will be implemented. Unlike the other SOPM operations, Luobupo does not have access to KCl to give it the option of converting its magnesium sulfate into SOP.

The consumption of SOPM fertilizers is heavily concentrated in a small number of regions around the world (Table 19-5). The most important is North America which, together with Latin America, accounts for 60% of the world total. These regions are followed in importance by Europe (15%) and China (12%), with the rest of the world accounting for the balance of 13%. It is striking that Southeast Asia, which is a major consumer of magnesium fertilizers in the form of kieserite, is only a small importer of SOPM.

Table 19-5 Consumption of SOPM in 2008

Consumption of SOPM in 2008		
Region	'000 tons (tonnes)	% of Total
Europe	210 (191)	15.0
Southeast Asia	59 (54)	4.0
East Asia, Oceania	228 (207)	16.0
(of which, China)	169(154)	12.0
North America	532 (484)	38.0
Latin America	315 (286)	23.0
Others	52 (47)	4.0
WORLD TOTAL	**1396 (1269)**	**100.0**

Data: CRU Fertilizers estimates

In the United States most of the demand for SOPM fertilizers has been in Florida and California, where citrus and other tree crops have been the main drivers. In Latin America there is significant demand for fertilizing these crops, as well as bananas, coffee, sugar cane and various high-end fruit and vegetable crops grown for export to world markets. In Europe, several different Mg fertilizers are available from K+S Kali, which aims its SOPM product at crops that respond to chloride-free fertilizers, including potatoes and other root vegetables, leaf vegetables, tree fruits, soft fruits, grapes and ornamental trees.

In China, the crops that represent the main potential market for soluble magnesium fertilizers, such as bananas and oil palm, are grown in Hainan, Guangdong, Guangxi and other areas in the south of the country. Until now it has proved difficult to persuade farmers that they should pay for secondary nutrients such as magnesium and sulfur, in addition to potash.

20 HYDROGEOLOGY

The Ochoa Project is anticipated to require about 900 gpm of water, however a capacity of approximately 2,000 gpm of water is considered here to allow for expansion and optimization of the process flow sheet. This translates to approximately 2.9 million gallons per day (mgd), or approximately 3,200 acre-feet per year (ac-ft/yr). This section provides a summary of the evaluation of potential water sources that are being considered for the project.

20.1 Evaluation of Potential Water Sources

Water is available for the Ochoa Project from a variety of potential sources. Options that are under consideration for supplying the Ochoa Project include (1) purchasing water from the City of Carlsbad, New Mexico's Double Eagle Water System (DEWS, supplied by the Double Eagle Well Field) or other municipalities; (2) purchasing and transferring water rights; (3) purchasing water from an out-of-state source; (4) applying for a new appropriation from the Capitan Administrative Basin (Capitan Basin); or (5) developing deep brackish groundwater (for which a water right is not required for mining operations). Note that the Ochoa Project site is in the Carlsbad Administrative Basin (Carlsbad Basin) and adjacent to the Capitan Basin (Figure 20-1); however the Carlsbad Basin is closed to new appropriations.

20.2 Purchasing Water from the City of Carlsbad or Other Municipality

The City of Carlsbad's DEWS draws water from the Ogallala aquifer northeast of Carlsbad, and serves, in addition to other areas, the Department of Energy's Waste Isolation and Pilot Plant (WIPP). WIPP is located approximately 20 mi northwest of the western boundary of the Ochoa Project area, and is served by the DEWS pipeline. The pipeline terminates at the WIPP site (Figure 20-1), but could be extended. The City of Carlsbad may be willing to upgrade or add to the existing pipeline to serve new users. In addition, there may be excess capacity in the pipeline for wheeling purchased irrigation water from the Lea County Administrative Basin (Lea County Basin) or elsewhere via the DEWS facilities.

ICP has initiated discussions with the City of Carlsbad to explore options for purchasing water from the city. With the current infrastructure, the city indicated that it has approximately 5,300 ac ft/yr (about 3,300 gpm) of excess water potentially available for purchase from the Double Eagle Well Field. For industrial water purchase agreements, the city sells water by the barrel at $0.448/barrel (about $0.01/gallon) and has a standard three-year agreement. The city is open to considering longer agreements and may consider an adjustment to that rate, depending on a large quantity purchase, but those details were not available at the time of the initial meeting. The pipeline that currently services WIPP, which was constructed and paid for by WIPP, consists of 18 mi of 10 in. asbestos cement pipe. This line is primarily fed by the Double Eagle Well Field. WIPP is the primary consumer on this line and is a senior user. Based on how the WIPP agreement was written, WIPP has priority during shortage sharing to receive water from this line.

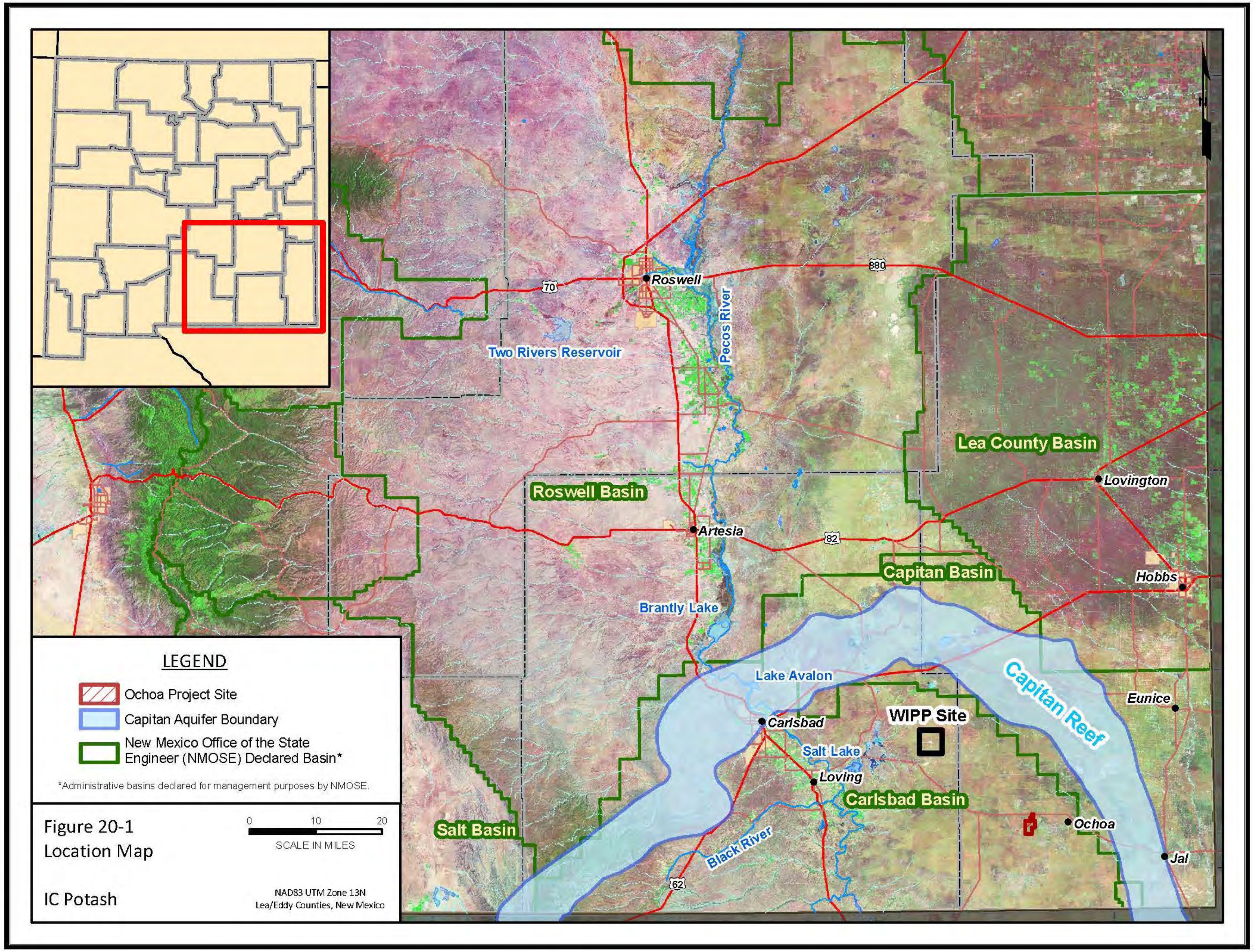


Figure 20-1 Location Map

Junior to WIPP are the industrial (oil and gas) customers that the city supplies with 2 in. taps along the line before it enters WIPP property. These 2 in. “rig taps” consist of a tap into the main 10 in. water line where oil and gas producers run piping to supply frac pits and other oil- and gas-related projects for their production purposes. To extend this line to the Ochoa Project site, another line would need to be constructed from a point approximately 18 mi. north of where the line terminates on WIPP property, all the way down to the mine site, which would require a 20- to 25-mi pipeline.

The attributes of this alternative that require evaluation include cost and long-term availability of the water. The potential cost of the water is relatively high, at approximately $10/1,000 gallons. To supply the mine at a constant rate of 2,000 gpm would cost approximately $10 million annually and $400 million over the 40-year life of the mine. In addition, ICP would likely have to fund most or all of the cost of a pipeline from the WIPP site to the Ochoa Project area. At this time, a detailed cost analysis for a pipeline has not been completed. Ensuring the long-term availability of water from the City of Carlsbad would entail negotiating a long-term lease with the city that was consistent with their known limitations with respect to supply and demand.

To evaluate the potential longevity of water availability from the city, it is necessary to review the city’s current water-right holdings versus known and potential demands. The city has a total of 18,288 ac-ft available from the Double Eagle Well Field. Of that, 10,620 ac-ft are permitted for municipal use, 2,442 ac-ft are permitted for commercial use, 4,943 ac-ft are permitted for secondary recovery of oil, and 263 ac-ft are permitted for commercial/irrigation. Thus, the theoretical maximum amount of the water potentially available for the Ochoa Project (assuming full build-out of the well field) is the sum of municipal and commercial water rights, or 13,062 ac-ft (Leedshill-Herkenhoff 1995, Table 7), neglecting the commercial/irrigation rights. In addition to the water rights associated with the DEWS, the city owns 9,274 ac-ft of water rights in the Capitan aquifer, for a total of 22,336 ac-ft (not including commercial/irrigation rights) available for municipal and industrial use. Comparing known water-right holdings (22,336 ac-ft) with projected future demand (18,556 ac-ft in 2035 [Pecos Valley Water Users Organization 2001]) indicates an overall surplus of 3,780 ac-ft (about 2,400 gpm) continuing at least through 2035.

While the city appears to have enough capacity in their system, the cost for this water option is high ($400 million or more over the life of the mine). Therefore, this alternative will be retained for further evaluation, pending additional meetings with the city, but it is not considered to be the most viable option due to its high cost.

The City of Jal was also evaluated as a potential supplier; however, their total water-right ownership is only about 1,600 ac-ft, which leaves little capacity with which to supply the Ochoa Project.

20.2.1 Purchasing and Transferring Water Rights

Options for purchasing water rights include purchases from the Carlsbad, Capitan, or Lea County basins (Figure 20-1). Since the Ochoa Project area is in the Carlsbad Basin and adjacent to the Capitan Basin, it is likely that water rights purchased in either basin could be physically transferred to a well or wells within the Ochoa Project area. In addition, water-right transfers from the Lea County Basin were also considered. Purchase and transfer of water rights would trigger the New Mexico Office of the State Engineer (NM OSE) administrative process for change of place of use, and possibly change of purpose (if nonindustrial water rights were purchased). This process includes public notification and a hearing before the NM OSE before the transfer can be approved. Irrigation water rights may also be available for sale in the Lea County Basin to the north. Accessing this water may involve transfer via pipeline, again possibly via the existing DEWS pipeline. ICP is actively negotiating with a current water-right holder in the Lea County Basin, although thus far it appears that due to limitations related to the administration of the Lea County Basin (NM OSE 2009), only a small portion of the Ochoa Project needs can be met by this source. The Lea County Basin Guidelines (NM OSE 2009) limit the allowable impacts of water-right transfers within the basin, particularly in areas known as critical management areas (CMAs). An initial analysis of the change of place of use of water rights being considered for purchase indicated that pumping would be limited based on the Lea County Basin Guidelines to such an extent that the quantity of water available would likely not be economically viable, given the construction cost of an approximately 40 mi. pipeline to move the water to the Ochoa Project site.

This option will be retained for future consideration while ICP continues to hold discussions with potential water-right sellers, but it is not considered to be the best option for the project because (1) water rights consistent with Ochoa Project demands may not be available locally; (2) the purchase of water rights is expensive; (3) the transfer of water rights involves a time-consuming NM OSE hearing process that allows for public notification and protest, which may not be consistent with the project timetable; (4) the Lea County Basin Guidelines (NM OSE 2009) limit the amount of water that can be transferred; and (5) it is likely that the amount of water that is potentially available under the Lea County Basin Guidelines would not justify the construction cost of a pipeline to move the water to the Ochoa Project site.

20.2.2 Purchasing Water from an Out-of-State Provider

ICP has been in contact with a Texas water provider that has offered to provide water to the project. However, thus far, due-diligence requests on the part of ICP have not been successful in eliciting the necessary information to evaluate the viability of this source. This option will be retained for further analysis, although at this time it appears that the probability of this source being able to provide the project with water is low.

20.2.3 Applying for New Groundwater Appropriation

New appropriations may be allowed in the Capitan Basin, with the exception of the following areas: in the vicinity of the Pecos River, near the towns of Eunice and Jal, or within the Capitan Reef. Potential aquifers for new appropriations within the Capitan Basin include the Rustler Formation, the Santa Rosa Sandstone of the Dockum Group, the Dewey Lake Formation, and alluvium. Similar to a purchase and transfer of an existing water right, permitting a new appropriation is subject to hearing and approval before the NM OSE, which includes a public notification and protest process. In addition, acquiring a new water right typically involves significant hydrogeologic work to support availability of the new appropriation as well as to prove that it will have no detrimental effect on existing water-right holders. Thus, while there may be some limited potential for acquiring a new appropriation, this approach is not consistent with the project timetable given the significant timeframe that would be required to develop a new appropriation within the context of the NM OSE hearing process. Therefore, this option will not be retained for further consideration.

20.2.4 Developing Deep Brackish Groundwater

Based on current information, the most viable source of water in the vicinity of the Ochoa Project is brackish groundwater from the Capitan aquifer (Figure 20-1). The Capitan aquifer is the most viable water supply option because (1) no water rights are needed to develop deep brackish water in New Mexico, (2) the NM OSE and BLM are both supportive of the use of deep brackish groundwater for industrial purposes, (3) there is a track record of previous deep brackish groundwater development from the Capitan Reef (primarily for secondary oil recovery), and (4) the hydrogeology of the system is favorable in that there would be no expected impacts on other water-right holders from the Ochoa Project.

According to NM OSE guidance (72-12-25 New Mexico Statutes Annotated [NMSA]), brackish groundwater is defined as water in aquifers with the top of formation below 2,500 ft bgs and with greater than 1,000 parts per million (ppm) total dissolved solids (TDS). This water is available for development without a water right from NM OSE for oil and gas exploration and production, prospecting, mining, road construction, agriculture, generation of electricity, or industrial or geothermal uses.

20.2.4.1 Regulatory Considerations

Initial discussions with both the NM OSE and the BLM have indicated that there is broad regulatory acceptance for use of brackish water for industrial purposes in New Mexico. The key issues related to the use of Capitan Reef water include (1) potential impacts on shallow freshwater aquifers and (2) potential depletion of the Pecos River as a result of pumping from the Capitan Reef. Both of these topics will be discussed in more detail later in this section.

Pursuant to NMSA 1978 72-12-26 and 27, the NM OSE requires that a Notice of Intent (NOI) be filed when proposing to develop brackish groundwater. The NOI requirements include the following:

- A description of the target aquifer and overlying confining strata
- Geologic cross-sections of the target aquifer and overlying confining strata
- The lateral extent of the target aquifer and overlying confining strata
- Quantification of TDS in groundwater from the target aquifer
- Proof of hydraulic separation of the target aquifer from shallower freshwater aquifer systems and surface water

Several initial meetings with the NM OSE have indicated the NM OSE's general acceptance of the conceptual plan for deep brackish groundwater development, and ICP will be submitting its NOI in the very near future. Likewise, meetings with BLM staff members have indicated that the BLM is supportive of the plan to produce deep brackish groundwater from the Capitan Reef.

20.2.4.2 Water Availability in the Capitan Aquifer

This section presents background information for water availability in the Capitan Reef, including the general hydrogeologic framework, the history of brackish water use from the Capitan Reef, and also the potential for impacts on other surface- and/or groundwater resources caused by pumping from the Capitan aquifer.

20.2.4.3 General Hydrogeology of the Ochoa Project Area

While the general geology of the Ochoa Project area has been presented previously, it is provided here as it pertains to groundwater development. The general hydrogeology of the Ochoa Project area is presented within the context of understanding how the Capitan Reef fits within it. The area of interest consists of almost 12,000 ft of Permian age deposits. Older Permian deposits (San Andres, Yes, Abo, and Hueco formations) consist of approximately 4,000 ft of mostly fine-grained sandstones, siltstones, shales, and various types of limestone deposited before the Capitan Reef was built and the Delaware Basin was formed (Figure 20-2). The Delaware Basin deposits from the Permian age in southeastern New Mexico are divided into the Guadalupian Series and the Ochoa Series. The Guadalupian Series consists primarily of sandstones that make up the Delaware Mountain Group (Bjorklund and Motts 1959). The Ochoa Series is composed of, from oldest to youngest, the Castile Formation, the Salado Formation, the Rustler Formation, and the Dewey Lake red beds (Bachman 1983). The Castile Formation is composed primarily of anhydrite and gypsum and rests unconformably on the upper member of the Bell Canyon Formation, the last sequence of the Delaware Mountain Group (Bjorklund and Motts 1959).

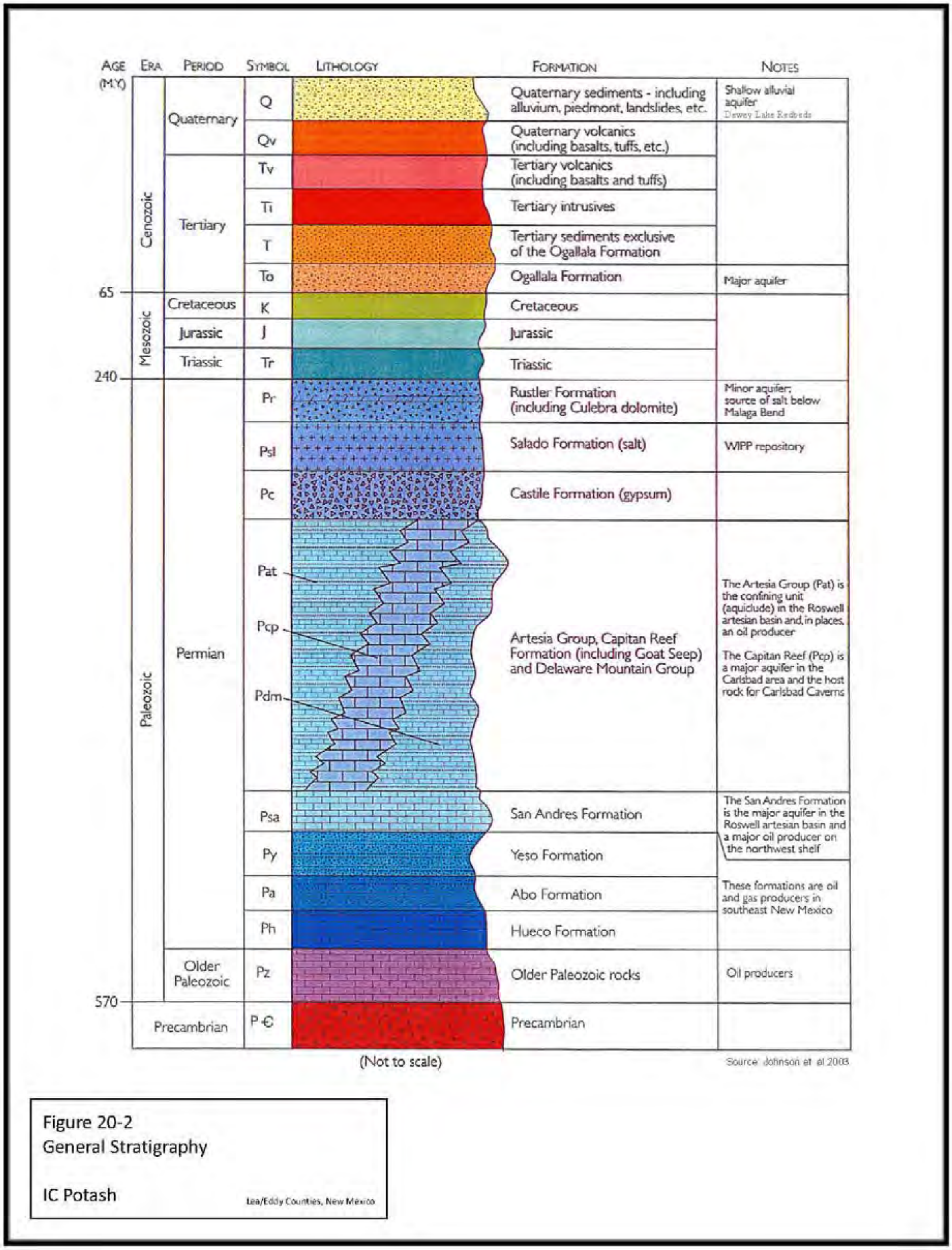


Figure 20-2 General Stratigraphy

The Salado Formation consists primarily of halite and interfingers laterally with the underlying Castile Formation (Bjorklund and Motts 1959). Near the Capitan Reef escarpment, a thin clay layer is present at the contact between the upper Salado Formation and the overlying Rustler Formation that creates a local barrier to downward water movement (Bjorklund and Motts 1959; Bachman 1983). The Rustler Formation is composed of anhydrite, halite, and two carbonate beds (Bjorklund and Motts 1959). The Dewey Lake red beds conformably overlie the Rustler Formation and consist of red siltstone, sandstone, and shale (Bjorklund and Motts 1959).

The Delaware Basin Permian sediments contain aquifer units with low permeabilities, poor-quality water, and low well yields (Uliana 2001). Aquifer yields in the Permian shelf facies are highly dependent on fracture and karst porosity (Uliana 2001). The Capitan aquifer exhibits higher permeability and yields than either the Permian Basin or shelf facies. While the Capitan aquifer produces large quantities of water, water quality throughout the reef is highly variable (Uliana 2001). The geologic units around the Capitan Reef complex are less permeable and have lower conductivity, and so act as barriers to significant horizontal groundwater movement to or from the Capitan aquifer (Leedshill-Herkenhoff Inc. et al. 2000).

A discussion of the important hydrostratigraphic units that lie above and below the Capitan aquifer is presented here to facilitate an overall understanding of the hydrogeologic system. The hydrogeology of the Capitan Reef itself is presented after the discussion of each of the other important hydrostratigraphic units. Understanding of the interrelationship of the Capitan aquifer with the other hydrostratigraphic units is also key to the submittal of the NOI.

<u>Alluvium (surface to 700 ft bgs)</u>

Quaternary alluvial deposits exist throughout Lea County, although the saturated thickness of the alluvium is only sufficient in a few places to provide a significant water source (Leedshill-Herkenhoff Inc. et al. 2000). The amount and characteristics of water in storage in the alluvial aquifer are difficult to determine because the aquifer is not continuous and in most areas the extent of saturated alluvium is quite limited (Leedshill-Herkenhoff Inc. et al. 2000).

The Dewey Lake Formation consists of clastic red beds that unconformably overlie the Rustler Formation and are considered part of the Ochoa Series (Summers 1972). The Dewey Lake red beds are presumed to have very low permeability and would yield very little water, if any; however, very little data are available about the hydraulic properties of the beds (Summers 1972).

<u>Santa Rosa Sandstone of the Dockum Group (150 to 2,000 ft bgs)</u>

The Dockum Group has thick areas of sediments and is estimated to have large amounts of stored groundwater; however, low permeability appears to have limited well completion in the Santa Rosa aquifer (Leedshill-Herkenhoff Inc. et al. 2000; Summers 1972). The Santa Rosa aquifer is the principal aquifer of the Dockum Group and has well yields that average 25 to 30 gpm in southern Lea County (Summers 1972). Depth to water in the Santa Rosa aquifer ranges from 120 to 700 ft (Leedshill-Herkenhoff Inc. et al. 2000).

Rustler Formation (1,200 to 1,600 ft bgs)

The Rustler Formation is the target formation for the Ochoa Project. The Rustler Formation contains aquifers east of the Pecos River with variable yields and water quality (Bjorklund and Motts 1959). Well yields are quite variable, and have been reported from 7 to 4,400 gpm throughout the formation south of the Ochoa Project area in Texas. Aquifer permeability is believed to be locally enhanced by carbonate and evaporite dissolution (Boghici and Van Broekhoven 2001). Water from the Rustler aquifer contains relatively large amounts of sulfate and chloride (Bjorklund and Motts 1959). Discharge from the aquifer is from pumping wells and flow into the overlying Edwards-Trinity aquifer in Texas (Boghici and Van Broekhoven 2001). The Rustler Formation is also the source of saline water discharging to the Pecos River in the vicinity of Malaga Bend (Figure 20-3).

Salado Formation (1,600 to 2,700 ft bgs)

The Salado Formation is not water bearing (Bjorklund and Motts 1959), is the host formation for the WIPP site, and is characterized by extremely low permeability. A red silt and clay layer at the contact of the Salado Formation and the overlying Rustler Formation acts as a barrier to the vertical movement of water (Bjorklund and Motts 1959; Bachman 1983).

Castile Formation (2,700 to 4,200 ft bgs)

The Castile Formation does not contain any appreciable amount of groundwater and acts as a barrier to the movement of water from the Capitan Reef into the Castile Formation. Only in areas of outcrop does the Castile Formation contain water, typically in small caverns (Bjorklund and Motts 1959). Water found in the Castile Formation is highly mineralized, including high sulfate. This water has been used for stock wells west of Carlsbad, near the Guadalupe Mountains (Bjorklund and Motts 1959), but not generally as a significant source of freshwater for uses other than stock watering.

Delaware Mountain Group (4,200 to 8,000 ft bgs)

Little or no potable groundwater has been found in the Delaware Mountain Group in the vicinity of Carlsbad, although some wells have been drilled to beds containing saline water and others to beds containing petroleum and gas (Bjorklund and Motts 1959). The Delaware Mountain Group appears to act as the lower confining beds of the Capitan aquifer and also constrains lateral flow on the basin side of reef facies (Bjorklund and Motts 1959).

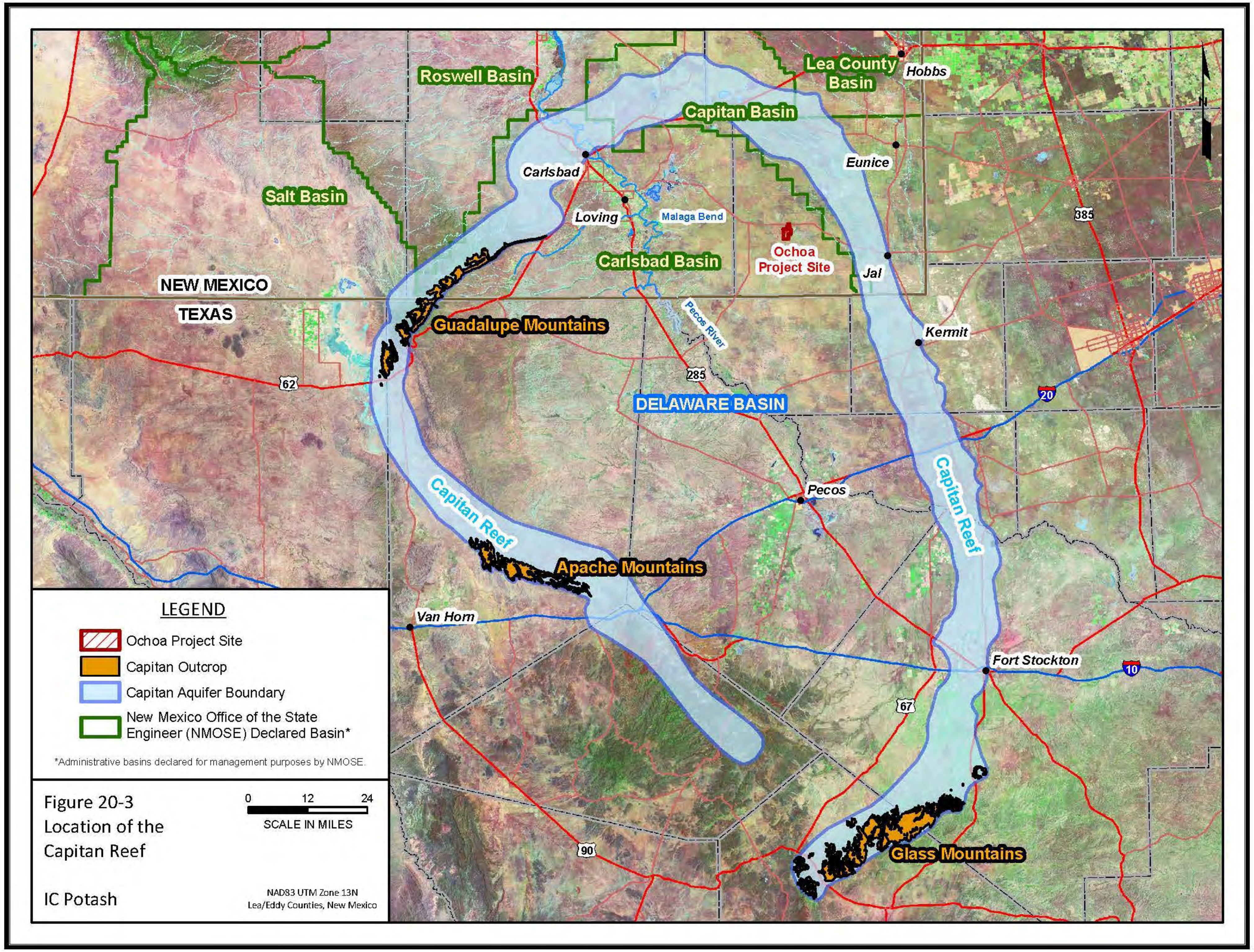


Figure 20-3 Location of the Capitan Reef

Victorio Peak and Bone Spring Limestone (8,000 to 11,000 ft bgs)

Based on available information, the Victorio Peak and Bone Spring Limestones have not been evaluated for aquifer characteristics in the vicinity of the area of interest. The Diablo Plateau aquifer systems consist of interconnected solution cavities in the Victorio Peak and Bone Spring Formations west of the Guadalupe Mountains (Ashworth 2001). The Diablo Plateau aquifer is generally of poor quality with TDS ranging from approximately 1,000 to more than 6,500 milligrams per liter (mg/L) (Ashworth 2001). This unit is a productive aquifer elsewhere, but has not been studied at this location due to its depth.

20.3 Hydrogeology of the Capitan Reef

The Capitan aquifer is composed of the Capitan Formation, parts of the Goat Sheep Formation, and the Artesia Group (all referred to as the Capitan Reef complex) (Uliana 2001; Hiss 1980). The Capitan Reef complex is a horseshoe-shaped limestone deposit surrounding the Delaware Basin as shown on Figure 20-3. The reef complex is present in southeastern New Mexico and western Texas and extends over a distance of approximately 200 mi. Within Lea County, the aquifer ranges from 800 to 2,200 ft thick and is approximately 12 mi wide near the Eddy County and Lea County boundary and 6 mi wide near Jal, NM (Leedshill-Herkenhoff Inc. et al. 2000). The Capitan Reef complex outcrops in the Guadalupe Mountains in New Mexico and Texas and in the Glass Mountains and Apache Mountains in Texas. The reef dips below the ground surface to the east and north from the areas of outcrop in the Guadalupe and Glass mountains, and in some areas, the bottom of the aquifer is more than 5,000 ft bgs (Hiss 1975). Submarine canyons that were incised into the limestone reef and then filled in with sandstone, siltstone, and clay are present along the northern and northeastern portions of the Capitan Reef complex (Hiss 1975). The most prominent of the submarine canyons occur near the Eddy County / Lea County boundary in New Mexico and create a groundwater divide (Hiss 1975). A Tertiary igneous dike also cuts across the northern portion of the Capitan aquifer near the Eddy County / Lea County boundary.

The hydraulic conductivity of the Capitan aquifer east of the Pecos is approximately 5 ft per day (ft/day) (Leedshill-Herkenhoff Inc. et al. 2000). Hydraulic conductivity ranges from 1 to 25 ft/day (Hiss 1975) (Figure 20-4). Hydraulic conductivities of 1 to 5 ft/day are more representative for the eastern part of the Capitan aquifer (Hiss 1975). In the northern and eastern limbs of the reef, average transmissivities are 10,000 square feet per day (ft^2/day) in thick parts of the reef and about 500 ft^2/day in thinner sections of the reef that have been incised by submarine canyons (Hiss 1975). The high permeability of the Capitan aquifer is due to solution channels (Bjorklund and Motts 1959; Uliana 2001). Some variability in the porosity and permeability of the Capitan Reef was reported by Garber et al. (1989). At a location east of Carlsbad along the northern portion of the reef, the upper approximately 400 ft of the reef has a porosity of 5% to 25% and an intrinsic permeability of up to 2 darcies (approximately 4.86 ft/day), while the lower portion has a porosity of less than 5% and a much lower permeability

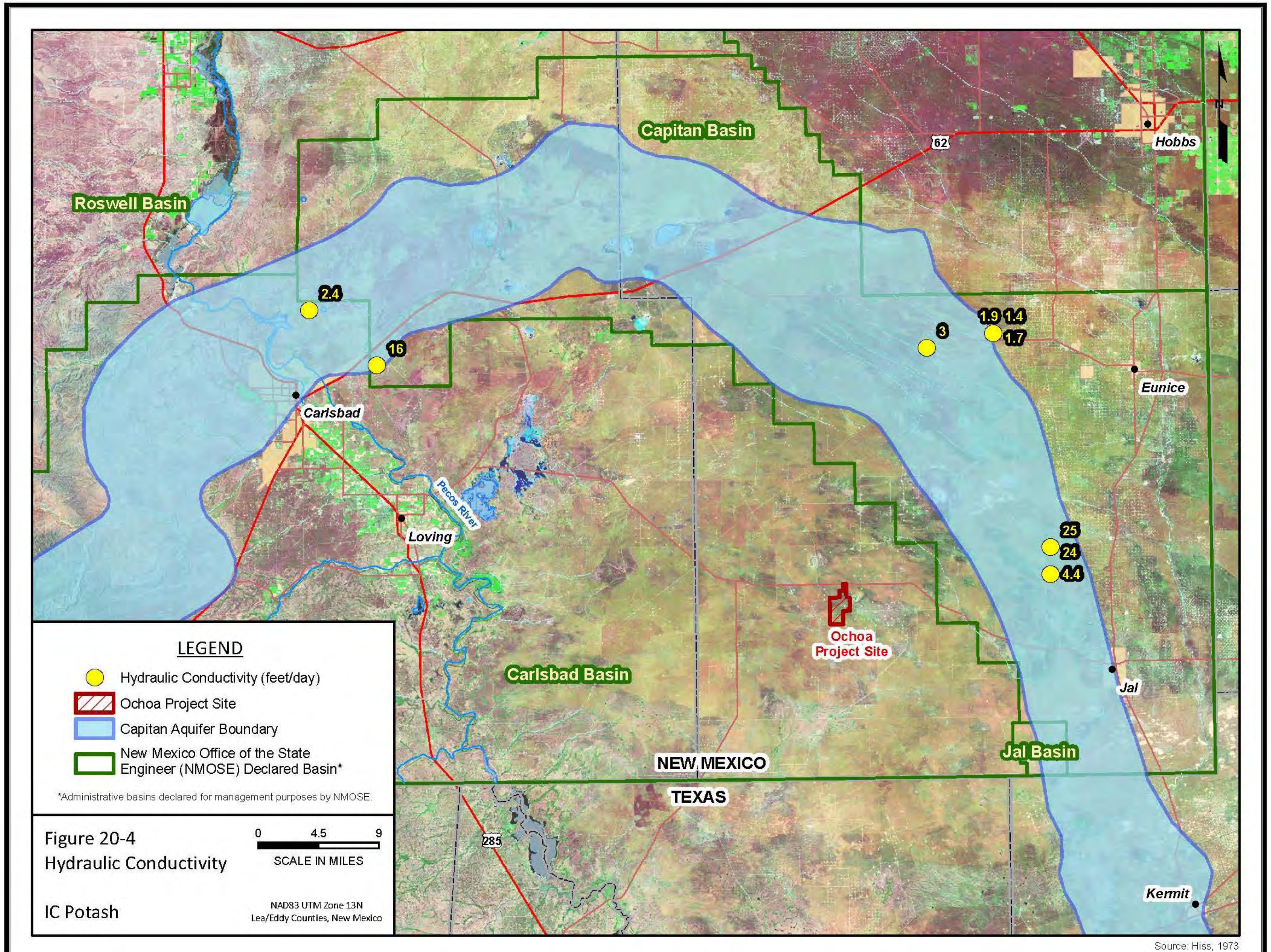


Figure 20-4 Hydraulic Conductivity

(Garber et al. 1989). Near the New Mexico/Texas boundary, a permeability of about 1 darcy (approximately 2.43 ft/day) is more representative for the Capitan aquifer (Hiss 1975). Hiss (1975) also reports that oil and gas companies have detected relatively thin zones porosity in the forereef edge of the northern and eastern portions of the Capitan aquifer (Hiss 1975).

The Delaware Mountain Group Formation underlying the reef acts as a barrier to downward movement of groundwater in the Capitan aquifer (Bjorklund and Motts 1959). The basin deposits along the inner arc of the reef also create a barrier to groundwater movement; however, groundwater interaction does occur with the outer arc deposits, particularly the Tansil and Yates formations (Bjorklund and Motts 1959; Barroll et al. 2004). Hiss (1975, 1980) also reports poor hydraulic communication between the Capitan aquifer and aquifers on the basin side and shelf side of the reef complex. The hydraulic conductivity of the basin formations is much less than that of the Capitan, thus restricting groundwater movement from the Capitan into the basin (Hiss 1975). Recharge to the Capitan aquifer is primarily in the areas where the limestone outcrops in the Guadalupe Mountains along the New Mexico/Texas border and in the Glass Mountains in Brewster and Pecos counties, Texas (Figure 20-3). A substantial amount, as much as 10,000 to 20,000 ac-ft/yr, of recharge also comes from Lake Avalon in Eddy County, New Mexico (Bjorklund and Motts 1959). The aquifer discharges into the Pecos River near Carlsbad, New Mexico, and a small amount discharges into the shelf aquifers, particularly the San Andres Formation in the northeastern corner of the Capitan Reef complex (Hiss 1975, 1980). Water production for oil and gas in Eddy and Lea counties, New Mexico, and Winkler, Ward, and Pecos counties, Texas, has also been a significant source of discharge since the 1950s (Richey et al. 1985).

Current groundwater flow directions within the Capitan aquifer vary significantly throughout the reef complex as shown on Figure 20-5. Groundwater flow direction in the western arc of the aquifer is eastward from the area of recharge in the Guadalupe Mountains, and primarily discharges into the Pecos River near Carlsbad, New Mexico, limiting groundwater flow farther east (Hiss 1975). Hiss has stated that prior to oil and gas development in this area, the groundwater flow in the Capitan aquifer discharged from the reef in the northeastern corner, near Eunice, New Mexico, into the San Andres Formation (Hiss 1975, 1980). Hiss (1975) also reports a constriction in the reef aquifer near the boundary between Lea County and Eddy County that is believed to reduce the transmissivity of the Capitan aquifer, possibly due to large, incised submarine canyons, and that restricts groundwater flow from the western arc of the aquifer to the eastern arc as shown in Figures 20-6 and 20-7. Hydraulic heads east of the county line have dramatically declined in response to large withdrawals of oil and gas, while hydraulic heads west of the county line remain relatively stable (Barroll et al. 2004).

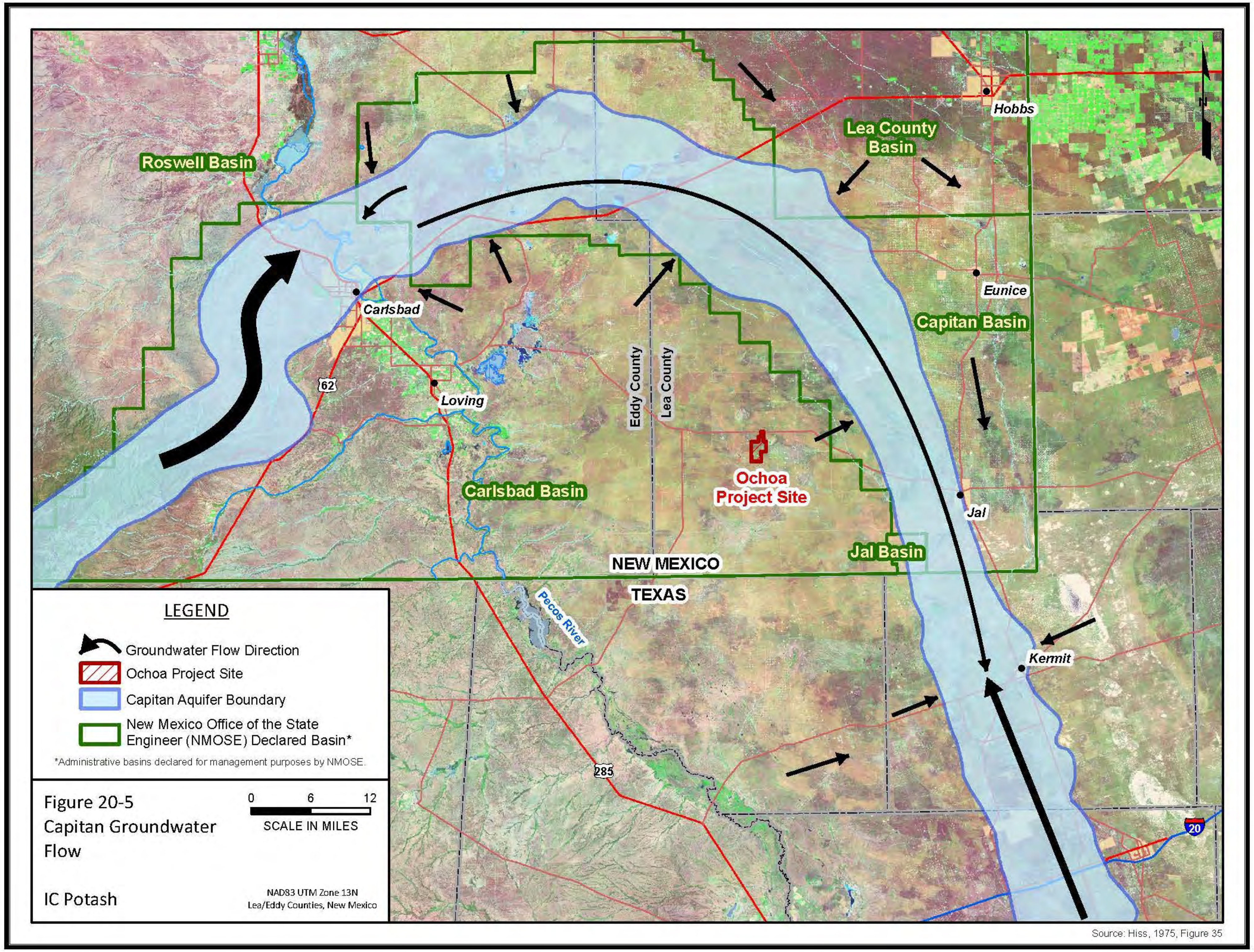


Figure 20-5 Capitan Groundwater Flow

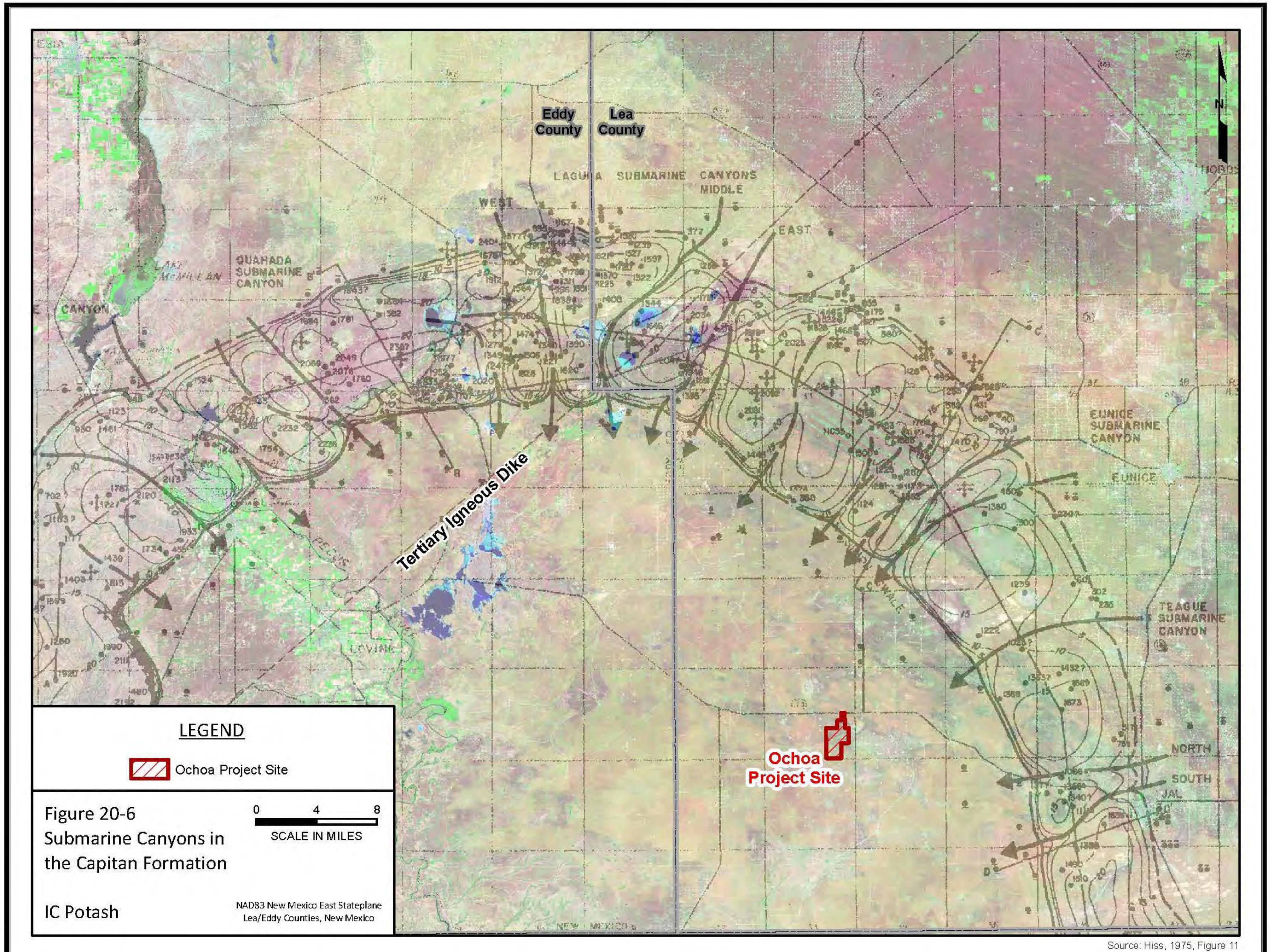


Figure 20-6 Submarine Canyons in the Capitan Formation

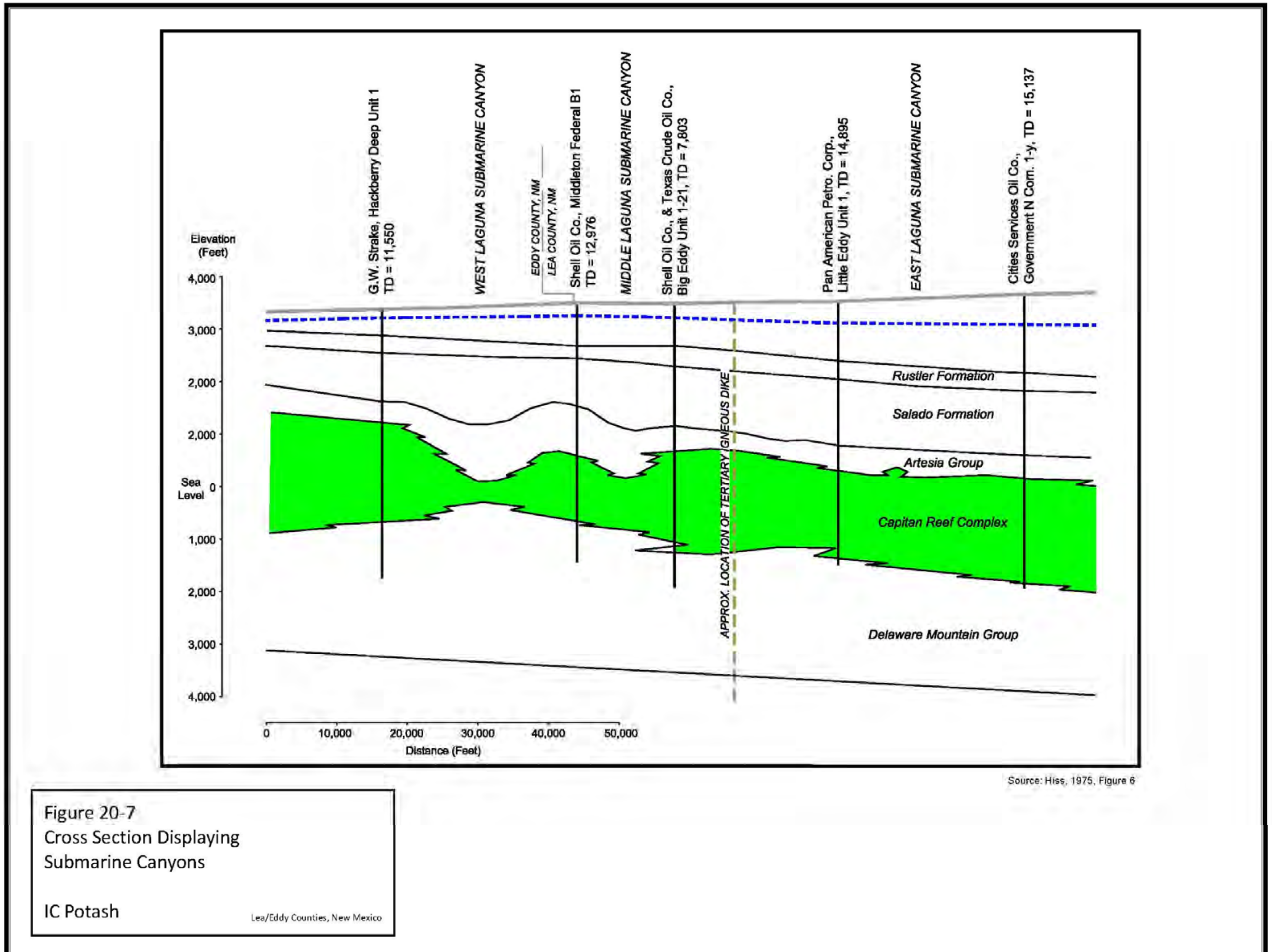


Figure 20-7 Cross Section Displaying Submarine Canyons

The rise in oil and gas development and water production for secondary oil recovery from the Capitan aquifer beginning in the 1920s altered the flow direction in the eastern arm of the reef complex from the north (where it discharged into the San Andres Formation near Eunice, New Mexico) to the south (where groundwater now flows to a potentiometric low near Kermit, Texas) (Hiss 1975). Thus, groundwater east of the Eddy County / Lea County line in New Mexico flowed east and southeast toward Kermit, Texas, while groundwater in the Capitan aquifer flowed north from the Glass Mountains (see Figure 20-3) toward Kermit, Texas (Figure 20-5). Following peak oil production in the mid-1970s, water production from the reef declined, allowing heads in the Capitan aquifer to rebound. The current flow direction along the eastern portion of the reef may have re-established itself in a northward direction. However, collection of additional head data (currently underway) is needed to confirm present-day flow directions.

Based on long-term monitoring in Lea County, water-level declines as great as 160 ft were observed from 1967 through 1975 (Hiss 1975). Withdrawal of groundwater for secondary oil recovery and oil and gas production from adjacent Guadalupian age formations that are in hydraulic connection with the Capitan aquifer is also thought to have contributed to water-level declines in the Capitan aquifer (Leedshill-Herkenhoff Inc. et al. 2000). Water levels in the Capitan aquifer south of the Texas/New Mexico boundary declined by about 700 ft during a 45-year period prior to the 1970s, causing the change in direction of groundwater flow discussed above (Hiss 1975).

Water-quality data for the Capitan aquifer are sparse. Near areas of recharge, the Capitan aquifer produces potable freshwater. However, salinity values increase significantly east of the Pecos River in New Mexico and north of the Glass Mountains in Texas (Uliana 2001; Leedshill-Herkenhoff Inc. et al. 2000; Hiss 1975). The concentration of TDS varies significantly throughout the Capitan aquifer as shown on Figure 20-8. During the late 1960s and early 1970s, TDS concentrations near Carlsbad, New Mexico, ranged from about 600 ppm to more than 55,000 ppm (Hiss 1973). The chloride ion concentrations measured during the same time period range from less than 300 ppm near Carlsbad, New Mexico, to more than 20,000 ppm in the eastern part of Eddy County, New Mexico (Hiss 1973).

Local water quality data in the vicinity of the Ochoa Project area are in the range of 6,000 to 13,000 mg/L TDS, based on samples collected from wells at the nearby Jal Water System, a system that supplied brackish water for secondary oil recovery to oilfields to the east (NM OSE various dates). The Jal Water System, which is discussed in more detail later in this section, is no longer in operation.

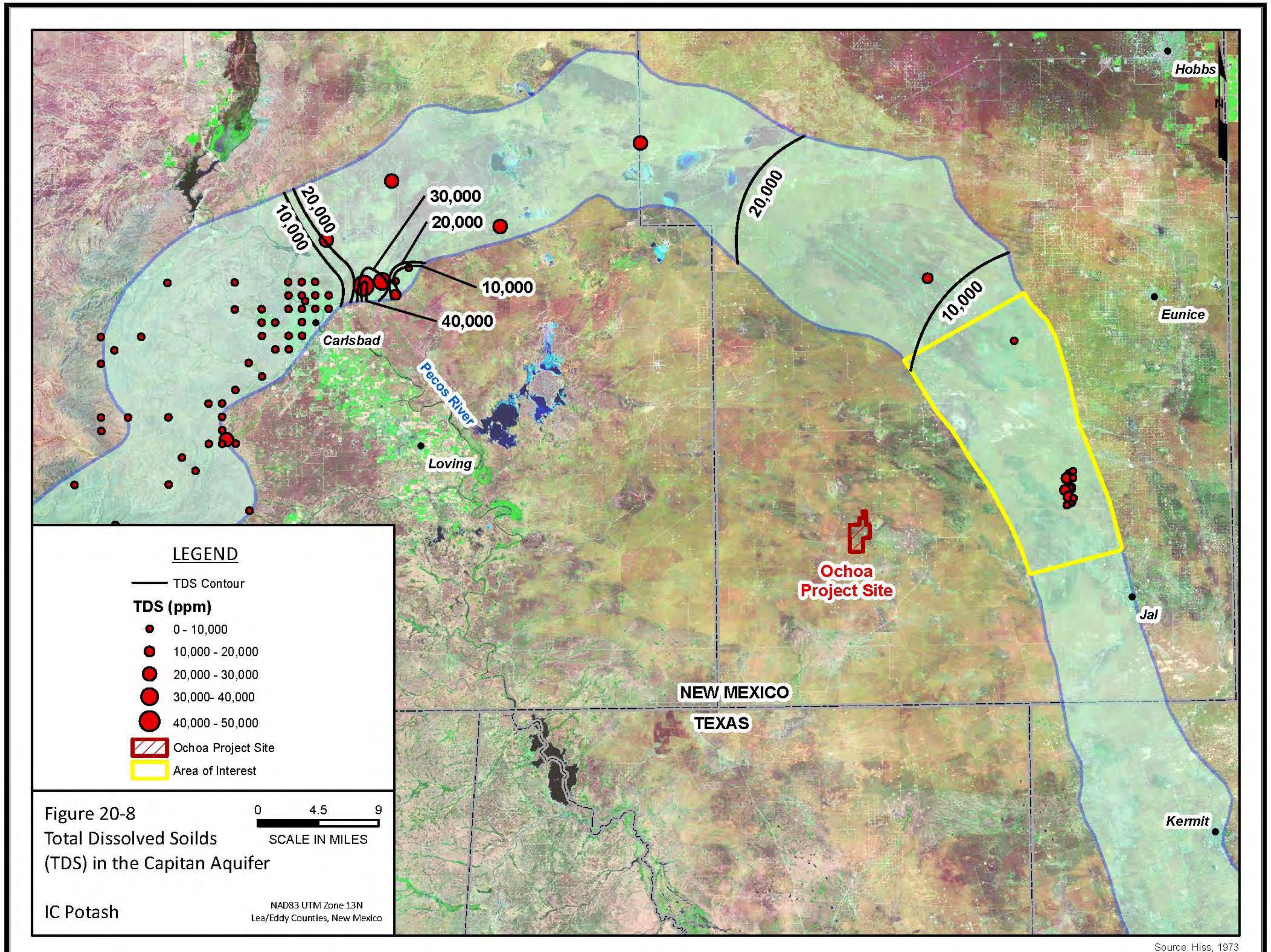


Figure 20-8 TDS in the Capitan Aquifer

20.3.1 History of Water Use from the Capitan Reef

Brackish groundwater from the Capitan Reef has been used historically for secondary oil recovery, thus establishing a precedent for using this resource for industrial purposes. Hiss (1975) discusses a number of brackish groundwater development projects in the Capitan Reef, including the Jal Water System near Jal, NM, and El Capitan Well Field near Kermit, Texas.

The Jal Water System was originally developed in the 1960s by Skelly Oil and was used to supply water for secondary oil recovery to the east in Texas (NM OSE n.d.). The Jal Water System consisted of seven wells that were completed from approximately 3,900 to 4,500 ft bgs (subsequent research has revealed that it is likely that these wells were completed starting in the Seven Rivers dolomite, just above the Capitan Reef itself). The majority of the Jal Water System wells had been oil and/or gas wells, and were subsequently plugged at the base of the Capitan Reef and then perforated over the reef itself. All the wells were tested and shown to flow at rates of approximately 560 gpm. Available NM OSE records indicate that the system pumped a maximum of approximately 1,800 ac-ft/yr, although it is likely that more was pumped from this system. The wells, now owned by Chevron, were plugged and abandoned in 2006 and are no longer active.

The El Capitan system was developed in the mid-1960s by Shell Oil as a water source for secondary oil recovery (Brackbill and Gaines 1964). These wells were completed in the Capitan Reef with plans to pump up to 28,000 ac-ft/yr. Although records from Shell are not available, the NM OSE did document water use from this well field in the range of 8,000 ac-ft/yr in 1964, expected to be in the range of 13,000 ac-ft/yr in 1965 (Akin 1965). Akin (1965) estimated that total fluid withdrawals from the Capitan Reef in Texas were in the range of 30,000 to 40,000 ac-ft/yr from 1945 to 1965. Records from the Texas Water Development Board (TWDB) (2011) indicate that by the mid-1980s, pumping from the Capitan Reef in Texas had decreased significantly.

Thus there is clear evidence of significant historical usage of brackish water from the Capitan Reef, indicating a high probability of success for its use as a supply source for this project.

20.3.1.1 Potential Impacts on Shallow Freshwater Resources

The Capitan Reef is hydraulically separated vertically from shallow freshwater resources in the vicinity of the Ochoa Project, and thus pumping effects from the reef are not expected to propagate vertically. Figure 20-7 presents a cross-section of the reef and some of the overlying and underlying formations. The closest aquifer above the Capitan Reef is the Rustler Formation, which provides water only in moderate amounts and is brackish in some areas.

The Capitan Reef is overlain by the Salado Formation. The Salado Formation is characterized by extremely low hydraulic conductivity, between 10^{-7} and 10^{-8} centimeters per second (4×10^{-2} and 4×10^{-3} ft/day). Rocks of this type are considered to be essentially impermeable, and in fact, the Salado Formation is where WIPP has been constructed, owing to the formation's impermeable nature. The thickness of the Salado Formation ranges from 1,200 to 2,300 ft in the vicinity of the Ochoa Project (Mercer 1983). Other studies (Hunter 1985), based on water levels from many existing wells, have revealed no hydraulic connection between rocks overlying and underlying the Salado Formation. Thus, no vertical communication is expected between the Capitan Reef and any overlying aquifers.

Potential impacts on the Pecos River from Capitan aquifer pumping are expected to be de minimis, if present at all. As discussed previously, Hiss (1975) reports a constriction in the reef aquifer near the boundary between Lea County and Eddy County that is believed to reduce the transmissivity of the Capitan aquifer, possibly due to large, incised submarine canyons, which restrict groundwater flow from the eastern arc of the reef (where the proposed pumping would occur) to the western arc (Figures 20-6 and 20-7). There are also other empirical data that support this concept. Hydraulic heads east of the county line have dramatically declined in response to large withdrawals of oil and gas, while hydraulic heads west of the county line remain relatively stable (Barroll et al. 2004). This behavior indicates that the eastern arc of the reef is hydraulically disconnected from the western arc of the reef.

To confirm lack of impacts on shallow surface-water and/or groundwater resources, a numerical groundwater flow model will be developed to simulate the behavior of the system under the proposed pumping stress. The overall approach to developing the predictive groundwater flow model includes the following:

- Compiling relevant data
- Developing a conceptual groundwater model (CGM) of the groundwater flow system
- Developing a defensible numerical groundwater flow model including predictive simulations of possible mine scenarios
- Preparing a modeling report summarizing findings
- Presenting results to regulatory agencies and stakeholders

The development of a defensible numerical groundwater flow model first requires the development of a CGM. The CGM relies on data and an understanding of the processes governing groundwater flow to provide a physically based and accurate description of the groundwater flow system. The CGM provides a format for collecting, describing, and presenting all the information needed to clearly and accurately understand the groundwater flow system and on which to base the numerical groundwater flow model. A variety of formats can be used and are tailored to a particular project's scope and objectives. The CGM for the Ochoa Project will be represented by a three-dimensional geologic block model developed using the Leapfrog Hydro software (ARANZ Geo Limited 2010) along with supporting text, tables, and figures to describe the parameters and processes governing groundwater flow. The block model will allow the incorporation of all pertinent spatial data and information into a single, cohesive, visual representation of the groundwater flow system. The spatial extent of the conceptual model will be based on aquifer extent, recharge areas, and areas of potential impact (e.g., the Pecos River, adjacent aquifers, recharge areas in New Mexico and Texas). One of the benefits of creating a three-dimensional spatial model is that this information can be used to directly develop the numerical model grid and can also be used to assign the flow parameters for the different hydrostratigraphic units within the grid. Additional data and information can be easily incorporated into the conceptual model; for instance, aspects of the model that are transient in nature will be further described by time-series plots. Transient processes include recharge, Pecos River stage and flows, and pumping well schedules. The conceptual model will be presented in a report using maps, plots, and plan and cross-section views taken from the block model along with text. The CGM will also be presented to and discussed with the NM OSE to ensure their agreement with ICP's approach relative to the NOI.

Components of the CGM will include the following:

- A delineation of the extent of the study area, or model domain, and associated flow boundaries
- A complete description of hydrostratigraphic units within the model domain
- Estimates of flow parameters and their distributions
- Identification of recharge and discharge areas and associated rates
- The location of wells along with information relating to groundwater flow (e.g., extraction/injection rates, hydraulic conductivity, hydrolithologic contacts)
- The location of springs and surface water bodies and associated flows
- The water balance for the model domain
- Identification and description of all potential impacts from pumping

Due to the depth of the Capitan Reef and the regional extent of the numerical model, data collected from deep, intermediate, and shallow aquifers will be needed. Fortunately, due to the large number of oil and gas wells in the region, many well logs should be available that will provide data at depths equal to the Capitan Reef. Reviewing available oil and gas well logs and other data sources and developing a database of the pertinent data will be a key component of delineating the hydrostratigraphic units to be included in the numerical model. This work is substantially complete at present. The database will be the basis for the development of the conceptual block model, which will lead directly into the development of the numerical model. In addition to the compilation of pre-existing data, water wells will be installed by ICP for the purpose of conducting aquifer tests. The aquifer tests will provide important information on the

Capitan aquifer to support the development of the CGM and the subsequent development of the numerical groundwater flow model.

The types of data needed to develop the CGM include the following:

- Water-right data
- Well data, including shallow-water supply wells and deep oil and gas wells
- Physiography and climate
- Hydrostratigraphy and structure
- Local and regional aquifer heads
- Surface-water locations and flow rates
- Spring locations and flow rates
- Shallow- and deep-aquifer recharge and discharge rates

Many of these data have already been compiled at this point. Data that have already been collected include the following:

- Historic water-level and water-quality data for the Capitan Reef and back-reef (primarily in New Mexico)
- Flow rates at Carlsbad springs
- Water levels and water quality for Carlsbad-area wells
- Hydraulic parameters of Capitan Reef and Carlsbad-area aquifers
- Water levels for wells in the shallow aquifers near the mine
- Geologic and geophysical logs from oil and gas wells in New Mexico (limited to Hiss wells and a few other select wells)
- Water levels, water quality, hydrogeology, and discharge/injection rates for select locations in Texas

Additional data compilation efforts needed for the CGM (and ultimately the numerical flow model) include the following:

- Oil/gas well logs and water well logs for describing the Capitan Reef and back-reef hydrostratigraphy and structure
- Current and historic water-level data for the New Mexico and Texas portions of the Capitan Reef and back-reef (in addition to what has been collected)
- Descriptions of potential impacts in New Mexico and Texas in terms of type, location, geology, and extent of communication with the Capitan Reef
- Rates of discharge from and injection into the Capitan Reef and back-reef
- Data needed to quantify recharge to the Capitan Reef and back-reef

Once the CGM is prepared, the development of the numerical model will follow. The primary objective of the numerical groundwater flow model is to develop a predictive tool to evaluate potential impacts on adjacent freshwater supplies due to pumping from the Capitan aquifer. Components of the numerical flow model include the following:

- Identifying the groundwater flow code
- Identifying the model domain and developing the model grid
- Specifying boundary conditions
- Specifying hydrostratigraphic zones based on the CGM
- Estimating initial flow parameters for different hydrostratigraphic zones
- Identifying the calibration period and calibration targets
- Calibrating the model
- Conducting sensitivity analyses
- Conducting predictive simulations based on mining scenarios
- Evaluating types and locations of potential impacts identified in the CGM

Several options are available when deciding which groundwater flow code to use in developing the numerical model. Both finite difference (e.g., MODFLOW) and finite element (e.g., FEFLOW) will be considered, because each has advantages and disadvantages. Finite elements are more flexible for describing complex geometry, and this may be a factor given the shape and varying orientation of the Capitan Reef. Another consideration is whether groundwater will be modeled as a variable-density fluid or whether the system can be modeled using equivalent freshwater heads, whereby total heads derived from fluids of variable density (e.g., brines) are first converted to freshwater heads. Variable-density flow codes are available as finite difference (e.g., SEAWAT) or finite element (e.g., FEFLOW). Currently it is anticipated that variable-density flow will not be a concern in modeling groundwater flow in the Capitan Reef and that MODFLOW will be the code of choice, and that MODFLOW will be used to model the system via equivalent freshwater heads.

As discussed above, once the CGM is developed, the development of the numerical model grid, the assignment of hydrostratigraphic units and zones, and the identification of model boundaries will be straightforward. Identification of model boundaries will be an important part of the overall development of the numerical model. Given the depth of the Capitan aquifer, the identification of model boundaries at such depths will rely heavily on the data available from oil and gas well logs. It may be that naturally occurring flow boundaries that can normally be identified in the shallower portions of the flow system, such as the Pecos River or outcrop areas of the Capitan Reef that represent recharge areas, may not be easily identifiable for the deeper portions of the reef and back-reef. In these cases, the model boundaries will be placed far enough from the Capitan aquifer that the boundary conditions applied at those boundaries will not adversely influence the numerical flow solution, given the simulation times involved. Note that a preliminary MODFLOW grid has already been developed, as well as a preliminary set of boundary conditions. Some preliminary simulations have been run that have allowed ICP to more fully understand the behavior of the system and develop attributes that will need to be included in the final model.

Model calibration consists of changing values of the model input parameters (e.g., hydraulic conductivity) to better match field conditions within acceptable criteria (BLM 2008). Measured field conditions will include hydraulic head, hydraulic gradient, recharge/discharge rates, and water budget estimates. Calibration of the model may be done for steady-state and/or transient conditions. Model calibration will be done using inverse modeling software (such as PEST) as well as manual methods. Overall, calibration will be conducted using industry-accepted methods (e.g., American Society for Testing and Materials [ASTM] International) (Zheng and Bennett 2002; Anderson and Woessner 1992).

A model sensitivity analysis will be performed. The sensitivity analysis is a process of varying model parameters over a reasonable range (range of uncertainty in values of model parameters) and observing the relative change in model response (BLM 2008). The observed changes in hydraulic head or flow rate will be noted. The reason for the sensitivity analysis is to demonstrate the sensitivity of the model simulations to uncertainty in values of model input data. The results of the sensitivity analysis will help to determine the robustness of the model calibration and whether any of the model parameters require further evaluation. Parameters considered in the sensitivity analysis will include hydraulic conductivity, recharge, and aquifer storage. The effect of boundary condition parameters on computed heads and groundwater flow rates will also be evaluated if appropriate.

The calibrated model will be used to predict potential impacts of pumping groundwater from the Capitan aquifer. The predictive scenarios to be evaluated will be based on estimates of water supply needs over the life of the mine. Input parameters in the model will be selected so as to provide conservative predictive results, and the predictive simulations will further evaluate uncertainty where appropriate. These simulations will be used to augment ongoing discussions with the NM OSE associated with the NOI to confirm the lack of potential for impacts on surface-water and/or groundwater resources from Capitan Reef pumping.

20.4 Water Distribution and Treatment

The total water demand for the project is expected to be approximately 2,000 gpm. Of the total supply required for the project, approximately 73% of the total supply (or 1,460 gpm) will be used for ore processing and 27% of the total supply (or 540 gpm) will be treated to drinking water standards and provided to the plant facilities building.

20.4.1 Well Field and Pipeline

Options for developing brackish groundwater from the Capitan Reef include using an existing well field or developing an entirely new well field. The initial analysis of potential well fields included an evaluation of using the existing Jal Water System, discussed previously. The Jal Water System represented an opportunity to use an existing, proven well field for the Ochoa Project. However, discussions with the current owner (Chevron) indicated a strong unwillingness to allow ICP access to the wells, even for testing purposes, so this option was eliminated from further consideration, and efforts were focused on the evaluation of options for developing a new well field.

In developing a new well field, a structured approach to siting the well field was used, implementing the following measures:

- Minimizing infrastructure costs by siting the well field as close as reasonably possible to the Ochoa Project site
- Identifying the most productive areas of the aquifer based on reef thickness, lithology, and locations of submarine canyons
- Identifying areas of the reef with the best water quality (lowest TDS)
- Considering property ownership
- Using existing right-of-ways wherever possible (INTERA 2011a)

Given the location of the Ochoa Project site, areas of the aquifer that were approximately equidistant radially from the project site were considered, given that these areas would result in similar infrastructure costs (Figure 20-8). Next, the most productive areas of the aquifer were considered, based primarily on identifying the thickest areas of the Capitan Reef according to the structure developed by the TWDB (2009), combined with the locations of known submarine canyons as developed by Hiss (1975). The submarine canyons are areas where the reef thins significantly. Well areas were identified to ensure well placement in the thicker areas of the reef between the submarine canyons (Figure 20-9).

Based on water quality samples from the Jal Water System (NM OSE, n.d.), the area of interest (Figure 20-10) of the Capitan Reef northeast of the project site contains water with TDS values in the range of 8,000 to 13,000 ppm, which are well within design parameters for supply for the Ochoa Project. Given the attributes discussed above, two general areas were identified that are coincident with the thickest portions of the reef (Figure 20-11). Within these two areas, three potential well field location areas were identified, based on property ownership (Figure 20-12).

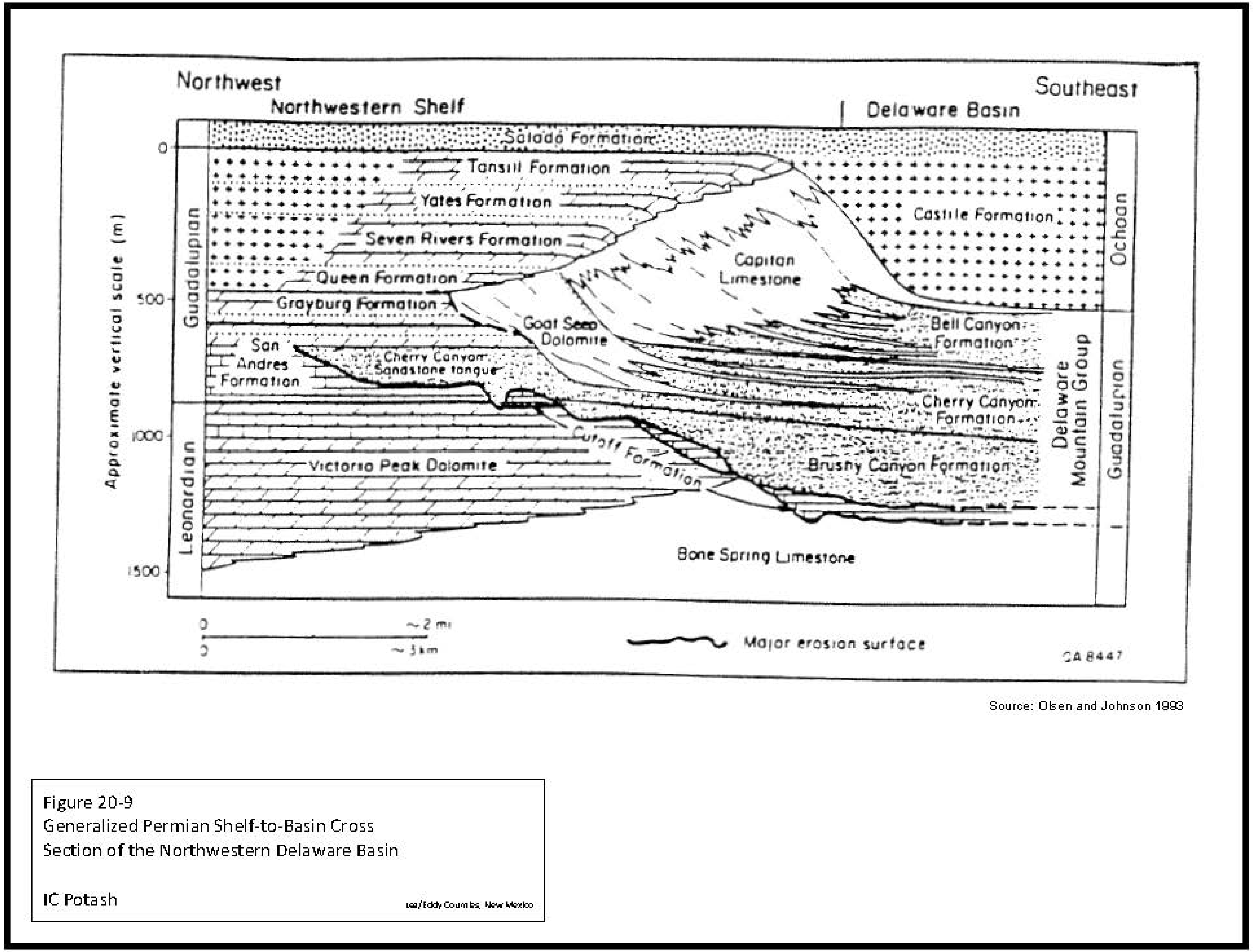


Figure 20-9 Generalized Permian Shelf-to-Basin Cross Section of the Northwestern Delaware Basin

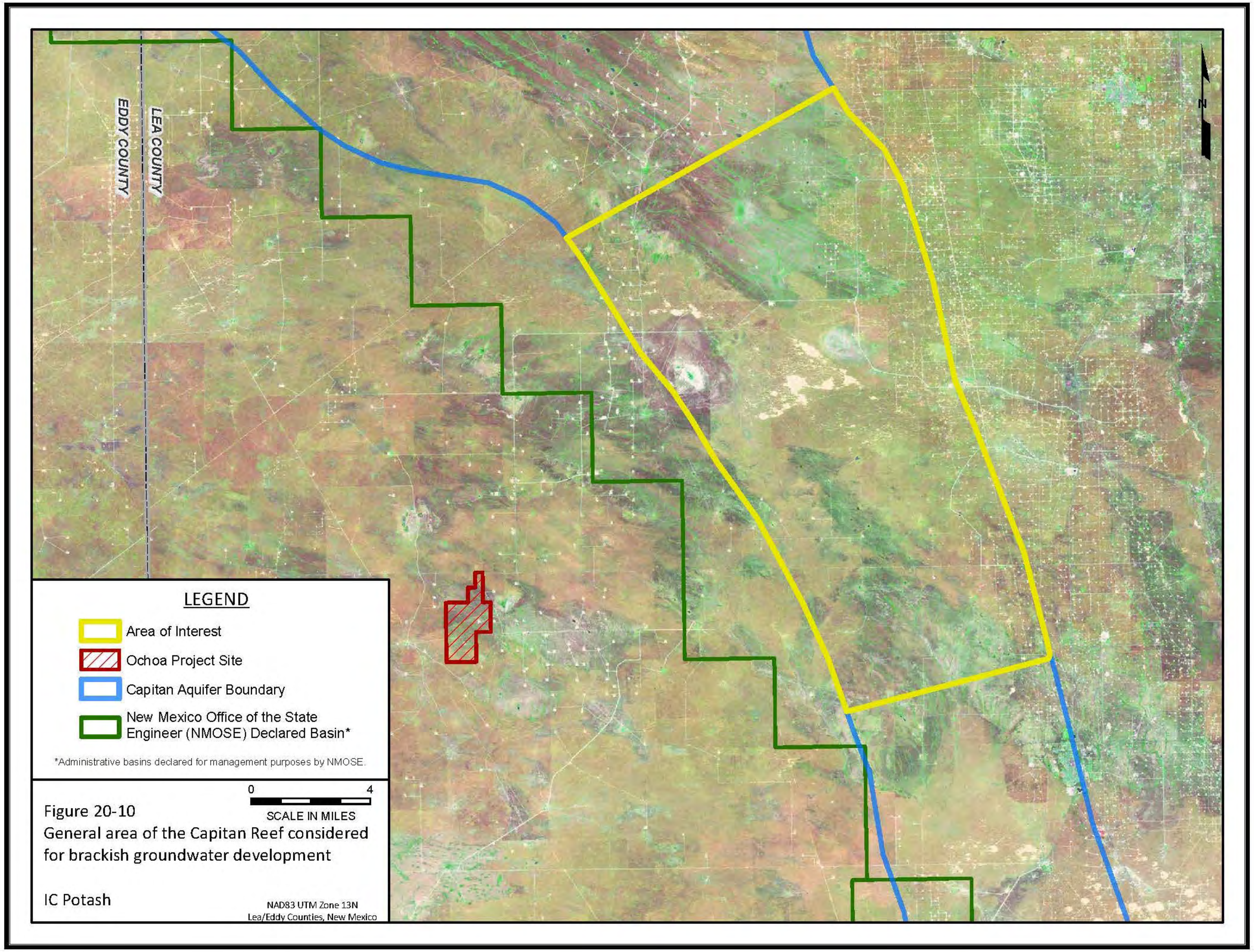


Figure 20-10 General Area of the Capitan Reef Considered for Brackish Groundwater Development

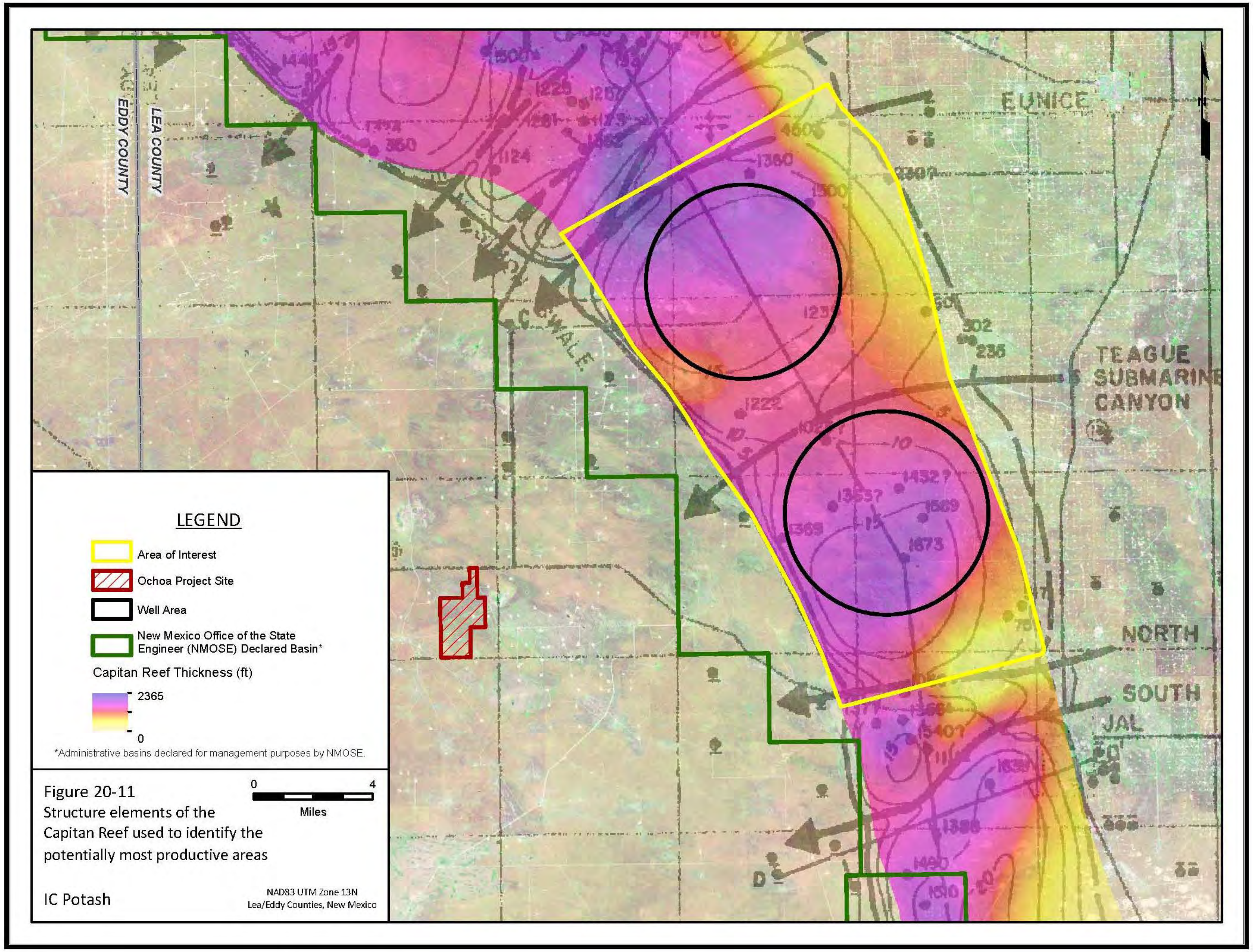


Figure 20-11 Structure Elements of the Capitan Reef Used to Identify the Potentially Most Productive Areas

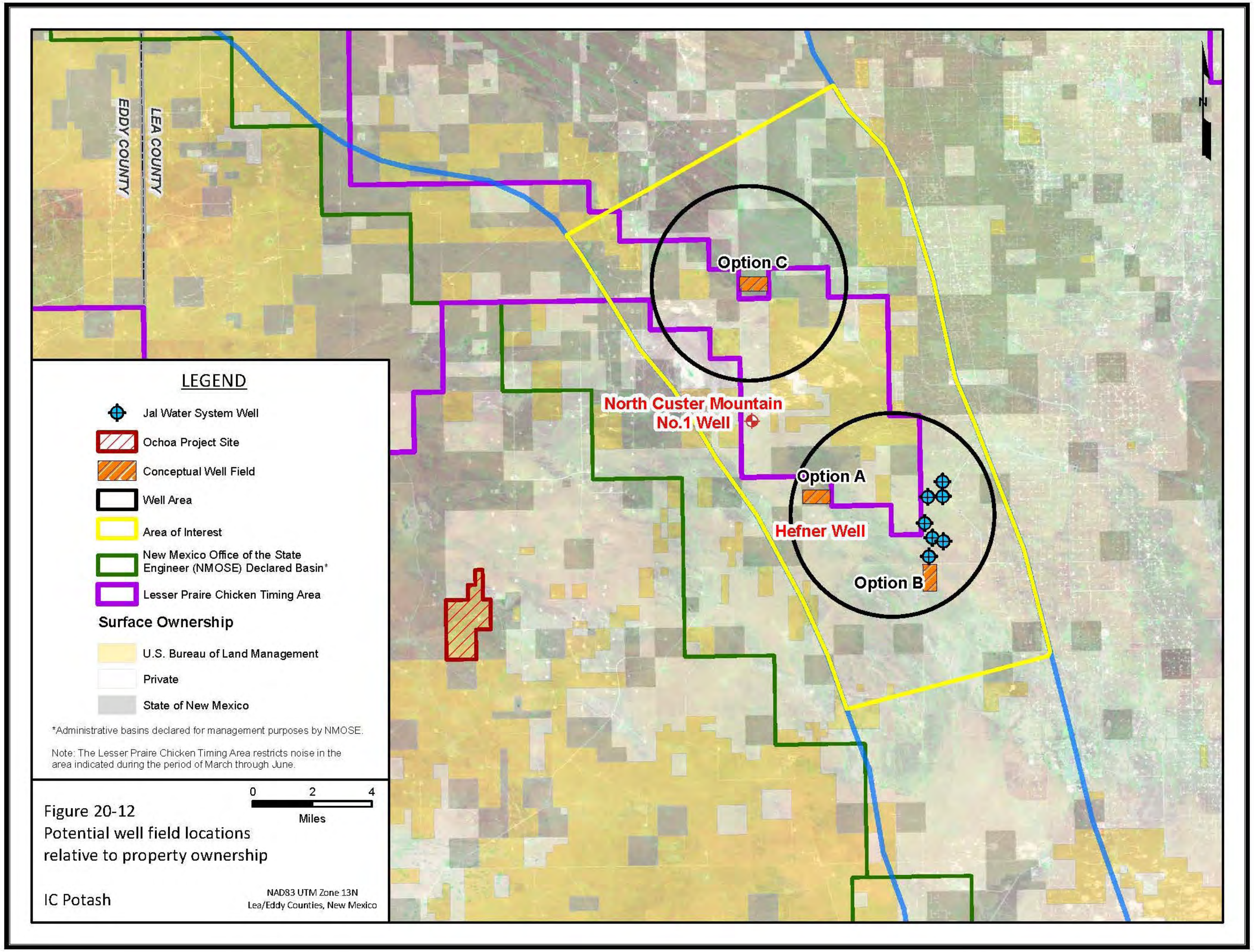


Figure 20-12 Potential Well Field Locations Relative to Property Ownership

Locations on BLM, New Mexico State Land Office (NMSLO), and private land were considered. Discussions with the BLM indicated that from a permitting perspective, the state permitting process to access NMSLO lands would be more straightforward than the federal permitted process that would be required for access to BLM land, and thus locations were chosen to favor NMSLO rather than BLM land. Locations on private land were considered, with the condition that there was a strong probability that a given landowner would be receptive to siting a production well field on their property.

The three potential well fields (Figure 20-12) have been have been proposed on NMSLO land (Options A and C) and private land (Option B). Specifically, Option C was considered because it is located within a thick portion of the reef (Figures 20-11 and 20-12) as well as being located on NMSLO land. Option B was selected based on its proximity to the Jal Water System (a known area of good production) and the ability to locate the proposed well location on private property (ICP felt that they could gain permission from the property owner to locate a production well field on the property) (Figure 20-12).

The third and final option, Option A, was also sited due to its relative proximity to the Jal Water System, but the location was also guided by several other considerations. The first is its location on NMSLO land; the second is its proximity to a nearby oil and gas well, the Hefner 11 Com No. 1 (an area of the reef that has been analyzed in some detail by others); and the third is that it is outside the Lesser Prairie Chicken Timing Area, providing more flexibility with respect to installation (Figure 20-13).

The Hefner 11 Com No. 1 well was used along with several other nearby oil and gas wells to perform a detailed analysis of a localized portion of the reef in the vicinity of Option A (Harris 2009). The Hefner well geophysical log shows relatively high porosity within the upper 800 ft of the Capitan, and high-porosity zones are the drilling targets for ICP water-supply wells. Because of the detailed geologic information available from Harris (2009) for the Option A location, as well as its location on NMSLO land, the decision was made to move forward with well installation and aquifer testing in that area.

Once the location of the production well field had been identified as Option A, specific work plans were developed for well installation and aquifer testing (INTERA 2011c and 2011d, included as Appendix L and Appendix M to this document, respectively). These work plans include an approach for ultimately installing two wells. Initially, one of the wells will be used as a pumping well during aquifer testing, while the other well will be used as an observation well during aquifer testing. Ultimately, both wells are planned to be used as production wells.

Note that some consideration was given to using an existing well, if available, as an observation well for the aquifer testing. For this reason, a fourth location was evaluated but dismissed from

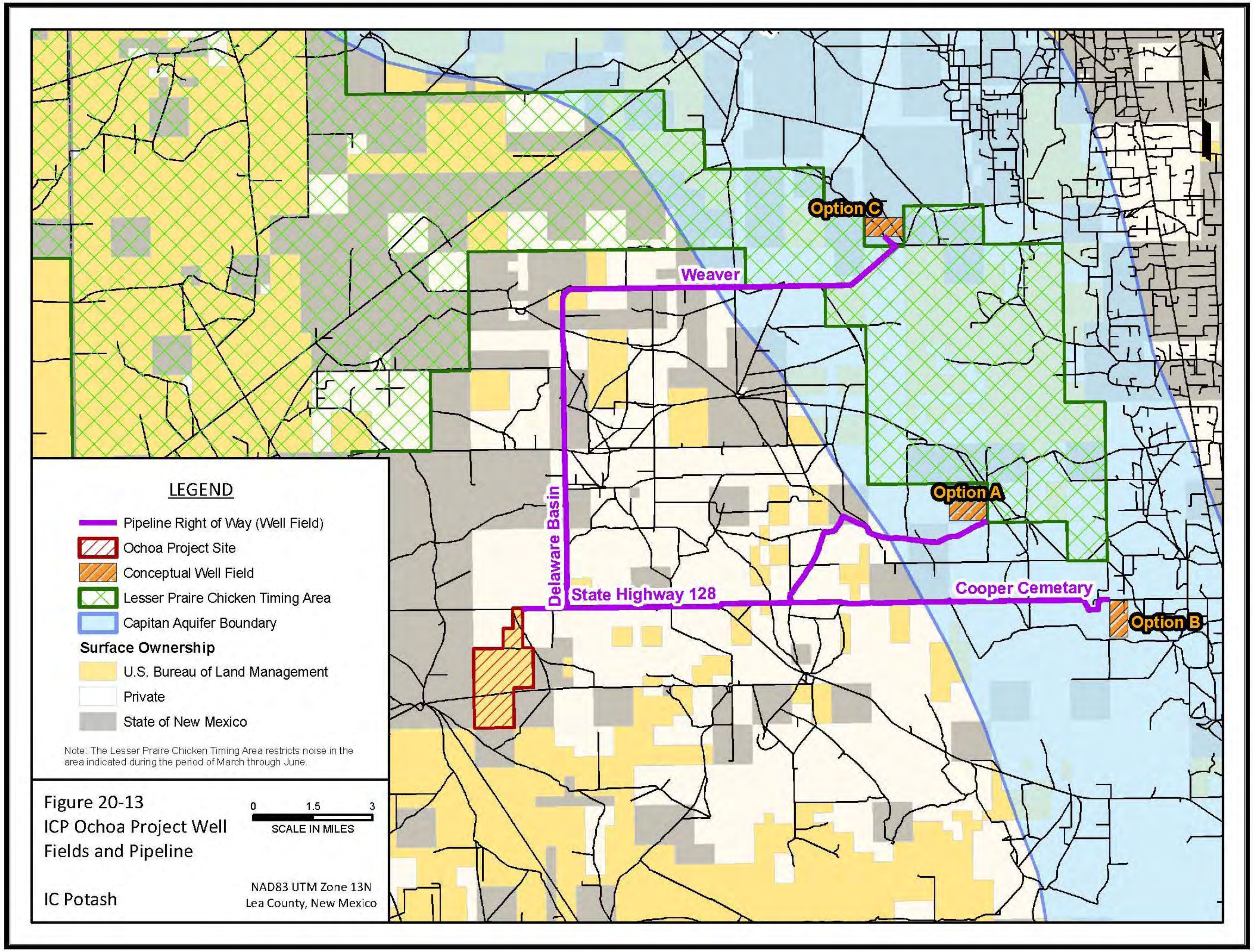


Figure 20-13 ICP Ochoa Project Well Fields and Pipeline

further consideration due to a number of drawbacks. An existing USGS monitoring well, the North Custer Mountain Unit No. 1 (North Custer) well, is present approximately 3.5 mi to the northwest of Option A (Figure 20-12). This location was considered primarily as a potential cost-saving measure in that the North Custer well could potentially be used as an observation well. However, closer analysis revealed a number of shortcomings in this approach: (1) only 11 ft of the North Custer well casing is perforated, and thus water levels may not be representative of the full reef; (2) rehabilitation and reperforation of the well would involve substantial uncertainty, given the age and unknown condition of the well casing and cement; (3) permission to rehabilitate and reperforate the well has not been given by either the well owner or the landowner; and (4) the North Custer well is located within the Lesser Prairie Chicken Timing Area, which limits construction activities during certain times concurrent with the Lesser Prairie Chicken booming season.

Additional consideration was given to performing a single-well pumping test, also based on cost considerations associated with the installation of two wells rather than one. This option was removed from consideration based on its lack of technical merit. A single-well test would consist of drilling one well and conducting a pumping test and logging the well with geophysical logging tools. The pumping test would provide an estimate of hydraulic conductivity and transmissivity. However, a single-well pumping test does not provide an estimate of the aquifer storativity or specific storage. In order to estimate storativity or specific storage, it has been proposed that an acoustic log be used to collect shear and compressional velocity data that can be used to calculate the bulk modulus of the formation. The bulk modulus can then theoretically be used to determine the specific storage of the formation along the borehole. The purpose of obtaining a representative estimate of storativity and specific storage for the aquifer is for the assessment of potential impacts due to pumping. The estimated storativity and specific storage will be used during calibration of the groundwater flow model that will be finalized subsequent to aquifer testing. Due to the large scale of the model domain, the storativity and specific storage measured from an aquifer test conducted with a pumping and observation well would be much more applicable and appropriate than storativity and specific storage determined as a local-scale point measurement at a single well based on the acoustic log. The acoustic log estimate of storativity and specific storage will contain a bias of unknown magnitude due to aquifer heterogeneity, measurement error, and/or log interpretation error. Thus it was concluded that a pumping test using both a pumping and observation well would provide much higher-quality data at a more appropriate scale for evaluation of long-term water availability. The data from this test will greatly increase the quality of the groundwater flow model that will be developed to evaluate potential impacts on surface-water and/or groundwater resources, which will be of interest to the NM OSE. A robust groundwater flow model built from high-quality data is more likely to be accepted by the NM OSE.

In addition to well field locations, rights-of-way for water-supply pipelines were also considered. The proposed locations of pipelines associated with each well field option are illustrated in

Figure 20-13. To minimize disturbance, the pipeline for each option would be located in a right-of-way ancillary to the existing road rights-of-way owned by Lea County. While the evaluation of the rights-of-way was not crucial to the selection of the Option A well field as the preferred alternative, the right-of-way locations are presented here in the event that further testing at Option A results in a decision to consider well field options B or C.

20.4.2 Desalination

A preliminary design for the desalination system has been developed (Harrison Western 2011). The reverse osmosis (RO) water treatment system was designed assuming the Capitan Reef well water contains TDS of 10,000 ppm and is close to calcium sulfate saturation. The preliminary system includes a design feed rate of 4,000 gpm (a high, conservative estimate) and will operate at a recovery rate estimated to be greater than 90% to provide at least 3,600 gpm of purified water containing less than 250 ppm of TDS. The primary system consists of three skids, each providing 1,000 gpm of low-TDS source water. The secondary system includes an interstage precipitation reactor and will treat the concentrate stream from the primary system to recover an additional 750 gpm of low-TDS water, resulting in a final concentrate stream of only 250 gpm. The membrane skids, interstage precipitation reactor, and associated pumps, tanks, motor control center (MCC) room, and cleaning skid will require a building approximately 125 ft long and 70 ft wide. The total power requirement for the entire system is approximately 2,000 kW. Capital and operation costs for the system have been estimated and are within nominal bounds.

More accurate capital and operating costs can be obtained when an accurate and comprehensive Capitan Reef well water-quality analysis is available. Small changes in water chemistry can have significant impacts on overall recovery rates. It is likely that bench and pilot testing on samples of Capitan Reef well water will be conducted in order to obtain precise RO membrane design parameters and more accurate capital and operating costs.

21 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

21.1 Land Status

The project area is sparsely vegetated and no cultivation is present. Cattle grazing occurs throughout most of the leased areas and BLM has leased lands in the Ochoa Project vicinity for grazing. Petroleum exploration and development is widespread around the project area. There is a small amount of oil and gas production within the project area, however those wells are generally older and are experiencing declining production. The nearest Native American reservation is the Mescalero Apache, approximately 146 mi to the northwest.

21.2 Groundwater

ICP proposes to develop brackish water from the Capitan Aquifer to supply the Ochoa Project with water. The Capitan Aquifer comprises the Capitan Formation, parts of the Goat Sheep Formation, and the Artesia Group (together referred to as the Capitan Reef complex [Uliana 2001; Hiss 1980]). The Capitan Reef complex is a horseshoe-shaped limestone deposit surrounding the Delaware Basin (Figure 21-1). The Capitan Reef complex is present in southeastern New Mexico and western Texas and extends over a distance of approximately 200 mi. Within Lea County, the aquifer ranges from 800 to 2,200 ft thick. The Aquifer is approximately 12 mi wide near the Eddy County and Lea County boundary, and 6 mi wide near Jal, NM (Leedshill-Herkenhoff, Inc., et al. 2000). The hydraulic conductivity of the Capitan Aquifer east of the Pecos is approximately 5 ft/day (Leedshill-Herkenhoff, Inc., et al. 2000) and ranges from 1 to 25 ft/day (Hiss 1975). Hydraulic conductivities of 1 to 5 ft/day are more representative for the eastern part of the Capitan Aquifer (Hiss 1975), the area of interest for developing water for the Ochoa Project. There is relatively little water being developed from the Capitan Aquifer in the area of the Ochoa Project compared to the area of Carlsbad, New Mexico, on the western limb of the Capitan Reef. Based on data from Hiss (1975), it is expected that groundwater in the area of the proposed well field will have a total dissolved solids concentration of about 11,000 ppm. Aquifer testing and groundwater quality sampling will evaluate the aquifer characteristics and water quality of the Capitan Aquifer.

21.3 BLM Resource Management Plans

The existing Carlsbad Resource Management Plan (RMP; BLM 1988) includes potash mining as an approved land use within the BLM management area. This plan was modified through the 1997 *Resource Management Plan Amendment for Oil & Gas in the Carlsbad Resource Area* (BLM 1997), and again by the 2008 *Special-status Species Resource Management Plan Amendment and EIS* (RMP Amendment; BLM 2007). The existing plan, prepared in 1988, is currently in the process of being revised and data collection is already underway. The development of the new RMP and the NEPA process to approve the new plan are anticipated to be completed by 2013.

It is anticipated that potash mining will be an approved activity under the new RMP, as it is under the existing RMP. However, the stipulations, mitigations, and protections required to allow mining may change in the new RMP. Therefore, it is advisable to get the permitting process started, and if possible, completed before the new plan is approved through the NEPA process.

21.4 Environmental Impact Statement/Environmental Analysis

Proposed mining projects are typically evaluated for a range of potential social, economic, cultural, and environmental impacts in response to national regulations such as the National Environmental Policy Act of 1969 (NEPA) and state permitting regulations. Because the Ochoa Project proposes to mine federal minerals and would be partially located on lands managed by the BLM, ICP submitted a Mine Plan of Operations (MPO) to the BLM on September 30, 2011, to initiate the mine permitting process. As part of processing ICP's MPO, the BLM requires that an environmental impact statement (EIS) be prepared in compliance with NEPA and Council on Environmental Quality (CEQ) regulations. The EIS will assess the environmental impacts of implementing the proposed action (construction and operation of mine facilities as described in the MPO), a No-Action alternative (required under NEPA to assess what would happen if the BLM did not act on the MPO), and a range of reasonable alternatives. The BLM will use the EIS to make an informed decision on whether and how to approve the MPO and award a permit to construct and operate the mine.

On August 25, 2011, ICP and the BLM signed a memorandum of understanding (MOU) that describes the respective responsibilities, conditions, and procedures to be followed by both parties during the preparation of the EIS. In addition, ICP and the BLM signed a cost reimbursement agreement (CRA) on May 4, 2011, that facilitates the BLM's management and participation in the EIS. As part of the CRA, the BLM agrees to process ICP's application to construct, operate, and maintain a polyhalite mining operation within the timeline agreed to in the MOU. Processing includes the coordination, administration, preparation, and approval of all necessary environmental analyses (EAs), including the EIS, and coordination with appropriate federal, state, and local agencies. In turn, ICP agrees to reimburse the BLM for costs incurred in processing the application.

The BLM initiated the EIS process by holding a kick-off meeting on November 10, 2011. Typically, an EIS for a new mining project requires two years for completion. The current Ochoa Project NEPA schedule is shown in Table 21-1.

Table 21-1 Schedule for Environmental Impact Statement

Task	Start Date	Time Required	Responsible Party
Review MPO	October 2011	30 days	BLM
Address review comments on MPO	November 2011	30 days	ICP
Publish EIS Kick-off Meeting	November 2011	1 day	BLM
Publish notice of intent (NOI) to prepare EIS	January 2012	1 day	BLM
Conduct public scoping meetings	March 2012	2 days	BLM
Prepare draft EIS (DEIS)	April 2012	12 months	BLM
Publish DEIS	May 2013	1 day	BLM
Public Comment Period	May 2013	30 days	BLM
Incorporate comments	June 2013	2 months	BLM
Publish final EIS (FEIS)	October 2013	1 day	BLM
Publish record of decision (ROD), including errata if necessary	January 2014	1 day	BLM
End protest period for ROD	February 2014	1 day	BLM
Issue grant	March 2014	1 day	BLM
Hold preconstruction meetings	TBD	1 day	BLM, Applicant
Start construction and compliance inspections	TBD	As required	BLM

TBD = to be determined

The NEPA process generally includes the following components: baseline data collection, development of a proposed action, scoping, development of alternatives, description of the existing environment, mitigation measures, impact evaluation, preparation of a DEIS and an FEIS, and a public participation and review process.

21.5 Baseline Studies

Typically, baseline studies of at least 1 year are required for NEPA processes; however, data collection for some resources may be seasonally dependent.

An estimate of baseline sampling schedules is shown below:

- Air quality monitoring—1 year, if no regional data are available to serve as proxy for collected data
- Groundwater quality monitoring—1 year
- Surface water quality monitoring—1 year
- Archaeological and cultural resources surveys—spring and summer
- Vegetation field survey—3 months, but there are seasonal requirements

- Wildlife field survey—6 to 9 months
  - Migratory birds—spring and fall
  - Bats—summer and fall
  - Raptors—spring
  - Prairie chicken—spring
  - General wildlife—spring and summer

ICP conducted baseline vegetation and wildlife surveys in the Ochoa Project vicinity in 2011 and studies are ongoing. Baseline surveys, to date, are briefly summarized below.

The project area contains six vegetation communities, including coppice dune and sand flat scrub, creosote desert scrub, mesquite shrubland, mesquite upland scrub steppe, mixed desert scrub steppe, and shinnery oak shrubland. These communities comprise essentially the same mix of shrub, herb, and grass species, with different combinations of dominant shrub and grass species differentiating community types.

Wildlife habitat is poor and does not support a diverse or unique wildlife population. Migratory birds and raptors are present throughout the area. Bats were not observed and bat habitat is poor in the Ochoa Project area. There were no threatened, endangered, or special status species observed in the project area.

21.5.1 EIS Sections

The Purpose and Need provides the justification for a federal proposed action. The Purpose and Need is developed from the ICP's MPO and reclamation plan. It is critical that the MPO and reclamation plan be complete because the NEPA analysis will rely on the information in these two documents.

Scoping meetings are held to obtain public input in the NEPA process. The Proposed Action is presented and the public is invited to comment on the proposal. The results of scoping are summarized in the EIS and a scoping document becomes an appendix to the EIS.

The Proposed Action will be developed from the MPO and reclamation plan. The BLM will also evaluate a "No Action" alternative and will develop additional alternatives that meet the project needs while avoiding or minimizing impacts to resources. These additional alternatives could include mitigation actions or operational variations. The alternatives will become the basis for the impact evaluation.

The Affected Environment section of the EIS describes the existing environment, including physical, natural, and human-made resources, and is intended to provide adequate detail to assess potential project impacts. Resources that are described in the Affected Environment section of the EIS include those that could be adversely or positively impacted, directly or indirectly, by the Proposed Action or alternatives. Both existing data and those data collected specifically for the project (e.g., baseline surveys) will be used to characterize existing environmental conditions. Existing data include published literature, existing surveys, modeling, data analyses, and agency databases. Where existing data do not provide adequate detail, new data are collected to supplement the existing data.

The Environmental Consequences section describes the impacts of the Proposed Action and alternatives on the resources described in the Affected Environment section. This section provides the basis on which the BLM will make their decision with respect to the Ochoa Project's effects on the natural and social environment.

The impact analysis will include a description of the types and magnitudes of impacts. For example, an impact could be long or short term, adverse or beneficial. Mitigation measures are part of the analysis and additional measures may be proposed as part of the impact analysis.

Cumulative impacts are determined by evaluating the effect of the impacts of the proposed project in light of any other "past, existing or reasonably foreseeable" activities in the area. For example, a proposed project may add a small amount of emissions into the air, which when combined with emissions from other existing or proposed projects could adversely affect air quality compared to existing conditions. Cumulative impact determination has been a matter of contention in numerous NEPA processes and must be defined and addressed early in the process to successfully avoid delays.

21.5.1.1 Draft EIS, Public Comment, Final EIS

The Draft EIS (DEIS) will be prepared and released for public review. Public meetings are generally held during this time to facilitate public response. These meetings are typically presentations of the project and identified impacts with opportunities for verbal or written public responses. The public comments and BLM responses are summarized in the Final EIS (FEIS) and included as an appendix. The BLM takes into account the public comments received and develops an FEIS that may include additional information or clarifications.

21.5.1.2 Record of Decision

The BLM will prepare the record of decision (ROD). The ROD is the final statement of approval or denial of the NEPA process. It will contain the requirements to which the project must adhere if it is to go forward, usually by referral to the EIS. Typically, all the other permitting agencies will set standards equal to or exceeding those in the ROD. Following this period, if all other state and local construction permits have been obtained, work can begin at the site.

It is important to realize that NEPA is a public environmental review process. The EIS is not a permit document or a design report. This is a significant difference from permitting processes in that the DEIS and FEIS are intended to document the impacts and the review process, not provide a starting point for negotiations or present ultimate designs. As part of the NEPA process, BLM will define a "preferred alternative" that can be the Proposed Action, or a combination of alternatives.

21.5.2 Potential Impacts

The potential socioeconomic, cultural, and environmental impacts that could result from the Ochoa Project include the following:

- Groundwater impacts related to seepage of solutions from the solar ponds, tailings facility, and solution transportation facilities;
- Groundwater impacts from seepage of process solutions from processing operations;
- Air quality impacts due to dust and emissions from construction activities;
- Air quality impacts due to emissions from the operation of the processing facility and transportation equipment;
- Subsidence of the land surface and associated impacts on oil and gas well operations;
- Impacts on soils from disturbance-related activities;
- Impacts on vegetation and wildlife habitat from disturbance-related activities;
- Impacts on federally threatened and endangered and state-listed sensitive plant and animal species due to disturbance and habitat removal;
- Archaeological and cultural impacts due to disturbance activities;
- Socioeconomic impacts (most likely positive) due to employment of residents and tax and royalty revenues paid to state and local governments;
- Socioeconomic impacts due to strains on existing local resources caused by increased population;
- Land use impacts due to changes in the use status of large tracts of land, including grazing;
- Visual impacts due to changes in the viewshed; and
- Environmental justice impacts due to selective placement of the mine or hiring practices.

It is anticipated that the majority of these impacts either would be minor or would be eliminated through relatively easy and/or required mitigation measures.

Based on the *Waste Isolation Pilot Plant* (WIPP) *Supplemental EIS II* (U.S. Department of Energy [DOE] 1997), and the EIS currently being prepared for the HB In-Situ Solution Potash

Mine, about 20 mi away, impacts on groundwater and air quality and effects on oil and gas operations will be the major issues for any new potash mine in the region.

New Mexico is an anti-degradation state and any discharges must not degrade the existing groundwater quality in the area. Groundwater protection may be required for facilities such as the solar ponds, tailings facility, processing facility, and solution pipelines. These requirements could include liners, double liners, and/or leak-detection systems for the facilities. The purpose of such requirements would be to protect groundwater below the facilities. However, it is also understood that the existing groundwater in the area is deep, already saline, and of poor quality.

Threatened and endangered species, specifically lesser prairie chicken and sand dune lizard, were the focus of the BLM's RMP Amendment (BLM 2007). A site-specific evaluation of threatened, endangered, and special-status species (state and BLM) was started in 2011 and is ongoing. To date, no threatened, endangered, or special-status species have been found.

The BLM and other agencies may impose restrictions and special reclamation requirements to protect the lesser prairie chicken, the sand dune lizard, and perhaps migratory birds and bats, as well as their habitat. Timing limitations on when land disturbance activities or work in certain areas can occur may result due to the breeding season of lesser prairie chicken. On- or off-site mitigation may also be required, depending on whether there is habitat for these species in the proposed project area slated for disturbance. Migratory birds and bats may require additional mitigation.

21.6 Monitoring

21.6.1 Groundwater Quality

A groundwater quality monitoring plan will be developed for the proposed Ochoa Project site and the loadout facility. The monitoring plan will consist of data collection for baseline, operational, and closure phases. The baseline phase of the groundwater monitoring phase will include collection of baseline hydrology data until the proposed evaporation ponds and the loadout facility pond are constructed and filled. The operational phase will begin once the mining activities and disturbance begins. And the closure phase will begin once mine operations have ceased and reclamation activities have been completed.

A minimum of four monitoring wells will be used to evaluate the Ochoa Project's site-specific hydrologic setting and the groundwater quality at each monitoring location (disposal ponds and loadout facility evaporation pond) within the alluvium (where present) and the Dewey Lake Formation. These data will be used to support the discharge permitting activities. The monitoring well network will be developed so that a minimum of one well is upgradient of the ponds and three wells are downgradient of the ponds. The monitoring wells will be positioned to optimize spatial analysis of the groundwater characteristics in and adjacent to the proposed disposal ponds and the loadout facility evaporation pond.

A monitoring well network of existing wells or newly constructed wells will be used to monitor the loadout facility evaporation pond, which will be approximately 28 mi from the Ochoa Project processing plant.

21.6.2 Surface Water Quality

Surface water quality and sediment loads will be monitored during and/or following storm events, to the extent practicable. Specific monitoring locations and analytes will be determined according to Ochoa Project operations, and identified in the stormwater pollution prevention plan (SWPPP).

21.6.2.1 Permit Requirements

The permitting schedule for the Ochoa Project will be dominated by the NEPA process. Time periods for the completion of applications and submittal, review, and approval for most permits are typically less than 24 to 30 months, more on the order of 6 to 12 months.

Numerous other federal, state, and local permits and approvals that are required for the project and discussed below are prepared separately from, and outside of, the NEPA process. When these approvals are dependent on the NEPA findings, they are generally obtained following the NEPA process. Frequently, the BLM will include other federal or state agencies in the NEPA process as “cooperators”; for example, the U.S. Fish and Wildlife Service or the New Mexico Department of Game and Fish could be cooperators for endangered species. The cooperators may have frequent meetings to discuss issues of concern.

The following section provides a comprehensive overview and listing of permits potentially required for the Ochoa Project.

21.6.3 List of Permits and Registrations

Table 21-2 shows the permits potentially necessary for the Ochoa Project, as well as the agencies and the approximate timing for each permit. It is premature to develop a complete list of permits for the project before the project is delineated in greater detail as development progresses. However, the major permits, and many of the minor permits, are included in the list.

Table 21-2 Permits and Registrations

Permit	Agency	Approximate Timing
Mine registration	Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals, and Natural Resources Department	3 months, but not approved until after ROD
Air permit to construct	Air Quality Bureau (AQB) of the New Mexico Environment Department (NMED)	6 1 year
Air permit to operate	AQB, NMED	6 months
State trust land mineral leases and permits	Commissioner of Public Lands of the New Mexico State Land Office (NMSLO)	1 year
State trust land water exploration permit	NMSLO	1 month
State trust land right-of-way easement	NMSLO	2 months
State trust land water easement	NMSLO	6 months
County land use permits	Eddy and Lea Counties	Not approved until after ROD
Permit to appropriate underground waters of New Mexico	Water Rights Division (WRD) of the New Mexico Office of the State Engineer (NM OSE)	6 months
NMED groundwater discharge permit	Ground Water Quality Bureau (GWQB) of the NMED	6 months
Mine drill holes that encounter water–plugging permit	NM OSE	2 months
Notice of Intention to Drill Wells to Appropriate Non potable Groundwater and Application to Drill an Exploratory Well	NM OSE	6 months
Permit to drill exploratory well (groundwater)	NM OSE	2 months
National Pollutant Discharge Elimination System (NPDES) stormwater permit	U.S. Environmental Protection Agency (EPA)	1 year
Fuel storage tanks permits (need not anticipated)	Petroleum Storage Tank (PST) Bureau of the NMED	6 months
Utility location permit	New Mexico Public Regulation Commission	6 months
Section 404 Wetlands and Section 401 Water Certification permits (need not anticipated)	U.S. Army Corps of Engineers (USACE)	6 months

21.6.3.1 Mine Registration

Potash mining is exempt from both the New Mexico Hardrock Mining Act and the New Mexico Coal Mining Act and is therefore not required to obtain mine closure and closeout permits. However, the Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals, and Natural Resources Department registers all mines (including potash mines, borrow pits, and sand and gravel mines), mills, concentrators, and smelters prior to startup of the mining operation. The purpose of this registration is to inform the MMD of the location, operator, commodity, and type of operation. Production, sales, and employment data are collected annually from registrants for the MMD's use in evaluating extractive industry trends. Reporting permanent or temporary closures, reactivations, and safeguarding after operation closure is also required. Additionally, any changes in the original registration, such as a change in owner or operator, must be reported. Production information for individual operators is held confidential in accordance with state law.

21.6.3.2 Air Permit to Construct

The Air Quality Bureau (AQB) of the New Mexico Environment Department (NMED), under the authority of the Air Quality Control Act, issues air quality construction and operating permits. This authority applies to all New Mexico counties except Bernalillo County and Indian Lands. The AQB administers most federal air programs in New Mexico, which include New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAPs), Prevention of Significant Deterioration (PSD), Title V Operating Permits, Title III Air Toxics, and Title IV Acid Rain.

The purpose of these permits is to ensure that air pollution sources meet applicable regulations and will not exceed ambient concentration standards for air pollutants. The air permit to construct must be approved and issued before construction or modification begins. ICP held a pre-application meeting with the NMED AQB on November 21, 2011 to initiate the construction permit application process.

21.6.3.3 Air Permit to Operate

The New Mexico Operating Permit Program (20.2.70 New Mexico Administrative Code [NMAC]) applies to major sources and sources that emit substantial amounts of hazardous air pollutants. Significant documentation and recordkeeping requirements are incorporated in the Operating Permit Program. The Operating Permit will specify all regulations and limits that apply to a source. Possible alternative operating scenarios that could affect the facility must be identified and detailed. No provisions for "grandfathered facilities" are included.

21.6.3.4 State Trust Land Mineral Leases and Permits

State trust land leases, administered by the Commissioner of Public Lands of the NMSLO, are required for mineral exploration and development activities on state trust land. The leases provide for the controlled development of state property and the protection of New Mexico's natural resources. For different types of exploration and prospecting, various permits are required.

Because the requirements for each resource are unique, contacting the Commissioner of Public Lands for detailed information is required.

21.6.3.5 *State Trust Land Water Exploration Permit*

Right of entry onto state trust lands is required for the purposes of exploring for water. ICP obtained NMSLO Water Exploration Permit No. 782, which grants for the term of 1 year, starting October 6, 2011, and ending October 5, 2012, the right of entry onto Section 2, Township 24S, Range 35E for the purpose of exploring, test drilling, and related activities to locate a source of underground water and to establish a well with related equipment.

21.6.3.6 *State Trust Land Right-of-Way Easement*

A right-of-way easement for a term of 35 years or less will be required by the NMSLO for constructing a temporary retention pond to store water discharged onto the surface during an aquifer test performed at the proposed groundwater well location. The right-of-way easement will authorize ICP to use the designated state trust lands for constructing the retention pond for testing purposes.

21.6.3.7 *State Trust Land Water Easement*

For water developed on New Mexico state lands that require a water right to be granted by the New Mexico Office of the State Engineer (NM OSE), the Commissioner of Public Lands requires a water easement to grant applicants the right to discover, appropriate, and divert groundwater to be put to beneficial use. Should groundwater be produced from New Mexico state lands from a depth within the jurisdiction of the NM OSE, an application will be filed for a water easement. ICP does not anticipate filing an application for a water easement, because no groundwater wells are proposed to be located on state lands that would require a water right.

21.6.3.8 *County Land Use Permits*

County land use permits may be required from Lea County. Additional information on local government land use and natural resource control enabling laws can be obtained from the appropriate agencies.

21.6.3.9 *Notice of Intention (NOI) to Drill Wells to Appropriate Non-potable Groundwater and Application for Permit to Drill an Exploratory Well*

The NM OSE requires applicants to file with its office a NOI to drill wells to appropriate non-potable groundwater from aquifers, the top of which is at a depth of 2,500 ft or more. ICP filed on November 9, 2011 two NOIs to Drill Wells to Appropriate Non-Potable Groundwater that were accepted by the NM OSE. Under §72-12-28 NMSA 1978, applications to appropriate non-potable water are not subject to protest or hearing before the State Engineer. In addition NOI, a permit to drill exploratory wells is required. ICP filed for and received two exploratory well drilling permits that are numbered CP-01056 and CP-01057. An Artesian Well Plan of Operations for each permit was also submitted and approved by the NM OSE.

21.6.3.10 Permit to Appropriate Underground Waters of New Mexico

The Water Rights Division of the NM OSE is responsible for issuing permits to appropriate the public underground waters of the State of New Mexico under the authority of New Mexico Statutes Annotated (NMSA) 1978, Chapter 72.

21.6.3.11 NMED Groundwater Discharge Permit

Under the authority of the New Mexico Water Quality Act, the Ground Water Quality Bureau (GWQB) of the NMED is responsible for issuing groundwater discharge permits other than those related to the production and refinement of oil or natural gas. The purpose of this permitting process is to prevent groundwater pollution that could result from discharges of effluent or leachate, and to abate any groundwater pollution that occurs at permitted facilities. Discharge permits are required for all discharges of effluent or leachate that may move directly or indirectly into groundwater that has an existing concentration of 10,000 mg/L or less of TDS. Mill tailings, waste rock stockpiles, leach ore stockpiles, and other mine facilities are regulated under this requirement. Additionally, the GWQB has primacy for non–oil and gas–related underground injection wells under the Underground Injection Control Program of the federal Safe Drinking Water Act, including injection wells associated with uranium or other subsurface, in situ, leach mining operations. Authority for brine production wells has been assigned to the Oil Conservation Division.

21.6.3.12 Mine Drill Holes That Encounter Water–Plugging Permit

Approval of drill hole plugging is required by the Water Rights Division of the NM OSE to ensure that water encountered during drilling activities is confined to the aquifer in which it was encountered.

21.6.3.13 Permit to Drill Exploratory Well (Groundwater)

Approval of an exploratory well permit is required by the NM OSE in advance of drilling to ensure that the proposed drilling would not be to the detriment of any others having existing rights, and is not be contrary to the conservation of water in New Mexico nor detrimental to the public welfare.

21.6.3.14 National Pollutant Discharge Elimination System (NPDES) Permit

The NPDES program requires a permit for discharging pollutants from a point source into waters of the United States. These terms are mandated by the Clean Water Act (CWA) and outlined in 40 CFR 122.2. The U.S. Environmental Protection Agency (EPA) issues NPDES permits in the six states, including New Mexico, that have not been authorized to issue these permits. "Pollutants" are defined as any material that is added to water that changes the physical, chemical, and/or biological nature of the receiving water. "Waters of the United States" includes most surface waters as well as adjacent wetlands, and also includes intermittent streams and arroyos associated with tributary systems. Permits may also be required for discharges composed entirely of surface runoff from rainfall events. However, as spelled out in 40 CFR 122.26(c)(1)(iii) and 40 CFR 122.26(c)(1)(iv), uncontaminated runoff from mining operations or oil and gas exploration, production, processing, and transmission facilities that is not associated with the construction of those types of facilities is exempted from permit requirements. An application for an NPDES permit must be filed at least 180 days before the discharge is expected to commence. The EPA makes the final determination as to whether an NPDES permit is required for a particular operation.

21.6.3.15 Fuel Storage Tank Permits

The Petroleum Storage Tank (PST) Bureau of the NMED oversees the installation, operation, closure, investigation, and cleanup of sites with aboveground storage tanks (ASTs) and underground storage tanks (USTs). The PST Bureau's authority is under the New Mexico Hazardous Waste Act, which implements the provisions of federal Resource Conservation and Recovery Act (RCRA) Subtitle I for USTs.

21.6.3.16 Utility Location Permit

A location permit administered by the New Mexico Public Regulation Commission is required of any person or municipality prior to the construction of any plant designed to generate more than 300 megawatts (MW) of electricity or transmission lines designed to operate at 230 kV or more.

21.6.3.17 Section 404 Wetlands and Section 401 Water Certification Permits

Section 404 of the CWA falls under the direction of the U.S. Army Corps of Engineers (USACE) and requires permitting for dredging or filling into any waters of the United States. Although no surface water is anticipated to be found on site, a survey for waters of the United States should be conducted by a knowledgeable expert and an agreement should be reached with the USACE before eliminating this procedure. No issues relating to these permits are anticipated.

21.6.3.18 Archaeological and Cultural Resource Considerations

Archeological and cultural resources will generally be addressed during the NEPA process because the information will become part of the EIS. However, there are additional requirements. In accordance with the National Historic Preservation Act (NHPA) and State Historic Preservation Act, Section 106 consultation and cultural resource surveys are required. The BLM will consult with the State Historic Preservation Office (SHPO) on cultural issues in the area. Additionally, consultation with Tribal entities is required to determine whether there are sites or artifacts of special Tribal significance in the area. ICP will be required to conduct a Class I research survey and Class III pedestrian survey of the proposed site.

All historic and cultural resources in the vicinity of the proposed action will be identified and the effects of the Ochoa Project on any cultural or historic resources will be disclosed. Class I and Class III surveys for all proposed surface facilities were initiated in November 2011.

22 CAPITAL AND OPERATING COSTS

22.1 Capital Cost Estimate

The capital cost estimate for the Ochoa Project includes all quoted equipment costs, quoted installation costs, and quantity takeoffs for major components. A breakdown of the total estimated initial capital cost is presented in Table 22-1.

Table 22-1 Ochoa Project Total Initial Capital Cost Estimate

Description	Cost
Mine Department	
Underground Equipment	$23,340,000
Surface Equipment	3,765,000
Earthwork Development	19,036,000
Administrative Capital	10,000,000
Primary Development	62,970,000
Indirect Costs @ 4.0%	4,764,000
Owner's Costs @ 3.0%	3,574,000
Total Mine Department Capital	***$127,449,000***
Plant Department	
Contracted Construction	
Crushing	$2,508,000
Milling/NaCl Wash	28,602,000
Calcining	71,450,000
Leaching	45,478,000
Production/Granulation	52,972,000
Loadout and Shipping	10,867,000
Tailings	133,000
Concentrate Pond	109,000
Water Management	8,099,000
Electricity/Natural Gas	1,050,000
Boiler/Steam	17,132,000
Air Pollution Control	15,792,000
Total Contracted Construction Capital	***$254,192,000***
Turn-Key Construction	
Leonite Dissolver System	$1,600,000
SOP Evaporator Preconcentrator System	51,000,000
SOP Evaporator Crystallizer System	51,000,000
SOP Separation System	3,200,000

Description	Cost
Langbeinite Crystallizer Feed Tank and Pumps	800,000
Langbeinite Evaporator/Crystallizer System	102,000,000
Langbeinite Separation System	1,600,000
Langbeinite Decomposition System	13,600,000
Leonite Separation System	2,400,000
Total Turn-Key Construction Capital	***$227,200,000***
Total Plant Department Capital	***$481,392,000***
Product Loadout Department	
Jal Loadout Facility	$30,585,000
Indirect Costs @ 4.0%	1,223,000
Owner's Costs @ 3.0%	918,000
Total Product Loadout Capital	***$32,726,000***
Utilities and Reclamation	
Utilities	$12,338,000
Indirect Costs @ 4.0%	495,000
Owner's Costs @ 3.0%	370,000
Reclamation Bonding	4,000,000
Total Description	***$17,203,000***
Contingency	
Contingency, @ 5% of Mine & JAL Facilities	$8,669,000
Contingency, @ 15% of Constructed Plant	38,129,000
Total Contingency	***$46,798,000***
Total Initial Capital	***$705,568,000***

22.1.1 Basis

Capital costs for the Ochoa PFS were estimated from a variety of sources, but are primarily based on quotes from vendors. Costs for smaller items were obtained from "Cost Mine" books published by InfoMine USA, built up and estimated from engineering take-offs, or based on historic data. Capital costs shown in the sections below represent capital that is necessary to start the mine, process polyhalite, and sell the product. Additional sustaining and ongoing capital is included in the economic model as production and mining increases from start up to full production and to sustain the mine for the 40 year life of this study.

All equipment listed in this section is subject to final selection and determination.

22.1.2 Mine Development

The surface access development is based on the requirements of the room and pillar mining method described in Section 18. Overall mine development includes all costs associated with constructing the mine prior to mining polyhalite. This includes sinking the shaft, installing the head frame and hoist, developing the underground shops and facilities, driving the decline, and installing the decline conveyor. It is expected that mine development will take approximately 90 weeks to complete and cost $65 million. Mine development will be performed by a contractor and all expected contractor costs are included within the estimated costs. Table 22-2 below shows a breakdown of the mine development costs.

Table 22-2 Ochoa Project Mine Development Costs

Description	Qty	Unit	$/Unit	Cost
Primary Mine Development				
Shaft Development				
Mobilization, Hoist & Headframe Erection & Sink to 25 ft	1	LmpSm	$1,975,000	$1,975,000
Shaft Sinking 25 ft to 1600 ft	1	LmpSm	6,285,000	6,285,000
Shaft Station Excavation	1	LmpSm	227,000	227,000
Loading Pocket Excavation, Hardware & Installation	1	LmpSm	432,000	432,000
Station Steel Installation	1	LmpSm	142,000	142,000
Lower Roadheader & LHD's	1	LmpSm	34,000	34,000
Install Electrics & Vent for Development	1	LmpSm	175,000	175,000
Install Steel Sets and Guides	1	LmpSm	2,108,000	2,108,000
Install Cage Counter-weight	1	LmpSm	208,000	208,000
Dismantle & Remove Temporary Equipment	1	LmpSm	56,000	56,000
Contractor G & A and Profit @ 20%	1	LmpSm	2,316,000	2,316,000
Total Shaft Development Capital				***$13,958,000***
Development From Shaft				
Initial Development from Shaft	1	LmpSm	$6,899,000	$6,899,000
Contractor G & A and Profit @ 20%	1	LmpSm	1,380,000	1,380,000
Total Development From Shaft Capital				***$8,279,000***
Shaft Equipment and Facilities				
Hoist	1	Ea	$2,044,000	$2,044,000
Headframe	1	Ea	307,000	307,000
Hoist Sheaves	1	Ea	47,000	47,000
Galloway Sheaves	1	Ea	63,000	63,000
Compressors	1	Ea	124,000	124,000
Hoist Building	1	Ea	82,000	82,000
Front End Loader 2 cu yd.	1	Ea	106,000	106,000
Rock Drills / Jacklegs	1	Ea	13,000	13,000
Fan	1	Ea	11,000	11,000
Total Shaft Equipment and Facilities Capital				***$2,797,000***
Ramp, Equipment and Construction				
Mobilization	1	LmpSm	$196,000	$196,000
Portal Excavation	1	LmpSm	448,000	448,000
Portal Concrete	1	LmpSm	1,771,000	1,771,000
Roadheader, Conveyor & Fan Initial Installation	1	LmpSm	449,000	449,000
Decline Construction 342 to 10,382	1	LmpSm	16,306,000	16,306,000
Contractor G & A and Profit @ 20%	1	LmpSm	3,834,000	3,834,000
Atlas Copco MR 360 Roadheader	1	Ea	2,532,000	2,532,000
LHD 2 cu yd.	1	Ea	264,000	264,000

Description	Qty	Unit	$/Unit	Cost
Scissor Lift	1	Ea	211,000	211,000
Atlas Copco MC R Bolter w Screen Arm	1	Ea	1,029,000	1,029,000
Crew Transporter	1	Ea	66,000	66,000
60 HP Fan	1	Ea	11,000	11,000
Mine Power Center	1	Ea	95,000	95,000
Conveyor System	1	Ea	9,827,000	9,827,000
Shotcrete Equipment	1	Ea	897,000	897,000
Total Ramp, Equipment and Construction Capital				***$37,936,000***
Total Primary Mine Development Capital				***$62,970,000***

22.1.3 Mine Equipment

22.1.3.1 Shaft Construction Equipment

The 600 HP, double drum hoist, 80 or 90 ft high headframe and compressors will not only be used in the sinking of the shaft but will remain as permanent equipment servicing the shaft. The hoist will not require any modification for shaft sinking but the headframe will require minor modification to convert from a sinking mode to a permanent personnel and materials hoisting mode.

22.1.3.2 Decline Construction Equipment

The principal item of equipment will be a Sandvik MR 360 Roadheader. The roof will be supported using rock bolts, mesh and shotcrete.

The product of the roadheader will be transferred to an extensible loading section of conveyor and subsequently transported to surface using a 42 in belt conveyor.

Installation of roof bolts will be the task of an Atlas Copco MC Roof Bolter which will also carry an arm to handle wire mesh.

22.1.4 Permanent Shaft Equipment

As stated earlier the hoist and headframe will remain as part of the permanent equipment. The muck buckets and the Galloway stage will be removed.

To accommodate the hoisting of men and materials a cage and counterweight will be installed along with the necessary shaft steel sets and timber guides. The cage will be fitted with a broken rope safety device as required by law. The chutes and deck doors used for sinking will be removed and the collar area will be adapted with a steel structure to accommodate the cage.

The sheaves used in conjunction with the Galloway stage will be removed and the hoist sheaves relocated to their permanent position to accommodate the cage and counterweight.

22.1.4.1 Permanent Decline Equipment

The conveyor will be extended as the decline progresses; it will therefore not require a great deal of modification to prepare the conveyor for a production format.

22.1.4.2 Mining Equipment

Equipment used in the mining portion is presented throughout Section 18 in this report. Most mining equipment costs were determined by obtaining budgetary quotes from vendors. Quotes that were not obtained through a vendor were estimated using “Mine and Mill Equipment Cost” book from InfoMine USA. Initial mine equipment will cost approximately $23,340,000. . Table 22-3 shows the initial mine equipment that is necessary to be on hand prior to production. The overall amount of mining equipment will increase as production increases and the mill goes to full production.

Table 22-3 Mine Equipment

Description	Qty	Unit	$/Unit	Cost
Underground Equipment				
Continuous Miner	2	Ea	$2,722,000	$5,444,000
Feeder Breaker	2	Ea	438,000	876,000
Shuttle Car	4	Ea	721,000	2,884,000
Rock Bolter	2	Ea	657,000	1,314,000
Booster Fans	16	Ea	9,000	144,000
Fuel Tanks	1	Ea	6,000	6,000
Refuge Station Equipment	1	Ea	110,000	110,000
Underground Facilities Equipment	1	Ea	329,000	329,000
Water Storage Tanks	1	Ea	23,000	23,000
Lube Truck	1	Ea	110,000	110,000
Rescue Car	2	Ea	35,000	70,000
Crew Transport Car	4	Ea	25,000	100,000
Mine Collection Conveyor	1	Ea	3,942,000	3,942,000
Panel Conveyor	2	Ea	3,942,000	7,884,000
Stoppings	5	Ea	700	4,000
Overcast	3	Ea	15,000	45,000
Safety Gear	1	Ea	55,000	55,000
Total Underground Equipment Capital				**$23,340,000**

22.1.5 Mine Support and Facilities

Mine support and facilities include construction of mine administrative buildings, waste piles, and ore stockpiles. It also includes any surface equipment that supports the mine and processing facility. Initially, administrative building requirements will be rented, but permanent facilties will be constructed after production begins. The following table shows the costs for the mine support facilities and equipment.

Table 22-4 Initial Mine Support and Facilities

Description	Qty	Unit	$/Unit	Cost
Mine General and Administration				
Hoist House	1	Ea	$114,000	$114,000
Office Building	1	Ea	0	0
Change House	1	Ea	0	0
Warehouse	1	Ea	307,000	307,000
Security	1	Ea	0	0
First Aid	1	Ea	0	0
Head Frame Building	1	Ea	102,000	102,000
Mine Rescue	1	Ea	0	0
Fan Building	1	Ea	102,000	102,000
Software	1	Ea	158,000	158,000
Truck Repair Shop	1	Ea	1,034,000	1,034,000
Lab Building	1	Ea	1,078,000	1,078,000
Warehouse	3	Ea	540,000	1,620,000
Water Supply & Engineered Membrane Plant	1	Ea	5,429,000	5,429,000
Security	1	Ea	56,000	56,000
Truck Wash-down Area	1	Ea	0	0
Total Mine General and Administration Capital				**$10,000,000**

22.1.6 Infrastructure

The Ochoa Project will need to establish infrastructure as currently none exist. Electrical supply will be brought to the site by Xcel energy as stated previously. ICP will distribute electrical requirements to all parts of the processing plant and mine. Water and gas supply along with road access will be established to meet the requirements of the Ochoa Project.

22.1.7 Water

Water will be obtained by building a pipeline from the water well field, where water is extracted from the Capitan Aquifer, transported to the site and distributed. Water that needs to be cleaned will be treated using a reverse osmosis plant at the site. Estimated costs for delivering, distributing, and treating water for the Ochoa project is approximately $17.6 million and are shown in Table 22-5.

Table 22-5 Initial Water Costs

Description	Qty	Unit	Cost per Unit	Total Cost
Water Management				
Capitan Water Storage Tank	1	Ea	$ 10,000	$ 10,000
Raw Water Pump	1	Ea	$ 30,000	$ 30,000
RO Feed Tank	1	Ea	$ 10,000	$ 10,000
Fresh Water Pump	1	Ea	$ 20,000	$ 20,000
Fresh Water Storage Tank	1	Ea	$ 10,000	$ 10,000
Fresh Water Pump	1	Ea	$ 30,000	$ 30,000
Fresh Water Transfer Pump	1	Ea	$ 30,000	$ 30,000
Fresh Water Transfer Pump	1	Ea	$ 30,000	$ 30,000
Raw Water Transfer Pump	1	Ea	$ 30,000	$ 30,000
Fire Protection Water Storage Tank	1	Ea	$ 10,000	$ 10,000
Fresh Water Transfer Pump	1	Ea	$ 20,000	$ 20,000
Fire Protection Auxiliary Power Unit	1	Ea	$ 15,000	$ 15,000
UV Treatment Unit	1	Ea	$ 10,000	$ 10,000
Pressured Potable Water Tank	1	Ea	$ 12,000	$ 12,000
Potable Water Feed Tank	1	Ea	$ 10,000	$ 10,000
Fire Protection Jockey Pump	1	Ea	$ 20,000	$ 20,000
Fire Protection Pump	2	Ea	$ 30,000	$ 60,000
Chlorination Unit	1	Ea	$ 5,000	$ 5,000
Bulk Chlorine Storage Vessel	1	Ea	$ 1,000	$ 1,000
Potable Water Pump	1	Ea	$ 20,000	$ 20,000
Equipment Installation Factor	2.1	Equip Cost	$ 383,000	$ 804,000
Concrete Material	1	LmpSm	$ 127,000	$ 127,000
Steel Material	1	LmpSm	$ 1,935,000	$ 1,935,000
Process Water (Raw) Distribution	1	LmpSm	$ 1,200,000	$ 1,200,000
Process Water (Fresh) Distribution	1	LmpSm	$ 1,200,000	$ 1,200,000
Fire Loop with PIVs and Hydrants	1	LmpSm	$ 1,500,000	$ 1,500,000
Domestic Water Distribution	1	LmpSm	$ 800,000	$ 800,000
Safety Showers and Eye Washes	30	Ea	$ 5,000	$ 150,000
Water Pipelines	18	mi	$ 222,000	$ 3,996,000
Septic System	2	Ea	42,000	84,000
Water Supply & Engineered Membrane Plant	1	Ea	$ 5,429,000	$ 5,429,000
Total Water Management Capital				***$17,608,000***

22.1.8 Power

Electrical distribution and installation for the processing plant and crystallizers is already included in the capital costs estimated above for each portion of the processing plant. Mine electrical distribution and underground communication installation are listed below in Table 22-6 and are initially estimated to cost approximately $6.9 million.

Table 22-6 Power Costs

Description	Qty	Unit	Cost per Unit	Total Cost
Electricity/Communications				
Power Substation	1	LmpSm	$ 250,000	$ 250,000
Electrical Distribution	1	LmpSm	$ 200,000	$ 200,000
Communications, Surface	1	Ea	$ 110,000	$ 110,000
Lighting	50	Ea	$ 2,190	$ 110,000
Transmission Lines	3	mi	$ 491,000	$ 1,473,000
Electrical - Wire/Switch Gear	1	Ea	$ 1,820,000	$ 1,820,000
Power Substation, At Plant	1	Ea	$1,298,000	$ 1,298,000
Power Substation, At Shaft	1	Ea	$ 865,000	$ 865,000
Fan Building Electrics	1	Ea	$ 54,000	$ 54,000
Communications, Underground	1	EA	$ 332,533	$ 333,000
Electrical Distribution, Including Installation	1	LmpSm	$ 383,000	$ 383,000
Total Cost				***$ 6,896,000***

22.1.9 Gas

Transwestern Gas has provided ICP with the cost of building a pipeline and distributing the gas to the Ochoa project. Currently a 3 mi pipeline will need to be built in order to access the Ochoa site. It will cost approximately $2.4 million to construct this pipeline as shown in Table 22-7. The cost of distributing gas within the plant is included in the processing capital costs.

Table 22-7 Gas Costs

Description	Qty	Unit	Cost per Unit	Total Cost
Electricity/Natural Gas				
Natural Gas Terminus	1	LmpSm	$ 250,000	$ 250,000
Natural Gas Distribution	1	LmpSm	$ 200,000	$ 200,000
Piping, Instrumentation, Process Controls	1	LmpSm	$ 150,000	$ 150,000
Gas Pipeline	3	mi	$ 604,000	$ 1,812,000
Total Gas Costs				***$ 2,412,000***

22.1.10 Roads

Additional gravel roads will be built initially in order to provide access for contractors, employees, construction vehicles, and personnel. Initial costs for the roads will be approximately $700,000 as shown in Table 22-8 below.

Table 22-8 Road Costs

Description	Qty	Unit	Cost per Unit	Total Cost
Earthwork Development				
Access Roads, Gravel	35,520	SqYd	$ 7.03	$ 250,000
Auxiliary Roads, Gravel	64,856	SqYd	$ 6.92	$ 449,000
Total Road Costs				***$ 699,000***

22.1.11 Coarse Ore Storage

A stockpile of 5 days requirement of raw coarse ore will be stored on the surface. A covered overland conveyor will convey the raw ore from the decline portal to a storage stockpile that will have a clear span cover. All polyhalite from the mine will be deposited at this stockpile. Front-end loaders will load ore onto a reclaim conveyor belt which will transport raw polyhalite directly to the crushers in the processing plant. This conveyor and dome system is estimated to cost approximately $2 million. Table 22-9 below shows the detailed costs of this coarse ore storage system.

Table 22-9 Coarse Ore Storage Capital Costs

Description	Qty	Unit	Cost per Unit	Total Cost
Coarse Ore Storage				
ROM Transfer Conveyor	250	Ft	$ 892	$ 223,000
ROM Dome Feed Conveyor	500	Ft	$ 945	$ 472,000
Clear Span Storage Facility	1	Ea	$ 1,022,000	$ 1,022,000
ROM Reclaim Conveyor	100	Ft	$ 892	$ 89,000
ROM Process Feed Conveyor	300	Ft	$ 945	$ 283,000
Total Coarse Ore Storage Capital Cost				**$ 2,089,000**

22.1.12 Crushing and Grinding

. The overall initial capital costs for crushing and grinding portion of the processing facility is approximately $2.5 million as shown in Table 22-10.

Table 22-10 Crushing and Grinding Costs

Description	Qty	Unit	Cost per Unit	Total Cost
Crushing Circuit				
Apron Feeder	1	Ea	$ 227,000	$ 227,000
Apron Feeder Motor	1	Ea	$ 15,000	$ 15,000
Vibrating Screen	1	Ea	$ 74,000	$ 74,000
Low Speed Sizer	1	Ea	$ 98,000	$ 98,000
Collector Belt Conveyor	42	LinFt	$ 2,000	$ 84,000
Equipment Installation Factor	2.1	Equip Cost	$ 497,000	$1,044,000
Concrete Material	1	LmpSm	$ 91,000	$ 91,000
Steel Material	1	LmpSm	$ 875,000	$ 875,000
Total Crushing Circuit Capital				$***2,508,000***

22.1.13 Milling and Washing

Equipment used for the milling and washing portion of the process is presented in Table 22-11. Overall initial costs are approximately $28.6 million.

Table 22-11 Milling and Washing Cost Estimate

Description	Qty	Unit	Cost per Unit	Total Cost
Milling/NaCl Washing				
Overhead Crane	1	Ea	$ 125,000	$ 125,000
Bucket Elevator	30	LinFt	$ 2,000	$ 60,000
Rod Mill	1	Ea	$ 3,055,000	$ 3,055,000
Rod Mill Scrap Bin	1	Ea	$ 5,000	$ 5,000
Rod Mill Discharge Sump	1	Ea	$ 5,000	$ 5,000
Slurry Pump	1	Ea	$ 38,200	$ 38,000
Head Tank	1	Ea	$ 10,000	$ 10,000
Stacksizer Screens	6	Ea	$ 208,400	$ 1,250,000
Oversize Re-Pulp Slurry Sump	1	Ea	$ 5,000	$ 5,000
Slurry Pump	1	Ea	$ 38,200	$ 38,000
Underflow Slurry Sump	1	Ea	$ 5,000	$ 5,000
Hydrocyclone Feed Pump	1	Ea	$ 37,910	$ 38,000
Hydrocyclones	1	Ea	$ 100,000	$ 100,000
Slurry Spreader onto Belt Filter	1	Ea	$ 25,000	$ 25,000
Vacuum Belt Filter	1	Ea	$ 2,484,000	$ 2,484,000
Filtrate Collection Tank	1	Ea	$ 5,000	$ 5,000
Filtrate Transfer Pump	1	Ea	$ 35,000	$ 35,000
Transfer Belt Conveyors	177	LinFt	$ 2,000	$ 354,000

Description	Qty	Unit	Cost per Unit	Total Cost
Brine Balance Tank	1	Ea	$ 60,000	$ 60,000
Brine Transfer Pump	1	Ea	$ 35,000	$ 35,000
Brine Bleed Pump	1	Ea	$ 35,000	$ 35,000
Equipment Installation Factor	2.1	Equip Cost	$ 7,768,000	$16,313,000
Concrete Material	1	LmpSm	$ 528,000	$ 528,000
Steel Material	1	LmpSm	$ 3,959,000	$ 3,959,000
Rod Mill Charger	1	Ea	$ 35,000	$ 35,000
Total Milling/NaCl Washing Capital				***$28,602,000***

22.1.14 Calcining

Equipment used for the calcining portion of the process is presented in Table 22-12. A single calciner will be used which will be large enough to process the necessary ore at full production. The design of the processing facility allows for a second calcining circuit to be added to the plant in the future without disrupting production. Overall initial cost for the calcining circuit is estimated to be $71.5 million.

Table 22-12 Calcining Cost Estimate

Description	Qty	Unit	Cost per Unit	Total Cost
Calcining				
Bucket Elevator	30	LinFt	$ 2,000	$ 60,000
Calciner Feed Screw Conveyor	58	LinFt	$ 2,500	$ 145,000
Polyhalite Calciner Kiln	1	Ea	$ 21,150,000	$21,150,000
Kiln Burner Assembly	1	Ea	$ 30,000	$ 30,000
Hot Water Sump	1	Ea	$ 5,000	$ 5,000
Hot Water Transfer Pump	1	Ea	$ 35,000	$ 35,000
Cooling Tower	1	Ea	$ 250,000	$ 250,000
Cooled Water Sump	1	Ea	$ 5,000	$ 5,000
Cooled Water Transfer Pump	1	Ea	$ 35,000	$ 35,000
Transfer Screw Conveyor	50	LinFt	$ 2,500	$ 125,000
Transfer Belt Conveyor	125	LinFt	$ 1,200	$ 150,000
Equipment Installation Factor	2.1	Equip Cost	$ 21,990,000	$46,179,000
Kiln Feed Building and Foundations	1	Ea	$ -	$ -
Concrete Material	1	LmpSm	$ 941,000	$ 941,000
Steel Material	1	LmpSm	$ 1,585,000	$ 1,585,000
Auxiliary Power Unit (Skid Mnt/Enclosure)	1	Ea	$ 755,000	$ 755,000
Total Calcining Capital				***$71,450,000***

22.1.15 Leaching

Equipment used for the leaching circuit is presented in table 22-13. Additional leach tanks can be added to the circuit for future production increases. The initial capital estimate for the leaching circuit is $45.5 million.

Table 22-13 Leaching Cost Estimate

Description	Qty	Unit	Cost per Unit	Total Cost
Leaching				
Overhead Crane	1	Ea	$ 125,000	$ 125,000
Leach Tank 1-A	1	Ea	$ 313,000	$ 313,000
Leach Tank 1-A Agitator	1	Ea	$ 55,000	$ 55,000
Leach Tank 1-B	1	Ea	$ 313,000	$ 313,000
Leach Tank 1-B Agitator	1	Ea	$ 55,000	$ 55,000
Leach Tank 1-C	1	Ea	$ 313,000	$ 313,000
Leach Tank 1-C Agitator	1	Ea	$ 55,000	$ 55,000
Slurry Sump	1	Ea	$ 5,000	$ 5,000
Hydrocyclone Feed Pump	1	Ea	$ 38,000	$ 38,000
Hydrocyclone	1	Ea	$ 100,000	$ 100,000
Centrifuge	3	Ea	$ 1,100,000	$ 3,300,000
Brine Collection Tank	1	Ea	$ 60,000	$ 60,000
Brine Transfer Pump	1	Ea	$ 35,000	$ 35,000
Collector Screw Conveyor	36	LinFt	$ 2,500	$ 90,000
Transfer Screw Conveyor	24	LinFt	$ 2,500	$ 60,000
Overhead Crane	1	Ea	$ 125,000	$ 125,000
Leach Tank 2-A	1	Ea	$ 313,000	$ 313,000
Leach Tank Agitator	1	Ea	$ 55,000	$ 55,000
Leach Tank 2-B	1	Ea	$ 313,000	$ 313,000
Leach Tank Agitator	1	Ea	$ 55,000	$ 55,000
Leach Tank 2-C	1	Ea	$ 313,000	$ 313,000
Leach Tank Agitator	1	Ea	$ 55,000	$ 55,000
Slurry Sump	1	Ea	$ 5,000	$ 5,000
Slurry Pump	1	Ea	$ 38,000	$ 38,000
Leach Tank 2-D	1	Ea	$ 313,000	$ 313,000
Leach Tank Agitator	1	Ea	$ 55,000	$ 55,000
Leach Tank 2-E	1	Ea	$ 313,000	$ 313,000
Leach Tank Agitator	1	Ea	$ 55,000	$ 55,000
Leach Tank 2-F	1	Ea	$ 313,000	$ 313,000
Leach Tank Agitator	1	Ea	$ 55,000	$ 55,000
Slurry Sump	1	Ea	$ 5,000	$ 5,000

Description	Qty	Unit	Cost per Unit	Total Cost
Slurry Pump	1	Ea	$ 38,000	$ 38,000
Leach Tank 2-G	1	Ea	$ 313,000	$ 313,000
Leach Tank Agitator	1	Ea	$ 55,000	$ 55,000
Leach Tank 2-H	1	Ea	$ 313,000	$ 313,000
Leach Tank Agitator	1	Ea	$ 55,000	$ 55,000
Leach Tank 2-J	1	Ea	$ 313,000	$ 313,000
Leach Tank Agitator	1	Ea	$ 55,000	$ 55,000
Slurry Sump	1	Ea	$ 5,000	$ 5,000
Hydrocyclone Feed Pump	1	Ea	$ 38,000	$ 38,000
Hydrocyclone	1	Ea	$ 100,000	$ 100,000
Centrifuge	2	Ea	$ 1,100,000	$ 2,200,000
Brine Collection Tank	1	Ea	$ 60,000	$ 60,000
Brine Pump	2	Ea	$ 35,000	$ 70,000
Collection/Transfer Screw Conveyor	48	Ea	$ 900	$ 43,000
Overland Belt Conveyor	222	Ea	$ 2,000	$ 444,000
Equipment Installation Factor	2.1	Equip Cost	$ 11,397,000	$23,934,000
Concrete Material	1	LmpSm	$ 1,770,000	$ 1,770,000
Steel Material	1	LmpSm	$ 8,374,000	$ 8,374,000
Total Leaching Capital				***$45,478,000***

22.1.16 Crystallization

Equipment used for the crystallization portion of the process is presented in table 22-14. The estimated cost of the crystallizer was provided by HPD and is a turnkey price. Turnkey pricing includes all materials, installation, engineering, and contractor profits which is approximately $227 million.

Table 22-14 Crystallization Cost Estimate

Description	Qty	Unit	Cost per Unit	Total Cost
Turn Key Systems				
Leonite Dissolver System	1	LmpSm	$ 1,600,000	$ 1,600,000
SOP Evaporator Preconcentrator System	1	LmpSm	$ 51,000,000	$ 51,000,000
SOP Evaporator Crystallizer System	1	LmpSm	$ 51,000,000	$ 51,000,000
SOP Separation System	1	LmpSm	$ 3,200,000	$ 3,200,000
Langbeinite Crystallizer Feed Tank and Pumps	1	LmpSm	$ 800,000	$ 800,000
Langbeinite Evaporator Crystallizer System	1	LmpSm	$ 102,000,000	$102,000,000
Langbeinite Separation System	1	LmpSm	$ 1,600,000	$ 1,600,000
Langbeinite Decomposition System	1	LmpSm	$ 13,600,000	$ 13,600,000
Leonite Separation System	1	LmpSm	$ 2,400,000	$ 2,400,000
Total Turn Key Systems Capital				***$227,200,000***

22.1.17 Product Drying and Granulation

Equipment used for product drying and granulation is presented in Table 22-15. A single granulation circuit will be used to dry and granulate both SOP and langbeinite. As production increases, an additional granulation circuit will be added.. The initial capital cost for the granulation circuit is approximately $53 million.

Table 22-15 Product Drying and Granulation Cost Estimate

Description	Qty	Unit	Cost per Unit	Total Cost
Production/Granulation (*Subarea - SOP/Langbeinite Granulation*)				
Feed Screw Conveyor	30	LinFt	$ 900	$ 27,000
SOP Product Dryer	1	Ea	$ 2,000,000	$ 2,000,000
Screw Conveyor	16	LinFt	$ 900	$ 14,000
Bucket Elevator 1	30	LinFt	$ 2,000	$ 60,000
Feed Bin	1	Ea	$ 10,000	$ 10,000
Rotex Mineral Screener	1	Ea	$ 234,000	$ 234,000
Roll Crusher	1	Ea	$ 95,000	$ 95,000
Recycle Belt Conveyor	32	LinFt	$ 1,500	$ 48,000
Transfer Belt Conveyor 1	52	LinFt	$ 1,500	$ 78,000
Transfer Belt Conveyor 1	160	LinFt	$ 1,500	$ 240,000
Transfer Belt Conveyor 2	13	LinFt	$ 1,500	$ 20,000
Transfer Belt Conveyor 2	110	LinFt	$ 1,500	$ 165,000
Transfer Belt Conveyor 2	70	LinFt	$ 1,500	$ 105,000
Bucket Elevator 2	30	LinFt	$ 2,000	$ 60,000
Distribution Screw Conveyor	35	LinFt	$ 900	$ 32,000

Description	Qty	Unit	Cost per Unit	Total Cost
Reclaim/Transfer Belt Conveyor 3	41	LinFt	$ 1,500	$ 62,000
Stream Splitter	1	Ea	$ 10,000	$ 10,000
Feed Screw Conveyor	41	LinFt	$ 900	$ 37,000
Feed Screw Conveyor	41	LinFt	$ 600	$ 25,000
Raymond Roller Mill	1	Ea	$ 1,400,000	$ 1,400,000
Transfer Screw Conveyor	20	LinFt	$ 600	$ 12,000
Bucket Elevator 3	30	LinFt	$ 2,000	$ 60,000
Distribution Screw Conveyor	16	LinFt	$ 600	$ 10,000
Reclaim Conveyor	18	LinFt	$ 1,200	$ 22,000
Reclaim Conveyor	35	LinFt	$ 1,200	$ 42,000
Transfer Belt Conveyor 4	92	LinFt	$ 1,200	$ 110,000
Transfer Belt Conveyor 4	162	LinFt	$ 1,200	$ 194,000
Bucket Elevator 4	30	LinFt	$ 2,000	$ 60,000
Distribution Screw Conveyor	35	LinFt	$ 900	$ 32,000
Transfer Belt Conveyor 5	70	LinFt	$ 1,200	$ 84,000
Transfer Belt Conveyor 5	70	LinFt	$ 1,500	$ 105,000
Haul Back Dump Pocket	1	Ea	$ 80,000	$ 80,000
Dump Pocket Reclaim Feeder	1	Ea	$ 20,000	$ 20,000
Transfer Screw Conveyor	45	LinFt	$ 900	$ 41,000
Reclaim Screw Conveyor	43	LinFt	$ 600	$ 26,000
Reclaim Screw Conveyor	28	LinFt	$ 600	$ 17,000
Reclaim Screw Conveyor	52	LinFt	$ 900	$ 47,000
Solution Transfer Pump	4	Ea	$ 15,000	$ 60,000
Solution Transfer Pump	4	Ea	$ 15,000	$ 60,000
Paddle Mixer	1	Ea	$ 190,000	$ 190,000
Feed Screw Conveyor	13	LinFt	$ 900	$ 12,000
Drum Granulator	1	Ea	$ 1,150,000	$ 1,150,000
Feed Screw Conveyor	33	LinFt	$ 900	$ 30,000
SOP Granule Dryer	1	Ea	$ 3,581,000	$ 3,581,000
Screw Conveyor	13	LinFt	$ 900	$ 12,000
Bucket Elevator 7	30	LinFt	$ 2,000	$ 60,000
Stream Splitter	1	Ea	$ 10,000	$ 10,000
Rotex Mineral Screener	2	Ea	$ 234,000	$ 468,000
Roll Crusher 2 & 3	2	Ea	$ 94,000	$ 188,000
Total Subarea - SOP/Langbeinite Granulation Capital				***$11,505,000***

Description	Qty	Unit	Cost per Unit	Total Cost
Equipment Installation Factor	2.1	Equip Cost	$ 11,505,000	$24,161,000
Concrete Material	1	LmpSm	$ 4,275,000	$ 4,275,000
Steel Material	1	LmpSm	$ 10,835,000	$10,835,000
Auxiliary Power Unit (Skid Mnt/Enclosure)	2	Ea	$ 88,000	$ 176,000
Compressor Unit	1	LmpSm	$ 20,000	$ 20,000
Product Campaigning Bins	1	LmpSm	$ 2,000,000	$ 2,000,000
Total Production/Granulation Capital				***$52,972,000***

22.1.18 Product Loadout

Equipment used for the product loadout at the processing plant is presented in Table 22-16. All material will be loaded onto haul trucks at the plant and transported to the Jal loadout where it will be stored and later loaded onto trains or sold to local customers. Initial cost for the loadout at the processing plant is approximately $10.9 million.

Table 22-16 Product Loadout Costs

Description	Qty	Unit	Cost per Unit	Total Cost
Loadout and Shipping				
Bucket Elevator 1	130	LinFt	$ 2,000	$ 260,000
Bucket Elevator 2	130	LinFt	$ 2,000	$ 260,000
Bucket Elevator 3	130	LinFt	$ 2,000	$ 260,000
Transfer Conveyor 1	64	LinFt	$ 1,800	$ 115,000
Transfer Conveyor 2	24	LinFt	$ 1,800	$ 43,000
Transfer Conveyor 3	44	LinFt	$ 1,800	$ 79,000
Distribution Conveyor 1	66	LinFt	$ 1,800	$ 119,000
Distribution Conveyor 2	66	LinFt	$ 1,800	$ 119,000
Distribution Conveyor 3	64	LinFt	$ 1,800	$ 115,000
Product Oil Storage	1	Ea	$ 20,000	$ 20,000
Product Oil Application System	1	LS	$ 30,000	$ 30,000
Truck Scales w/Load Cells	3	Ea	$ 15,000	$ 45,000
Equipment Installation Factor	2.1	Equip Cost	$1,465,400	$ 3,077,000
Concrete Material	1	LmpSm	$ 680,000	$ 680,000
Steel Material	1	LmpSm	$5,645,000	$ 5,645,000
Total Loadout and Shipping Capital				***$10,867,000***

22.1.19 Product Storage / Loadout near Jal

Finished product is transported to and stored at the Jal loadout facility where it will be dispatched by truck or train to customers. The initial storage and loadout facility is adequate for approximately 1.5 months of finished product. The design of the loadout facility allows for additional storage to be added seamlessly in the future. Initial estimated capital cost for the Jal loadout facility is approximately $30.6 million. The following table outlines the equipment that will be used at the Jal loadout facility.

Table 22-17 Jal Loadout Facility

Description	Qty	Unit	Cost per Unit	Total Cost
JAL Loadout Facility				
Truck Dump Hopper	1	Ea	$ 44,000	$ 44,000
Reclaim Belt Feeder	1	Ea	$ 54,000	$ 54,000
Dome Feed Conveyor	1	Ea	$ 354,000	$ 354,000
SOP Dome 62,000 Tons	1	Ea	$ 4,497,000	$ 4,497,000
SOP Reclamation System	1	Ea	$ 2,761,000	$ 2,761,000
Vibratory Feeders	3	Ea	$ 65,000	$ 195,000
Reclaim Belt Conveyor	1	Ea	$ 272,000	$ 272,000
Screen Feed Belt Conveyor	1	Ea	$ 272,000	$ 272,000
Fine Product Screen	2	Ea	$ 294,000	$ 588,000
Screen Support Tower	1	Ea	$ 80,000	$ 80,000
SOP Fines Bin	1	Ea	$ 50,000	$ 50,000
Touchup Equipment	1	Ea	$ 33,000	$ 33,000
Enclosed Train Loading Station Feed Conveyor	1	Ea	$ 245,000	$ 245,000
Soluble SOP Silo, 6,000 Tons	1	Ea	$ 852,000	$ 852,000
Truck Dump Hopper	1	Ea	$ 44,000	$ 44,000
Reclaim Belt Feeder	1	Ea	$ 65,000	$ 65,000
Silo Vibratory Feeder	1	Ea	$ 33,000	$ 33,000
Collection Belt Conveyor	1	Ea	$ 223,000	$ 223,000
Silo Feed Conveyor	1	Ea	$ 327,000	$ 327,000
Truck Dump Hopper	1	Ea	$ 44,000	$ 44,000
Reclaim Belt Feeder	1	Ea	$ 54,000	$ 54,000
Dome Feed Conveyor	1	Ea	$ 354,000	$ 354,000
Langbeinite Dome 62,000 Tons	1	Ea	$ 4,497,000	$ 4,497,000
Langbeinite Reclamation System	1	Ea	$ 2,761,000	$ 2,761,000
Vibratory Feeders	3	Ea	$ 65,000	$ 195,000
Reclaim Belt Conveyor	1	Ea	$ 272,000	$ 272,000
Screen Feed Belt Conveyor	1	Ea	$ 272,000	$ 272,000
Fine Product Screen	2	Ea	$ 286,000	$ 572,000

Description	Qty	Unit	Cost per Unit	Total Cost
Screen Support Tower	1	Ea	$ 80,000	$ 80,000
SOP Fines Bin	1	Ea	$ 50,000	$ 50,000
Touchup Equipment	1	Ea	$ 33,000	$ 33,000
Enclosed Train Loading Station Feed Conveyor	1	Ea	$ 245,000	$ 245,000
Rail Scales	2	Ea	$ 95,000	$ 190,000
Train Loading Station	2	Ea	$ 1,035,000	$ 2,070,000
Air Compressor	1	Ea	$ 349,000	$ 349,000
Siding	3	Ea	$ 1,635,000	$ 4,905,000
Septic System/ Leach Pond	1	Ea	$ 54,000	$ 54,000
Scale Shack/Control Room	1	Ea	$ 212,000	$ 212,000
Oil Storage Tank	1	Ea	$ 10,000	$ 10,000
Warehouse	1	Ea	$ 53,000	$ 53,000
Lube Building	1	Ea	$ 53,000	$ 53,000
Semi Truck Tractor	6	Ea	$ 121,000	$ 726,000
Belly Dump Trailer	6	Ea	$ 47,000	$ 282,000
Yard Locomotive	1	Ea	$ 218,000	$ 218,000
Rail Mule	1	Ea	$ 109,000	$ 109,000
Truck Maintenance Shop *	1	Ea	$ -	$ -
Rail Car Washing Area	1	Ea	$ 159,000	$ 159,000
Truck Scale	1	Ea	$ 131,000	$ 131,000
Electricity Tie In	1	Ea	$ 613,000	$ 613,000
Water Tank and Pumps	1	Ea	$ 33,000	$ 33,000
Total JAL Loadout Facility Capital				***$30,585,000***

22.1.20 Tailings and Ponds

Waste brine will be pumped from the processing plant to evaporation ponds where crystallized waste will be collected and transported to the dry stack tailings facilities. All dry tails produced in the process will be trucked to the tailings facility. Initial costs for the tailing disposal and evaporation ponds are approximately $16 million. These costs are for 2 initial evaporation ponds and a starter tailings facility. Over time, additional ponds will be built and the dry stack tailings facility will be expanded. The capital cost for the tailings and ponds are presented in Table 22-18.

Table 22-18 Tailings and Ponds

Description	Qty	Unit	Cost per Unit	Total Cost
Tailings				
Slurry Sump	1	Ea	$ 5,000	$ 5,000
Slurry Transfer Pump	1	Ea	$ 38,000	$ 38,000
Equipment Installation Factor	2.1	Equip Cost	$ 43,000	$ 90,000
Concentrate Pond				
Concentrate Sump	1	Ea	$ 5,000	$ 5,000
Concentrate Transfer Pump	1	Ea	$ 30,000	$ 30,000
Equipment Installation Factor	2.1	Equip Cost	$ 35,000	$ 74,000
Start Up Tailings Dry Stack				
Clear & Grub	2,529,641	SqFt	$ 0.02	$ 48,000
Excavate Topsoil to Stockpile	140,536	CuYd	$ 1.50	$ 211,000
Site Grading Fill	2,680	CuYd	$ 3.00	$ 8,000
Perimeter Berm	36,713	CuYd	$ 3.00	$ 110,000
Surface Preparation (Strip or Fill, and Grade)	2,283,883	SqFt	$ 0.02	$ 43,000
Stack Liner Anchor Trench Excavation	248	CuYd	$ 4.50	$ 1,000
Stack Liner Anchor Trench Backfill	248	CuYd	$ 4.50	$ 1,000
Stack 60 mil LLDPE Liner	2,290,645	SqFt	$ 0.58	$1,329,000
Startup Tailings Collection Pond, Sized for Ultimate Stack				
Clear & Grub	402,566	SqFt	$ 0.02	$ 8,000
Excavate Topsoil to Stockpile	22,365	CuYd	$ 1.50	$ 34,000
Site Excavation	347,049	CuYd	$ 3.00	$1,041,000
Pond Surface Preparation (Strip or Fill, and Grade)	404,911	SqFt	$ 0.02	$ 8,000
Pond Liner Anchor Trench Excavation	116	CuYd	$ 4.50	$ 1,000
Pond Liner Anchor Trench Backfill	116	CuYd	$ 4.50	$ 1,000
Operation Pond 80 mil HDPE Top Liner	176,419	SqFt	$ 0.69	$ 122,000
Operation Pond 5mm HDPE Geonet w/ Filter Wrap	177,077	SqFt	$ 0.47	$ 83,000
Operation Pond Geofabric	177,077	SqFt	$ 0.32	$ 57,000
Operation Pond 60 mil HDPE Bottom Liner	177,077	SqFt	$ 0.58	$ 103,000
Storm Pond 80 mil HDPE Top Liner	231,303	SqFt	$ 0.69	$ 160,000
Storm Pond Geofabric	231,523	SqFt	$ 0.32	$ 74,000
Evaporation ponds, 2 pond set				
Clear & Grub	2,602,230	SqFt	$ 0.02	$ 49,000
Excavate Topsoil to Stockpile	144,568	CuYd	$ 1.50	$ 217,000
Site Grading Excavation to Compacted Fill	200,001	CuYd	$ 3.00	$ 600,000
Surface Preparation (Strip or Fill, and Grade)	2,602,230	SqFt	$ 0.02	$ 49,000
Liner Anchor Trench Excavation	167	CuYd	$ 4.50	$ 1,000
Trench Backfill	167	SqYd	$ 4.50	$ 1,000

Description	Qty	Unit	Cost per Unit	Total Cost
60 mil HDPE Liner	157,256	SqFt	$ 0.58	$ 91,000
60 mill LLDPE Liner	2,389,677	SqFt	$ 0.58	$1,386,000
Geofabric	157,256	SqFt	$ 0.32	$ 50,000
Protective base layer	88,946	CuYd	$ 12.00	$1,067,000
Surge Ponds				
Clear & Grub	5,628,172	SqFt	$ 0.02	$ 107,000
Excavate Topsoil to Stockpile	312,676	CuYd	$ 1.50	$ 469,000
Site Grading Excavation to Compacted Fill	789,232	CuYd	$ 3.00	$2,368,000
Site Grading Additional Compacted Fill	363,183	CuYd	$ 3.00	$1,090,000
Surface Preparation (Strip or Fill, and Grade)	5,628,172	SqFt	$ 0.02	$ 107,000
Liner Anchor Trench Excavation	446	CuYd	$ 4.50	$ 2,000
Trench Backfill	446	CuYd	$ 4.50	$ 2,000
80 Mil HDPE Liner	4,602,656	SqFt	$ 0.69	$3,176,000
Geofabric	4,602,656	SqFt	$ 0.32	$1,473,000
Total Tailings and Ponds				***$15,990,000***

22.1.21 Boiler Steam Generation

Steam will be needed at various points in the process in order to produce finished product. Initial capital for steam generation and distribution is approximately $17.1 million and is shown in Table 22-19.

Table 22-19 Steam Generation Costs

Description	Qty	Unit	Cost per Unit	Total Cost
Boiler/Steam				
Boiler Feed Transfer Pump	1	Ea	$ 20,000	$ 20,000
Boiler Feed Tank	1	Ea	$ 10,000	$ 10,000
Natural Gas-Fired Boiler	2	Ea	$ 250,000	$ 500,000
Equipment Installation Factor	2.1	Equip Cost	$ 530,000	$ 1,113,000
Concrete Material	1	LmpSm	$ 1,719,000	$ 1,719,000
Steel Material	1	LmpSm	$ 10,770,000	$10,770,000
Steam Distribution	1	LmpSm	$ 2,000,000	$ 2,000,000
Condensate Recovery	1	LmpSm	$ 1,000,000	$ 1,000,000
Total Boiler/Steam Capital				***$17,132,000***

22.1.22 Owner's Costs

Owners costs were estimated to be 3% of the initial mine capital and equipment, mine utilities, and the Jal loadout for a total of $4.9 million.

22.1.23 EPCM

Engineering, procurement, and construction costs are included as part of the capital cost estimates described in the individual sections above.

22.1.24 Working Capital

Working capital is estimated to be the first 2 months of operating costs plus first fills and consumable supplies.

22.1.25 Sustaining Capital

As production throughput increases over the first 18 months to full production, the mine will need to increase its equipment and capital requirements to meet the demands of the processing facility. Initially, the mine will produce ore prior to the plant coming on line and faster than it is initially consumed. This polyhalite will be stockpiled on the surface during the initial stages of the project. Once the plant depletes this temporary stockpile, sufficient equipment and mining crews will be in place to meet the daily demand of the plant.

Sustaining capital for the remainder of the 40 year life of this study includes allowances for rebuilds of mobile and conveying equipment for the mine and processing plant.

22.2 Operating Cost Estimate

22.2.1 Project Cost and Basis

Operating costs are based on scheduled production, equipment requirements, operating hours, hourly equipment operating costs, and manpower requirements. These costs and requirements were determined from a variety of sources which include, estimates from vendors, FLSmidth, HPD, Gustavson's experience and cost estimates, InfoMine USA Mine and Mill Equipment Cost Estimators Guide and from ICP employees who have extensive first-hand knowledge of the potash operations in the Carlsbad region.

Equipment costs for the mine and processing plant includes maintenance parts, lube, tires, wear parts, supplies, and diesel fuel where applicable. Electricity costs and labor were tracked separately from the equipment operating costs. Maintenance and operating staff were included in the staff and personnel detail. The operating costs were determined based on production of 568k tons of SOP and 275k tons of langbeinite (660k SOP equivalent). Cost per ton of finished product is based on total mineral production. A summary of the life of mine and average annual operating costs are shown in Table 22-20. Major component rebuild costs are not included within the operating costs as these items are capitalized as discussed previously in sustaining capital.

Table 22-20 Ochoa Life of Mine Average Annual Operating Costs

Operating Cost	Life of Mine Cost	Average Annual Cost	Cost/ton ore	Cost/ ton of Product
Mining	$961,318,000	$24,032,950	$6.91	$28.95
Processing	$3,437,831,000	$85,945,775	$24.72	$103.54
Loadout	$133,248,000	$3,331,200	$0.96	$4.01
General & Administrative	$358,762,000	$8,969,050	$2.58	$10.81
Total Operating Costs	***$4,891,159,000***	***$122,279,000***	***$35.17***	***$147.31***

22.2.2 Project Manpower

Personnel requirements and wages were estimated with extensive input from Randy Foote, Chief Operating Officer of ICP, Ken Kramer, Corporate Controller of ICP, and Tom McGuire, Director of Technical Services for ICP. All of these people have extensive knowledge in operating and staffing Potash mines and processing plants in the Carlsbad, New Mexico Region. A summary of the annual manpower costs is shown in Table 22-21.

Table 22-21 Average Yearly Manpower Costs

Manpower Summary	# Per Year	Base Annual Costs	Annual Overtime Costs	Annual Burden Costs	Total Annual Costs
Mine Department					
Hourly Personnel	127	$6,655,000	$599,000	$2,662,000	$9,916,000
Salaried Personnel	12	$1,040,000	-	$416,000	$1,456,000
Total Mine Department	**139**	**$7,695,000**	**$599,000**	**$3,078,000**	**$11,372,000**
Plant Department					
Hourly Personnel	158	$8,177,000	$702,000	$3,271,000	$12,150,000
Salaried Personnel	9	$754,000	-	$301,000	$1,055,000
Total Plant Department	**167**	**$8,931,000**	**$702,000**	**$3,572,000**	**$13,205,000**
Jal Loadout Crew					
Hourly Personnel	7	$360,000	$32,000	$144,000	$537,000
Salaried Personnel	0	-	-	-	-
Total Jal Loadout Crew	**7**	**$360,000**	**$32,000**	**$144,000**	**$537,000**
General & Administrative					
Hourly Personnel	0	-	-	-	-
Salaried Personnel	33	$1,975,000	-	$790,000	$2,765,000
Total G&A Department	**33**	**$1,975,000**	-	**$790,000**	**$2,765,000**
Project Totals	**346**	**$18,961,000**	**$1,333,000**	**$7,584,000**	**$27,879,000**

The mine is scheduled to operate 20 hours per day with two-10 hour shifts. The 4 hours that the mine is not in operation will allow for a daily maintenance window. The processing plant and trucking operations to the Jal loadout will operate 24 hours per day with three-8 hour or two-12 hour shifts. The Jal loadout will operate on a single 8 hour shift per day. All hourly workers have a 6% overtime allowance based on their base salary and burden is 40% of base salary for all employees of the mine.

The projected manpower and annual costs for the personnel in the mine department is listed in Table 22-22, based upon the average estimated manpower levels for the life-of-mine. The mine department represents approximately 41% of the total project manpower.

The estimated annual manpower costs for the processing department are shown in Table 22-23. The processing department accounts for approximately 47% of the total project labor costs.

The projected personnel and annual labor costs for the Jal loadout facility is listed in Table 22-24, based upon the average estimated manpower levels for the life-of-mine. The Jal loadout facility represents approximately 2% of the total project labor. The General and Administrative (G&A) estimated manpower requirements are shown in Table 22-25. G & A labor costs are approximately 10% of the total project labor costs.

Table 22-22 Mine Manpower

				Salary/Hrly	Annual	OT		Annual
Mine Personnel	**Positions**	**Crews**	**#**	**Rate**	**Wage**	**Allowance**	**Burden**	**Cost**
Mine Management								
Mine Manager	1	1	1	$134,000	$134,000		$53,760	$188,160
Mine Superintendent	1	1	1	$101,000	$101,000		$40,000	$141,000
Hoisting Supervisor	1	1	1	$80,000	$80,000		$32,000	$112,000
Mine Maintenance Superintendent	1	1	1	$101,000	$101,000		$40,000	$141,000
Chief Mine Engineer	1	1	1	$100,000	$100,000		$40,000	$140,000
Mine Engineer	2	1	2	$72,000	$144,000		$58,000	$202,000
Lead Surveyor	1	1	1	$70,000	$70,000		$28,000	$98,000
Surveyor	1	1	1	$50,000	$50,000		$20,000	$70,000
Chief Geologist	1	1	1	$100,000	$100,000		$40,000	$140,000
Geologist	2	1	2	$80,000	$160,000		$64,000	$224,000
Total Mine Management			***12***					***$1,456,000***
Mining Crew, (6 panels)								
Foremen	1	4	4	$37.70	$313,664	$28,230	$125,466	$467,360
Miner	6	4	24	$24.70	$1,233,024.00	$110,972	$493,210	$1,837,206
Shuttle Operator	12	4	48	$24.70	$2,466,048	$221,944	$986,419	$3,674,411
Stockpile/Rehandle Operator	1	4	4	$23.70	$197,184	$17,747	$78,874	$293,805
Hoist Operator	1	4	4	$23.70	$197,184	$17,747	$78,874	$293,805
Hoist Bottomlander	1	1	1	$23.70	$49,296	$4,437	$19,718	$73,451
Hoist Toplander	1	1	1	$22.70	$47,216.00	$4,249.00	$18,886.00	$70,351.00

				Salary/Hrly	Annual	OT		Annual
Mine Personnel	**Positions**	**Crews**	**#**	**Rate**	**Wage**	**Allowance**	**Burden**	**Cost**
Underground Warehouse Attendant	1	1	1	$22.70	$47,216.00	$4,249.00	$18,886.00	$70,351.00
Total Mining Crew, (6 panels)			***87***					***$6,780,740.00***
Utility Crew (Days)								
Foreman	1	1	1	$27.00	$56,160.00	$5,054.00	$22,464.00	$83,678.00
Conveyor Operator	3	1	3	$24.70	$154,128.00	$13,872.00	$61,651.00	$229,651.00
Conveyor Helper	2	1	2	$23.70	$98,592.00	$8,873.00	$39,437.00	$146,902.00
Ventilation Laborer	2	1	2	$23.70	$98,592.00	$8,873.00	$39,437.00	$146,902.00
Power Operations Laborer	1	1	1	$23.70	$49,296.00	$4,437.00	$19,718.00	$73,451.00
Total Utility Crew (Days)			***9***					***$680,584.00***
Mine Maintenance (Shift)								
Lead Mechanic	1	4	4	$27.00	$224,640.00	$20,218.00	$89,856.00	$334,714.00
Mechanic	1	4	4	$25.70	$213,824.00	$19,244.00	$85,530.00	$318,598.00
Electrician	1	4	4	$25.70	$213,824.00	$19,244.00	$85,530.00	$318,598.00
Mechanical Helper	1	4	4	$23.70	$197,184.00	$17,747.00	$78,874.00	$293,805.00
Total Mine Maintenance (Shift)			***16***					***$1,265,715.00***
Mine Maintenance (Days)								
Maintenance Foreman	1	1	1	$37.70	$78,416.00	$7,057.00	$31,366.00	$116,839.00
Mechanic	8	1	8	$24.70	$411,008.00	$36,991.00	$164,403.00	$612,402.00

				Salary/Hrly	Annual	OT		Annual
Mine Personnel	**Positions**	**Crews**	**#**	**Rate**	**Wage**	**Allowance**	**Burden**	**Cost**
Electrician	4	1	4	$24.70	$205,504.00	$18,495.00	$82,202.00	$306,201.00
Mechanical Helper	2	1	2	$24.70	$102,752.00	$9,248.00	$41,101.00	$153,101.00
Total Mine Maintenance (Days)			***15***					***$1,188,543.00***
Total Mine Personnel			***139***		***$7,694,752.00***	***$598,928.00***	***$3,077,902.00***	***$11,371,582.00***

Table 22-23 Processing Department Manpower

				Salary/Hrly	Annual	OT		Annual
Plant Personnel	**Positions**	**Crews**	**QTY**	**Rate**	**Wage**	**Allowance**	**Burden**	**Cost**
Plant Management								
Mill Manager	1	1	1	$130,000.00	$130,000.00		$52,000.00	$182,000.00
Mill Superintendent	1	1	1	$100,800.00	$100,800.00		$40,320.00	$141,120.00
Mill Clerk	1	1	1	$20.70	$43,056.00	$3,875.00	$17,222.00	$64,153.00
Mill Maintenance Superintendent	1	1	1	$100,800.00	$100,800.00		$40,320.00	$141,120.00
Mill Maintenance Planners	2	1	2	$78,400.00	$156,800.00		$62,720.00	$219,520.00
Chief Process Engineer	1	1	1	$95,200.00	$95,200.00		$38,080.00	$133,280.00
Process Engineers	2	1	2	$85,000.00	$170,000.00		$68,000.00	$238,000.00
Total Plant Management			***9***					***$1,119,193.00***
Process Plant Operations								
Shift Supervisor	1	4	4	$37.70	$313,664.00	$28,230.00	$125,466.00	$467,360.00
Crush/Grind/Wash/Debrine Operator	1	4	4	$23.70	$197,184.00	$17,747.00	$78,874.00	$293,805.00
Calcination/Dissolver Operator	1	4	4	$23.70	$197,184.00	$17,747.00	$78,874.00	$293,805.00
Preconcentrator/Dryer Feed Operator	2	4	8	$23.70	$394,368.00	$35,493.00	$157,747.00	$587,608.00
Granulation/Drying Operator: SOP	1	4	4	$23.70	$197,184.00	$17,747.00	$78,874.00	$293,805.00
Granulation/Drying Oper: Langbeinite	1	4	4	$23.70	$197,184.00	$17,747.00	$78,874.00	$293,805.00
Product Dispatch Operator	1	4	4	$23.70	$197,184.00	$17,747.00	$78,874.00	$293,805.00

				Salary/Hrly	Annual	OT		Annual
Plant Personnel	**Positions**	**Crews**	**QTY**	**Rate**	**Wage**	**Allowance**	**Burden**	**Cost**
Control Room Operator	2	4	8	$23.70	$394,368.00	$35,493.00	$157,747.00	$587,608.00
Water & Treatment Plant Operator	1	4	4	$23.70	$197,184.00	$17,747.00	$78,874.00	$293,805.00
Heater & Boiler Operator	1	4	4	$23.70	$197,184.00	$17,747.00	$78,874.00	$293,805.00
Tailings System Operator	1	4	4	$23.70	$197,184.00	$17,747.00	$78,874.00	$293,805.00
Shift Mechanic	2	4	8	$23.70	$394,368.00	$35,493.00	$157,747.00	$587,608.00
Shift Electrician	1	4	4	$23.70	$197,184.00	$17,747.00	$78,874.00	$293,805.00
Total Process Plant Operations			***64***					***$4,874,429.00***
Maintenance Department								
Electrical Foreman	1	1	1	$37.70	$78,416.00	$7,057.00	$31,366.00	$116,839.00
Electrician	7	1	7	$24.70	$359,632.00	$32,367.00	$143,853.00	$535,852.00
Instrument Technician	3	1	3	$24.70	$154,128.00	$13,872.00	$61,651.00	$229,651.00
Mechanical Foreman	2	1	2	$37.70	$156,832.00	$14,115.00	$62,733.00	$233,680.00
Maintenance Mechanic	26	1	26	$24.70	$1,335,776.00	$120,220.00	$534,310.00	$1,990,306.00
Construction Mechanic	10	1	10	$24.70	$513,760.00	$46,238.00	$205,504.00	$765,502.00
Utility Foreman	1	1	1	$32.00	$66,560.00	$5,990.00	$26,624.00	$99,174.00
Utility Crew	6	1	6	$22.70	$283,296.00	$25,497.00	$113,318.00	$422,111.00
Total Maintenance Department			***56***					***$4,393,115.00***
Plant Loadout Crew								

				Salary/Hrly	Annual	OT		Annual
Plant Personnel	**Positions**	**Crews**	**QTY**	**Rate**	**Wage**	**Allowance**	**Burden**	**Cost**
Loadout Foreman	1	1	1	$32.00	$66,560.00	$5,990.00	$26,624.00	$99,174.00
Loadout Operator	1	1	1	$23.70	$49,296.00	$4,437.00	$19,718.00	$73,451.00
Transport Drivers	24	1	24	$23.70	$1,183,104.00	$106,479.00	$473,242.00	$1,762,825.00
Total Plant Loadout Crew			***26***					***$1,935,450.00***
Lab support								
Lab Supervisor	1	1	1	$90,000.00	$90,000.00		$36,000.00	$126,000.00
Lab Technician	3	1	3	$44,800.00	$134,400.00		$53,760.00	$188,160.00
Lab Assistant	1	4	4	$18.00	$149,760.00	$13,478.00	$59,904.00	$223,142.00
Total Lab support			***8***					***$537,302.00***
Plant Human Resources								
Human Resources Manager	1	1	1	$90,000.00	$90,000.00		$36,000.00	$126,000.00
Human Resources Specialist	1	1	1	$65,000.00	$65,000.00		$26,000.00	$91,000.00
Clerks	2	1	2	$20.70	$86,112.00	$7,750.00	$34,445.00	$128,307.00
Total Plant Human Resources			***4***					***$345,307.00***
Total Plant Personnel			***167***		***$8,930,712.00***	***$701,797.00***	***$3,572,287.00***	***$13,204,796.00***

Table 22-24 Projected Jal Loadout Facility Annual Manpower Costs

Product Loadout Personnel	Positions	Crews	QTY	Salary/Hrly Rate	Annual Wage	OT Allowance	Burden	Annual Cost
JAL Loadout Crew								
Loadout Foreman	1	1	1	$32.00	$66,560	$5,990	$26,624	$99,174
Loadout Operator	5	1	5	23.70	246,480	22,183	98,592	367,255
Utility Crew	1	1	1	22.70	47,216	4,249	18,886	70,351
Total Product Loadout Personnel			***7***		***$360,256***	***$32,422***	***$144,102***	***$536,780***

Table 22-25 General and Administration Department Annual Labor Costs

				Salary/Hrly	Annual	OT		Annual
G & A Personnel	**Positions**	**Crews**	**QTY**	**Rate**	**Wage**	**Allowance**	**Burden**	**Cost**
Administration								
General Manager	1	1	1	$168,000.00	$168,000.00		$67,200.00	$235,200.00
Controller	1	1	1	$100,000.00	$100,000.00		$40,000.00	$140,000.00
Accountant	4	1	4	$65,000.00	$260,000.00		$104,000.00	$364,000.00
Accounting Clerk	4	1	4	$36,700.00	$146,800.00		$58,720.00	$205,520.00
Administrative Assistants	2	1	2	$36,700.00	$73,400.00		$29,360.00	$102,760.00
Total Administration			***12***					***$1,047,480.00***
Safety								
Safety Director	1	1	1	$95,000.00	$95,000.00		$38,000.00	$133,000.00

				Salary/Hrly	Annual	OT		Annual
G & A Personnel	Positions	Crews	QTY	Rate	Wage	Allowance	Burden	Cost
Safety Support	3	1	3	$60,000.00	$180,000.00		$72,000.00	$252,000.00
Total Safety			***4***					***$385,000.00***
Environmental								
Environmental Manager	1	1	1	$89,600.00	$89,600.00		$35,840.00	$125,440.00
Environmental Support	2	1	2	$44,800.00	$89,600.00		$35,840.00	$125,440.00
Total Environmental			***3***					***$250,880.00***
Procurement								
Procurement Manager	1	1	1	$95,000.00	$95,000.00		$38,000.00	$133,000.00
Purchasing Agents	4	1	4	$56,000.00	$224,000.00		$89,600.00	$313,600.00
Warehouse Attendant	4	1	4	$44,800.00	$179,200.00		$71,680.00	$250,880.00
Total Procurement			***9***					***$697,480.00***
Customer Service								
Sales Associate	4	1	4	$44,800.00	$179,200.00		$71,680.00	$250,880.00
Total Customer Service			***4***					***$250,880.00***
Power Management								
Chief Electrical Engineer	1	1	1	$95,200.00	$95,200.00		$38,080.00	$133,280.00
Total Power Mgmt			***1***					***$133,280.00***
Total G & A Personnel			***33***		***$1,975,000.00***	***$0.00***	***$790,000.00***	***$2,765,000.00***

22.2.3 Mine Operating Costs

The overall operating cost for the mine is approximately $24 million per year. Mine costs include parts, supplies and maintenance materials for all mining equipment as well as diesel for any pieces of equipment that do not run on electricity. Costs were determined for each individual piece of equipment and aggregated on an annual basis. The annual electrical cost for the mine was calculated from installed horsepower of the equipment in the mine at the prevailing utility rates. The summary of the mining costs are shown in Table 21-26.

Table 22-26 Average Annual Mine Operating Costs

Description	Average Annual Operating Costs	Cost/Ton of Ore	Cost/Ton of Final Product
Labor Costs	$11,288,000.00	$3.25	$13.60
Underground Mining Equipment	$4,412,000.00	$1.27	$5.31
Conveying	$1,949,000.00	$0.56	$2.35
Electricity	$3,422,000.00	$0.98	$4.12
Hoisting & Ventilation	$325,000.00	$0.09	$0.39
Surface Facilities & Equipment	$2,638,000.00	$0.76	$3.18
Total Operating Costs	***$24,034,000.00***	***$6.91***	***$28.95***

22.2.4 Plant Operating Costs

Processing costs for the plant were estimated by FLSmidth for all areas of the plant except the Crystallizer circuit. HPD provided the operating costs for the crystallizer portion of the plant. FLSmidth used 3% of equipment costs per year for the cost of plant supplies and 4% of the equipment costs per year for the annual maintenance costs. HPD determined the annual operating costs for the crystallizers, which include equipment costs and supplies to be 1.5% of the crystallizer portion of the processing facility. The annual electrical cost for the plant was calculated both from power factors for equipment in the non-crystallizer circuits and from installed horsepower of the major equipment in the crystallizer section of the plant at the prevailing utility rate.

Table 22-27 Ochoa Yearly Plant Operating Costs

Description	Average Annual Operating Costs	Cost/Ton of Ore	Cost/Ton of Final Product
Manpower	$13,098,000.00	$3.77	$15.78
Crushing/Milling	$598,000.00	$0.17	$0.72
Calcining	$13,288,000.00	$3.82	$16.01
Leaching	$825,000.00	$0.24	$0.99
Production/Granulation	$8,533,000.00	$2.45	$10.28
Loadout	$5,270,000.00	$1.52	$6.35
Water Management	$33,000.00	$0.01	$0.04
Power Dissolution Circuit	$6,676,000.00	$1.92	$8.04
Steam Production	$7,904,000.00	$2.27	$9.52
Crystallizer Equipment and Materials	$3,437,000.00	$0.99	$4.14
Crystallizer Power	$26,283,000.00	$7.56	$31.66
Total Processing Operating Costs	***$85,945,000.00***	***$24.72***	***$103.54***

22.2.5 Product Transportation and Loadout

Finished product will be transported to the train loadout facility in Jal, NM approximately 22 mi east of the processing plant. It is assumed that ICP will run its own trucking fleet to transport the material. The operating costs in this portion include all materials, supplies, mechanical parts, diesel, and electricity. The rail loadout facility will have its own electrical supply separate from the plant and mine. Road taxes are currently $0.04 per truck mi. Table 22-28 summarizes the product transport and loadout operating costs.

Table 22-28 Annual Transport and Loadout Operating Costs

Description	Average Annual Operating Costs	Cost/Ton of Ore	Cost/Ton of Final Product
Manpower	$533,000.00	$0.15	$0.64
Trucking Costs	$1,505,000.00	$0.43	$1.81
Jal Loadout Equipment Costs	$1,158,000.00	$0.33	$1.40
Road Tax and General Costs	$134,000.00	$0.04	$0.16
Total JAL Loadout Facility Operating Costs	***$3,330,000.00***	***$0.96***	***$4.01***

22.2.6 General and Administration Costs

General and administrative labor costs include general management, safety, accounting, environmental, purchasing, sales, and plant power management. Office supplies and equipment is $0.03 per ton of ore, insurance is $1.2 million per year, and annual property taxes are 1.1% of the previous year's revenue.

Table 22-29 Ochoa Yearly General and Administration Costs

Description	Average Annual Operating Costs	Cost/Ton of Ore	Cost/Ton of Final Product
Manpower	$2,763,000.00	$0.79	$3.33
Office Supplies/Expenses	$104,000.00	$0.03	$0.13
Insurance	$1,200,000.00	$0.35	$1.45
Property Taxes	$4,902,000.00	$1.41	$5.91
Total	***$8,969,000.00***	***$2.58***	***$10.81***

22.2.7 Insurance

General liability and property insurance is estimated to be approximately $100,000 per month which is comparable to other operations in the area.

23 ECONOMIC ANALYSIS

23.1 Financial Analysis

The economic evaluation for the Ochoa Project is based on the underground mine design for reserves controlled by ICP and incorporates processing, loadout, and administrative activities. The economic model assumes the first 40 years of mining available reserves. Those reserves closest to the plant location will be exploited initially at a rate of approximately 3.25 million tons per year. The starting point for the economic model is assumed to be the date final permits are obtained.

The projected unit operating costs over 40 years is shown in Table 23-1, and are based on average annual ore production of approximately 3,250,000 (~ 10,000 tons per day) and 337 days per year of operation.

Table 23-1 Ochoa Operating Cost Summary by Cost Type

	Average Annual Cost	40 Year Aggregate Cost	Cost/ ton Ore	Cost/ton Finished Product
Mine – Underground				
Mine Manpower	$11,372,000	$451,525,000	$3.25	$13.60
Underground Equipment	4,463,000	176,422,000	1.27	5.31
Conveying	1,972,000	77,971,000	0.56	2.35
Power	3,462,000	136,882,000	0.98	4.12
Hoisting & Ventilation	329,000	12,996,000	0.09	0.39
Surface Equipment	2,669,000	105,522,000	0.76	3.18
Total Mine - Underground	$24,267,000	$961,318,000	$6.91	$28.95
Processing Plant				
Manpower	$13,205,000	$523,900,000	$3.77	$15.78
Crushing/Milling	605,000	23,909,000	0.17	0.72
Calcining	13,445,000	531,533,000	3.82	16.01
Leaching	834,000	32,986,000	0.24	0.99
Production/Granulation	8,634,000	341,339,000	2.45	10.28

	Average Annual Cost	40 Year Aggregate Cost	Cost/ ton Ore	Cost/ton Finished Product
Loadout	5,332,000	210,800,000	1.52	6.35
Water Management	34,000	1,335,000	0.01	0.04
Power Dissolution Circuit	6,755,000	267,052,000	1.92	8.04
Steam Production	7,998,000	316,174,000	2.27	9.52
Crystallizer Equipment and Materials	3,437,000	137,488,000	0.99	4.14
Crystallizer Power	26,283,000	1,051,315,000	7.56	31.66
Total Processing Plant	***$86,562,000***	***$3,437,831,000***	***$24.72***	***$103.53***
Jal Loadout Facility				
Manpower	$537,000	$21,334,000	$0.15	$0.64
Trucking Costs	1,529,000	60,206,000	0.43	1.81
Jal Loadout Equipment Costs	1,176,000	46,333,000	0.33	1.40
Road Tax and General Costs	136,000	5,375,000	0.04	0.16
Total Jal Loadout Facility	***$3,378,000***	***$133,248,000***	***$0.95***	***$4.01***
Site General & Administration				
Manpower	$2,765,000	$110,506,000	$0.79	$3.33
Office Supplies/Expenses	106,000	4,172,000	0.03	0.13
Insurance	1,200,000	48,000,000	0.35	1.45
Property Taxes	5,645,000	196,085,000	1.41	5.91
Total Site General & Administration	***$9,716,000***	***$358,763,000***	***$2.58***	***$10.82***
Cash Operating Costs	***$123,923,000***	***$4,891,160,000***	***$35.16***	***$147.31***

.

23.2 Business Factors

ICP has researched the local labor market and concludes that qualified labor will be available. Market research indicates that demand for SOP and langbeinite will be available when production commences and throughout the life of the mine. Secure transportation of final product appears to readily available and required utilities and infrastructure can be obtained.

23.2.1 Contracts

Gustavson know of no contracts or agreements that ICP currently has that would adversely affect any information presented in this study.

23.3 Commodity Price(s)

A market study of the Company's finished products was commissioned from CRU Strategies of London, England in the summer of 2011. The study's price projections were based on product pricing in Northwest Europe, over a time period from 2015 through 2025. These projected netback prices are adjusted from metric tonnes to short tons and for the premium in the market place for granular product with consideration of transportation costs. The average estimated netback price for 2020 through 2024 is projected through the remainder of the economic model, from 2026 through 2055.

23.3.1 Granular SOP

Year of Projected Sale	Granular SOP; Hobbs, NM
	Net $/ton
2016	592
2017	622
2018	642
2019	704
2020	765
2021	815
2022	915
2023	813
2024	778
2025	745
2026 - 2055	817

23.3.2 Langbeinite (SOPM)

Year of Projected Sale	Granular SOPM; Hobbs, NM
	Net $/ton
2016	206
2017	210
2018	215
2019	231
2020	246
2021	261
2022	285
2023	261
2024	253
2025	245
2026 - 2055	261

23.4 <u>Royalties and Taxes</u>

The project will be subject to various agreements and laws which require payments of royalties and taxes on the gross revenues or net income of the operations. There are royalties to federal and state agencies, to one party who possess a royalty per ton of finished product and to another party who possess a royalty based on a percent of revenue.

Property taxes and income taxes are payable annually.

23.4.1 Royalties

23.4.1.1 <u>Royalties to the BLM or to the State</u>

A royalty of 2% of gross netback revenue (i.e., fob Hobbs, NM) is payable on all production from the project from lands leased from the BLM. A separate royalty of 2.5% of gross netback revenue (i.e., fob Hobbs, NM) is payable on all production from the project from lands leased from the State of New Mexico (State). All reserves lie either on BLM or on State lands, and approximately 50% of all production comes from each. Therefore, a blended rate of 2.25% was used to calculate this royalty obligation.

23.4.1.2 <u>Royalties based on Tonnage</u>

A royalty in the amount of $1/ton on all production from the project is owed on the first 1,000,000 tons of finished product sold. Thereafter, the royalty falls to $0.50/ton on product sold.

23.4.1.3 <u>Royalties based on Revenue</u>

A royalty in the amount of 3% on net profit is payable once the capital expenditures of the project are recouped from positive cash flows. There is a provision allowing ICP to buy down the royalty, to 1.5% of the net profit, for $9,000,000. This payment is projected to be made in the quarter in which this recoupment is achieved. The 1.5% royalty continues to be payable until the end of the 25th year from the commencement of production.

23.4.2 Property Tax

For potash properties in the state of New Mexico, property taxes are assessed in the aggregate for all assets (equipment, machinery, buildings, land and reserves) and are calculated based upon the prior year’s gross revenue multiplied by 1.1%. The tax is calculated as of July 1 of the current year and 50% of this tax is payable in December of the current year and the remainder is payable in May of the following year.

23.4.3 State and Federal Income Tax

New Mexico imposes a state income tax, which is based upon Federal taxable income. For Federal taxable income, a) development expenditures are deducted 70% in the year expended and amortized 30% over 5 years, b) equipment, machinery and buildings are depreciated according to the Modified Accelerated Cost Recovery System rules of the tax code, and c) a percentage depletion deduction is taken at 14% of gross revenue net of royalties. A combined federal and state income tax rate of 40% was applied to the projected taxable income.

An analysis of minimum federal tax was made, and no alternative minimum tax is projected to be incurred.

23.5 Cash Flow Analysis

The economic model for the Ochoa Project indicates that a positive cash flow of an average of $254.3 million per year, after tax, will generate $10,172.3 million over the 40 years of operations. After the $705.6 million initial capital investment, the net cash flow is $9,466.7 million.

Aggregate Gross Revenues for the first 40 years are projected to be $20,696.6 million, royalties are estimated to be $621.3 million and operating costs are estimated to be $4,891.2 million, which yield an operating margin of $15,184.1 million (73% of gross revenues). Initial capital expenditures are estimated to be $705.6 million, with continuing and sustaining, reclamation and working capital estimated to total $480.3 million over the life of the project. The cumulative State and Federal Income Taxes are expected to be $4,531.4 million.

Total tax and liability includes: State/BLM royalties, property taxes, state and federal income taxes and are projected to be $5,193.1 million (25% of gross revenues).

23.6 Economic Projection

The project has robust economics. The NPV at a 10% discount rate is expected to be $2,030 million on a Pre-Tax basis and $1,286 million on a Post-Tax basis, with a Pre-Tax Internal Rate of Return (IRR) of 32% and a Post-Tax IRR of 26%.

The project is expected to be developed and constructed over a 24 month time period, with initial capital expenditures aggregating to $706 million. The projected payback period from the cash flows generated during commissioning and operations is 3 years and 11 months, reflecting that production will be gradually increased over 18 months to full scale throughput. The expected payback multiple is 14.4 times the original investment.

Table 23-2 shows the economic projection.

Table 23-2 Economic Projection Base Tons Per Year Case

Intercontinental Potash OCHOA Project
3,500,000 Ore tpy, MVR Processing, SOP & Langbeinite, $798 Average SOP Price/$256 Average Langbeinite Price, Start Date = 1-Jan-16

	Year -2 TOTAL	Year -1 TOTAL	Year 1 TOTAL	Year 2 TOTAL	Year 3 TOTAL	Year 4 TOTAL	Year 5 TOTAL	Year 6 TOTAL	Year 7 TOTAL	Year 8 TOTAL	Year 9 TOTAL	Year 10 TOTAL	Year 11 TOTAL
PRODUCTION SCHEDULE													
TOTAL MINE PRODUCTION													
Tons Ore	0	0	1,489,013	3,435,832	3,644,544	3,554,288	3,469,152	3,401,220	3,381,120	3,383,300	3,323,252	3,357,712	3,451,164
Percent Polyhalite in Ore	0.0%	0.0%	82.4%	77.1%	75.8%	78.5%	80.9%	82.3%	82.8%	82.7%	84.2%	83.1%	81.1%
Recovery Percentage	0.0%	0.0%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%
Finished Product, K_2SO_4	0	0	250,935	536,286	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000
Finished Product, Langbeinite	0	0	121,491	259,648	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Income Statement													
REVENUE													
K_2SO_4 Sales Price, $/t	0	0	592	622	642	704	765	815	915	912	779	745	817
Langbeinite Sales Price, $/t	0	0	208	210	216	231	248	261	285	261	253	245	261
Gross Revenue, K_2SO_4	0	0	148,553,000	333,570,000	364,656,000	399,872,000	434,520,000	462,920,000	519,720,000	[illegible]	441,904,000	423,160,000	464,056,000
Gross Revenue, Langbeinite	0	0	25,027,000	54,461,000	59,120,000	63,616,000	67,600,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
less: State/BLM Royalties, @ 2.25%	0	0	(3,905,000)	(8,730,000)	(9,536,000)	(10,428,000)	(11,296,000)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	(12,056,000)
less: Prod Royalty, $14 Sold, for 1st million tons, then $0.5/t	0	0	(373,000)	(796,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)
less: Production Royalty, @ 1.5% after Capital Repaid	0	0	0	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Net Revenue	0	0	169,302,000	378,455,000	413,828,000	443,640,000	484,677,000	516,080,000	576,994,000	514,987,000	493,682,000	473,488,000	517,209,000
OPERATING EXPENSES													
Mining													
Mine Manpower	0	0	8,032,597	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600
Underground Equipment	0	0	1,889,144	4,359,114	4,624,040	4,509,412	4,388,700	4,315,204	4,289,700	4,292,468	4,216,284	4,272,692	4,378,568
Conveying	0	0	834,917	1,926,532	2,043,616	1,992,956	1,939,608	1,907,124	1,895,856	1,897,076	1,863,408	1,888,336	1,935,128
Power	0	0	1,465,741	3,382,134	3,587,684	3,498,748	3,405,088	3,348,064	3,328,276	3,330,424	3,271,312	3,315,080	3,397,228
Hoisting & Ventilation	0	0	139,162	321,110	340,624	332,180	323,288	317,876	315,996	316,200	310,588	314,744	322,544
Surface Equipment	0	0	1,129,936	2,607,277	2,765,736	2,697,176	2,624,976	2,581,012	2,565,760	2,567,416	2,521,848	2,555,584	2,618,912
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Mining	0	0	13,491,497	23,967,767	24,733,300	24,402,072	24,053,260	23,840,880	23,767,188	23,775,184	23,555,040	23,718,036	24,023,980
Processing													
Manpower	0	0	8,912,871	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800
Crushing/Milling	0	0	256,021	590,759	626,660	611,128	594,768	584,808	581,352	581,724	571,400	579,044	593,396
Calcining	0	0	5,691,697	13,133,339	13,931,516	13,586,164	13,222,480	13,001,036	12,924,204	12,932,540	12,703,008	12,872,952	13,191,944
Leaching	0	0	353,214	815,027	864,560	843,128	820,560	806,816	802,048	802,564	788,320	798,868	818,664
Production/Granulation	0	0	3,655,082	8,433,942	8,946,512	8,724,736	8,491,184	8,348,980	8,299,640	8,304,992	8,157,592	8,266,728	8,471,576
Loadout	0	0	2,257,262	5,208,533	5,525,080	5,388,120	5,243,884	5,156,064	5,125,592	5,128,896	5,037,868	5,105,268	5,231,776
Water Management	0	0	14,298	32,990	34,996	34,128	33,216	32,660	32,464	32,488	31,908	32,336	33,140
Power Dissolution Circuit	0	0	2,859,609	6,598,421	6,999,440	6,825,928	6,643,208	6,531,948	6,493,348	6,497,536	6,382,216	6,467,600	6,627,868
Steam Production	0	0	3,385,615	7,812,159	8,286,940	8,081,516	7,865,184	7,733,460	7,687,760	7,692,716	7,556,184	7,667,272	7,847,020
Crystallizer Equipment and Materials	0	0	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212
Crystallizer Power	0	0	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Processing	0	0	57,105,761	85,550,062	88,140,596	87,019,740	85,839,376	85,120,664	84,871,300	84,898,348	84,153,388	84,704,960	85,740,276
JAL Loadout Facility													
Manpower	0	0	399,063	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784
Trucking Costs	0	0	675,323	1,443,266	1,528,620	1,528,612	1,528,612	1,528,612	1,528,612	1,528,620	1,528,612	1,528,612	1,528,612
Jal Loadout Equipment Costs	0	0	519,715	1,110,707	1,176,396	1,176,388	1,176,388	1,176,388	1,176,388	1,176,396	1,176,388	1,176,388	1,176,388
Road Tax and General Costs	0	0	60,295	128,859	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Total JAL Loadout Facility	0	0	1,654,396	3,219,616	3,378,280	3,378,264	3,378,264	3,378,264	3,378,264	3,378,280	3,378,264	3,378,264	3,378,264
Site General & Administration													
Manpower	0	0	2,670,920	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000
Office Supplies/Expenses, @ $0.03/ ton Ore	0	0	44,670	103,075	109,340	106,628	103,776	102,036	101,432	101,500	99,696	101,032	103,536
Insurance	0	0	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Property Taxes	0	0	0	477,000	1,544,000	2,232,000	2,440,000	2,656,000	2,852,000	3,116,000	3,112,000	2,874,000	4,105,000
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Site General & Administration	0	0	3,915,590	4,545,075	5,618,340	6,303,628	6,508,776	6,723,036	6,918,432	7,182,500	7,176,696	6,940,032	8,173,536
Cash Operating Costs	0	0	76,167,244	117,282,520	121,870,516	121,103,704	119,779,676	119,062,844	118,935,184	119,234,312	118,263,388	118,741,292	121,316,056
Operating Margin - before Tax Deductions	0	0	93,134,756	261,172,480	291,957,484	322,536,296	364,897,324	397,017,156	458,058,816	395,752,688	375,418,612	354,746,708	395,892,944
Development Deduction	0	0	0	0	0	0	0	0	0	0	0	0	0
Amortization	0	0	18,068,800	18,068,800	18,068,800	18,068,800	18,068,800	0	0	0	0	0	0
Depreciation	0	0	63,069,051	108,434,984	82,803,080	61,018,519	48,071,483	47,326,705	44,992,545	28,159,327	12,550,294	12,616,552	13,429,136
Income - before NOL & Percentage Depletion	0	0	11,996,905	134,668,696	191,085,604	243,448,977	298,757,041	349,690,451	413,066,271	367,593,361	362,868,318	342,129,156	382,463,808
Net Operating Loss Adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0
Depletion	0	0	-5,998,453	-52,983,700	-57,935,920	-62,109,600	-67,854,780	-72,251,200	-80,779,160	-72,098,180	-69,115,480	-66,288,180	-72,409,260
Federal Income Tax	0	0	-2,399,381	-32,673,999	-53,259,873	-72,535,751	-92,360,905	-110,975,701	-132,914,844	-118,198,072	-117,501,136	-110,336,390	-124,021,819
Taxable Income, less Tax	0	0	3,599,071	49,010,997	79,889,811	108,803,626	138,541,356	166,463,550	199,372,267	177,297,109	176,251,702	165,504,586	186,032,729
Cash Flow Calculation													
Adjustments for Non Cash Items													
Development Deduction	0	0	0	0	0	0	0	0	0	0	0	0	0
Amortization	0	0	18,068,800	18,068,800	18,068,800	18,068,800	18,068,800	0	0	0	0	0	0
Depreciation	0	0	63,069,051	108,434,984	82,803,080	61,018,519	48,071,483	47,326,705	44,992,545	28,159,327	12,550,294	12,616,552	13,429,136
Net Operating Loss Adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0
Depletion	0	0	5,998,453	52,983,700	57,935,920	62,109,600	67,854,780	72,251,200	80,779,160	72,098,180	69,115,480	66,288,180	72,409,260
Total Adjustments for Non Cash Items	0	0	87,136,304	179,487,484	158,807,800	141,196,919	133,995,063	119,577,905	125,771,705	100,257,507	81,665,774	78,904,732	85,838,396
Pre-Production Capital													
Initial Investment - Mine	61,818,973	65,630,027	0	0	0	0	0	0	0	0	0	0	0
Initial Investment - Plant	239,368,109	242,023,891	0	0	0	0	0	0	0	0	0	0	0
Initial Investment - Jal Loadout	0	32,726,000	0	0	0	0	0	0	0	0	0	0	0
Initial Investment - G&A	10,201,082	7,001,918	0	0	0	0	0	0	0	0	0	0	0
Initial Capital Contingency	22,290,000	24,508,000	0	0	0	0	0	0	0	0	0	0	0
Total Pre-Production Capital	333,678,164	371,889,836	0	0	0	0	0	0	0	0	0	0	0
Continuing and Sustaining Capital	0	0	21,959,000	27,838,000	8,874,000	8,893,000	8,902,000	14,174,000	8,934,000	8,954,000	8,966,000	8,982,000	13,867,000
Ongoing Reclamation Funding	0	0	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Total Capital	333,678,164	371,889,836	22,459,000	28,338,000	9,374,000	9,393,000	9,402,000	14,674,000	9,434,000	9,454,000	9,466,000	9,482,000	14,367,000
Working capital	0	0	15,609,000	0	0	0	0	0	0	0	0	0	0
Total Capital & Working Capital	333,678,164	371,889,836	38,068,000	28,338,000	9,374,000	9,393,000	9,402,000	14,674,000	9,434,000	9,454,000	9,466,000	9,482,000	14,367,000
CASHFLOW	-333,678,164	-371,889,836	52,667,375	200,160,481	229,323,611	240,607,545	263,134,419	271,367,455	315,709,972	268,100,616	248,451,476	234,927,318	257,504,125
CUMULATIVE CASHFLOW	-333,678,164	-705,568,000	-652,900,625	-452,740,144	-223,416,533	17,191,012	280,325,431	551,692,886	867,402,858	1,135,503,474	1,383,954,950	1,618,882,268	1,876,386,393

	Year 12 TOTAL	Year 13 TOTAL	Year 14 TOTAL	Year 15 TOTAL	Year 16 TOTAL	Year 17 TOTAL	Year 18 TOTAL	Year 19 TOTAL	Year 20 TOTAL	Year 21 TOTAL	Year 22 TOTAL	Year 23 TOTAL	Year 24 TOTAL	Year 25 TOTAL
Tons Ore	3,517,256	3,410,904	3,409,944	3,460,608	3,526,840	3,526,840	3,526,840	3,526,840	3,526,840	3,526,840	3,526,840	3,526,840	3,526,840	3,526,840
Percent Polyhalite in Ore	79.6%	82.1%	82.1%	80.9%	79.4%	79.4%	79.4%	79.4%	79.4%	79.4%	79.4%	79.4%	79.4%	79.4%
Recovery Percentage	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%
Finished Product, K_2SO_4	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000
Finished Product, Langbeinite	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
K_2SO_4 Sales Price, $/t	817	817	817	817	817	817	817	817	817	817	817	817	817	817
Langbeinite Sales Price, $/t	261	261	261	261	261	261	261	261	261	261	261	261	261	261
Gross Revenue, K_2SO_4	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000
Gross Revenue, Langbeinite	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
less: State/BLM Royalties, @ 2.25%	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)
less: Prod Royalty, $14 Sold, for 1st million tons, then $0.5/t	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)
less: Production Royalty, @ 1.5% after Capital Repaid	[illegible]	[illegible]	[illegible]	[illegible]	(6,174,000)	(6,174,000)	(6,174,000)	(6,174,000)	(6,174,000)	(6,174,000)	(6,174,000)	(6,174,000)	(6,174,000)	(6,174,000)
Net Revenue	517,248,000	517,226,000	517,226,000	517,238,000	517,254,000	517,254,000	517,254,000	517,254,000	517,254,000	517,254,000	517,254,000	517,254,000	517,254,000	517,254,000
Mine Manpower	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600
Underground Equipment	4,462,548	4,327,488	4,325,128	4,390,548	4,474,580	4,474,580	4,474,580	4,474,580	4,474,580	4,474,580	4,474,580	4,474,580	4,474,580	4,474,580
Conveying	1,972,244	1,912,556	1,911,512	1,940,424	1,977,564	1,977,564	1,977,564	1,977,564	1,977,564	1,977,564	1,977,564	1,977,564	1,977,564	1,977,564
Power	3,462,384	3,357,596	3,355,764	3,406,524	3,471,720	3,471,720	3,471,720	3,471,720	3,471,720	3,471,720	3,471,720	3,471,720	3,471,720	3,471,720
Hoisting & Ventilation	328,728	318,780	318,604	323,424	329,616	329,616	329,616	329,616	329,616	329,616	329,616	329,616	329,616	329,616
Surface Equipment	2,669,144	2,588,360	2,586,948	2,626,080	2,676,340	2,676,340	2,676,340	2,676,340	2,676,340	2,676,340	2,676,340	2,676,340	2,676,340	2,676,340
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Mining	24,266,648	23,876,380	23,869,556	24,058,600	24,301,420	24,301,420	24,301,420	24,301,420	24,301,420	24,301,420	24,301,420	24,301,420	24,301,420	24,301,420
Processing Manpower	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800
Crushing/Milling	604,776	586,472	586,152	595,016	606,404	606,404	606,404	606,404	606,404	606,404	606,404	606,404	606,404	606,404
Calcining	13,444,964	13,038,052	13,030,944	13,228,044	13,481,216	13,481,216	13,481,216	13,481,216	13,481,216	13,481,216	13,481,216	13,481,216	13,481,216	13,481,216
Leaching	834,364	809,112	808,672	820,904	836,616	836,616	836,616	836,616	836,616	836,616	836,616	836,616	836,616	836,616
Production/Granulation	8,634,060	8,372,752	8,368,184	8,494,760	8,657,340	8,657,340	8,657,340	8,657,340	8,657,340	8,657,340	8,657,340	8,657,340	8,657,340	8,657,340
Loadout	5,332,120	5,170,744	5,167,924	5,246,092	5,346,496	5,346,496	5,346,496	5,346,496	5,346,496	5,346,496	5,346,496	5,346,496	5,346,496	5,346,496
Water Management	33,772	32,752	32,732	33,228	33,864	33,864	33,864	33,864	33,864	33,864	33,864	33,864	33,864	33,864
Power Dissolution Circuit	6,754,984	6,550,548	6,546,976	6,646,004	6,773,200	6,773,200	6,773,200	6,773,200	6,773,200	6,773,200	6,773,200	6,773,200	6,773,200	6,773,200
Steam Production	7,997,524	7,755,480	7,751,252	7,868,492	8,019,088	8,019,088	8,019,088	8,019,088	8,019,088	8,019,088	8,019,088	8,019,088	8,019,088	8,019,088
Crystallizer Equipment and Materials	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212
Crystallizer Power	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Processing	86,561,466	85,240,804	85,217,728	85,857,432	86,679,116	86,679,116	86,679,116	86,679,116	86,679,116	86,679,116	86,679,116	86,679,116	86,679,116	86,679,116
JAL Manpower	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784
Trucking Costs	1,528,612	1,528,612	1,528,612	1,528,612	1,528,620	1,528,620	1,528,620	1,528,620	1,528,620	1,528,620	1,528,620	1,528,620	1,528,620	1,528,620
Jal Loadout Equipment Costs	1,176,388	1,176,388	1,176,388	1,176,388	1,176,396	1,176,396	1,176,396	1,176,396	1,176,396	1,176,396	1,176,396	1,176,396	1,176,396	1,176,396
Road Tax and General Costs	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total JAL Loadout Facility	3,378,264	3,378,264	3,378,264	3,378,264	3,378,280	3,378,280	3,378,280	3,378,280	3,378,280	3,378,280	3,378,280	3,378,280	3,378,280	3,378,280
Site G&A Manpower	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000
Office Supplies/Expenses, @ $0.03/ ton Ore	105,520	102,328	102,272	103,820	105,804	105,804	105,804	105,804	105,804	105,804	105,804	105,804	105,804	105,804
Insurance	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Property Taxes	5,645,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Site General & Administration	9,715,520	9,961,328	9,961,272	9,962,820	9,964,804	9,964,804	9,964,804	9,964,804	9,964,804	9,964,804	9,964,804	9,964,804	9,964,804	9,964,804
Cash Operating Costs	123,921,888	122,456,776	122,426,820	123,257,116	124,323,620	124,323,620	124,323,620	124,323,620	124,323,620	124,323,620	124,323,620	124,323,620	124,323,620	124,323,620
Operating Margin - before Tax Deductions	393,326,112	394,769,224	394,799,180	393,980,884	392,930,380	392,930,380	392,930,380	392,930,380	392,930,380	392,930,380	392,930,380	392,930,380	392,930,380	392,930,380
Development Deduction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amortization	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation	13,791,888	13,146,507	12,770,229	12,797,615	19,749,456	23,810,413	19,212,388	16,464,529	16,491,915	15,489,066	14,065,736	13,420,352	13,044,076	13,071,460
Income - before NOL & Percentage Depletion	379,534,224	381,622,717	382,028,951	381,183,269	373,180,924	369,119,967	373,717,992	376,465,851	376,438,465	377,441,314	378,864,644	379,510,028	379,886,304	379,858,920
Net Operating Loss Adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depletion	-72,414,720	-72,411,640	-72,411,640	-72,413,320	-72,415,560	-72,415,560	-72,415,560	-72,415,560	-72,415,560	-72,415,560	-72,415,560	-72,415,560	-72,415,560	-72,415,560
Federal Income Tax	-122,847,802	-123,684,430	-123,846,924	-123,507,980	-120,306,146	-118,681,763	-120,520,973	-121,620,117	-121,609,162	-122,010,302	-122,579,633	-122,837,787	-122,988,297	-122,977,344
Taxable Income, less Tax	184,271,702	185,526,647	185,770,387	185,261,969	180,459,218	178,022,644	180,781,459	182,430,174	182,413,743	183,015,452	183,869,451	184,256,681	184,482,447	184,466,016
Adj. Development Deduction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adj. Amortization	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adj. Depreciation	13,791,888	13,146,507	12,770,229	12,797,615	19,749,456	23,810,413	19,212,388	16,464,529	16,491,915	15,489,066	14,065,736	13,420,352	13,044,076	13,071,460
Adj. Net Operating Loss Adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adj. Depletion	72,414,720	72,411,640	72,411,640	72,413,320	72,415,560	72,415,560	72,415,560	72,415,560	72,415,560	72,415,560	72,415,560	72,415,560	72,415,560	72,415,560
Total Adjustments for Non Cash Items	86,206,608	85,558,147	85,181,869	85,210,935	92,165,016	96,225,973	91,627,948	88,880,089	88,907,475	87,904,626	86,481,296	85,835,912	85,459,636	85,487,020
Initial Investment - Mine	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Initial Investment - Plant	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Initial Investment - Jal Loadout	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Initial Investment - G&A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Initial Capital Contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Pre-Production Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continuing and Sustaining Capital	7,460,000	7,460,000	7,460,000	7,460,000	43,596,000	7,460,000	7,460,000	7,460,000	7,460,000	12,716,000	7,460,000	7,460,000	7,460,000	7,460,000
Ongoing Reclamation Funding	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Total Capital	7,960,000	7,960,000	7,960,000	7,960,000	44,096,000	7,960,000	7,960,000	7,960,000	7,960,000	13,216,000	7,960,000	7,960,000	7,960,000	7,960,000
Working capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capital & Working Capital	7,960,000	7,960,000	7,960,000	7,960,000	44,096,000	7,960,000	7,960,000	7,960,000	7,960,000	13,216,000	7,960,000	7,960,000	7,960,000	7,960,000
CASHFLOW	262,518,310	263,124,794	262,992,256	262,512,904	228,528,234	266,288,617	264,449,407	263,350,263	263,361,218	257,704,078	262,390,747	262,132,593	261,982,083	261,993,036
CUMULATIVE CASHFLOW	2,138,904,703	2,402,029,497	2,665,021,753	2,927,534,657	3,156,062,891	3,422,351,508	3,686,800,915	3,950,151,178	4,213,512,396	4,471,216,474	4,733,607,221	4,995,739,814	5,257,721,897	5,519,714,933

	Year 26 TOTAL	Year 27 TOTAL	Year 28 TOTAL	Year 29 TOTAL	Year 30 TOTAL	Year 31 TOTAL	Year 32 TOTAL	Year 33 TOTAL	Year 34 TOTAL	Year 35 TOTAL	Year 36 TOTAL	Year 37 TOTAL	Year 38 TOTAL	Year 39 TOTAL	Year 40 TOTAL	Life-of-Mine Year -2 - Year 40
Tons Ore	3,526,840	3,526,840	3,526,840	3,595,368	3,629,292	3,629,292	3,629,292	3,629,292	3,629,292	3,629,292	3,629,292	3,629,292	3,629,292	3,629,292	3,629,292	139,655,117
Percent Polyhalite in Ore	79.4%	79.4%	79.4%	77.2%	77.1%	77.1%	77.1%	77.1%	77.1%	77.1%	77.1%	77.1%	77.1%	77.1%	77.1%	
Recovery Percentage	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	
Finished Product, K_2SO_4	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	568,000	22,371,221
Finished Product, Langbeinite	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10,831,042
K_2SO_4 Sales Price, $/t	817	817	817	817	817	817	817	817	817	817	817	817	817	817	817	
Langbeinite Sales Price, $/t	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	
Gross Revenue, K_2SO_4	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	464,056,000	17,912,339,000
Gross Revenue, Langbeinite	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
less: State/BLM Royalties, @ 2.25%	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	(12,056,000)	[illegible]
less: Prod Royalty, $14 Sold, for 1st million tons, then $0.5/t	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(420,000)	(17,129,000)
less: Production Royalty, @ 1.5% after Capital Repaid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Net Revenue	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	523,428,000	20,075,239,000
Mine Manpower	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	11,371,600	451,524,997
Underground Equipment	4,474,580	4,474,580	4,474,580	4,561,524	4,604,564	4,604,564	4,604,564	4,604,564	4,604,564	4,604,564	4,604,564	4,604,564	4,604,564	4,604,564	4,604,564	176,422,306
Conveying	1,977,564	1,977,564	1,977,564	2,015,988	2,035,008	2,035,008	2,035,008	2,035,008	2,035,008	2,035,008	2,035,008	2,035,008	2,035,008	2,035,008	2,035,008	77,970,701
Power	3,471,720	3,471,720	3,471,720	3,539,176	3,572,572	3,572,572	3,572,572	3,572,572	3,572,572	3,572,572	3,572,572	3,572,572	3,572,572	3,572,572	3,572,572	136,881,875
Hoisting & Ventilation	329,616	329,616	329,616	336,020	339,192	339,192	339,192	339,192	339,192	339,192	339,192	339,192	339,192	339,192	339,192	12,995,988
Surface Equipment	2,676,340	2,676,340	2,676,340	2,728,340	2,754,084	2,754,084	2,754,084	2,754,084	2,754,084	2,754,084	2,754,084	2,754,084	2,754,084	2,754,084	2,754,084	105,521,849
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Mining	24,301,420	24,301,420	24,301,420	24,552,648	24,677,020	24,677,020	24,677,020	24,677,020	24,677,020	24,677,020	24,677,020	24,677,020	24,677,020	24,677,020	24,677,020	961,317,716
Processing Manpower	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	13,204,800	523,900,071
Crushing/Milling	606,404	606,404	606,404	618,188	624,020	624,020	624,020	624,020	624,020	624,020	624,020	624,020	624,020	624,020	624,020	23,909,136
Calcining	13,481,216	13,481,216	13,481,216	13,743,160	13,872,832	13,872,832	13,872,832	13,872,832	13,872,832	13,872,832	13,872,832	13,872,832	13,872,832	13,872,832	13,872,832	531,533,004
Leaching	836,616	836,616	836,616	852,872	860,920	860,920	860,920	860,920	860,920	860,920	860,920	860,920	860,920	860,920	860,920	32,985,821
Production/Granulation	8,657,340	8,657,340	8,657,340	8,825,556	8,908,828	8,908,828	8,908,828	8,908,828	8,908,828	8,908,828	8,908,828	8,908,828	8,908,828	8,908,828	8,908,828	341,338,804
Loadout	5,346,496	5,346,496	5,346,496	5,450,380	5,501,808	5,501,808	5,501,808	5,501,808	5,501,808	5,501,808	5,501,808	5,501,808	5,501,808	5,501,808	5,501,808	210,799,939
Water Management	33,864	33,864	33,864	34,524	34,848	34,848	34,848	34,848	34,848	34,848	34,848	34,848	34,848	34,848	34,848	1,335,192
Power Dissolution Circuit	6,773,200	6,773,200	6,773,200	6,904,804	6,969,956	6,969,956	6,969,956	6,969,956	6,969,956	6,969,956	6,969,956	6,969,956	6,969,956	6,969,956	6,969,956	267,051,554
Steam Production	8,019,088	8,019,088	8,019,088	8,174,900	8,252,036	8,252,036	8,252,036	8,252,036	8,252,036	8,252,036	8,252,036	8,252,036	8,252,036	8,252,036	8,252,036	316,174,014
Crystallizer Equipment and Materials	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	3,437,212	137,488,480
Crystallizer Power	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	1,051,315,200
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Processing	86,679,116	86,679,116	86,679,116	87,529,276	87,950,140	87,950,140	87,950,140	87,950,140	87,950,140	87,950,140	87,950,140	87,950,140	87,950,140	87,950,140	87,950,140	3,437,831,215
JAL Manpower	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	536,784	21,333,639
Trucking Costs	1,528,620	1,528,620	1,528,620	1,528,612	1,528,612	1,528,612	1,528,612	1,528,612	1,528,612	1,528,612	1,528,612	1,528,612	1,528,612	1,528,612	1,528,612	60,205,965
Jal Loadout Equipment Costs	1,176,396	1,176,396	1,176,396	1,176,388	1,176,388	1,176,388	1,176,388	1,176,388	1,176,388	1,176,388	1,176,388	1,176,388	1,176,388	1,176,388	1,176,388	46,333,286
Road Tax and General Costs	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	136,480	5,375,394
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total JAL Loadout Facility	3,378,280	3,378,280	3,378,280	3,378,264	3,378,264	3,378,264	3,378,264	3,378,264	3,378,264	3,378,264	3,378,264	3,378,264	3,378,264	3,378,264	3,378,264	133,248,284
Site G&A Manpower	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	2,765,000	110,505,920
Office Supplies/Expenses, @ $0.03/ ton Ore	105,804	105,804	105,804	107,860	108,880	108,880	108,880	108,880	108,880	108,880	108,880	108,880	108,880	108,880	108,880	4,171,653
Insurance	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	48,000,000
Property Taxes	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	5,894,000	196,085,000
Contingency, @ 0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Site General & Administration	9,964,804	9,964,804	9,964,804	9,966,860	9,967,880	9,967,880	9,967,880	9,967,880	9,967,880	9,967,880	9,967,880	9,967,880	9,967,880	9,967,880	9,967,880	358,762,573
Cash Operating Costs	124,323,620	124,323,620	124,323,620	125,427,048	125,973,304	125,973,304	125,973,304	125,973,304	125,973,304	125,973,304	125,973,304	125,973,304	125,973,304	125,973,304	125,973,304	4,891,159,788
Operating Margin - before Tax Deductions	399,104,380	399,104,380	399,104,380	398,000,952	397,454,696	397,454,696	397,454,696	397,454,696	397,454,696	397,454,696	397,454,696	397,454,696	397,454,696	397,454,696	397,454,696	15,184,079,212
Development Deduction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amortization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90,344,000
Depreciation	13,847,303	14,202,658	13,557,275	13,181,000	13,208,384	20,160,225	24,221,181	19,623,159	16,875,298	16,902,683	15,899,836	14,476,504	13,831,121	13,454,847	9,044,627	972,283,407
Income - before NOL & Percentage Depletion	385,257,077	384,901,722	385,547,105	384,819,952	384,246,312	377,294,471	373,233,515	377,831,537	380,579,398	380,552,013	381,554,860	382,978,192	383,623,575	383,999,849	388,410,069	14,121,451,805
Net Operating Loss Adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depletion	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-73,279,920	-2,792,829,633
Federal Income Tax	-124,790,863	-124,648,721	-124,906,875	-124,616,013	-124,386,557	-121,605,820	-119,981,438	-121,820,647	-122,919,791	-122,908,837	-123,309,976	-123,879,308	-124,137,462	-124,287,971	-126,052,060	-4,531,448,870
Taxable Income, less Tax	187,186,294	186,973,081	187,360,310	186,924,019	186,579,835	182,408,731	179,972,157	182,730,970	184,379,687	184,363,256	184,964,964	185,818,964	186,206,193	186,431,958	189,078,089	6,797,173,302
Adj. Development Deduction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adj. Amortization	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90,344,000
Adj. Depreciation	13,847,303	14,202,658	13,557,275	13,181,000	13,208,384	20,160,225	24,221,181	19,623,159	16,875,298	16,902,683	15,899,836	14,476,504	13,831,121	13,454,847	9,044,627	972,283,407
Adj. Net Operating Loss Adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adj. Depletion	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	73,279,920	2,792,829,633
Total Adjustments for Non Cash Items	87,127,223	87,482,578	86,837,195	86,460,920	86,488,304	93,440,145	97,501,101	92,903,079	90,155,218	90,182,603	89,179,756	87,756,424	87,111,041	86,734,767	82,324,547	3,855,457,040
Initial Investment - Mine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	127,449,000
Initial Investment - Plant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	481,392,000
Initial Investment - Jal Loadout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32,726,000
Initial Investment - G&A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17,203,000
Initial Capital Contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46,798,000
Total Pre-Production Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	705,568,000
Continuing and Sustaining Capital	12,716,000	7,460,000	7,460,000	7,460,000	7,460,000	43,596,000	7,460,000	7,460,000	7,460,000	7,460,000	12,716,000	7,460,000	7,460,000	7,460,000	7,460,000	444,723,000
Ongoing Reclamation Funding	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	20,000,000
Total Capital	13,216,000	7,960,000	7,960,000	7,960,000	7,960,000	44,096,000	7,960,000	7,960,000	7,960,000	7,960,000	13,216,000	7,960,000	7,960,000	7,960,000	7,960,000	1,170,291,000
Working capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15,609,000
Total Capital & Working Capital	13,216,000	7,960,000	7,960,000	7,960,000	7,960,000	44,096,000	7,960,000	7,960,000	7,960,000	7,960,000	13,216,000	7,960,000	7,960,000	7,960,000	7,960,000	1,185,900,000
CASHFLOW	261,097,517	266,495,659	266,237,505	265,424,939	265,108,139	231,752,876	269,513,258	267,674,049	266,574,905	266,585,859	260,928,720	265,615,388	265,357,234	265,206,725	263,442,636	9,466,730,342
CUMULATIVE CASHFLOW	5,780,812,450	6,047,308,109	6,313,545,614	6,578,970,553	6,844,078,692	7,075,831,568	7,345,344,826	7,613,018,875	7,879,593,780	8,146,179,639	8,407,108,359	8,672,723,747	8,938,080,981	9,203,287,706	9,466,730,342	

After Tax Analysis	
NPV @ 8.0%; (millions)	$1,815.51
NPV @ 10.0%; (millions)	$1,286.46
NPV @ 12.0%	$920.68
Internal Rate of Return	25.9%
Payback Period	3.93
Payback Multiple	14.42

23.7 Sensitivity Analysis

The Ochoa Project economics are most sensitive to changes in the sales prices of its products. In this PFS, an increase of 10% in the average sales prices would augment the After-Tax, Net Present Value (NPV)-10 by 19% as illustrated in Figure 23-2.

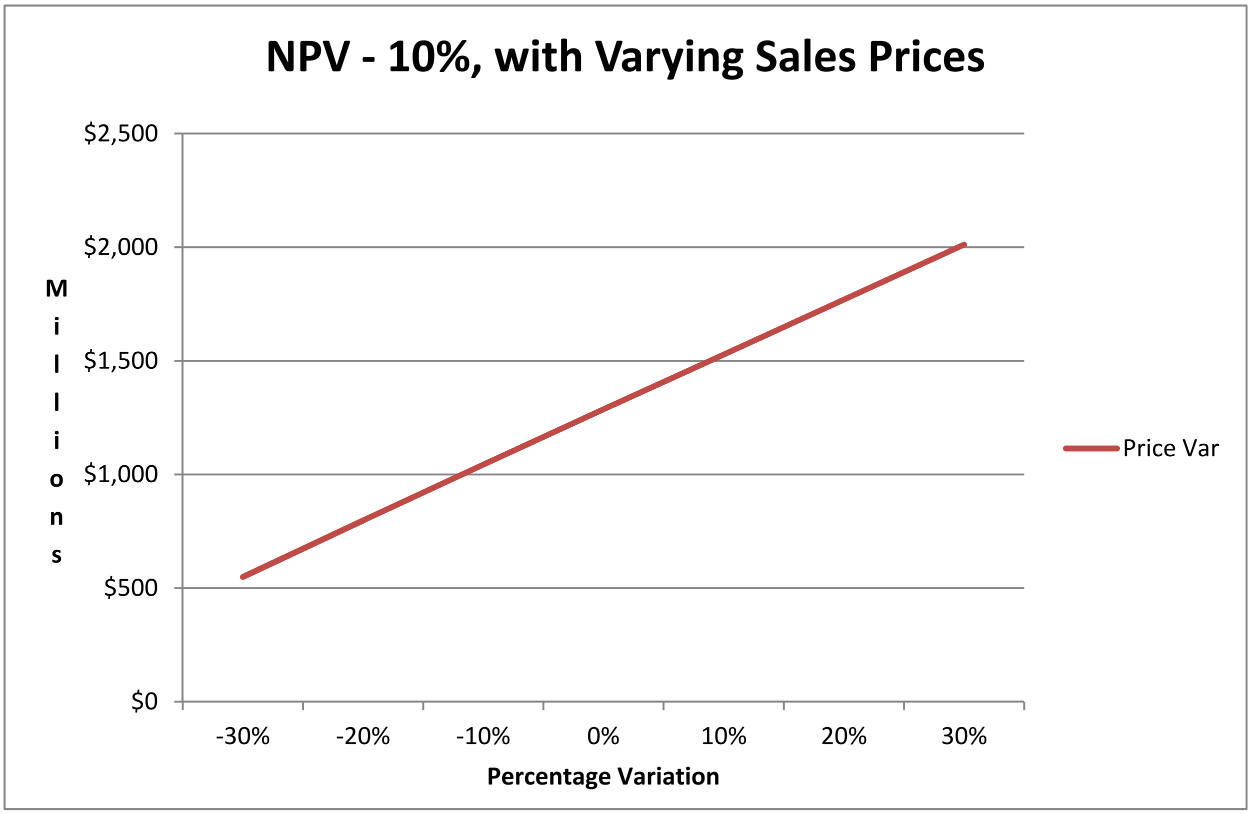


Figure 23-1 NPV 10%

The project economics will vary modestly with variations in the operating and cash costs, yielding a 5% decline in the After-Tax, NPV-10 for each 10% increase in the operating costs and a 6% decline in the After-Tax, NPV-10 for each 10% increase in the capital costs. The variation in the After-Tax, NPV-10 from the variation from changes in the sales prices as illustrated in Figure 23-3.

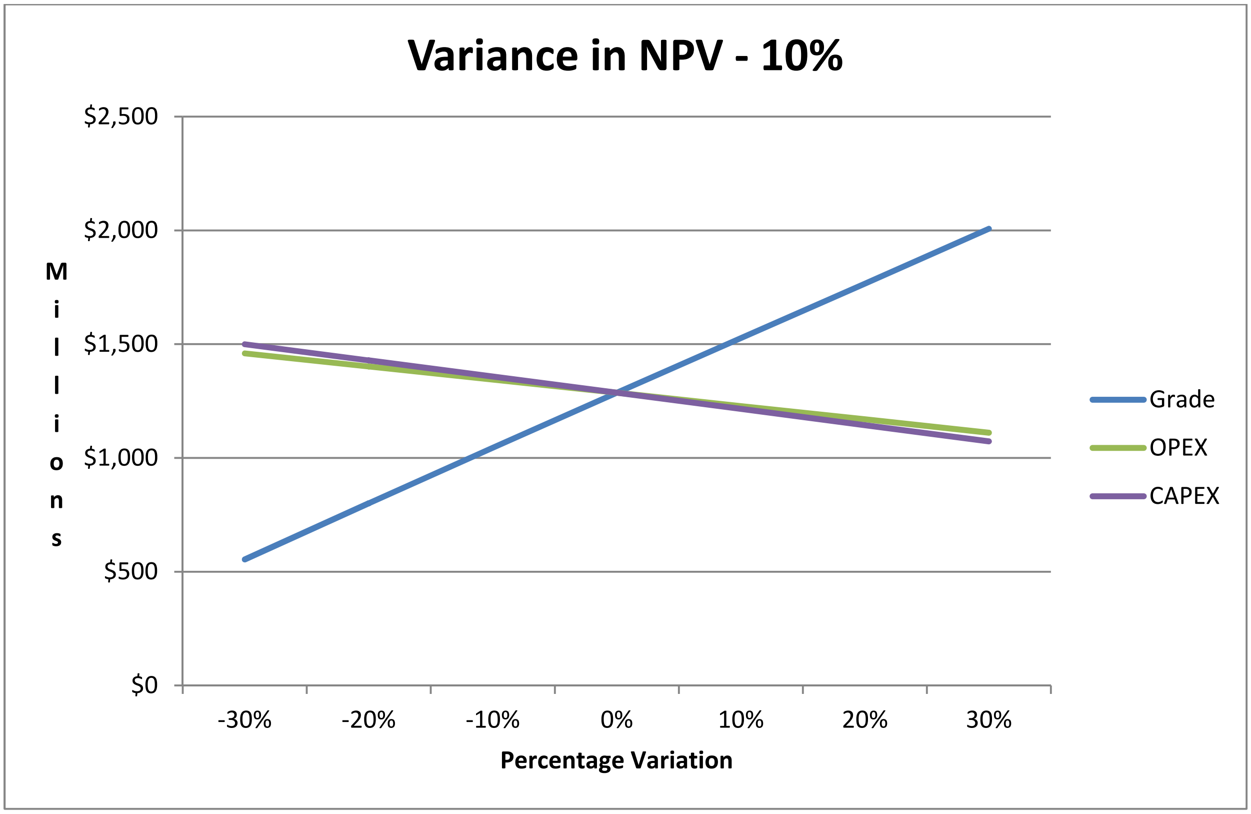


Figure 23-2 Variance in NPV – 10%

23.8 Expansion of Production by 50%

Gustavson considered a sensitivity to production, raising production by 50%, to an average production level of 852,000 tons of SOP and 412,500 tons of SOPM per year (990,000 tons SOP equivalent). In this case, initial capital expenditures are expected to rise to $958.3 million (approximately $758 per ton of finished product) and annual operating costs are estimated to average around $135 per ton of finished product. The projected Net Present Value at a 10% discount would be $2,002 million after-tax for the first 40 years of operations and the Payback Period would be approximately 3.8 years. The economic model for this scenario is reproduced in Table 23-3.

Table 23-3 Economic Projection for 50% Expansion Per Year Case

Intercontinental Potash — **OCHOA Project**

5,300,000 Ore tpy, MVR Processing, SOP & Langbeinite, $798 Average SOP Price/$256 Average Langbeinite Price, Start Date = 1-Jan-16

	Year -2 Total	Year -1 TOTAL	Year 1 TOTAL	Year 2 TOTAL	Year 3 TOTAL	Year 4 TOTAL	Year 5 TOTAL	Year 6 TOTAL	Year 7 TOTAL
PRODUCTION SCHEDULE									
TOTAL MINE PRODUCTION									
Tons Ore	0	0	1,489,013	3,975,144	5,327,734	5,212,384	5,096,976	5,067,232	5,003,784
Percent Polyhalite in Ore	0.0%	0.0%	83.4%	77.1%	77.6%	80.6%	82.4%	82.9%	83.9%
Recovery Percentage	0.0%	0.0%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%	89.6%
Finished Product, K_2SO_4	0	0	250,935	619,120	839,220	852,000	852,000	852,000	852,000
Finished Product, Langbeinite	0	0	121,491	299,748	406,309	412,496	412,496	412,496	412,496
Income Statement									
REVENUE									
K_2SO_4 Sales Price, $/t	0	0	592	622	642	704	765	815	915
Langbeinite Sales Price, $/t	0	0	206	210	215	231	246	261	285
Gross Revenue, K_2SO_4	0	0	148,553,000	385,092,000	538,780,000	599,808,000	651,780,000	694,380,000	779,580,000
Gross Revenue, Langbeinite	0	0	25,027,000	62,816,000	87,359,000	95,424,000	101,412,000	107,772,000	117,504,000
less: State/BLM Royalties, @ 2.25%	0	0	(3,905,000)	(10,078,000)	(14,089,000)	(15,644,000)	(16,948,000)	(18,048,000)	(20,184,000)
less: Prod Royalty, $1/t Sold, for 1st million tons, then $0.5/t	0	0	(373,000)	(776,000)	(622,000)	(632,000)	(632,000)	(632,000)	(632,000)
less: Production Royalty, @ 1.5% after Capital Repaid	0	0	0	0	0	(10,961,000)	(8,795,000)	(9,532,000)	(10,968,000)
Net Revenue	0	0	169,302,000	437,054,000	611,428,000	667,995,000	726,817,000	773,940,000	865,300,000
OPERATING EXPENSES									
Mining									
Mine Manpower	0	0	9,507,633	14,909,086	16,571,072	16,571,072	16,571,072	16,571,072	16,571,072
Underground Equipment	0	0	1,889,144	5,043,352	6,759,413	6,613,064	6,466,644	6,428,908	6,348,412
Conveying	0	0	834,917	2,228,934	2,987,356	2,922,676	2,857,964	2,841,288	2,805,712
Power	0	0	1,465,741	3,913,017	5,244,466	5,130,920	5,017,316	4,988,036	4,925,580
Hoisting & Ventilation	0	0	139,162	371,514	497,925	487,144	476,360	473,580	467,648
Surface Equipment	0	0	1,129,936	3,016,534	4,042,947	3,955,412	3,867,836	3,845,264	3,797,116
Contingency, @0.0%	0	0	748,327	1,474,123	1,805,158	1,784,016	1,762,860	1,757,408	1,746,776
Total Mining	0	0	15,714,860	30,956,560	37,908,337	37,464,304	37,020,052	36,905,556	36,661,316
Processing									
Manpower	0	0	8,842,283	14,737,784	16,551,788	16,551,788	16,551,788	16,551,788	16,551,788
Crushing/Milling	0	0	256,021	683,489	916,053	896,220	876,376	871,260	860,352
Calcining	0	0	5,691,697	15,194,840	20,365,064	19,924,144	19,483,000	19,369,304	19,126,776
Leaching	0	0	353,214	942,960	1,263,813	1,236,452	1,209,072	1,202,020	1,186,968
Production/Granulation	0	0	3,655,082	9,757,793	13,077,997	12,794,848	12,511,556	12,438,540	12,282,796
Loadout	0	0	2,257,262	6,026,101	8,076,553	7,901,688	7,726,736	7,681,648	7,585,464
Water Management	0	0	14,298	38,169	51,158	50,048	48,940	48,656	48,048
Power Dissolution Circuit	0	0	2,859,609	7,634,155	10,231,766	10,010,240	9,788,604	9,731,480	9,609,632
Steam Production	0	0	3,385,615	9,038,409	12,113,836	11,851,560	11,589,156	11,521,524	11,377,260
Crystallizer Equipment and Materials	0	0	4,383,912	4,383,912	4,383,912	4,383,912	4,383,912	4,383,912	4,383,912
Crystallizer Power	0	0	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880	26,282,880
Contingency, @5.0%	0	0	2,899,094	4,736,024	5,665,740	5,594,188	5,522,600	5,504,152	5,464,792
Total Processing	0	0	60,880,967	99,456,516	118,980,560	117,477,968	115,974,620	115,587,164	114,760,868
JAL Loadout Facility									
Manpower	0	0	341,678	490,876	536,784	536,784	536,784	536,784	536,784
Trucking Costs	0	0	675,323	1,666,192	2,258,531	2,292,924	2,292,924	2,292,924	2,292,924
Jal Loadout Equipment Costs	0	0	519,715	1,282,268	1,738,120	1,764,588	1,764,588	1,764,588	1,764,588
Road Tax and General Costs	0	0	60,295	148,763	201,649	204,720	204,720	204,720	204,720
Contingency, @5.0%	0	0	54,952	107,854	139,765	141,484	141,484	141,484	141,484
Total JAL Loadout Facility	0	0	1,651,963	3,695,953	4,874,849	4,940,500	4,940,500	4,940,500	4,940,500
Site General & Administration									
Manpower	0	0	3,313,240	3,466,120	3,513,160	3,513,160	3,513,160	3,513,160	3,513,160
Office Supplies/Expenses, @$0.03/ ton Ore	0	0	44,670	119,254	159,833	156,372	152,908	152,016	150,112
Insurance	0	0	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Property Taxes	0	0	0	477,000	1,709,000	2,954,000	3,634,000	3,983,000	4,277,000
Contingency, @5.0%	0	0	227,896	263,118	329,100	391,176	425,004	442,410	467,014
Total Site General & Administration	0	0	4,785,806	5,525,492	6,911,093	8,214,708	8,925,072	9,290,586	9,597,286
Cash Operating Costs	0	0	83,033,596	139,634,521	168,674,839	168,097,480	166,860,244	166,723,806	165,959,770
Operating Margin - before Tax Deductions	0	0	86,268,404	297,419,479	442,753,161	499,897,520	559,956,756	607,216,194	699,340,230
Development Deduction	0	0	0	0	0	0	0	0	0
Amortization	0	0	18,874,200	18,874,200	18,874,200	18,874,200	18,874,200	0	0
Depreciation	0	0	90,153,782	149,278,632	108,035,633	80,131,409	65,179,869	61,355,289	57,345,722
Income - before NOL & Percentage Depletion	0	0	-22,759,578	129,266,647	315,843,328	400,891,911	475,902,687	545,860,905	641,994,508
Net Operating Loss Adjustment	0	0	22,759,578	-22,759,578	0	0	0	0	0
Depletion	0	0	0	-41,527,779	-85,599,920	-93,519,300	-101,754,380	-108,351,600	-121,142,000
Federal Income Tax	0	0	0	-25,991,717	-92,097,362	-122,949,044	-149,659,323	-175,003,723	-208,341,003
Taxable Income, less Tax	0	0	0	38,987,573	138,146,046	184,423,567	224,488,984	262,505,582	312,511,505
Cash Flow Calculation									
Adjustments for Non Cash Items									
Development Deduction	0	0	0	0	0	0	0	0	0
Amortization	0	0	18,874,200	18,874,200	18,874,200	18,874,200	18,874,200	0	0
Depreciation	0	0	90,153,782	149,278,632	108,035,633	80,131,409	65,179,869	61,355,289	57,345,722
Net Operating Loss Adjustment	0	0	-22,759,578	22,759,578	0	0	0	0	0
Depletion	0	0	0	41,527,779	85,599,920	93,519,300	101,754,380	108,351,600	121,142,000
Total Adjustments for Non Cash Items	0	0	86,268,404	232,440,189	212,509,753	192,524,909	185,808,449	169,706,889	178,487,722
Pre-Production Capital									
Initial Investment - Mine	61,818,973	127,190,027	0	0	0	0	0	0	0
Initial Investment - Plant	318,156,627	322,405,373	0	0	0	0	0	0	0
Initial Investment - Jal Loadout	0	41,760,000	0	0	0	0	0	0	0
Initial Investment - G&A	13,017,676	8,934,324	0	0	0	0	0	0	0
Initial Capital Contingency	29,506,000	35,491,000	0	0	0	0	0	0	0
Total Pre-Production Capital	422,499,276	535,780,724	0	0	0	0	0	0	0
Continuing and Sustaining Capital	0	0	11,516,000	11,541,000	12,051,115	13,213,808	13,227,757	13,719,705	13,293,757
Ongoing Reclamation Funding	0	0	636,000	636,000	636,000	636,000	636,000	636,000	636,000
Total Capital	422,499,276	535,780,724	12,152,000	12,177,000	12,687,115	13,849,808	13,863,757	14,355,705	13,929,757
Working capital	0	0	17,145,000	0	0	0	0	0	0
Total Capital & Working Capital	422,499,276	535,780,724	29,297,000	12,177,000	12,687,115	13,849,808	13,863,757	14,355,705	13,929,757
CASHFLOW	-422,499,276	-535,780,724	56,971,404	259,250,762	337,968,684	363,088,668	396,433,676	417,856,766	477,069,470
CUMULATIVE CASHFLOW	-422,499,276	-958,280,000	-901,308,596	-642,057,834	-304,089,150	59,009,518	455,443,194	873,299,960	1,350,369,430

After Tax Analysis	
NPV @ 8.0%; (millions)	$2,805.64
NPV @ 10.0%; (millions)	$2,002.35
NPV @ 12.0%	$1,447.29
Internal Rate of Return	27.3%
Payback Period	3.84
Payback Multiple	16.07

24 ADJACENT PROPERTIES

The southeastern portion of New Mexico is home to the Carlsbad potash mining district, which hosts the largest U.S. production of potash, primarily in the form of MOP. Production is not necessarily indicative of the mineralization on the Ochoa Project area. There are no active polyhalite mines in the immediate Ochoa area. Gustavson knows of no publicly available reports on polyhalite occurrences in the Ochoa Project area and adjacent properties have no known existing, potential, or reasonable future material impact on the Ochoa Polyhalite Project.

25 OTHER RELEVANT DATA AND INFORMATION

Gustavson knows of no additional information or explanation necessary to make this report more understandable or not misleading.

26 INTERPRETATION AND CONCLUSIONS

Ochoa is a large sedimentary polyhalite deposit with a resource capable of supporting mining and processing operations for nearly 100 years. The deposit has an average polyhalite thickness of 5.49 ft at a grade of 80.3 % polyhalite. The polyhalite can be mined using continuous mining equipment and room and pillar mining methods. Polyhalite can be processed to produce salable SOP and langbeinite products. The project has an estimated initial capital cost of $705.6 million. The estimated operating cost is $147.31 / ton of product. The project NPV at 10% discount rate is $1.286 billion, after tax.

Certain of the statements made and information contained herein, including the mine plan, costs, financial estimates and other conclusions in the PFS, the reserve estimates themselves, the timing of the commencement of development and commercial production, the completion of milestones necessary to commence commercial production, are "forward-looking information" within the meaning of the Ontario Securities Act. Forward-looking information is subject to a variety of risks and uncertainties which could cause actual events or results to differ from those reflected in the forward-looking information, including, without limitation, risks and uncertainties relating to commodity price fluctuations; uncertain political and economic environments; changes in laws or policies, delays or the inability to obtain necessary governmental permits, risks inherent in mine planning and development such as cost overruns, metallurgical and recovery factors and financing risks; risks associated with the estimation of mineral resources and reserves and the geology, grade and continuity of mineral deposits; the possibility that future exploration, development or mining results will not be consistent with the Company's expectations; actual ore mined varying from estimates of grade, tonnage, dilution and metallurgical and other characteristics; the inherent uncertainty of production and cost estimates and the potential for unexpected costs and expenses, and other risks and uncertainties, including those described in our Annual Information Form and each management discussion and analysis. Forward-looking information is in addition based on various assumptions including, without limitation, the expectations and beliefs of management, the assumed long term price of SOP and SOPM; appropriate equipment and sufficient labor and that the political environment where the Company operates will continue to support the development and operation of mining projects. Should one or more of these risks and uncertainties materialize, or should underlying assumptions prove incorrect, actual results may vary materially from those described in the forward-looking information. Accordingly, readers are advised not to place undue reliance on forward-looking information. The Company does not assume any obligation to update forward looking statements except to the extent required by applicable securities laws.

26.1 <u>Risk</u>

Gustavson has identified areas of risk and quantified the relative risk of each aspect and made recommendations to reduce the risk of the most significant items.

26.1.1 Risk Assessment

Following is a risk assessment of the Ochoa PFS and development plan. Gustavson has rated each of the areas in three separate categories: Economic risk level, Schedule risk level, and Overall risk level.

These risks have been scored with:

🟢 Nominal Risk (Economic impact generally less than 5% of operating or capital cost, Schedule risk less than 2 month impact on project)

🟡 Moderate Risk (Economic impact generally less than 10% of operating or capital cost, Schedule risk of up to 6 months on project schedule)

🟣 High Risk (Economic impact generally greater than 10% of operating or capital cost, Schedule risk of more than 6 months on project schedule)

Table 26-1 Risk Assessment Summary

Technical	Economic Risk	Schedule Risk	Overall Risk
Geological Drilling & Test Work			
Drilling Validation	🟢	🟢	🟢
Downhole Surveys	🟢	🟢	🟢
Database Construction & Validation	🟢	🟢	🟢
Density Estimation	🟢	🟢	🟢
Sampling and Assaying	🟢	🟢	🟢
Geologic Modeling	🟢	🟢	🟢
Block Models			
Geologic Interpretation	🟢	🟢	🟢
Data Analysis	🟢	🟢	🟢
Estimation	🟢	🟢	🟢
Resource Classification	🟢	🟢	🟢
Mine Plans			
SOP price for mine design	🟢	🟢	🟢
Mine plan optimization	🟢	🟢	🟢
LoM Production Schedule	🟢	🟢	🟢
Rock stability	🟡	🟢	🟢
Waste Management	🟢	🟢	🟢
Mining Dilution	🟡	🟢	🟡

Technical	Economic Risk	Schedule Risk	Overall Risk
Chemical Test Work			
Test Sample Selection	🟢	🟢	🟢
Process Selection	🟡	🟡	🟡
Recovery	🟡	🟢	🟡
Crushing	🟢	🟢	🟢
Washing	🟢	🟢	🟢
Calcining	🟡	🟢	🟡
Leaching	🟡	🟡	🟡
Solid Liquid Separation	🟢	🟢	🟢
Crystallization	🟡	🟡	🟡
SOP granulation	🟢	🟢	🟢
Langbeinite Granulation	🟡	🟡	🟡
Calcium Scaling	🟡	🟡	🟡
Grind Size	🟢	🟢	🟢
Ore Blending	🟢	🟢	🟢
Ore Hardness	🟢	🟢	🟢
Infrastructure Design			
Power Supply	🟢	🟢	🟢
Accommodation Plan	🟢	🟢	🟢
Site/Plant Water balance / supply	🟢	🟢	🟢
Roads and site access	🟢	🟢	🟢
Buildings	🟢	🟢	🟢
Mine Services	🟢	🟢	🟢
Tails Stack Facility	🟢	🟢	🟢
Process Design			
Design Criteria	🟢	🟢	🟢
Mass / Metallurgical Balance	🟢	🟢	🟢
Equipment Sizing	🟡	🟢	🟡
Control Philosophy	🟢	🟢	🟢
Constructability	🟢	🟢	🟢
Environmental			
Permitting	🟢	🟡	🟡
Compliance	🟢	🟢	🟢

Technical	Economic Risk	Schedule Risk	Overall Risk
Air Quality	🟢	🟢	🟢
Soils and Land Use	🟢	🟢	🟢
Waste Management	🟢	🟢	🟢
Surface and Ground Water	🟢	🟢	🟢
Socio Economic	🟢	🟢	🟢
Execution Plan & Schedule			
Schedule (general)	🟢	🟢	🟢
Contracting Strategy	🟢	🟢	🟢
Logistics and Transportation	🟢	🟢	🟢
Capital Cost			
Site Establishment	🟢	🟢	🟢
Plant Costs & Infrastructure	🟡	🟢	🟡
Mining	🟢	🟢	🟢
Owner’s Costs	🟢	🟢	🟢
Contingency	🟢	🟢	🟢
Duties Taxes & Fees	🟢	🟢	🟢
Working Capital	🟢	🟢	🟢
Operating Cost			
Labor	🟢	🟢	🟢
Mining	🟢	🟢	🟢
Processing Costs	🟡	🟡	🟡
G&A	🟢	🟢	🟢
Product Handling	🟢	🟢	🟢
Preproduction Costs	🟢	🟢	🟢
Fuel Price	🟡	🟢	🟡
Financial Analysis			
Currency Exchange	🟢	🟢	🟢
SOP Price	🟡	🟢	🟡
Financing and Liquidity	🟡	🟢	🟡
Model	🟢	🟢	🟢
Predicted Cash Flow	🟢	🟢	🟢
Predicted NPV	🟡	🟢	🟡

Discussion of the identified levels of risk above Nominal Risk in the above table follow:

26.1.2 Rock Stability

Gustavson recognizes that the stability information tested and used in the PFS are appropriate for the rock types and testing accomplished to date. This is not a significant risk area, but additional analysis and some test work will need to be accomplished prior to feasibility study and final design.

26.1.3 Mining Dilution

There is always risk associated with dilution when mining a 4 ft to 6 ft horizon underground. Gustavson recognizes that the risk is low and manageable.

26.1.4 Process Selection

The process test work accomplished to date has carried the process definition quite far. There are still some outstanding questions regarding the selection of the appropriate process equipment and approach in some areas of the process. Additional test work is needed to finalize the equipment selection. For instance, excessive fines from the rod mill could lead to parallel calcination circuits one for fines and one for coarse material.

26.1.5 Recovery

Ultimate recovery of SOP involves recovery at each step of the process. Additional test work is required to determine how each of these steps will affect recovery, and what can be done to maximize recovery. At this point in the project, final recovery of product combination is yet to be determined.

26.1.6 Power Supply

The mine and plant will require greater than 100 megawatts of power. ICP has been working with Xcel Energy in defining how this power will be supplied. Permitting and construction of a power line to the site may require a longer duration than currently planned, and is therefore a risk.

26.1.7 Site/Plant Water Balance and Supply

Water is planned to be extracted from the Capitan Reef, however the quantity and quality available has yet to be determined. Work is ongoing to drill into the reef for testing purposes. For now, the risk exists but is low.

26.1.8 Equipment Sizing

The PFS includes a large assortment of equipment. The unknown factors in the process design lead to a minor risk in the sizing of the equipment.

26.1.9 Permitting

The project development plan is based upon a 24-month duration for the EIS and reaching a ROD. This duration is certainly achievable; however it is out of the direct control of the project team, and therefore could require additional time. At the same time, however, this project has good support of the State and the local community.

26.1.10 Plant Costs and Infrastructure

The capital costs for the plant and infrastructure were developed at some detail. However, at this stage of the project there is a tendency towards errors of omission. Combined with the unknown factors in the process design, there is therefore a risk that the plant and infrastructure costs may rise.

26.1.11 Fuel Price

The fluctuation in fuel prices over the past few years has shown that there is some risk with fuel prices on every emerging project. The price used in the PFS has been exceeded for short durations of time in the past few years. The price of fuel also impacts the power cost.

26.1.12 SOP Price

SOP has a large demand world-wide, however the price does fluctuate with economics of various regions. The project will be exposed to this price risk.

26.1.13 Financing and Liquidity

In order to develop and operate the project while maintaining its ability to meet its financial obligations as they come due, the Company will have to raise equity and other financing. The company has been successful in raising funds in the recent past, and intends to raise a combination of debt and equity to provide for its liquidity during development and initial operations, although there are no guarantees that such financing will be available.

26.1.14 Predicted NPV

The predicted NPV is a direct function of most of the factors included in the PFS, and reflects all the risks discussed above.

27 RECOMMENDATIONS

ICP controls a large land package that hosts a substantial polyhalite resource. The polyhalite occurs at depths of 1,180 to 1,740 ft within the project area, and is considered to be minable using conventional room and pillar mining methods with continuous miners and other underground mining equipment. ICP has drilled 20 core holes into the Ochoa polyhalite bed, and the mineral resource estimate is based on data from these and 789 previously drilled rotary holes. The Measured plus Indicated Mineral Resource is estimated at 838.2 million tons grading 80.3% polyhalite, at a 5-ft minimum thickness. Ochoa's projected economics for the first 40 years of envisioned operations outline robust results, with operating margins around 73% of gross revenues, initial capital of around $706 million ($873/ton of annual finished product), operating costs in the range of $147/ton of finished product, and an After- Tax Net Present Value at 10% of $1.29 billion. Importantly, if the market can be expanded and throughput can be increased by 50%, then initial capital is expected to rise by 36% (yielding a capital factor of $757.8/ton of annual finished product), annual operating costs are expected to increase by 41% (yielding an operating cost per ton of $139.6/ton of finished product), and the operating margin is predicted to be enhanced to 74.6%.

Gustavson believes that results of this study warrant continued efforts to advance the Ochoa Project, and that the data and information presented herein are sufficient to justify definition drilling, metallurgical testing, continued development and permitting, and preparation of a Feasibility Study.

Phase 3 Exploration Program and Project Development

Phase 3B	Feasibility study	$10,000,000
	Metallurgical testing	$1,500,000
	Aerial Survey	$200,000
	Geotechnical / Soil test	$500,000
	Hydrological Test	$3,500,000
	Environmental Permitting	$1,000,000
	Subtotal	$16,700,000
Phase 3C	Definition drilling	$4,000,000
	Total	$20,700,000

28 REFERENCES

Akin, P.D., 1965. Possible Effects on Fresh-Water Supplies in the Pecos River Valley in New Mexico Due to Pumping Water from the “Capitan Reef Complex” in Winkler, Ward, and Pecos Counties, Texas, for Use in Secondary Oil Recovery Operations and for Other Uses. Memo to S.E. Reynolds, New Mexico State Engineer. January 20, 1965.

Anderson, Mary P. and William W. Woessner. 1992. Applied Groundwater Modeling: Simulation of Flow and Advective Transport. Academic Press, San Diego.

ARANZ Geo Limited. 2010. http://www.leapfroghydro.com/hydro/.

Ashworth, J. B., 2001. The Geology and Hydrogeology of the Capitan Aquifer: A Brief Overview, *in* R. E. Mace, W. F. Mullican III, and E. S. Angle, editors, Aquifers of West Texas. Texas Water Development Board Report 356, p. 153-166.

ASTM International (ASTM). Standard Guide for Calibrating a Ground-Water Flow Model Application. ASTM Standard D 5918-96, 6 p.

Standard Guide for Comparing Ground-Water Flow Model Simulations to Site-Specific Information. ASTM Standard D 5490-93, 7 p.

Standard Guide for Conducting a Sensitivity Analysis for a Ground-Water Flow Model Application. ASTM Standard D 5611-94, 5 p.

Avian Power Line Interaction Committee (APLIC) and U.S. Fish and Wildlife Service, 2005. Avian Protection Plan Guidelines.

Bachman, G. O., 1983. Regional Geology of Ochoan Evaporites, Northern Part of Delaware Basin. New Mexico Bureau of Mines and Mineral Resources Open-File Report 184, 51pp.

Barroll, P., D. Jordan and G. Ruskauff, 2004. The Carlsbad Area Groundwater Flow Model. Report prepared by INTERA and submitted to the New Mexico Interstate Stream Commission. January 2004.

Beauheim, R.L., and R.M. Holt. 1990. "Hydrogeology of the WIPP Site," *Geological and Hydrological Studies of Evaporites in the Northern Delaware Basin for the Waste Isolation Pilot Plant (WIPP), New Mexico, GSA Field Trip #14 Guidebook*. Dallas, TX: Dallas Geological Society 131-179 pp.

Bjorklund, L. J. and W. S. Motts, 1959. Geology and Water Resources of the Carlsbad Area, Eddy County, New Mexico. U.S. Geological Survey Open-File Report, 322 pp.

BLM. 1985. Road Manual 9113. U.S. Department of the Interior.

BLM. 1988. Carlsbad Resource Management Plan. Carlsbad Field Office. Department of the Interior.

BLM 1997 or 1998 Resource Management Plan Amendment for Oil & Gas in the Carlsbad Resource Area U.S. Department of the Interior.

BLM 2007 Special-status Species Resource Management Plan Amendment and EIS. Roswell Field Office. U.S. Department of the Interior.

BLM. 2008. Nevada Bureau of Land Management Groundwater Modeling Guidance for Mining Activities. http://www.blm.gov/pgdata/etc/medialib/blm/nv/minerals/mining.Par.60011.File.dat/GroundwaterModeling.pdf, 14 p.

Boghici, R. and N. G. Van Broekhoven, 2001. The Geology and Hydrogeology of the Capitan Aquifer: A Brief Overview. i*n* R. E. Mace, W. F. Mullican III, and E. S. Angle, editors. Aquifers of West Texas. Texas Water Development Board Report 356, p. 153-166.

Borns, D.J., and Shaffer, S., 1985, Regional well-log correlation in the New Mexico portion of the Delaware Basin, Sandia National Laboratories, SAND83-1798, 73pp.

Brackbill, R. M. and J. C. Gaines, 1964. El Capitan Source Water System, in Groundwater Hydrology, p. 1351-1356. December 1964.

Broadhead, Ronald F., Zhou Jianhua, and William D. Raats, 2004, Play analysis of Major Oil Reservoirs in the New Mexico Part of the Permian Basin: Enhanced Production Through Advanced Technologies: Open File Report 479 New Mexico Bureau of Geology and Mineral Resources, 134 p.

Conley, J. E, Partridge, E. P., 1944, Potash Salts from Texas-New Mexico Polyhalite Deposits, Commercial Possibilities, Proposed Technology, and Pertinent Salt-Solution Equilibria, United States Department of the Interior, Bureau of Mines, Bulletin 459.

DOE. 1997. Waste Isolation Pilot Plant (WIPP) Supplemental EIS II (U.S. Department of Energy

Garber, R. A., G.A. Grover, and P.M. Harris, 1989. Geology of the Capitan Shelf Margin – Subsurface Data from the Northern Delaware Basin, in P.M. Harris and G.A. Grover, eds., Subsurface and Outcrop Examination of the Capitan Shelf Margin, Northern Delaware Basin: Society of Economic Paleontologists and Mineralogists Core Workshop No. 13, p. 3-269.

Harris, P.M., 2009. The Capitan Margin of the Guadalupe Mountains – A Field Trip Guide. Search and Discovery Article #60038, Reprint of Harris, Paul M. (Mitch), 2004, The Capitan margin of the Guadalupe Mountains – A field trip guide: AAPG Hedberg Conference - Carbonate Reservoir Characterization and Simulation: From Facies to Flow Units, March 14-18, El Paso, Texas, 43 p. and Appendices (96 p.).

Hiss, W.L., 1973. Capitan Aquifer Observation-Well Network Carlsbad to Jal, New Mexico. New Mexico State Engineer Technical Report 38.

Hiss, W. L., 1975. Stratigraphy and Groundwater Hydrology of the Capitan Aquifer, Southeastern New Mexico and Western Texas. Unpublished Ph.D. dissertation, University of Colorado, Boulder. 396pp.

Hiss, W. L., 1980. Movement of Groundwater in Permian Guadalupian Aquifer Systems, Southeastern New Mexico and Western States. New Mexico Geological Society Guidebook, 31st Field Conference, Trans-Pecos Region.

Hunter, R.L., 1985. A Regional Water Balance for the Waste Isolation Pilot Plant (WIPP) Site and Surrounding Area, SAND84-2233, Albuquerque, NM, Sandia National Laboratories.

INTERA, 2011a. Ochoa Mine Project Status Update Meeting Water Supply for the Ochoa Mine. Presentation presented to the Bureau of Land Management, June 15, 2011.

Final Aquifer Test and Groundwater Sampling Work Plan, Ochoa Mine Project, Lea County, New Mexico. October 14, 2011

Evaluation of alternative well field locations: Use North Custer Mountain Unit No. 1 groundwater monitoring well in place of drilling a new groundwater monitoring well. Technical Memorandum dated August 24, 2011.

Jeremic, M.L., 1994, Rock Mechanics and Salt Mining, A.A. Balkema, Netherlands.

Jones, C. L., 1972, Permian basin potash deposits, south-western United States, in Geology of Saline Deposits, Proceedings of Hanover Symposium, 1968, Unesco, Paris.

Leedshill-Herkenhoff, Inc., John Shomaker & Associates, Inc., and Montgomery & Andrews, P.A., 2000. Final Report, Lea County Regional Water Plan. Prepared for Lea County Water Users Association.

Mercer, J.W., 1983. Geohydrology of the Proposed Waste Isolation Pilot Plant Site, Los Medaños Area, Southeastern New Mexico. U.S. Geological Survey Water-Resources Investigations Report 83-4016.

CostMine Mine and Mill Equipment Costs, An Estimator's Guide, 2010, InfoMine USA, Inc., Spokane Valley, WA, 2010.

NM OSE. Undated. Water-right files associated with the following water rights: CP-435-X-3, CP-435X/CP-115-X-2, CP-435, CP-115-X-7/CP-435-X-2, CP-482/CP-115, CP-511, and CP-510.

NM OSE, 2009. Lea County Underground Water Basin Guidelines for Review of Water Right Applications. Adopted September 16, 2009

Pecos Valley Water Users Organization, 2001. Lower Pecos Valley Regional Water Plan, Volume II.

Powers, D.W. and Holt, R.M., 1999, The Los Medaños Member of the Permian (Ochoan) Rustler Formation, New Mexico Geology, November, 1999.

Richey, S.F., J.G. Wells, and K.T. Stephens, 1985. Geohydrology of the Delaware Basin and Vicinity, Texas and New Mexico: U.S. Geological Survey Water-Resources Investigations Report 84-4077, 99pp.

Standen, Allan, Finch, Steve, Williams, Randy, Lee-Brand, Beronica, and Kirby, Paul, 2009, Capitan Reef Complex Structure and Stratigraphy: Texas Water Development Board, 71p.

Summers, W.K., 1972. Geology and Regional Hydrogeology of the Pecos River Basin, New Mexico. New Mexico Bureau of Geology Open-File Report 37. June 1972.

Texas Water Development Board (TWDB), 2009. Capitan Reef Structure and Stratigraphy. Report submitted to TWDB, September 2009.

Current and Projected Water Use in the Texas Mining and Oil and Gas Industry. Draft Report, February 2011.

Uliana, M. M., 2001. The Geology and Hydrogeology of the Capitan Aquifer: A Brief Overview. *in* R. E. Mace, W. F. Mullican III, and E. S. Angle, editors. Aquifers of West Texas. Texas Water Development Board Report 356, p. 153-166.

Ward, R.F., St. C. Kendall, C.G, and Harris, P. M., 1988, Upper Permian (Guadalupian) Facies and Their Association with Hydrocarbons – Permian Basin, West Texas and new Mexico, Amer. Assoc. Petrol. Geologists, V. 70, no. 3, p. 239-262.

Wroth, J.S., 1930, Commercial Possibilities of the Texas-New Mexico Potash Deposits. USBM Bulletin 316. 144 p.

Zheng, C., and G. D. Bennett, 2002, Applied Contaminant Transport Modeling, Second Edition, John Wiley & Sons, New York, 621 pp.