# ROCA HONDA RESOURCES; WATER TREATMENT PLANT

# 60% DESIGN

# GRANTS, NEW MEXICO

Prepared for:

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**January 2011**

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# 1.0 EXECUTIVE SUMMARY

## 1.1 Introduction

Lyntek, Inc. (Lyntek) has been contracted by Roca Honda Resources LLC (Roca Honda) a Strathmore Minerals Corp. Subsidiary, to conduct a 60% design of a new Water Treatment Plant (WTP) for the purpose of Radium and Uranium removal from mine dewatering. The proposed WTP is located in proximity to San Mateo, New Mexico. The purpose of the water treatment is to remove Uranium and Radium from the mine water under the requirements of the State of New Mexico water discharge regulations before it is released. Lyntek has been instructed to make all decisions regarding Plant Operation and Design.

This report does not account for infrastructure required by the WTP or the mine. This includes access roads, power lines, water lines, etc. These costs will be addressed independently of the WTP and this report.

The design of the WTP has been performed using Best Available Technology (BAT). The proposed automation is moderate and includes Plant Controlled Logic (PLC) to control pump VFDs to maintain appropriate levels in tanks and ponds.

## 1.2 Plant Process

The proposed plant will be capable of processing 8,000 gpm with regular operation at 4,000 gpm. All ponds related to the plant have been sized for a capacity of 4,000 gpm but are able to accommodate the 8,000 gpm requirement pending plant feed solids content.

The WTP utilizes an appropriate resin in eight Ion Exchange (IX) Columns to remove Uranium. After uranium removal Barium Chloride ($BaCl_2$) in solution is added to precipitate Radium. The precipitated solids are filtered in Pressure Leaf Clarifiers and the treated water is discharged through Discharge Ponds. Both of these methods have been used extensively in the industry for removal of Uranium and Radium.

## 1.3 Costs

### *1.3.1 Development of Costs*

To develop the Capital and Operating Costs Lyntek performed the following:

- Development of Process Flow Sheets;
- Development of Plant 3D General Arrangement Drawing;
- Development of Piping and Instrument drawings;
- Development of Electrical One-Line drawings;
- Development of a Site Layout;

After these drawings were reviewed by Roca Honda, Lyntek obtained the following:

- Budgetary Quotations for Equipment;
- Cost Estimates for all Civil, Structural Steel and, Concrete Work;
- A Budgetary Quotation for the Process Building;
- Cost estimates for installation of the plant and equipment;
- Cost Estimates for Piping from dewatering well to WTP;
- Cost Estimates for Settling Pond, Discharge Ponds, and Solids Retention Pond;
- Estimated Operating Costs for the concentrator.

The following ancillary and infrastructure items are outside of the scope of this study:

- Mine Plan and mining;
- Mine Dewatering Pumps and Wells;
- Warehousing and distribution;
- Communications external to the plant;
- All owners costs;
- Environmental Audits and all permits;
- Access Roads; (note that the roads in and around the WTP are included in the estimate)
- Primary power supply line;
- Discharge Water after release into the arroyo

The above is a partial list provided for clarification purposes only. The following sections of the report explain the costs and how they were developed.

### *1.3.2 Capital Costs*

Lyntek has calculated the total installed costs for the Lyntek designed WTP which includes the pipeline to deliver the water to the WTP, to the Release of the treated water. The accuracy for this cost estimate is ± 15%. Written budgetary quotations have been obtained for all equipment. Vendors were selected for this study based on Lyntek's evaluation that they will be capable of providing a desired product at a representative cost. Vendors and quotations were not used that represented equipment that would not be selected for construction, or were not representative of probable costs. Final selection of equipment will be done after permitting, during the detailed engineering. In order to allow for any miscalculations, omissions, or variation in costs, a 15% contingency factor has been added to the bottom line total.

Total Cost for the WTP is estimated at $9,365,700

## 1.4 Operating Costs

Operation costs for the WTP includes all personnel required for operation, power consumption, reagent consumption, maintenance costs, and water quality testing (in-house and outside testing). Operating costs have been calculated for a maximum flow rate of 8,000 gpm, and a lower flow rate of 4,000 gpm. Annual operating costs are $1,683,907 and $1,159,995 for their respective flow rates.

## 2.0 INTRODUCTION

Lyntek, Inc. (Lyntek) has been contracted by Roca Honda to conduct a 60% design of a new WTP for the purpose of Radium and Uranium removal from mine dewatering to meet discharge requirements required by the EPA and state regulatory agencies. The proposed WTP is located in proximity to San Mateo, New Mexico.

The WTP will be capable of processing 8,000 gpm. This flow rate is expected to be at maximum with the plant operating at approximately 4,000 gpm on a regular basis. All sizing of equipment for the WTP have been for 8,000 gpm, generally from duplicating equipment for 4,000 gpm and all sizing of ponds has been performed at 4,000 gpm. It is currently unknown what concentrations of Radium and Uranium are expected. For the purpose of this report it was assumed that Radium would be present at 63 pCi/L and Uranium would be present between 0.1 to 1 ppm. Water discharge from the plant will be treated to discharge standards below 15 pCi/L Radium and 0.03 ppm Uranium.

### 2.1 Scope of Work

Lyntek's Scope of Work includes the following deliverables:

1. Design analysis including:
    - General Description of the Design with design criteria;
    - Justification for the selection of design alternatives;
    - Operations and Maintenance design philosophy;
    - Identification of Infrastructure requirements.
2. A Process Flow Diagram with a Mass Balance
3. A Process Instrumentation Diagram(s)
4. An Equipment List of Major Equipment
5. Equipment Specifications for Major Equipment
6. Plant General Arrangement Drawing(s)
7. Pond Design Drawings(s)
8. Site Plan
9. Detailed Cost Estimate-based on:

- vendor budgetary quotes for major equipment and metal buildings;
- estimated material take-offs (MTOs) for piping and valves;
- estimated MTOs of instrumentation;
- estimated MTOs of power supply and distribution;
- estimated MTOs of concrete;
- estimated MTOs of steel;
- estimated MTOs of earthwork;
- and factored ancillary costs.

The battery Limits for Lyntek's Scope of Work are defined as the following:

1. Receiving the water from the dewatering pumps;
2. Receiving surface water run-off;
3. Discharging water to a designated surface drainage;
4. A receiving/holding pond;
5. A WTP including all related pumping and treatment equipment, operator and administrative offices;
6. Treated water holding ponds;
7. Security Fence and Security System;
8. Maintenance and storage facilities to support the Water Treatment Facility.

## 2.2 Process Description

### *2.2.1 Process Overview*

The WTP uses what is considered to be the BAT for the removal of Uranium and Radium. Leak prevention and containment has been added throughout the Water Treatment Process. Process selection and implementation were finalized by Lyntek with input from Strathmore (Roca Honda Resources).

Lyntek has designed the Water Treatment Plant to treat for Uranium and Radium. These two elements have been specifically selected for removal due to historical information which demonstrates they will be above discharge limits. Other elements and compounds are present in low amounts but are not of concern due to their low concentrations. This is primarily due to the natural pH of the ground water and host material. Because the pH is consistently 7.5 to 8.5, there are relatively few metals or other dissolved solids. In the event that treatment is required for other compounds or metals, the necessary modifications will be made to treat the water to meet discharge requirements. Treatment methods for other compounds include Ion Exchange, precipitation, and Reverse Osmosis.

#### *2.2.2 Uranium Removal*

Uranium removal is accomplished by resins in Ion Exchange Columns. Ion Exchange is the most common method for Uranium extraction and removal and is utilized extensively both in Uranium processing and in water treatment.

#### *2.2.3 Radium Removal*

Radium removal will take place by Barium Chloride addition. Barium Chloride is also considered to be the BAT for Radium removal and performs reliably and economically.

Radium co-precipitates in the presence of Barium Chloride and Sulfate. Because sulfates are already present in the water from the mine dewatering, only the addition of Barium Chloride is required to co-precipitate the Radium.

### 2.3 Electrical System

Lyntek has developed a Capital Cost Estimate for the electrical requirements associated directly with the WTP. Total power draw for the plant is expected to be 724 KW at 8000 gpm. It is currently planned to provide power to the WTP from the main substation at the mine. A substation is included with the WTP that will receive power at 4160 volts from the main substation.

### 2.4 Instrumentation and Automation

Lyntek included instrumentation and automation where it is required in order to prevent overflow, regulate flow, and provide appropriate plant monitoring. The plant will require manual operation for preparation of reagents, resin transfer, and pressure leaf clarifier cleaning.

The plant is equipped with a PLC which will control flow rates and monitor levels and valve positions throughout the plant. Valves which are over 6” and valves in hard to reach places (such as on top of the IX Columns) have been equipped with actuators for ease of operation.

## 2.5 Water Testing

### *2.5.1 Uranium Testing*

Uranium Testing is planned to take place on-site using a Kinetic Phosphorescence Analyzer (KPA) which yields real time results for Uranium monitoring.

Uranium testing will also take place at an outside laboratory to confirm on-site test results. Outside laboratory testing requirements will be determined by the governing state regulatory agency.

### *2.5.2 Radium Testing*

On-site Radium Testing has been included in the design for the WTP. Radium testing is also scheduled to take place in outside laboratory.

On-site tests require additional equipment and tests are expected to be as expensive as or more expensive than outside laboratory costs. The advantage to in-house testing would be the relatively short turnaround time at approximately 10 to 12 hours, compared to outside testing requiring approximately 3 days total. On-site radium testing is considered to be optional at this time.

## 2.6 Environmental and Permitting

Current permitting and environmental work is assigned to Roca Honda. Lyntek will modify plant design or other requirements as necessary.

## 2.7 Capital and Operating Cost

A Capital Cost Estimate has been performed by Lyntek based on budgetary quotations and Material/Labor estimates. This includes all costs within Lyntek's Scope of Work.

# 3.0 PROCESS DESCRIPTION

## 3.1 Introduction

The Roca Honda WTP is designed to receive water from the mining operation as required to develop the underground workings and subsequently to support mining operations. The design requirement of the plant is to receive water from the mine dewatering operations at a rate of up to 8,000 gallons per minute (gpm) and to remove all suspended solids, radium, and uranium. The experience from former operations in the Grants Mineral Belt is that radium may be experienced in any subsurface water and that suspended solids and uranium may be experienced once mining operations start. The design uses what is recognized as the Best Available Technology (BAT) with the flexibility to deal economically with a range of flows and varying feed water quality.

This process description will cover:

1. The overall water treatment concept;
2. The operating philosophy;
3. The equipment and reagents selected;
4. Water Quality Sampling.

## 3.2 Water Treatment Plant Flow Sheet (Drawing 10034-F-01 Rev. A)

As may be seen in Drawing 10034-F-01 (Rev. A) located in Appendix A.1, water is delivered to the plant in one or two 16 inch HDPE pipes. Depending on the quality of the water delivered the water will be sent to:

1. A settling pond if suspended solids are anticipated otherwise the pond will be bypassed;
2. To Ion-Exchange (I-X) columns if uranium is anticipated otherwise the I-X columns will be by-passed ;
3. To Barium Chloride Reactor Tanks where the radium will be precipitated out of the water after contacting the Barium Chloride.

From the Reactor Tanks the water will be pumped through Pressure Leaf Clarifiers where the suspended solids are removed. Filtered water from the Pressure Leaf Clarifiers is discharged to a Holding Pond, and piped to a discharge point in an arroyo at approximately 100 ft. lower elevation.

### 3.3 Plant Operating Philosophy

The design of the plant is such that:

1. No licensable materials are produced by the plant;
2. The systems are manually controlled except where required to minimize hazards;
3. Staffing will be minimal with maintenance support during operations being supplied from the nearby mine site;
4. A laboratory will be located in the plant to prepare water samples and measure the water quality.

With regard to non-licensable materials, uranium will be removed from the water onto the resin in the I-X columns. Resin loading will be monitored by tracking the uranium content of the water going to the I-X columns. Prior to the anticipated breakthrough the resin will be removed from one column to a resin transfer truck or trailer using the resin transfer system provided in the design. This “loaded” resin will be transported off site to be stripped. The resin removed from the I-X column will be replaced either with fresh resin or stripped resin that has been returned to the WTP.

The radium will be precipitated out using Barium Chloride and the precipitated radium and any unused Barium Chloride will be filtered from the water in Pressure Leaf Clarifiers. Periodically, the solids in the Clarifiers will be removed by sluicing into a Solids Pond on site. The water level in the Solids Pond will be maintained two feet above the settled solids. Once every four months the settled solids will be removed from the Solids Pond using a vacuum truck and hauled to a low level radiation waste disposal site.

Similarly, the solids in the Settling Pond will be kept under water and removed by vacuum truck to a low level radiation waste disposal site.

With regard to automatic controls, a Process Hazard Analysis has been performed and is included as Appendix A in this report. The hazards of primary concern can be grouped into a general category of "spill" hazards. These hazards have been addressed first by providing containment and secondarily by limiting the quantity of spills with level sensors in tanks with alarms.

## 3.4 Equipment and Reagent Selection

### *3.4.1 IX Columns – Uranium Removal*

The Ion Exchange (IX) columns will remove the uranium. Lyntek is not aware of any other technology that will perform this function and it is considered the Best Available Technology (BAT).

A total of eight IX columns are planned to be installed, this allows for a maximum flow of 8,000 gpm to be treated below 0.03 ppm Uranium. The IX Columns are piped in parallel allowing individual columns to be placed in service as required depending on the plant flow rate. Further, any single column may be taken offline if necessary for maintenance or resin removal. (See Drawing 10034-D-02 and 10034-D-03 located in Appendix A.2 for piping details).

The Ion Exchange Columns will extract the Uranium to below 0.03 ppm to meet USEPA discharge water regulation. As the resin loading approaches its maximum capacity, the IX column will be taken offline, and the resin will be transported off site for stripping and regeneration. Lyntek has selected the high capacity PFA600 resin produced by Purolite for the WTP. However, several resins are available that may be used and will produce acceptable discharge water reliably.

### *3.4.2 Reaction Tanks – Radium Removal*

Water is fed from the IX Columns directly to Reaction Tank#1 (30-TK-10) through a down comer to prevent short circuiting. Reaction Tank #1 has a retention time of 6.5 minutes at 8,000 gpm then overflows into Reaction Tank #2 (30-TK-20) for an additional 6.5 minutes of retention time. Each reaction tank is equipped with an agitator (30-AG-10 and 30-AG-20) to ensure proper mixing for Radium precipitation. The water then overflows into the Overflow Tank (30-TK-50) and is pumped to the Pressure Leaf Clarifiers for filtration of the precipitated Radium and excess Barium Chloride.

In order to facilitate precipitation, Barium Chloride will be dosed to the Reaction Tanks (30-TK-10 & 20) at 15 ppm. The Barium Chloride feed is pumped from the Barium Chloride Mix Tanks (30-TK-30 and 30-TK-40) by Barium Chloride Metering Pumps (30-PP-30 and 30-PP-40). These pumps will be controlled by a VFD receiving a signal from the flow meter attached to the inlet pipe of Reaction Tank #1 (30-TK-10). The Barium Chloride Mix Tank and Metering Pumps are redundant and only require 1 in operation at any given time. Each tank provides Approximately 12 hours of continuous operation at 8,000 gpm.

All Tanks are equipped with level elements. Level elements in the plant serve as overflow alarms and flow control. The Level Element located on the Overflow Tank (30-TK-50) controls the Pressure Leaf Clarifier Feed Pumps (30-PP-10 and 30-PP-20) in order to maintain the water level. In case of overflow or leak, the containment area has been sized at 110% of the largest tank (the Reaction Tanks) and contains two separate sump pumps for dewatering in the event of any spill.

Radium removal by addition of Barium Chloride ($BaCl_2$) is well documented and has been used extensively for the purpose of Radium precipitation. A dose of 15 ppm Barium Chloride and a retention time of 10 minutes allows for the full precipitation of all Radium Isotopes. Radium may also be removed with certain resins. The removal by resin alternative is much more costly. The Barium Chloride precipitation technique is considered to be the BAT.

### *3.4.3 Pressure Leaf Clarifiers*

The Pressure Leaf Clarifiers (40-FT-10, 40-FT-20, and 40-FT-30) are fed from the Pressure Leaf Clarifier Feed Pumps (30-PP-10 and 30-PP-20). The precipitated Radium will be filtered and the treated water discharged to holding ponds. Discharge water will be tested for Water Quality Compliance, discussed further in section '***3.6 Discharge Water Testing***.'

Two Clarifiers will be online during standard operation with the remaining Clarifier on Stand-by. Periodically the Clarifiers will require cleaning; this is expected to be performed when a Clarifier reaches a pressure differential of 75psi across the filter. When this pressure is reached, cleaning is required. The Clarifier will be taken offline, and flow will be transferred to the third clarifier on standby. Removal of the solids in the Clarifier is performed by the Backwash Pump (30-PP-10) which sprays a high pressure stream across the clarifier filter cloth removing all solids. Solids are drained out the bottom of the Clarifier and are sluiced in a trough into the Solids Holding Pond. Once cleaning is complete, the Clarifier will remain offline until cleaning of another Clarifier is required.

The Clarifiers are pre-coated with Diatomaceous Earth (DE) to aid in filtration and prevent filter cloth blinding. This pre-coating is performed each time the filter is cleaned and brought online. This is an important step taken prior to bringing the Clarifier online to enhance process performance and operations. At this time it is expected that the Clarifiers will not require cleaning more than once per week per unit.

## 3.5 Ponds

### *3.5.1 Discharge Holding Pond*

Filtered water from the Pressure Leaf Clarifiers will be sent to the Discharge Holding Ponds for release. The Discharge Holding Ponds are sized to hold 1.2 hours of discharge at 4,000 gpm and will act as surge control for the treated water. Ponds will be lined with a Bentomat Liner to prevent seepage. Water from the ponds will gravity flow to a drainage area located downhill of the ponds. It is currently proposed to install a turbine at the end of this pipe to recover energy. Expected energy recovery is approximately 50KW. See drawing 10034-C-01 in Appendix A.4 for approximate location of the Discharge Holding Pond and other ponds.

### *3.5.2 Solids Holding Ponds*

Solids collected by the Pressure Leaf Clarifiers will be discharged into a settling pond where it will be stored for later disposal at a low level radiation waste disposal site. A second Solids Holding Pond will be available if maintenance or other shutdown of the primary Solids Holding Pond is required. The Solids Holding Ponds will have containment consisting of two plastic HDPE 80mil liners. The pond will be sloped to a sump with an 8 inch HDPE pipe. Leak detection is provided at the sump and, in the event of a leak, solution may be pumped from the sump. Water in the pond will be kept at an appropriate level to prevent any hazardous solids being blown out. See drawing 10034-C-01 in Appendix A.4 for the proposed location of these ponds.

When ponds require solids removal, a vacuum truck will collect and dispose of the solids at a site for low level radiation waste.

### *3.5.3 Settling Pond*

The Settling pond serves to collect any solids which may otherwise negatively affect the WTP. A second settling pond will be available if maintenance or other shutdown of the primary Settling Pond is required. The Settling Ponds are required to remove any solids specifically because the resin involved in Uranium removal cannot tolerate high solids. Solids collected in the Settling Pond will be stored for later disposal at a low level radiation waste disposal site. The Settling Ponds will have containment consisting of a geotextile Bentomat layer and two plastic HDPE 80mil liners. The pond will be sloped to a sump with an 8 inch HDPE pipe. Leak detection is provided at the sump and, in the event of a leak, solution may be pumped from the sump. Water in the pond will be kept at an appropriate level to prevent any hazardous solids being blown out. See drawing 10034-C-01 in Appendix A.4 for approximate location of these ponds.

### *3.5.4 Evaporation Ponds*

Evaporation Ponds are located where potential runoff water could be contaminated with Radium or Uranium. These Evaporation Ponds will be sized for the 100 year rain event and lined with a Bentomat layer to prevent seepage. They will be equipped with level elements and pumps which will pump water to the WTP for removal of Radium and Uranium.

## 3.6 Discharge Water Testing

The WTP will contain a fully functional laboratory equipped with instruments and required facilities for pH, ORP, Solids testing, Uranium detection, and Radium Detection. A Hach Metals instrument will also be included in the laboratory which will allow for testing of various metals which maybe a concern or require monitoring.

### *3.6.1 Uranium Testing (In-House)*

Uranium testing will be performed using a *ChemChek* Kinetic Phosphorescence Analyzer (KPA). By exciting the Uranium molecules using a laser, the Uranium emits radiation which is measured. The measured radiation is used to calculate a concentration. Results for this test are produced immediately. The Detection Limit for Uranium Testing using Kinetic Phosphorescence is 0.01 µg/L. After equipment purchase, operating costs are essentially labor costs.

### *3.6.2 Radium Testing (In-House)*

A Testing procedure which is outlined in Appendix F.2 has been identified for Radium Testing on site. Expected turn-around for this Radium testing procedure is approximately 12 hours, and can be completed in a single operating shift. At this time it is unknown if radium testing on site is required.

## 4.0 CAPITAL COST ESTIMATE

Capital Cost estimates have been provided for all areas which are contained in Lyntek's scope of work for the WTP. This includes the WTP, Discharge Ponds, Solid Pond, Settling Pond, and pumping equipment for the evaporation ponds. This does not include any necessary infrastructure, Mine Dewatering, Civil work for evaporation ponds, or any costs not directly related to the WTP, Table 4.1 outlines these costs. Appendix E.1 provides a capital cost summary which outlines these costs.

**TABLE 4.1: CAPITAL COST ESTIMATE**

| | | | |
|---|---|---|---|
| **Direct Costs** | | | |
| | Equipment | $ 2,541,097 | |
| | Piping and Valves | $ 297,093 | *Well Piping Not included |
| | Mechanical Installation | $ 152,295 | |
| | Civil | $ 862,327 | |
| | Concrete | $ 374,274 | |
| | Electrical | $ 619,353 | |
| | Instruments | $ 509,104 | *includes PLC |
| | Building | $ 489,000 | |
| | Plant Structural Steel | $ 18,484 | |
| | Coatings and Sealants | $ 25,000 | |
| | First Fills | $ 769,403 | |
| | Starup Spares | $ 50,822 | |
| | 1st year Capital Spares | $ 76,233 | |
| | **Subtotal** | **$ 6,784,483** | |
| | | | |
| **Indirect Costs** | | | |
| | Transportation | $ 330,343 | 13% of Equipment |
| | Detailed Engineering | $ 495,783 | |
| | Construction Management | $ 478,000 | |
| | Startup Assistance | $ 12,800 | |
| | **Subtotal** | **$ 1,316,926** | |
| | | | |
| | **Total Capital Cost Estimate:** | **$ 8,144,087** | |
| | CONTINGENCY | $ 1,221,613 | 15% |
| | | | |
| | **GRAND TOTAL** | **$ 9,365,700** | |

## 4.1 Site Preparation and Civil work

### *4.1.1 Plant Area*

The plant area is contained in an 80' by 280' building (See Appendix A-3 for drawing 10034-G-01 plant layout). It has been positioned on the plateau on the west side of the mesa. This is the best suited area for the WTP as it is the nearest flat area in proximity to the underground mines and has drainage in close proximity. Frost depth in this area is estimated at 30'. However, purposes for the WTP. This excavation depth is an estimate by Lyntek and is dependent upon a soils report post permitting. See Table 4.2 for plant area preparation and Civil Costs. These costs are shown in greater detail in Appendix E-4.

**TABLE 4.2: PLANT AREA PREPARATION AND CIVIL COSTS**

| | | | |
|---|---|---|---|
| **Earth Works by Area** | | | |
| | Plant Area | $ 53,101 | |
| | Settling Pond (2) | $ 374,685 | |
| | Solids Holding Pond (2) | $ 243,258 | |
| | Discharge Holding Pond (1) | $ 76,757 | |
| | Evaporation Ponds (7) | $ 84,000 | *Bentomat Liner only |
| | Plant Laydown Area | $ 30,525 | |
| | **Subtotal** | **$ 862,327** | |
| | | | |
| | **CONTINGENCY** | **$ 129,349** | **15%** |
| | | | |
| | **GRAND TOTAL** | **$ 992,000** | |

### *4.1.2 Ponds*

Ponds have been sized at approximately 6ft operating depth with 2ft of freeboard. and have been positioned on the same plateau as the WTP (See Appendix A-4 for drawing 10034-C-01, 10, 11). Ponds will require a pre-engineered backfill to provide support for the pond liners. The costs for the ponds have been developed using estimates based on the Pond Drawings in Appendix X. Costs are assigned to these estimates using *RS Means Building Construction Cost Data* 2010 and Means online resources. These costs will account for all earth work performed.

It is expected that a large portion of the excavation for the ponds will require blasting to loosen the rock for excavation. This is based on a visual inspection of the site, and will require geotechnical work to determine if blasting is required. Pond liners will be comprised of a single layer of Bentomat with the exception of the Solids holding ponds, and settling ponds which will have two layers of 80mil HDPE for leak protection. Both the Solids Holding Pond and Settling Ponds will be equipped with leak detection. Costs for these are included in the civil costs shown in Table 4.2 and are detailed in Appendix E-4.

## 4.2 Plant Concrete

A Concrete estimate has been performed for the WTP. This cost has been performed using plant layout 10034-G-01 shown in appendix A-3. A cost for this concrete has been developed using a cost per cubic yard which includes all costs associated with concrete materials and installation. See Table 4.3 for these costs. Additional detail for these costs can be found in Appendix E-5.

**TABLE 4.3: CONCRETE ESTIMATE**

| Plant Concrete by Area | | | |
|---|---|---|---|
| | Reaction Area | $ 139,238 | |
| | Leaf Filter Area | $ 16,980 | |
| | Resin Area | $ 19,417 | |
| | Building | $ 198,639 | |
| | **Subtotal** | **$ 374,274** | |
| | | | |
| | CONTINGENCY | $ 56,141 | 15% |
| | | | |
| | **GRAND TOTAL** | **$ 430,000** | |

## 4.3 Plant Equipment Capital

### *4.3.1 Plant Equipment*

Equipment costs for the WTP are all priced based on Vendor quotation and budgetary quotation. Minor equipment such as Safety Showers are priced using granger or equivalent supplier. Equipment Capital Costs have been developed based on Lyntek's Piping and

Instrumentation Diagram drawings 10034-D-01 through 10034-D-06. These drawings can be found in Appendix A-2. All equipment which appears on these drawings can be found on the equipment list in Appendix E-1. The equipment list includes a brief description of the equipment, pricing, power requirements, and source. Specifications for equipment can be found in the design criteria in Appendix F-1. Mass balances for equipment can be found in appendix D.

Plant Equipment was selected for this report based on Lyntek's experience with processing equipment and a representative cost. All quotes for equipment used in this report are can be found in Appendix B. A plant Equipment Cost by Area is show in Table 4.4.

**TABLE 4.4: PLANT EQUIPMENT COSTS BY AREA**

| | | |
|---|---|---|
| Plant Feed and Settling Pond | $ 46,652 | |
| IX Colum Area | $ 1,005,686 | |
| Barium Chloride Reaction Tank Area | $ 427,759 | |
| Pressure Leaf Clarifier | $ 742,220 | |
| Discharge, Solids, Evap. Pond Area | $ 47,180 | |
| Laboratory and QAQC Equipment | $ 154,500 | |
| Plant Ancilary Equipment | $ 117,100 | |
| **Equipment Total** | **$ 2,269,497** | |
| | | |
| Contingency | $ 340,425 | 15% |
| | | |
| **GRAND TOTAL** | **$ 2,610,000** | |

### *4.3.2 Plant Electrical*

Electrical costs for the WTP begin with the transformers at the plant. No costs for necessary infrastructure or power lines have been accounted for in this costing exercise. Costs for plant electrical equipment are gathered using quotations from vendor for equipment costs. Installation for all electrical equipment has been performed by Lyntek using estimations for installation hours and labor rates. These estimations are based on Lyntek's prior experience for electrical installation, and *RS Means Building Construction Cost Data 2010* where applicable. Costs for electrical equipment is shown below in Table 4.5. Further detail can be found in Appendix E-6.

| TABLE 4.5: PLANT ELECTRICAL EQUIPMENT COST | | |
|---|---|---|
| | Total | |
| Medium Voltage Transformer | $ 53,400.00 | |
| Motor Control Center | $132,954.00 | |
| Cable | $147,044.00 | |
| Cable Tray | $ 32,070.00 | |
| Conduit | $ 19,690.80 | |
| Grounding | $ 36,397.00 | |
| Lightning | $ 26,350.00 | |
| Remote Pump Panels | $ 40,138.00 | |
| Lighting Panel Xformer | $ 18,400.00 | |
| Lighting | $112,909.00 | |
| **Instrument Total** | **$ 619,353** | *Install Included |
| | | |
| Contingency | $ 92,903 | 15% |
| | | |
| **GRAND TOTAL** | **$ 712,000** | |

### *4.3.3 Plant Instruments*

Instrument costs for the WTP have been developed using the Piping and Instrumentation Diagrams located in Appendix A.2. An Instrument List shown in Table 4.6 identifies all instrumentation located in the WTP.

| TABLE 4.6: PLANT INSTRUMENT COST | | |
|---|---|---|
| HMI | $ 22,682 | |
| PLC Panel | $ 110,423 | |
| Radio Comms | $ 127,621 | |
| Remote I/O Panel | $ 50,305 | |
| Hand Switches | $ 76,040 | |
| Level Instruments | $ 102,859 | |
| Flow Instruments | $ 19,174 | |
| **Instrument Total** | **$ 509,104** | *Install Included |
| | | |
| Contingency | $ 76,366 | 15% |
| | | |
| **GRAND TOTAL** | **$ 585,000** | |

Because of pump control philosophy, a Plant Logic Control (PLC) has been included with the instruments. This will allow for easier operation and monitoring of the WTP. Also included in the instrumentation is appropriate level Elements, pressure gauges, flow meters, and relay devices for the 7 proposed evaporation ponds. Costs for instruments and installation can be found in Appendix E-7.

### *4.3.4 Plant Laboratory*

The plant laboratory includes a general facility for a WTP which includes equipment for pH, ORP, Conductivity, % Solids, Turbidity, etc. it includes laboratory counters, Sink, cabinets and the installation of these items. This cost is estimated based Lyntek's experience with laboratories of this type. Costs for the laboratory are included in the total capital equipment cost shown in Table 4.4 and detailed in Appendix E-1. Cost for the laboratory include a general WTP laboratory in combination with Uranium and Radium Testing. Instruments Specific to Radium and Uranium testing have their costs shown separately.

Radium and Uranium Testing equipment are also shown on the equipment list in Appendix E-1. Costs for uranium testing has been quoted by Chemchek using their Kinetic Phosphorescence Analyzer (KPA). Radium Testing has been estimated by Lyntek for the system described in Section 3.6.

## 4.4 Plant Equipment Installation

### *4.4.1 Plant Mechanical Installation*

Cost estimates for installation of plant equipment and piping is based on Lyntek's Equipment List in Appendix E-1, and Lyntek's general arrangement drawing 10034-G-01 in A-3. Installation hours are estimated using Lyntek's past project experience with equivalent equipment. Labor Rates are estimated using *RS Means Building Construction Cost Data 2010*. See Table 4.7 for costs of installation and Appendix E.3 for additional detail regarding equipment and piping installation costs.

| TABLE 4.7: EQUIPMENT INSTALLATION | | |
|---|---|---|
| | Total | |
| Tanks | $ 14,740 | |
| Pumps | $ 16,500 | |
| Equipment | $ 15,840 | |
| Piping | $ 37,840 | |
| Foreman/Supervision | $ 21,000 | |
| Equipment Rental and Others | $ 46,375 | |
| **Instrument Total** | **$ 152,295** | |
| | | |
| Contingency | $ 22,844 | 15% |
| | | |
| **GRAND TOTAL** | **$ 175,000** | |

### *4.4.2 Plant Electrical*

Electrical installation costs have been included with the electrical equipment costs shown in Table 4.0. Additional detail can be found in Appendix E-6. Installation costs estimates are based on Lyntek's past experience with equivalent electrical equipment. Labor rates for installation are estimated using *RS Means Building Construction Cost Data 2010*.

### *4.4.3 Plant Instruments*

Cost estimates for installation of plant instruments is based on Lyntek's past experience with equivalent instrumentation. These costs are shown with the instrumentation equipment in appendix E-7.

## 4.5 Plant Building

The building for the WTP has been sized according to the General Arrangement drawing 10034-G-01 located in Appendix A-3. The Building cost has been estimated at $409,000 using the budgetary quotation located in Appendix B-1. This quotation includes the materials, construction, and transportation of the building materials. It does not include any equipment or areas associated with the building such as the Laboratory, offices, lunch room, and MCC control room. These areas have been estimated at $80,000 based on Lyntek's past projects and experience. Total cost for the building including these areas is estimated at $489,000.

### 4.6 Transportation Costs

Transportation Costs for all items are estimated using a 13% factor based on the total capital equipment cost. This factor is based on Lyntek's past experience with similar projects.

### 4.7 Engineering and Construction Management Cost

Engineering and Construction Management costs have been developed by Lyntek. These costs are to bring the project forward from its current status, to its completion and startup. Boundaries for both construction management and Engineering share the same battery limits as this report for the WTP. Costs can be seen below in Table 4.8 and Table 4.9. Detailed costs can be found in Appendix E-10 and Appendix E-11.

**TABLE 4.8: ENGINEERING COSTS**

| | | Total | |
|---|---|---|---|
| | Engineering and Design | $ 295,670 | |
| | Project Management | $ 125,526 | |
| | Office Overhead | $ 29,516 | |
| | **Instrument Total** | **$ 450,712** | |
| | | | |
| | Contingency | $ 45,071 | 10% |
| | | | |
| | **GRAND TOTAL** | **$ 496,000** | |

| TABLE 4.9: CONSTRUCTION MANAGEMENT COSTS | | | |
|---|---|---|---|
| | | Total | |
| | Construction Supervisor | $ 245,000 | |
| | Project Engineer | $ 175,000 | |
| | Project Management | $ 87,500 | |
| | **Instrument Total** | **$ 507,500** | |
| | | | |
| | Contingency | $ 76,125 | 15% |
| | | | |
| | **GRAND TOTAL** | **$ 584,000** | |

# 5.0 OPERATING COST ESTIMATE

## 5.1 Operating Costs Overview

Operating Costs for the WTP consist of electrical consumption, personnel, reagent consumption, and water testing costs. Table 5.1 and Table 5.2 show a summary of these costs. The largest operating Costs for the water treatment plant is Reagents. The costs have been detailed at both 8,000 gpm and 4000gpmA detail of all operating costs associated with the WTP can be found in

Appendix C-1.

**TABLE 5.1: OPERATING COSTS (8000 GPM)**

| | | |
|---|---|---|
| Power | $ 375,511 | |
| Reagents | $ 706,051 | |
| Maintenance | $ 125,000 | |
| Labor | $ 380,000 | |
| QAQC Testing | $ 97,344 | |
| **Operating Total** | **$ 1,683,907** | |
| | | |
| Contingency | $ 252,586 | 15% |
| | | |
| **GRAND TOTAL** | **$ 1,936,492** | |

**TABLE 5.2: OPERATING COSTS (4000 GPM)**

| | | |
|---|---|---|
| Power | $ 187,661 | |
| Reagents | $ 36,990 | |
| Maintenance | $ 125,000 | |
| Labor | $ 380,000 | |
| QAQC Testing | $ 97,344 | |
| **Operating Total** | **$ 1,159,995** | |
| | | |
| Contingency | $ 173,999 | 15% |
| | | |
| **GRAND TOTAL** | **$ 1,333,994** | |

### *5.1.1 Personnel Costs*

The WTP is planned to operate with 2 operators per shift, 3 shifts per day, 8 hours per shift and a foreman and lab technician for 8 hours during the day shifts. WTP maintenance crew is expected to be combined with the mine maintenance crew and has not been accounted for in this cost exercise. This will allow

### *5.1.2 Power Costs*

Total operating power for the plant is expected to be 724KW, with total connected power at 850KW. The majority of this power is allocated for the IX Column Feed pumps (10-PP-30 and 10-PP-40), and the Leaf Filter Feed Pumps (30-PP-10 and 30-PP-20). Total operating power for these four pumps is 559KW. A detailed list of power consumption and connected power can be found on the equipment list in Appendix E-1. Prices for electricity ($0.06/KWH) are based on the Lyntek *Phase 1 report* issued on April 22$^{nd}$ 2010.

### *5.1.3 Reagent Costs*

Reagent costs for Barium Chloride ($BaCl_2$) and Diatomaceous Earth (DE) have been estimated using Lyntek's past experience on projects. Reagent consumption is 1442 lb/day and 129 lb/day for BaCl2 and DE respectively. Both Reagents are expected to be shipped in 50lb bags.

## 5.2 Water Quality Testing

### *5.2.1 In house Radium and Uranium Testing*

Uranium testing in house will be performed using a chemchek KPA-11M no operating costs are included for these tests as no sample preparation is required for Uranium detection at the desired detection range. A testing procedure is included in Appendix

Radium testing in-house will be performed using EPA approved methods listed in Appendix F-2. Estimated cost for radium testing is detailed in Appendix C.1

### *5.2.2 Outside Laboratory Radium and Uranium Testing*

Outside costs for Radium and Uranium testing have been estimated by Evergreen Analytical Laboratory. Two times per week, samples are expected to be tested at the outside laboratory. Frequency of testing is dependent upon the governing state's agency requirements.

## 6.0 CONSTRUCTION SCHEDULE

A Construction Schedule has been prepared by Lyntek based on the design outlined in section *3.0 PROCESS DESCRIPTION*. See Appendix E-12 for Construction Schedule.