

**SOUTHERN NEW MEXICO  
LOW TEMPERATURE GEOTHERMAL  
RESOURCE ECONOMIC ANALYSIS**

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**August 1990**

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RESOURCE ECONOMIC ANALYSIS**

**Final Technical Report**

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## TABLE OF CONTENTS

	Page
List of Tables.....	v
List of Figures.....	vi
Acknowledgements.....	vii
Executive Summary.....	viii
1.0 Introduction.....	1
1.1 Approach.....	1
1.2 Geothermal Resources of New Mexico.....	2
2.0 Lower Animas Valley Site Description.....	7
2.1 Site Location.....	7
2.2 Geothermal Resources.....	9
2.3 Potential for Geothermal Development.....	9
2.4 Land Ownership.....	10
2.5 Climatic Factors.....	10
2.6 Transportation and Utilities.....	10
2.7 Population.....	11
3.0 Las Cruces Site Description.....	12
3.1 Site Location.....	12
3.2 Geothermal Resources.....	14
3.3 Potential for Geothermal Development.....	14
3.4 Land Ownership.....	15
3.5 Climatic Factors.....	15
3.6 Transportation and Utilities.....	15
3.7 Population.....	16
4.0 Truth or Consequences Site Description.....	17
4.1 Site Location.....	17
4.2 Geothermal Resources.....	17
4.3 Potential for Geothermal Development.....	19
4.4 Land Ownership.....	19
4.5 Climatic Factors.....	19
4.6 Transportation and Utilities.....	19
4.7 Population.....	20

5.0	Project Cost Assumptions and Methodology .....	21
5.1	Capital Costs - Geothermal Systems .....	23
5.2	Operating Costs - Geothermal Systems.....	24
5.3	Capital Cost - Fresh Water Systems .....	24
5.4	Operating Costs - Fresh Water Systems .....	25
5.5	Capital and Operating Costs - Natural Gas System.....	26
6.0	Discussion.....	27
6.1	Comparative Analysis - Geothermal Systems.....	27
6.2	Comparative Analysis - Fresh Water Systems.....	30
7.0	Conclusions.....	33
8.0	References.....	36
Appendix A:	Model Description .....	37
Appendix B:	Greenhouse Heat Loss Simulations .....	71
Appendix C:	Levelized Life-Cycle Cost Data .....	85

## List of Tables

	Page
Table 1A	Comparative Geothermal System Levelized Costs.....x
Table 1B	Comparative Fresh Water System Levelized Costs.....x
Table 1	Geothermal Resource Classification Based Upon Thermal Regimes .....3
Table 2	Natural Gas System Capital Costs .....26
Table 3	Geothermal System Capital Cost Comparison.....27
Table 4	Distribution of Geothermal Development Costs.....28
Table 5	Comparative Geothermal System Levelized Annual Operating Costs.....28
Table 6	Comparative Geothermal System Levelized Costs.....29
Table 7	Fresh Water System Capital Cost Comparison .....31
Table 8	Comparative Fresh Water System Levelized Annual Operating Costs.....31
Table 9	Comparative Fresh Water System Levelized Costs .....31

## List of Figures

	Page
Figure 1A Site Location Map .....	ix
Figure 1 Map of New Mexico Showing Physiographic Provinces .....	4
Figure 2 New Mexico Geothermal Resource Base.....	5
Figure 3 Current Status of New Mexico Geothermal Resources.....	6
Figure 4 Location Map, Lower Animas Valley.....	8
Figure 5 Location Map, Las Cruces East Mesa.....	13
Figure 6 Location Map, Truth or Consequences .....	18
Figure 7 Levelized Life-Cycle Energy Costs .....	30
Figure 8 Levelized Life-Cycle Fresh Water Costs.....	32

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## Executive Summary

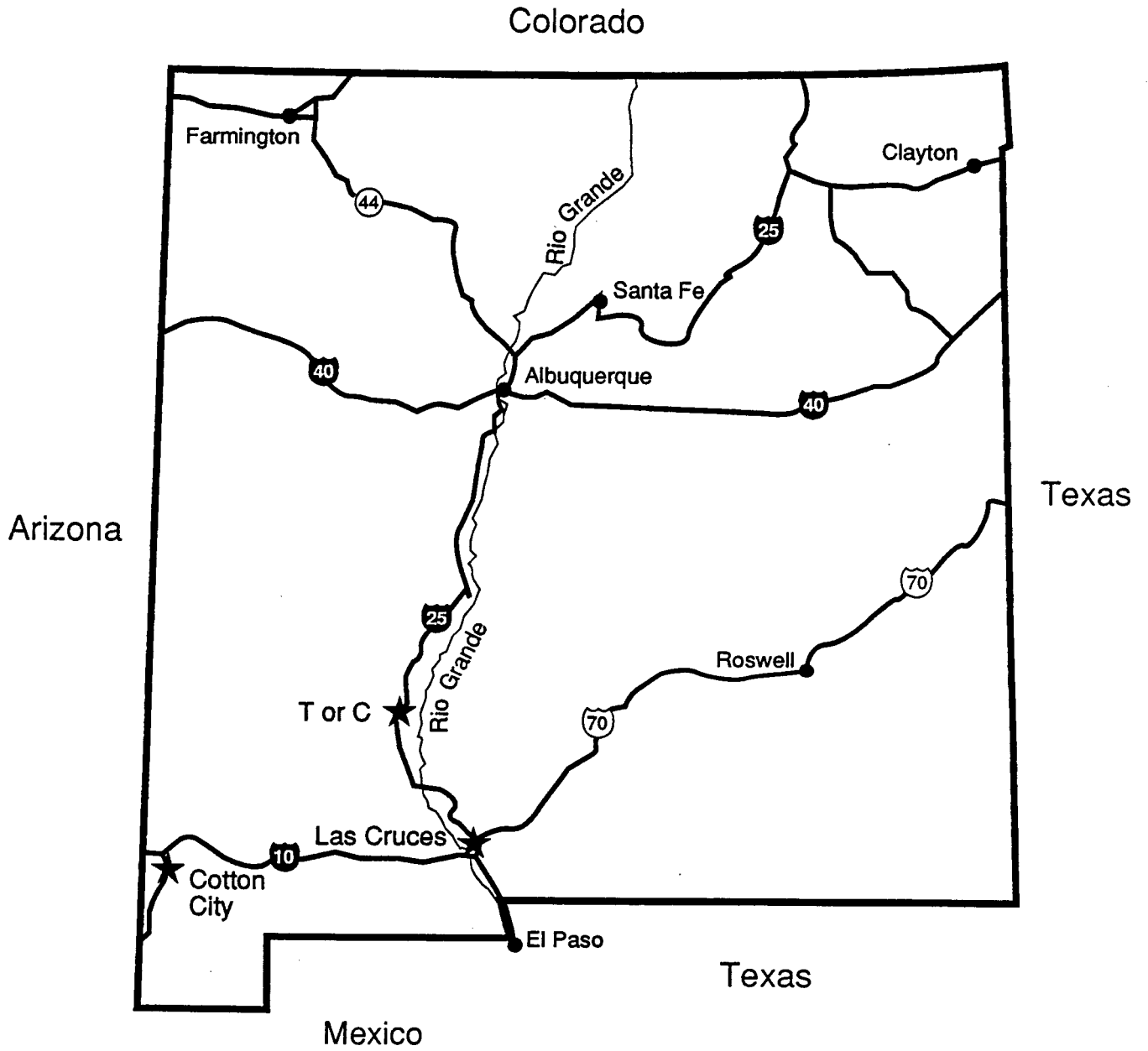
This report presents an overview of geothermal resource development for three low-temperature (i.e., < 200°F) sites in southern New Mexico: the Lower Animas Valley, the Las Cruces East Mesa, and Truth or Consequences (see Figure 1A). This report is intended to provide potential geothermal developers with detailed information on each site for planning and decision making purposes. Included in the overview for each site is both a full site characterization and an economic analysis of development costs associated with the construction and operation of both geothermal and fresh water systems at each of the three locations. The economic analysis focuses on providing utility services to a commercial greenhouse because greenhouse operations are among the most likely candidates for use of the resource base.

The costs of delivering hot and fresh water to the three sites are compared on an equivalent basis. The framework for allowing comparison of the varying capital and operating costs at the three sites was to establish levelized life-cycle costs for the production of geothermal energy and fresh water. Also for comparative purposes, levelized costs were calculated for a natural gas system for delivery of the same heating load as for the geothermal systems.

The thermal load was established by the heating requirements of a well-constructed and operated commercial greenhouse. Four different load categories (i.e., one acre, four acres, ten acres, and fifteen acres) were analyzed to illustrate scale effects associated with providing increasing thermal loads.

It was determined that the Lower Animas Valley has the least expensive geothermal development costs, primarily due to the shallow depth of a relatively warm reservoir. The most costly development location is in Las Cruces, largely because the depth to the geothermal aquifer is relatively great for a moderate temperature. Truth or Consequences has moderate development costs because it has very shallow wells but requires extensive piping and pumping to compensate for low temperatures.

Figure 1A.  
Site Location Map



Levelized costs, expressed in dollars per millions of Btu (\$/MMBtu), were least costly in Animas, followed by Las Cruces and Truth or Consequences. Based upon the assumptions, no geothermal system was found to be economically attractive for small (i.e., one acre) thermal loads. In Animas geothermal was more competitive than natural gas for the larger thermal loads while in Las Cruces only the largest thermal loads were competitive with natural gas. In Truth or Consequences geothermal energy is more expensive than natural gas for all of the thermal loads. Economy of scale effects favor larger thermal loads. Levelized costs are summarized in Table 1A.

**Table 1A. Comparative Geothermal System Levelized Costs**  
(\$/MMBtu)

Location	1 Acre	4 Acres	10 Acres	15 Acres
Animas	\$ 7.86	\$ 3.03	\$ 2.85	\$ 2.56
Las Cruces	14.78	6.79	5.66	5.38
Truth or Consequences	12.86	7.29	7.31	N/A
Natural gas *	6.43	6.00	5.95	6.13

\* Note: Natural gas cost is for all locations

Fresh water system development costs in the Lower Animas Valley are the least expensive of the three sites, primarily because the fresh water aquifer is located nearby to the geothermal field thereby reducing pipeline costs (see Table 1B). Fresh water costs are higher in Las Cruces due to the greater distance to a fresh water aquifer. Development costs for the Truth or Consequences site include only pipeline costs (i.e., no wells or pumps) because fresh water around the known geothermal development site is supplied by the city.

**Table 1B. Comparative Fresh Water System Levelized Costs**  
(\$/1,000 gal)

Location	1 Acre	4 Acres	10 Acres	15 Acres
Animas	\$ 21.96	\$ 5.49	\$ 2.44	\$ 1.74
Las Cruces	19.53	4.65	2.20	1.57
Truth or Consequences	3.39	1.76	1.46	N/A

Fresh water development capital and operating costs rival similar geothermal development costs. Indeed, in Las Cruces the fresh water is more costly to develop than the geothermal reservoir. This is largely because the pipeline costs are substantial in Las Cruces due to the distance of the geothermal field from the nearest fresh water aquifer.

Some obvious tradeoffs are immediately apparent when considering fresh water development. It may be useful to locate the project halfway between the geothermal and freshwater aquifers. To some extent such an approach has been undertaken in this analysis, but careful site selection studies can help to refine the spacing. One alternative to consider is the use of some form of water purification for the "spent" geothermal fluids. While most purification systems are considerably more expensive than conventional water supply systems, if the value of the energy source is sufficiently high then the cost of the purification process may be competitive.

In summary, geothermal energy may be developed at competitive costs in several areas in southern New Mexico. Particularly at higher thermal useage levels, geothermal energy offers economic advantages for users relative to current natural gas rates. However, geothermal development should not be considered in isolation. Energy supply and cost is only one factor in a firm's overall business planning and other utility services may have equal importance with energy supply. This analysis has shown that water supply development may incur substantial expense in areas co-located with geothermal resources. The costs associated with water development should be carefully evaluated concurrent with energy supply options.

## 1.0 INTRODUCTION

### 1.1 Approach

This report presents an overview of geothermal resource development for three low-temperature (i.e., <200°F) sites in southern New Mexico: the Lower Animas Valley, the Las Cruces East Mesa, and Truth or Consequences. The intent of this effort is to provide potential geothermal developers with comprehensive information on each site for planning purposes. Included in the overview for each site is a full site characterization (e.g., site location, geothermal resource description, demographic profile, climatic data, and business-related information) and an economic analysis of development costs associated with construction and operation of both geothermal and fresh water systems. The economic analysis focuses on providing utility services to a commercial greenhouse because greenhouse operations are among the most likely candidates for use of the resource base.

The three candidate locations were chosen for a variety of reasons. Each is considered to have advantages unique to the location. The foremost reason for selection was that each site has experienced some form of prior geothermal resource development. In general, for each site, the geothermal resources are reasonably accessible, roads and other infrastructure elements are in place to varying degrees, and fresh water is also available. While these conditions vary among the three locations, these essential elements necessary for site development are available.

There are specific reasons for the site selection for the three locations. For the Las Cruces East Mesa site, selection included the consideration that Las Cruces is among the fastest growing areas in the Southwest. Furthermore, Las Cruces has a large low-temperature aquifer adjacent to the city limits. It is useful to analyze the economic potential for the utilization of its considerable geothermal resource base. Animas, on the other hand, is a remote location, but it has the nation's largest geothermally-heated greenhouse development. Truth or Consequences offers a different geographical setting for a potential developer. It is reasonable to compare development costs among the various areas to provide potential developers a basis for comparison because of the different amenities of each area.

## 1.2 Geothermal Resources of New Mexico

New Mexico has a wide variety of geothermal resources (Table 1). This variety is largely the result of New Mexico's physiographic diversity (Figure 1). Each province, like each type of geothermal resource, tends to have unique geologic settings and thermal regimes. From a techno-economic perspective these provinces also show unique climatic ranges and demographics. When coupled with geography, it is readily apparent that each resource type ultimately has different economics and utility. Therefore, it is useful to describe New Mexico's resource base in terms of economic and technological feasibility and geologic certainty of occurrence (Figure 2). Identified and economic geothermal resources are called reserves. Geothermal reserves with measured temperatures, production rates, and extent are termed proven reserves. Figure 3 is a McKelvey diagram showing the current status of the different types of New Mexico geothermal resources. At the present time, only the hydrothermal convective type geothermal resources fall into the geothermal reserves category. The hydrothermal convective resources occur mainly in the Southern Basin and Range Province and they are currently utilized at several locations. Geothermal resource development in the near future will probably concentrate on this type of resource. For this reason, three representative, but different hydrothermal convective resources are investigated by this report.

Table 1. Geothermal Resource Classification Based Upon Thermal Regimes

I. CONDUCTIVE RESOURCES

- A. Hot Dry Rock Resources  
"Dry"-no natural reservoir fluid
- B. Geopressured Resources  
Characterized by deep-seated methane-bearing  
high pressure brines
- C. Conductive Hydrothermal Resources  
Deep confined aquifers

II. CONVECTIVE RESOURCES

- A. Magma Systems  
Magma transport of heat
- B. "Free" Convective Hydrothermal Systems  
Temperature induced buoyancy allows flow
- C. "Forced" Convective Hydrothermal Systems  
Water table induced hydraulic potential forces  
flow

NOTE: Convective resources may involve a combination of all subcategories. However, one type will tend to dominate, depending upon position within a complex convective system.

Figure 1. Map of New Mexico Showing  
Physiographic Provinces  
(Source: Witcher, 1987)

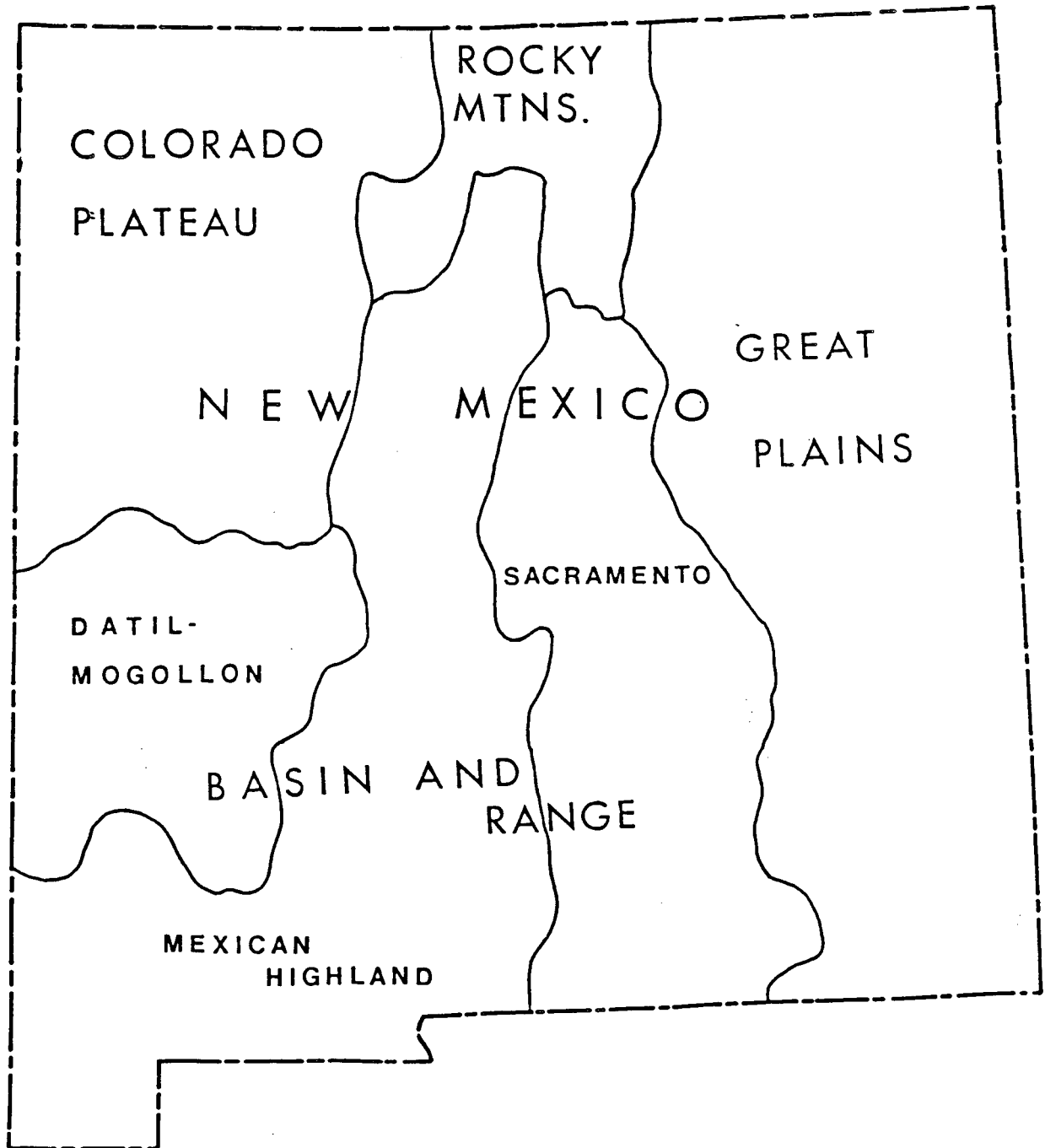
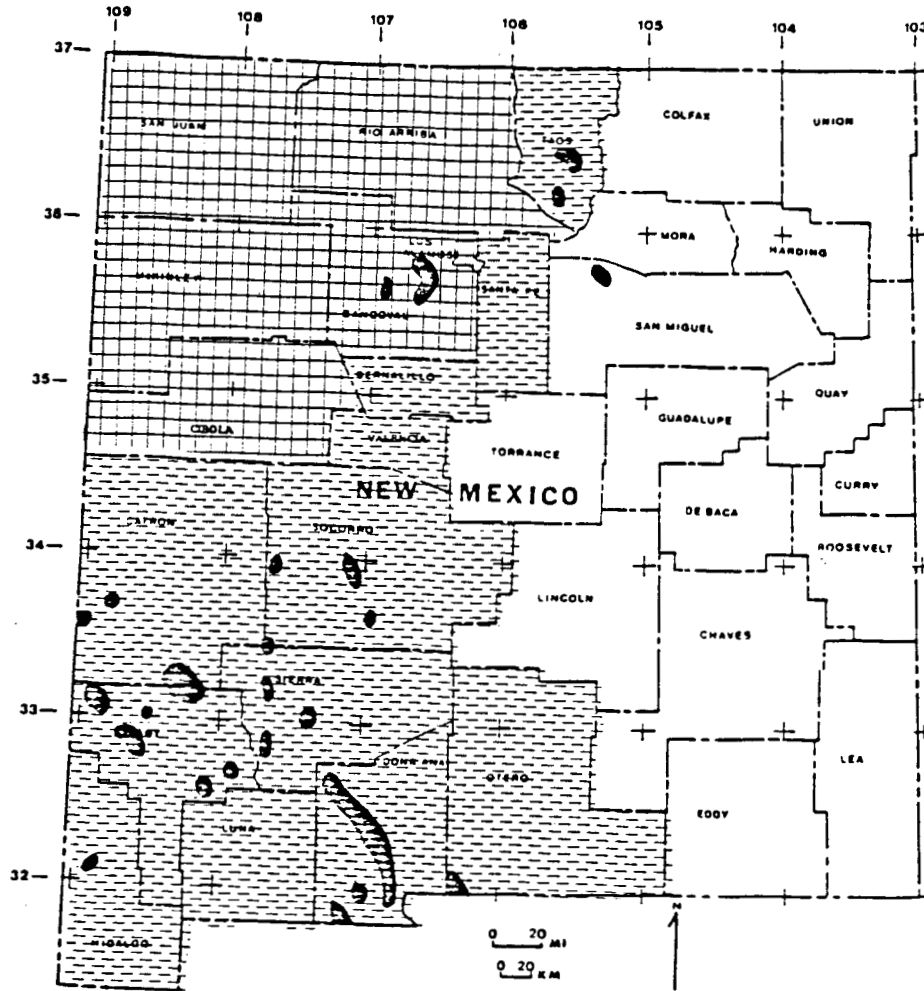


Figure 2. New Mexico Geothermal Resource Base  
 (Source: adapted from McKelvey, 1973)



AREAS WITH KNOWN CONVECTIVE HYDROTHERMAL SYSTEMS

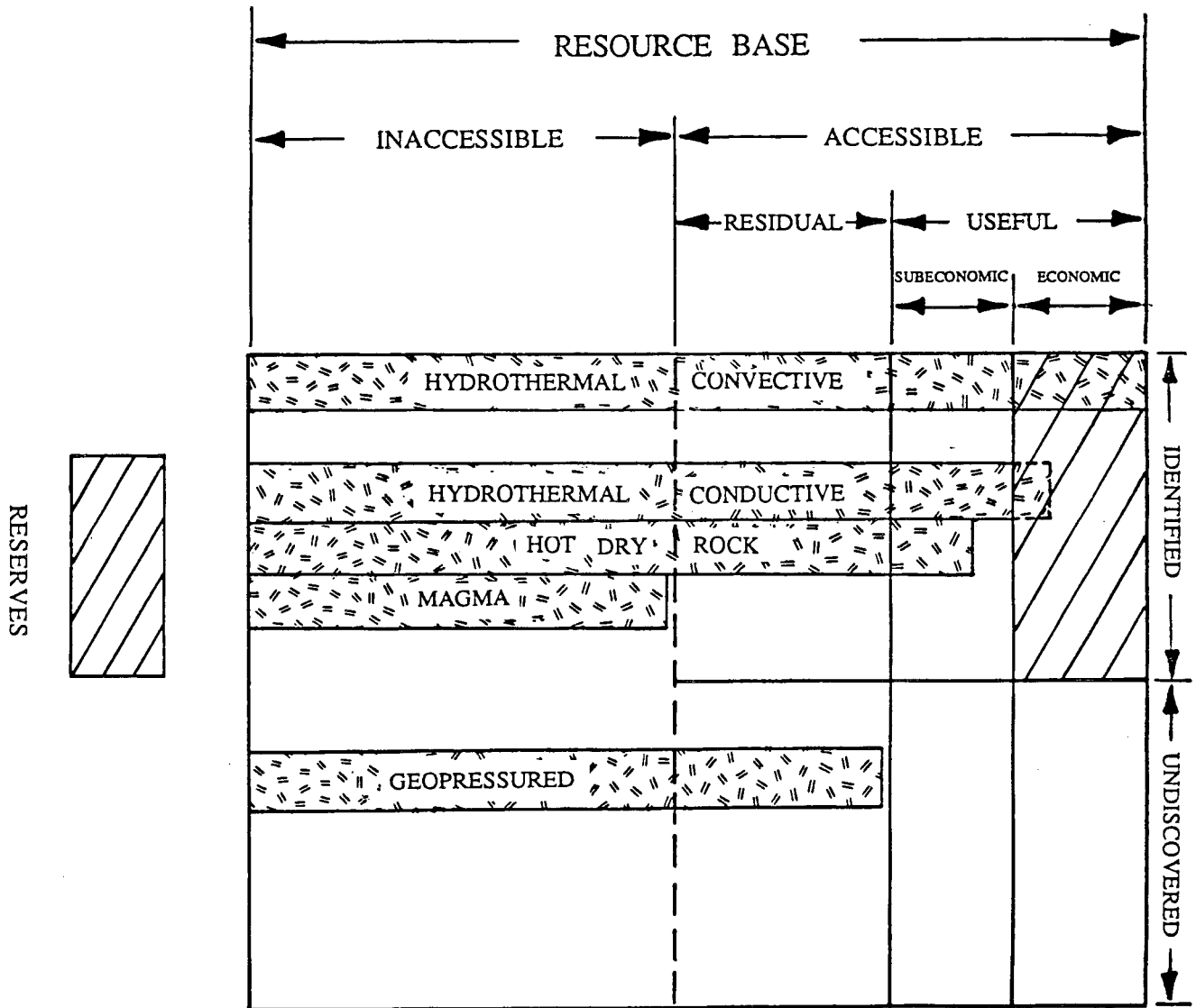


COUNTIES IN BASIN AND RANGE PROVINCE WITH INFERRED CONDUCTIVE TYPE GEOTHERMAL RESOURCES ( DEPTH > 2,000 FEET ).



COUNTIES ON COLORADO PLATEAU WITH CONDUCTIVE TYPE GEOTHERMAL RESOURCES ( DEPTH > 2,000 FEET ).

Figure 3. Current Status of New Mexico Geothermal Resources  
 (Source: adapted from McKelvey, 1973)



## **2.0 LOWER ANIMAS VALLEY SITE DESCRIPTION**

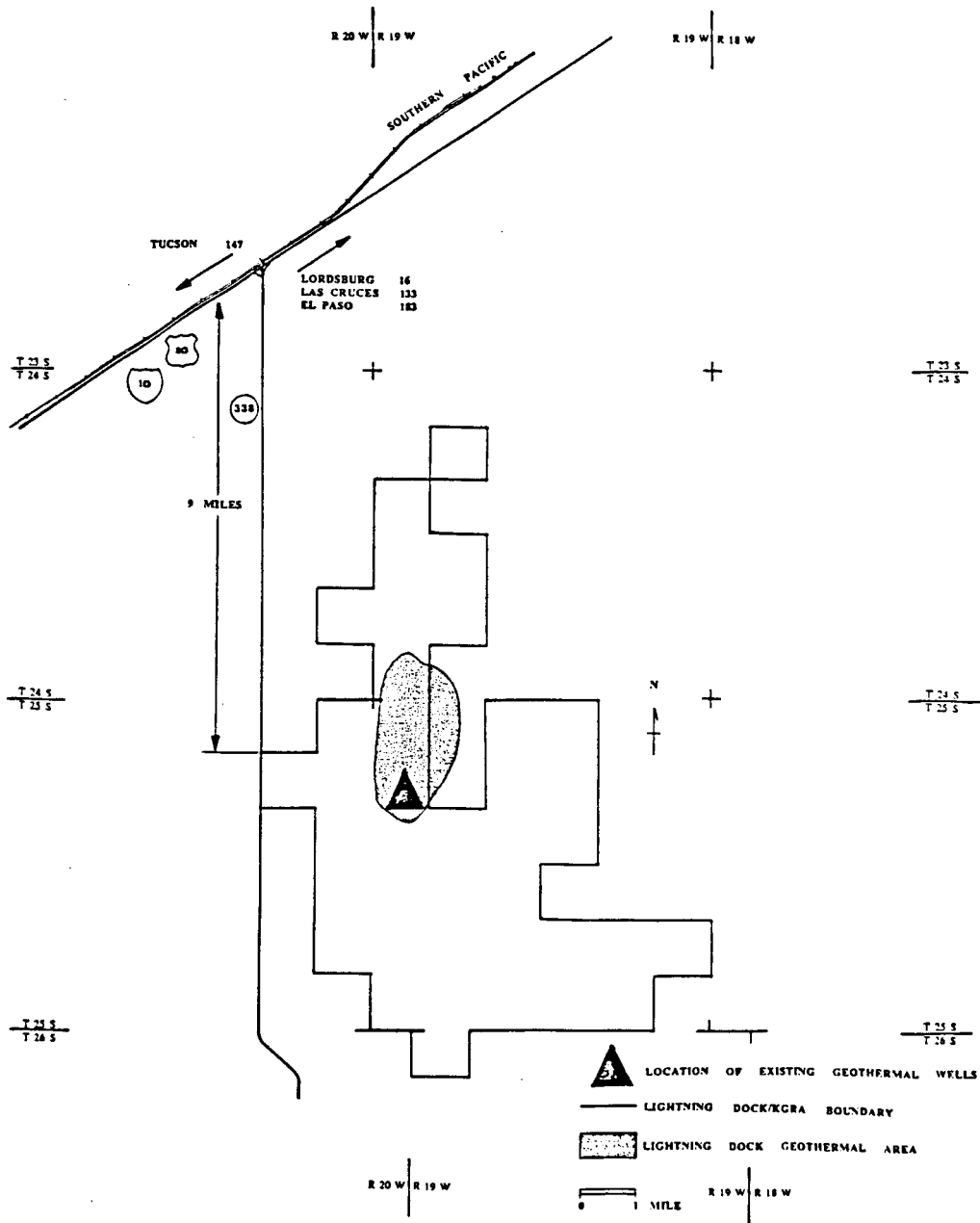
### **2.1 Site Location**

The Lower Animas Valley is a closed basin with internal drainage in Hidalgo County in southwestern New Mexico (Figure 4). The valley lies southwest of Lordsburg, the county seat, and extends from south of the town of Animas northward about 40 miles to the vicinity of Summit, northwest of Lordsburg. The Lower Animas Valley is bordered by the Peloncillo Mountains to the west and the Pyramid Mountains to the east. Several peaks in these ranges reach altitudes of more than 5,700 feet above mean sea level. The elevation at Cotton City, the nearest town to the geothermal site, is about 4,300 feet above mean sea level.

The valley has historically been an important agricultural area, its major crops being cotton and sorghum, and animal grazing has also been a key activity. However, the amount of agricultural activity has declined in recent years, and the current principal economic activity in the county is a large copper smelter located near Playas, approximately 25 miles southeast of the town of Animas.

In most of the Lower Animas Valley, ground water is the only dependable source of water supply, since there are no perennial streams or large springs in the valley. The ground water is found primarily in alluvial deposits of sand and gravel interbedded with lenses of clay and silt. The State Engineer defined an area of over 200 square miles in the Animas Valley as the Animas Valley Underground Water Basin and closed it to further appropriation of groundwater as of February 23, 1956 (Reeder, 1958). However, water rights may be purchased from current water rights owners.

Figure 4. Location Map, Lower Animas Valley



## 2.2 Geothermal Resources

The lower Animas Valley contains one proven low-to-intermediate temperature geothermal resource. This resource, the Lightning Dock geothermal field, is located fifteen miles north of Animas, fourteen miles south of U.S. Interstate I-10, and one mile east of New Mexico Highway 338. The federal land surrounding the Lightning Dock geothermal field has been designated the Lightning Dock Known Geothermal Resource Area (KGRA), primarily on the basis of overlapping geothermal lease applications. The identified resource extends beneath a 1 mile by 2.5 mile north-south elliptical area of high heat flow (See Figure 4). Wells less than 500 feet deep produce 95 to 250°F water from fractured rhyolite. Total dissolved solids (TDS) of the Lightning Dock geothermal waters are between 1,100 and 1,200 parts per million (ppm). Shallow, economically accessible resources (i.e., less than 1,000 feet) most likely have maximum temperatures that do not exceed 250°F. Flow rates of about 250 gallons per minute are common in existing wells.

## 2.3 Potential for Geothermal Development

The Animas Valley is one of several New Mexico locations where utilization of geothermal reserves has proven successful. There are currently over 16 acres of commercial greenhouses in production in the Valley using geothermal energy for space heating. In addition, geothermal energy has been used for the production of electricity using binary-cycle technology. This latter application has experienced technical difficulties and is not presently being used.

Additional shallow geothermal hot water, with temperatures between 180 and 250°F, will most likely be found within the existing well field. Because both the volume and the temperature of the shallow geothermal reservoir are relatively low, the most likely uses for hot water and steam would be for space heating, crop drying, food processing, and perhaps aquaculture applications.

The potential for geothermal development is greatly affected by the presence or absence of other resources in addition to the geothermal base. Because of its scarcity, water supply is critical to the success of any venture in the Animas Valley. Ample supplies of fresh water are located within one to five miles of the geothermal well field by pipeline.

## 2.4 Land Ownership

Approximately 33,000 acres of public lands in the Lightning Dock KGRA area were leased for geothermal exploration and development. Another 4,760 acres of public land were leased for geothermal exploration and development in the Animas Valley outside of the KGRA. At present most of the lease acreage has been dropped with only 2,500 acres of Federal geothermal leases remaining current.

## 2.5 Climatic Factors

The Animas Valley's climate is dry and characterized by light and variable total precipitation, with an average of ten and one-half inches annual precipitation. Relative humidity levels are low throughout the year, often below 15% for extended periods of time. Average annual sunshine in the Valley is almost 30% higher than the national average, with over 320 sunny days per year.

The average winter temperature lows are: December, 27°F; January, 26°F; and February, 28°F. The average summer temperature highs are: June, 95°F; July, 95°F; and August, 92°F. The Animas Valley has an average annual temperature of 60°F.

The mean annual wind speed is 7.2 mph, with the windiest season occurring during the months of March and April (New Mexico Climate Manual, 1985).

## 2.6 Transportation and Utilities

U.S. Interstate Highway I-10 (east-west) bypasses Lordsburg (located approximately 15 miles north of Animas), and provides access to Las Cruces, 120 miles to the east; El Paso, 165 miles southeast; Tucson, 160 miles west; Los Angeles, 600 miles west; and to other locations. Two state highways serve the town of Animas.

Major scheduled airline service and air freight service are available at the El Paso and Tucson International Airports. In addition, U.S. Customs service is provided at both airports.

A rail freight terminal for the Southern Pacific line is located in Lordsburg. The majority of its line is used to bridge traffic to California and the East.

Electrical service to Animas is provided by Columbus Electric of Deming, New Mexico. Electricity rates in the Animas Valley are comparable with those of other southern New Mexico communities. Natural gas is not readily available in most of the remote locations associated with the geothermal field.

## 2.7 Population

Hidalgo County is sparsely populated with approximately 6,200 residents. Almost 80% of the population reside in the northern part of the county (Bureau of Census, 1980). The population is primarily engaged in agricultural labor.

### **3.0 LAS CRUCES SITE DESCRIPTION**

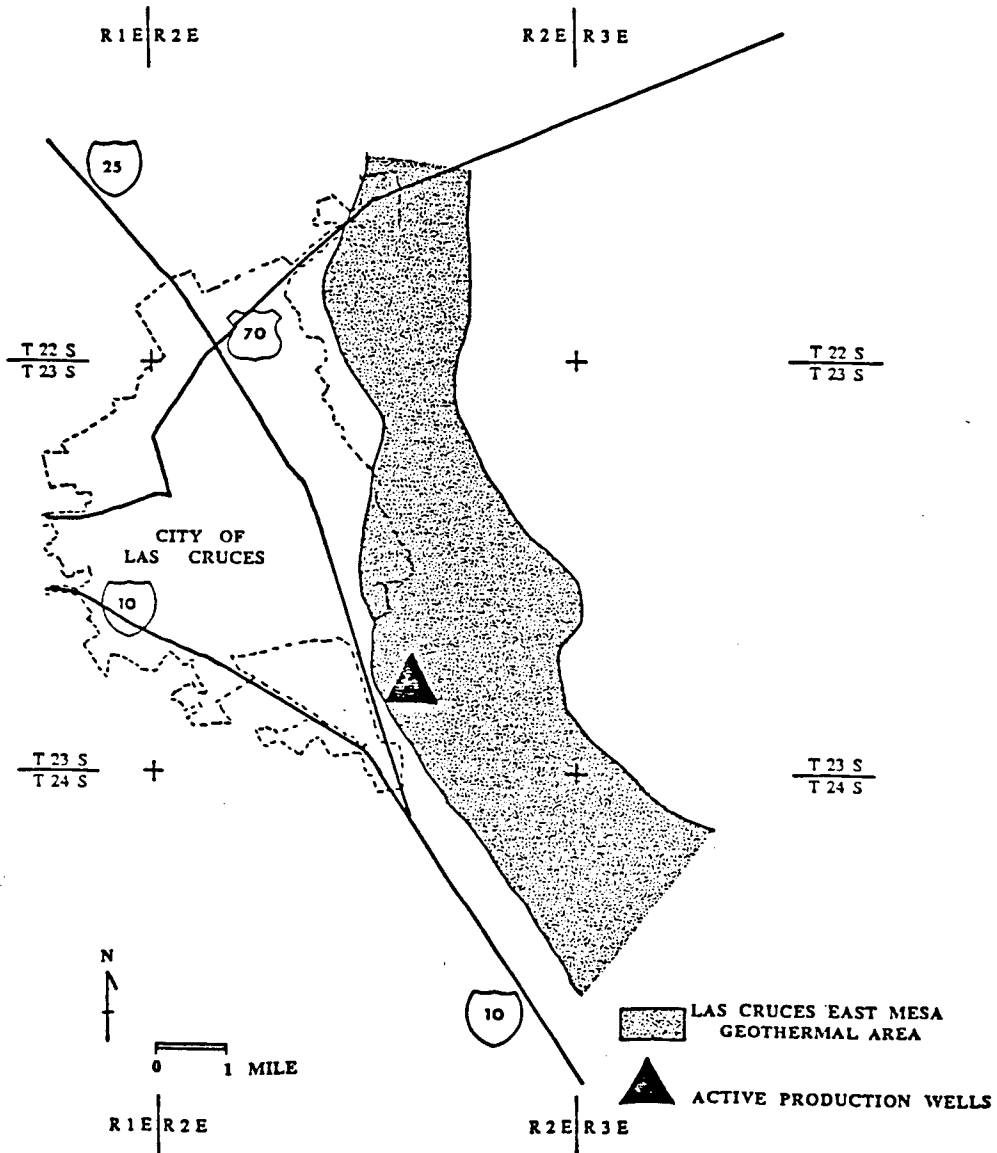
#### **3.1 Site Location**

The city of Las Cruces, the county seat of Doña Ana County, is in the Rio Grande Valley of south-central New Mexico, about 25 miles north of the Texas border (Figure 5). Las Cruces is located about 200 miles south of Albuquerque and 50 miles north of El Paso, Texas. At Las Cruces, the Chihuahuan Desert is transversed by the flood plain of the Rio Grande, forming a green, fertile valley about ten miles wide. The Organ Mountains serve as a dramatic visual backdrop to the east. Las Cruces sits at an elevation of about 4,000 feet above mean sea level.

Las Cruces is the center of the Mesilla Valley, which is a thriving agricultural area where cotton, chile peppers, pecans, and onions are some of the major crops grown. Major employers in the region include the White Sands Missile Range, the National Aeronautics and Space Administration, New Mexico State University (NMSU), and several local branches of national brand manufacturers. An emerging industry is commercial greenhouse operations serving national markets.

Water supplies in the Las Cruces area are from the Rio Grande and an extensive shallow ground water aquifer. A series of canals and laterals, operated by the Elephant Butte Irrigation District, serve the majority of the farmers in the area, providing water for irrigation. Potable water supplies are obtained from drilling wells into the underlying aquifer, referred to by the State Engineer as the Lower Rio Grande Basin. While the Lower Rio Grande Basin was closed to further appropriation of ground water in 1980, water rights may be purchased from current water rights owners.

Figure 5. Location Map, Las Cruces East Mesa



### 3.2 Geothermal Resources

Hot water was first discovered on the Las Cruces East Mesa in 1948 during exploratory drilling for oil and gas. Subsequent water wells, drilled for residential use, also encountered warm water at relatively shallow depths at Las Alturas, also on the East Mesa. However, no attempt was made to pursue exploration of geothermal resources until the mid-1970's, when NMSU researchers began testing to determine the extent of the geothermal anomaly and its temperatures.

The Las Cruces geothermal field is located to the east of the city of Las Cruces and may extend for nearly thirty miles in a generally north-south direction with a width of three to five miles. The majority of the field is located beneath undeveloped public lands adjacent to the city and its environs.

The Las Cruces geothermal field overlies a low-temperature geothermal reservoir contained in fractured volcanic rocks and limestone. Extensive exploration and development efforts by private and public groups have identified large volumes of geothermal fluids with a maximum temperature of about 160°F. The depth of the wells varies by location, but they are generally in the vicinity of 1,000 to 2,000 feet. Total dissolved solids of the Las Cruces geothermal field geothermal waters is between 1,900 and 2,100 ppm. Flow rates in wells may exceed 1,000 gallons per minute.

### 3.3 Potential for Geothermal Development

New Mexico State University has developed production wells that serve a portion of the campus' thermal load for water and space heating. Three production wells, connected to campus by a one and one-half mile insulated pipeline, serve thirty-three buildings and two swimming pools. The majority of the thermal load is for providing hot water for domestic use (i.e., bathing). NMSU also provides geothermal fluids for the space heating of 12,000 square feet of greenhouse that is used as a new business incubator facility. The spent geothermal fluids are disposed of into an injection well also located on the geothermal field.

Considerable interest has been shown by private firms for developing the geothermal reserves, primarily because of the close proximity of the resource to the metropolitan area. Initial production wells have been drilled,

and geothermal-based industrial parks have been planned. One greenhouse operation is currently in business utilizing the resource.

### 3.4 Land Ownership

Approximately 27,000 acres of public lands on the Las Cruces East Mesa were leased for geothermal exploration and development. At present, some of the lease acreage has been dropped. Current Federal geothermal leases total about 17,700 acres, and State leases are about 2,000 acres.

### 3.5 Climatic Factors

Las Cruces has an arid climate with an average of eight and one-half inches annual precipitation. Humidity is low throughout the year. The intense sunlight is about 27% higher than the national average, with 315 sunny days per year.

There are large diurnal and annual temperature ranges. The average winter temperature lows are: December, 26°F; January, 25°F; and February, 29°F. The average summer temperature highs are: June, 94°F; July, 94°F; and August, 92°F. Las Cruces' mean annual temperature is 60°F.

Wind velocities are highly variable, with an annual average of about 5 mph in the valley, and up to 8 mph on the mesas. However strong gusty winds may occur during the months of March through May (New Mexico Climate Manual, 1985).

### 3.6 Transportation and Utilities

Las Cruces is serviced by intersecting U.S. Interstate Highways I-10 (east-west) and I-25 (north-south). The city is also served by five U.S. and seven State highways.

Commuter air service and general aviation service are available at the Las Cruces International Airport. Major scheduled airline service is available at the El Paso International Airport, one hour's drive from Las Cruces. In addition, air freight service is available at the Santa Teresa International Airport, located in Doña Ana County northwest of El Paso and south of Las Cruces. U.S. Customs service is provided at all three airports.

Daily rail service, with piggyback and container service, is provided by the Atchinson, Topeka, and Santa Fe Railway and the Southern Pacific

Transportation Company. The Santa Fe Railway has both north-south and east-west lines, while the Southern Pacific is limited to east-west service.

The El Paso Electric Company is the principal supplier of electric power for the Las Cruces area. The cost of electricity is competitive with many southwestern cities. Natural gas is supplied by the city of Las Cruces and is presently priced at competitive rates. Current natural gas rates are approximately \$4.10/MMBtu and fluctuate within a ten percent range in either direction.

### 3.7 Population

With an urban population of approximately 65,000, Las Cruces is the largest city in southern New Mexico and the second largest city in the state. Doña Ana County is the fastest growing county in New Mexico. While the median age of the population is 29.2 years, Las Cruces is also a popular retirement community (Bureau of Census, 1980).

## 4.0 TRUTH OR CONSEQUENCES SITE DESCRIPTION

### 4.1 Site Location

The city of Truth or Consequences, Sierra County, is located along the Rio Grande in the south-central portion of New Mexico. Truth or Consequences is bordered on the east by the Caballo Mountains, and approximately 30 miles to the west by the Black Range, with peaks rising above 10,000 feet. The elevation at Truth or Consequences is 4,820 feet above mean sea level. Four miles east of Truth or Consequences is the Elephant Butte Dam that stores the spring runoff water of the Rio Grande, forming a large lake. A smaller reservoir is also formed at the Caballo Dam, twenty miles south of Truth or Consequences.

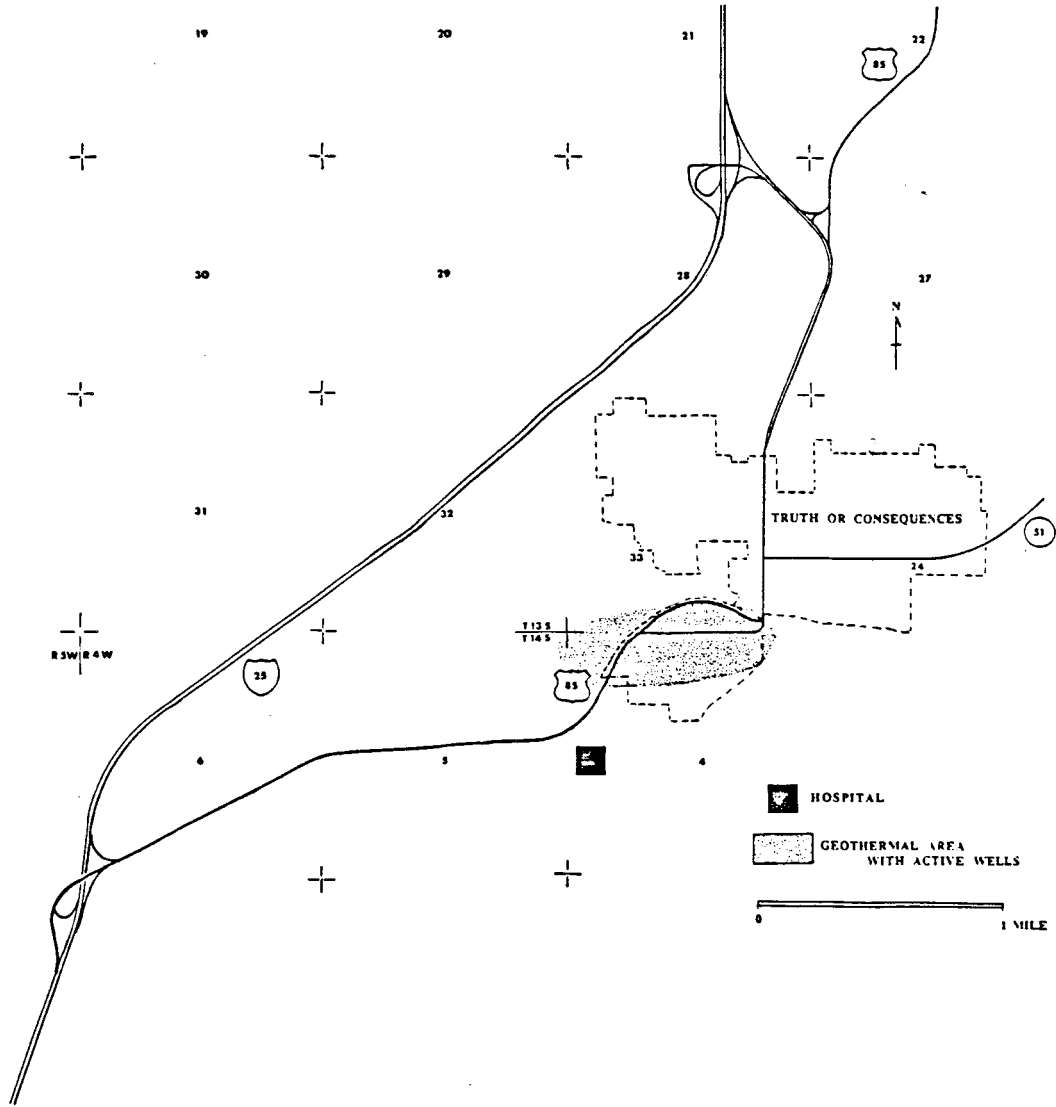
Truth or Consequences, formerly known as Hot Springs, has long been noted for its hot mineral springs and baths. In 1950 the city voted to adopt the name of the then popular radio show "Truth or Consequences." The hot springs, and Elephant Butte and Caballo Reservoirs, draw large numbers of tourists to the area. Agricultural activities in the area, both farming and ranching, also contribute to the local economy.

Truth or Consequences water supplies are obtained from the Hot Springs Water Basin. The State Engineer has not closed the basin to further water appropriation. Fresh water around the known geothermal development sites is supplied by the city of Truth or Consequences.

### 4.2 Geothermal Resources

The geothermal resource in the Truth or Consequences area is defined by a low-temperature, shallow geothermal reservoir. Temperatures range from 98 to 116°F. Most of the existing geothermal wells are less than 50 feet deep with some wells approaching 250 feet. Total dissolved solids for the area range from 2,300 to 2,500 ppm. Geothermal fluids are found in an area of roughly fifteen square miles as shown in Figure 5. Flow rates of ten to several hundred gallons per minute are producible in various wells.

Figure 6. Location Map, Truth or Consequences



#### 4.3 Potential for Geothermal Development

The potential for development of the geothermal reserves in Truth or Consequences is confined mainly to the area adjacent to downtown. A large tract of land, about 200 acres, contains known geothermal reserves and is readily available for development. No water supplies are known to exist within the immediate vicinity. Thus, any developer will have to purchase water from the city of Truth or Consequences.

Applications that appear to be appropriate for the resource base include space and water heating, aquaculture, spas, and pool heating. Each of these applications has potential for development in the area depending upon the prevailing economic conditions and business climate.

#### 4.4 Land Ownership

All of the known geothermal resource area is under private ownership. There are no Federal or State geothermal leases that are applicable to the area.

#### 4.5 Climatic Factors

The climate of Truth or Consequences is arid and mild. It receives an average of almost nine inches of precipitation annually, with just over half of that precipitation falling during the months of July through September in the form of brief afternoon and evening thundershowers. Relative humidity averages about 20% for the year. Sunshine can be expected almost 80% of the possible hours.

The average winter temperature lows are: December, 28°F; January, 27°F; and, February, 31°F. The average summer temperature highs are: June, 92°F; July, 93°F; and August, 90°F. Truth or Consequences' mean annual temperature is 60°F. The valley location, coupled with the typical high radiative cooling of the desert area, results in a large diurnal temperature range.

The annual average wind speed is approximately 10 mph. The highest winds occur during March through May (New Mexico Climate Manual, 1985).

#### 4.6 Transportation and Utilities

Truth or Consequences is located between Albuquerque and Las Cruces. Truth or Consequences' central location is ideal for access to major highways.

U.S. Interstate Highway 25 (north-south) bypasses the city, as do two State highways.

A municipal airport is located seven miles from Truth or Consequences. The nearest airport with major scheduled airline and air freight service is 120 miles south at the El Paso International Airport. Air service is also available at the Albuquerque International Airport. Both airports provide U.S. Customs service.

The nearest loading points for rail service can be obtained in both Las Cruces or Socorro through the Southern Pacific Transportation Company.

Electric power is supplied to the area by the Truth or Consequences Utility Department. Electricity rates in Truth or Consequences are considerably lower than those of other southern New Mexico communities. Natural gas is readily available from the local municipal utility.

#### 4.7 Population

Truth or Consequences has become a retirement community for almost 65% of the roughly 6,000 people who live there. The median age for the population is about 54 years (U.S. Census, 1980).

## 5.0 PROJECT COST ASSUMPTIONS AND METHODOLOGY

Development of each of the three candidate sites will require installation of infrastructure to support commercial activity. For this analysis, only the geothermal and fresh water systems have been included within the infrastructure development costs. Although there are other elements of the development infrastructure that may also be necessary (e.g., paved roads or a sanitation system), the capital and operating costs for the geothermal and fresh water systems will be far more significant. The cost estimates for this analysis were determined from a variety of sources, including prior experience in the respective areas, discussions with local developers, and projections from standard reference texts.

Capital cost projections most likely reflect highly conservative estimates. The high capital cost, or conservative estimates, were included in order to err on the side of caution so as not to unduly inflate expectations for a particular area. It is probable that a resourceful developer can reduce the estimated costs at each site.

Operating costs estimates have also been developed based on past experience in the three locations and with the use of computer-assisted simulation tools. The operating cost estimates are thought to be reasonably accurate with a slight bias towards overestimation of some of the requirements. Because capital costs tend to dominate the financial analysis, the slight inflation of operating costs does not greatly affect the economic evaluation of the projects.

Because natural gas is the most cost-competitive alternative for providing heat to greenhouses in southern New Mexico, the costs of supplying equal thermal loads with a natural gas-fired boiler are included for comparative purposes.

A levelized life-cycle cost approach, which is useful for comparing alternatives, is used to compare costs for geothermal energy, fresh water, and natural gas. The levelized cost approach provides a methodology for calculating the present value of a stream of cash flows over the project life. Levelized annual costs, presented in terms of \$/MMBtu for the geothermal system or \$/1,000 gallons of water for the fresh water system, represent the equivalent of an equal annual payment series or an ordinary annuity. A complete description of the levelized cost methodology is given in the Model Description in Appendix A.

The baseline annual costs for the geothermal and fresh water systems are computed absent inflationary or deflationary price trends. A conservative, 0.5%, annual inflation rate is used for the natural gas levelized cost calculation. The constant cost assumption greatly influences the discount rate used for both the amortization payment and the levelized cost calculation. The discount rate for the baseline analysis, also referred to as the interest rate, is 7.5%. The low discount rate reflects the subtraction of the rate of inflation or, in other words, is a real discount rate. For example, if inflation averages 5% per year and the discount rate is 12.5%, then the real discount rate is 7.5%.

A thermal load was used to establish the basic capital and operating characteristics of the geothermal supply system. The thermal load was based upon the energy requirements of a commercial greenhouse. There were several alternatives for establishing the thermal load requirements (e.g., a crop dehydrator, aquaculture, or enhanced mineral recovery from tailings piles), but the greenhouse requirements are considered to be most representative of potential business operations that would utilize geothermal resources in the southern New Mexico region. Furthermore, basic operating characteristics of greenhouses have been extensively modeled by the Southwest Technology Development Institute (SWTDI) and thus considerable in-house data was available. Four different thermal loads were established: one, four, ten, and fifteen acres of greenhouse space. The four load levels are used to illustrate scale effects associated with the geothermal development.

Some additional assumptions are useful to note at this point. For example, it was necessary to estimate well depths, pumping depths, pipeline lengths, and the presence or absence of certain operating equipment. All of the projects are expected to have a twenty-year life span. The twenty-year assumption means that all of the wells are useful for twenty years and that no new wells are drilled. However, regular maintenance is performed, and the pumps in the wells are replaced after specified time periods.

In all, over one hundred assumptions were made concerning capital and operating costs. A detailed listing of the assumptions, complete with references and explanations, is given in Appendix A, Tables A-1 through A-3. The assumptions, combined with the outlined methodological approach, should allow an independent reader to duplicate the cost calculations.

## 5.1 Capital Costs - Geothermal Systems

Geothermal capital costs include the costs associated with exploration, production well and injection well drilling, well testing, and pipeline installation. Exploration costs vary according to the current state of knowledge at a particular area. Drilling and pipeline costs vary by location due to different geophysical conditions.

The geothermal wells are sized to provide sufficient flow for meeting the thermal loads of varying sizes of commercial greenhouses at each location. In some cases, particularly for larger thermal loads, more than one well is required. The constraint that was assumed for determining the number of wells was the assumed maximum flow rate for an individual well. This figure varies by location and is based upon known flow rates in each area. It is assumed that each well is capable of equivalent production. Injection wells are also included. It is also assumed that the well field and pipelines are sized to meet with adverse conditions. In case of pump failure, a replacement pump is kept on-site for immediate service. The replacement pump is assumed to be purchased at the same time as the operational pump and is available at all times. No backup wells or boilers are included to help mitigate unfortunate circumstances.

Both the one and four acre greenhouses are assumed to have the same pipeline requirements. The pipelines are sized to accommodate flow rates 15% higher than those required to supply the design load. The increased pipeline size is useful to allow for future expansion of the system to supply increased thermal loads. A complete description of all project capital cost assumptions is shown in Tables A-4 through A-6.

An additional issue requiring consideration is that of the salvage value of geothermal resources. Because many geothermal resources are long-lived, it is recognized that at the end of 20 years the value of the geothermal resources will most likely be greater than the estimated 10% salvage value assumed in this evaluation. It is probable that the geothermal resource values will be equal to, or greater than, their current values. However, because of the difficulty in estimating realistic future values of geothermal resources, this analysis does not consider such values.

A similar situation exists with water rights. Water rights are a valuable commodity in New Mexico and it is reasonable to expect that they can only appreciate in value. Again, it is difficult to project a realistic future value for

water rights. Therefore, for this report's purposes, it is assumed that water rights will have a 100% salvage value.

### 5.2 Operating Costs - Geothermal Systems

Operating costs for the geothermal system were estimated for several categories: electricity required for pumping; regular well maintenance and pump repair; and annual royalty and insurance payments. Annual repair costs include such items as routine pump maintenance, well acidification on an as-needed basis, and repairs for leaks or damaged pipeline equipment. Annual repair costs do not include a replacement of the production pumps. Repair and maintenance and insurance costs are allocated to geothermal system operating costs based on the proportion of capital costs represented by the system. For example, for a ten acre greenhouse in Animas, geothermal capital costs represent 34% of total capital costs. Therefore, 34% of the repair and maintenance and insurance costs were charged to the geothermal system and the remainder was attributed to the fresh water system. Annual levelized operating costs were calculated for each site at all four thermal load levels (see Appendix C, Tables C-1 through C-11).

### 5.3 Capital Costs - Fresh Water Systems

Project developments at Animas and Las Cruces will require the installation of a fresh water supply system. In Truth or Consequences there are no capital costs for a fresh water system except for the costs of installing a pipeline from the city water distribution system to the project site. For both Animas and Las Cruces, co-location with the geothermal aquifer and transport of fresh water from the nearest potable aquifer is assumed.

The pipelines and storage tanks are sized to meet the water requirements of a commercial greenhouse using evaporative cooling and its irrigation needs. Both the one and four acre greenhouses are assumed to have the same pumping and pipeline requirements. This assumption was made so that the one acre grower could expand to four acres without the undue penalty of revamping the entire water supply system. It is estimated that a commercial greenhouse in southern New Mexico requires approximately 10 acre feet of water per acre of greenhouse per year for irrigation and evaporative cooling purposes (SWTDL, 1990).

It is assumed that a fresh water storage tank is necessary and is sized to meet a full day's water demand in the summer for a four acre greenhouse. Thus, a one acre and fifteen acre greenhouse are assumed to have the same sized water tank.

Another important cost for the fresh water systems is the cost of purchasing water rights. Water rights are estimated to cost \$1,500 per acre-foot in Animas and \$3,000 per acre-foot in Las Cruces and are assumed to be appropriated and transferable to the project. Therefore, for a four acre greenhouse, the estimated water rights cost would be \$60,000 in Animas and \$120,000 in Las Cruces. It was also assumed that the developer would purchase more water rights than are currently required for the initial development. The rationale for this assumption was that water rights are not only cheaper at present than they may be in the future, allowing for inflation and the enhancement of water's economic value, but water rights are also available as a commodity. It may be possible in the future that there would be no available water rights, and thus the developer would not be able to augment the initial purchased allotment.

It is possible to completely eliminate the water rights purchase cost if the developer purchases land with sufficient water rights that have already been appropriated. In such a scenario the developer would have access to all the water required for the project assuming that sufficient land was purchased. However, a simple purchase of land for \$10,000 per acre with three and one-half acre-feet of appropriated water rights per acre is the same as buying water rights for \$2,800 per acre-foot. In this scenario the purchaser would have possession of land, but the land may not have geothermal reserves.

#### 5.4 Operating Costs - Fresh Water Systems

Operating costs estimates for the fresh water system include electricity required for pumping, regular maintenance and pump repair, and insurance costs. Repair and maintenance and insurance costs are allocated to fresh water system operating costs based on the proportion of capital costs represented by the system. For example, for a ten acre in Animas, fresh water capital costs represent 66% of total capital costs. Therefore, 66% of the repair and maintenance and insurance costs were charged to the fresh water system and the remainder was attributed to the geothermal system. Annual

levelized operating costs were calculated for each site at all four thermal load levels (see Appendix C, Tables C-12 through C-22).

### 5.5 Capital and Operating Costs - Natural Gas System

For comparative purposes, costs for a natural gas-fired system designed to supply the equivalent heating load as the geothermal systems were also evaluated. Capital costs for the gas-fired boilers were obtained from Means 1989 Mechanical Costs Data. Boilers were sized to meet the same design conditions as for the geothermal system. All boilers are assumed to be capable of using two fuels, natural gas and oil. Table 2 summarizes the capital costs for the natural gas systems at the different thermal loads.

Table 2. Natural Gas System Capital Costs

Greenhouse Size (Acres)	Thermal Load (MMBTUH)	Boiler Size (MMBTUH)	Number of Boilers	Cost (\$)
1	2.6	2.8	1	19,900
4	10.4	5.5	2	86,400
10	26.2	6.9	4	236,000
15	39.0	13.5	3	630,000

Natural gas levelized costs are calculated in a manner similar to the cost calculation for the geothermal system. Current natural gas rates were obtained for the utility service territories.

## 6.0 DISCUSSION

### 6.1 Comparative Analysis - Geothermal Systems

Total project capital costs for the geothermal systems vary considerably by area. The least expensive site to develop is Animas. Development costs at Animas range from \$254,000 for a one acre supply system to \$850,000 for a fifteen acre supply system. Las Cruces and Truth or Consequences development costs are more expensive than Animas. In Las Cruces the costs are higher because the well depths are greater and pump sizes are larger. The Las Cruces geothermal resource is deeper and cooler than the Animas site. In Truth or Consequences the capital costs are higher than Animas because the low temperature makes it necessary to drill more wells and to install more and larger pumps. Table 3 compares the geothermal capital costs for each site at the different thermal load requirements.

Table 3. Geothermal System Capital Cost Comparison

Location	1 Acre	4 Acres	10 Acres	15 Acres
Animas	\$ 254,000	\$ 269,000	\$ 632,000	\$ 850,000
Las Cruces	420,000	494,000	920,000	1,316,000
Truth or Consequences	432,000	1,000,000	2,516,000	N/A

The distribution of geothermal system capital costs is shown in Table 4 for a four acre greenhouse thermal load. The other three thermal load categories show similar cost distribution patterns. The production and injection (P&I) equipment category, which includes pumps, replacement pumps, pipelines and miscellaneous valves and fittings, tends to dominate the costs for installation of the geothermal system. For each site, the P&I category represents more than 50% of the total capital costs. In Animas, the pipelines represent the largest fraction of the P&I category while in Truth or Consequences the replacement pumps account for the largest item. Well drilling, both production and injection wells, are the two next largest capital cost categories. A large fraction of Truth or Consequences' capital budget goes towards production wells. Exploration costs are low or negligible for all three sites because of the history of prior development efforts.

Table 4. Distribution of Geothermal Development Costs  
(Four Acre Greenhouse Thermal Load)

<u>Category</u>	<u>Animas (%)</u>	<u>Las Cruces (%)</u>	<u>Truth or Consequences (%)</u>
Exploration	0	2	1
Production Well(s)	17	17	27
Injection Well(s)	11	12	14
P & I Equipment	66	64	53
Contingency	6	5	5

Table 5 summarizes the different geothermal system operating costs associated with each site and size. The lowest annual levelized operating costs are found in Animas for all sizes. Las Cruces has the highest operating costs because of the calculation approach. One aspect of operating costs are regular maintenance costs. Maintenance costs are determined based upon a percentage of total capital costs. Because Las Cruces has the highest capital costs it also has the highest maintenance costs.

Table 5. Comparative Geothermal System  
Levelized Annual Operating Costs

<u>Location</u>	<u>1 Acre</u>	<u>4 Acres</u>	<u>10 Acres</u>	<u>15 Acres</u>
Animas	\$ 12,043	\$ 27,303	\$ 64,813	\$ 86,514
Las Cruces	26,361	69,423	154,617	220,417
Truth or Consequences	16,074	36,171	88,576	N/A

One category dominates annual geothermal operating costs: electricity costs for pumping. Other cost categories, royalty payments to the U.S. Bureau of Land Management (BLM), annual repair and maintenance costs, and insurance costs are all much less than the costs associated with pumping.

Pumping costs are a function of several items including pumping depth, pump horsepower, pipeline length and diameter, hours of system operation, and utility rates. In general, for all sites and sizes except the one acre size, pumping costs exceed 50% of the annual operating budget and in several instances exceed 70% of the budget.

Royalty payments to the BLM are the second highest cost category at roughly 15 to 20% of total operating costs for Las Cruces and Animas. There

are no royalty payments at Truth or Consequences because the geothermal resource is privately owned.

A detailed description of operating costs showing geothermal system operating expenses for years one through ten is given in Appendix A, Tables A-7 through A-17.

Table 6 shows the geothermal system levelized life-cycle costs for each of the three sites at the different thermal loads. Animas, which has the lowest capital and operating costs, also has the lowest levelized cost in terms of \$/MMBtu. In Animas, levelized costs for the geothermal heating system range from a high of \$7.68/MMBtu for one acre to a low of \$2.56/MMBtu for fifteen acres of greenhouse. For Truth or Consequences the heating costs range from \$12.86 to \$7.31 for one and ten acre greenhouses, respectively. The Las Cruces example exhibits a range from \$14.78 to \$5.38 for the one and fifteen acre greenhouses.

**Table 6. Comparative Geothermal System Levelized Costs**  
(\$/MMBtu)

Location	1 Acre	4 Acres	10 Acres	15 Acres
Animas	\$ 7.86	\$ 3.03	\$ 2.85	\$ 2.56
Las Cruces	14.78	6.79	5.66	5.38
Truth or Consequences	12.86	7.29	7.31	N/A
Natural gas *	6.43	6.00	5.95	6.13

\* Note: Natural gas cost is for all locations

For comparative purposes, levelized costs for a natural gas system designed to supply the equivalent heating load as the geothermal systems are also shown in Table 6. As might be expected, relative to geothermal levelized life-cycle costs, natural gas system levelized costs are relatively constant over the range of greenhouse sizes because of the lower capital costs. Natural gas levelized costs do not vary by location because the thermal requirements are similar at all three locations. For the one acre greenhouse at all three sites, natural gas is a less expensive alternative to geothermal energy. In Animas geothermal energy is less expensive than natural gas for the three larger sizes. For the two larger sizes in Las Cruces, geothermal energy is less expensive than natural gas. In Truth or Consequences, natural gas is less expensive than geothermal energy for all of the thermal loads. Figure 7 illustrates the relationship between size of the thermal load and the levelized cost of energy.

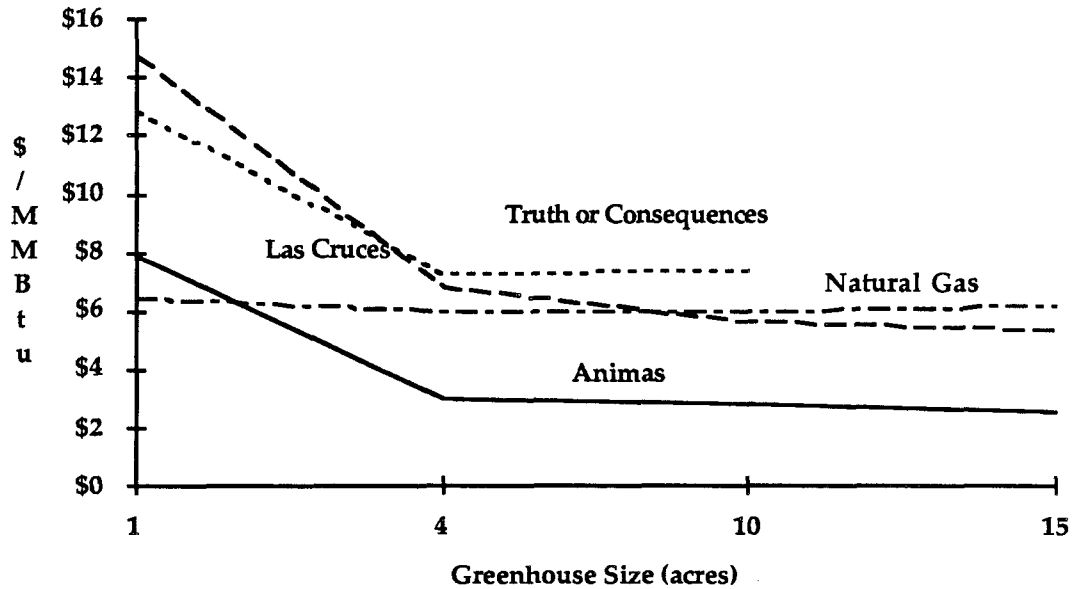


Figure 7. Levelized Life-Cycle Energy Costs

A complete list of tables showing the specific geothermal and natural gas system capital, present value, and levelized cost totals for the three sites and different size greenhouse thermal loads is included in Appendix C, Tables C-1 through C-26.

### 6.2 Comparative Analysis - Fresh Water Systems

The fresh water systems for the three sites may be compared in a similar manner to the geothermal system. Both Animas and Las Cruces have fully developed well field, pipeline, and pumping costs. In Truth or Consequences, overall costs are lower because water is purchased from the municipal utility. In both Animas and Las Cruces, the development costs are similar, with the primary difference being the cost of the water rights which is higher in Las Cruces. Table 7 shows the total capital costs for the fresh water systems at all three sites for the different size reference greenhouses. Refer to Tables A-4 through A-6 in Appendix A for an itemization of the capital costs for the fresh water systems.

Table 7. Fresh Water System Capital Cost Comparison

<u>Location</u>	<u>1 Acre</u>	<u>4 Acres</u>	<u>10 Acres</u>	<u>15 Acres</u>
Animas	\$ 626,000	\$ 651,000	\$ 901,000	\$ 913,000
Las Cruces	660,000	681,000	1,173,000	1,196,000
Truth or Consequences	56,000	56,000	56,000	N/A

\*NOTE: For Truth or Consequences, only pipeline costs are included

The category that dominates fresh water system capital costs are water storage tank costs. In many instances the storage tank exceeds 50% of the total water system capital costs

Estimated yearly levelized fresh water system operating costs range from about \$6,000 in Truth or Consequences to almost \$30,000 for a fifteen acre greenhouse in Animas. For both Animas and Las Cruces, at least 50% of the operating budget goes towards electricity costs. Repairs and maintenance constitute the next largest budget category, followed by insurance payments.

Table 8. Comparative Fresh Water System  
Levelized Annual Operating Costs

<u>Location</u>	<u>1 Acre</u>	<u>4 Acres</u>	<u>10 Acres</u>	<u>15 Acres</u>
Animas	\$ 19,656	\$ 17,368	\$ 23,070	\$ 27,549
Las Cruces	17,258	12,506	19,862	23,485
Truth or Consequences	5,695	17,626	42,389	N/A

As shown in Table 9, water is an expensive commodity. Levelized life-cycle costs for water in Animas and Las Cruces decline with increasing load but are considerably more than if purchased from a utility source. For comparative purposes, for a business located outside the city limits, water purchased from the municipal water system in Las Cruces costs \$1.60/1,000 gallons or about \$500 per acre-foot

Table 9. Comparative Fresh Water System Levelized Costs  
(\$/1,000 gal)

<u>Location</u>	<u>1 Acre</u>	<u>4 Acres</u>	<u>10 Acres</u>	<u>15 Acres</u>
Animas	\$ 21.96	\$ 5.49	\$ 2.44	\$ 1.74
Las Cruces	19.53	4.65	2.20	1.57
Truth or Consequences	3.39	1.76	1.46	N/A

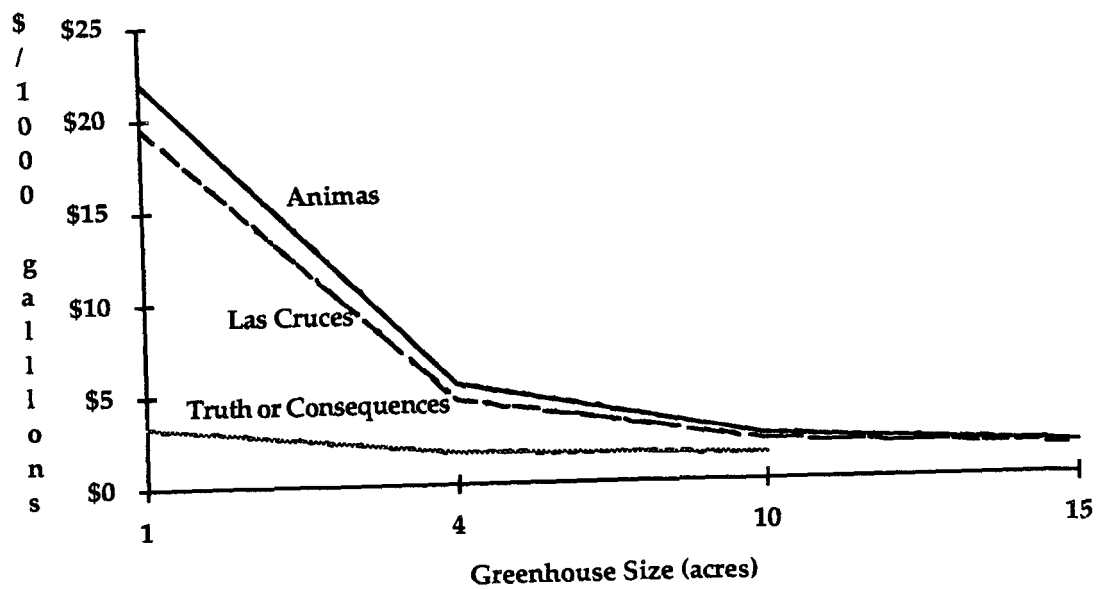


Figure 8. Levelized Life-Cycle Fresh Water Costs

A complete list of tables showing the assumptions used for calculating fresh water system costs are included in Appendix C, Tables C-4 through C-6.

## 7.0 CONCLUSIONS

Geothermal resource development encompasses many costs and tradeoffs in an effort to bring a successful project on-line. This report has analyzed some of the important aspects of resource development for low-temperature geothermal energy in southern New Mexico. Geothermal energy has the potential to be cost-competitive with other forms of energy, in particular natural gas. However, resource developers must plan carefully to avoid expensive mistakes because the margin for error is slim. Furthermore, the developer must also consider the value of the energy resource in context with other utility services that may be required. This report has examined the provision of one other utility, fresh water supply, and shown that fresh water development may require capital costs similar to geothermal development.

Of the three sites examined in this analysis, the Lower Animas Valley has the least expensive geothermal levelized costs. Although Animas is located in a remote area, it has considerable development potential, primarily due to the shallow depth of a relatively hot reservoir and the relatively close proximity of a fresh water source. The most costly geothermal system to develop is in Las Cruces, principally because the depth to the geothermal field is relatively great for a moderate temperature resource. Las Cruces geothermal fluids may have competitive costs at greater thermal useage levels. Furthermore, Las Cruces has a considerable geothermal resource base and is one of the fastest growing areas in the Southwest. The more centrally located City of Truth or Consequences has moderate development costs because it has very shallow wells, but requires extensive piping and more production wells to compensate for low temperatures. Truth or Consequences levelized geothermal costs are the highest of all three sites and are generally not competitive with current natural gas rates.

Some general observations may be made concerning the results of the analysis. Relative to a conventional system such as natural gas, geothermal development requires substantial capital costs in return for lower operating costs. At low thermal useage rates, the capital costs are often too high to compensate for the reduced operating costs, thereby placing the geothermal development in an unfavorable competitive situation. Conversely, at high thermal useage rates, such as for ten or more acres of greenhouses, geothermal energy offers a competitive alternative to natural gas. Some

economies of scale begin to come into effect with greater use of pipelines, wells, and other imbedded capital costs.

Two factors will greatly influence the development of geothermal resources: fuel escalation rates and interest rates. Geothermal energy may present a more stable future price horizon than other energy forms. While real natural gas prices have fallen over the past five to seven years, it may be anticipated that natural gas will experience escalation beyond inflation over some time period in the future. The developer with the foresight to anticipate such inflationary gains may well profit. Conversely, geothermal development will be hindered in times of high interest rates due to the capital intensive nature of the production activity.

Other arguments, outside of conventional economic analysis, may be used to support geothermal development. Geothermal is an indigenous resource that does not contribute to negative balance of trade payments. Concurrently, use of geothermal energy helps to maintain economic security in a world market place. Another element in favor of use of geothermal energy is that it does not require combustion of hydrocarbons thereby helping to alleviate pressure on the earth's atmosphere associated with the "greenhouse effect." Each of these arguments may constitute a social or environmental purpose for the use of a geothermal resource but none of the arguments lowers the levelized cost in present day accounting for the resource.

Several items have been excluded from the calculation of the geothermal levelized costs that could result in overall cost reductions. Corporate taxes, both State and Federal, have been ignored for the sake of simplifying calculations. Similarly, tax allowances associated with geothermal development (e.g., intangible drilling cost deductions), have not been included in the levelized cost computation. Furthermore, annual geothermal operating costs will be effectively reduced if the depletion allowances were considered. Finally, there may be significant tax advantages for a firm to produce geothermal energy for sale to a subsidiary, such as a greenhouse operation. It is likely that all of the factors discussed above would have the net effect of reducing geothermal levelized costs but none of these factors have been included in this analysis.

Fresh water costs are also an important consideration in geothermal development, particularly with respect to commercial greenhouse operations.

Fresh water system development costs in Animas are the least expensive of the three sites, primarily because the shorter distance from the fresh water aquifer lowers the pipeline cost. The costs are higher in Las Cruces because of the longer distance to a fresh water aquifer. Development costs for the Truth or Consequences site include only pipeline costs because fresh water around the known geothermal development sites is supplied by the City.

Fresh water development capital and operating costs rival similar geothermal development costs. Indeed, in Las Cruces the fresh water is more costly to develop than the geothermal reservoir. This is largely because the pipeline costs are substantial in Las Cruces due to the distance of the geothermal field from the nearest fresh water aquifer.

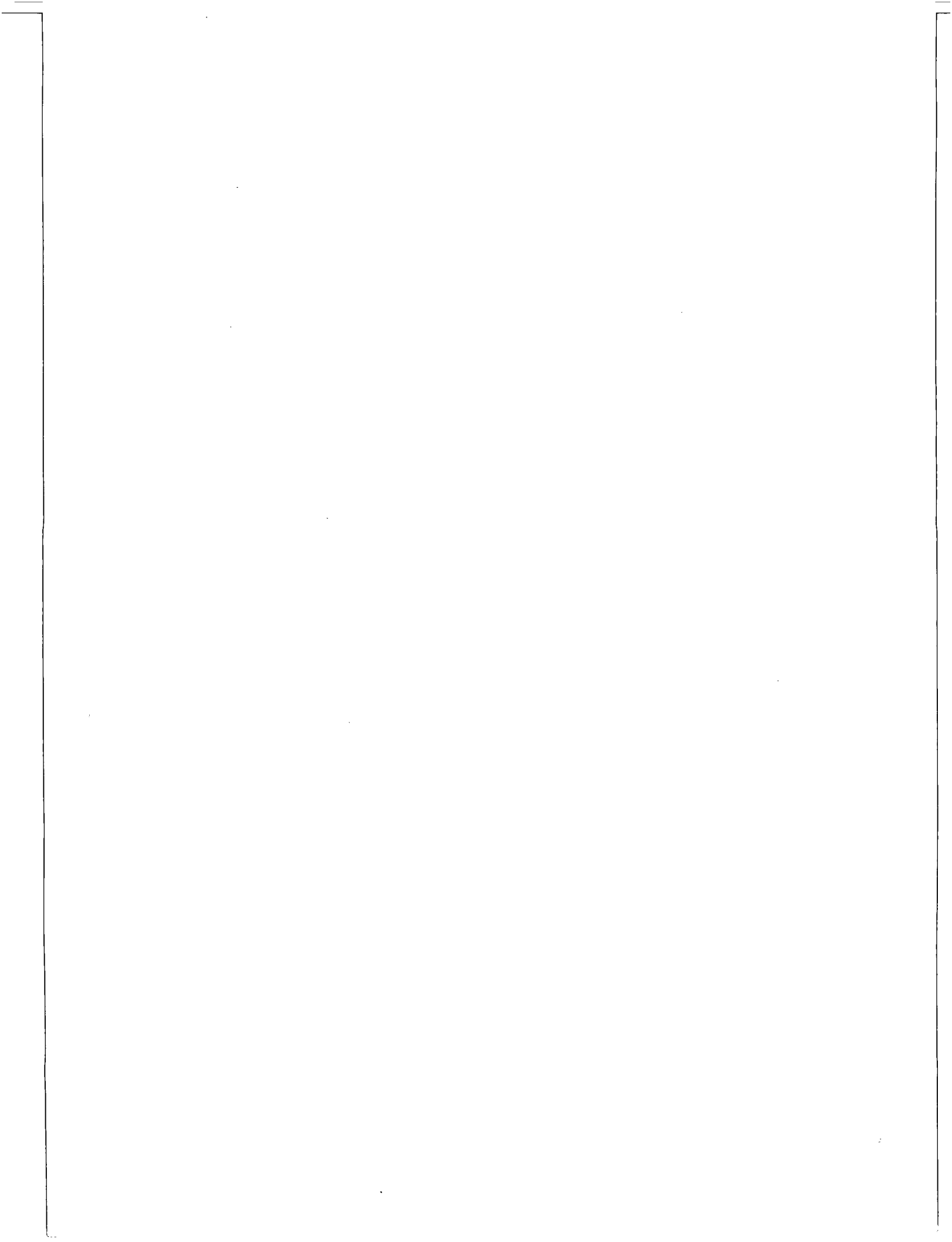
Some obvious tradeoffs are immediately apparent when considering fresh water development. It may be useful to locate the project halfway between the geothermal and freshwater aquifers. To some extent such an approach has been undertaken in this analysis, but careful site selection studies can help to refine the spacing. One alternative to consider is the use of some form of water purification for the "spent" geothermal fluids. While most purification systems are considerably more expensive than conventional water supply systems, if the value of the energy source is sufficiently high then the cost of the purification process may be competitive.

In summary, geothermal energy may be developed at competitive costs in several areas in southern New Mexico. Particularly at higher thermal useage levels, geothermal energy offers economic advantages for users relative to current natural gas rates. However, geothermal development should not be considered in isolation. Energy supply and cost is only one factor in a firm's overall business planning and other utility services may have equal importance with energy supply. This analysis has shown that water supply development may incur substantial expense in areas co-located with geothermal resources. The costs associated with water development should be carefully evaluated concurrent with energy supply options.

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Appendix A  
Model Description



## Appendix A Model Description

### TABLES A-1 through A-3 ASSUMPTIONS FOR ECONOMIC ANALYSIS

Assumptions for the economic analysis are based on a number of sources or calculations. Each assumption is specified in the following pages with the appropriate references.

#### **Geothermal System Assumptions**

**PRODUCTION PUMP SIZE:** The size (horsepower) of the production pump will vary with each location and depends upon specific pumping depths and flow rates. Pump sizes were calculated based upon the methodology outlined in the Geothermal Direct Use Engineering and Design Guidebook, page 180. A lineshaft pump with well head motor is assumed for all locations.

**NUMBER OF PRODUCTION PUMPS:** The number of production pumps required is a function of the required flow rate and the maximum capacity of the production wells.

**PRODUCTION PUMP LIFE:** Production pumps are assumed to have seven and one-half year lives and thus one pump is replaced per seven and one-half year period.

**INSTALLED COST OF PRODUCTION PUMP:** The installed cost of each production pump includes the bowl assembly, wellhead, enclosed lineshaft, motor, the motor electrical equipment, and lateral and geothermal adjustments. Pump prices were obtained from the Geothermal Direct Use Engineering and Design Guidebook, page 179.

**WELL DEPTH:** The production well depth was based on characteristics of known geothermal wells in the areas.

**PUMPING DEPTH:** Pumping depth refers to the depth at which the pump is set and is based on characteristics of known geothermal wells in the areas.

**NUMBER OF PRODUCTION WELLS:** The number of production wells will vary depending upon the required flow rates for any given location and greenhouse size and also as a function of the maximum capacity of wells in a given location.

**SYSTEM LOAD FACTOR:** The system load factor represents the percentage annual time that the geothermal system will operate. This estimate is used to calculate the annual electricity consumption.

**PRODUCTION PIPELINE:** The length of each production pipeline varies by location depending upon specific local factors (e.g., terrain, geology, roads, etc.).

**INSTALLED COST OF PRODUCTION PIPELINE:** Estimated production pipeline costs include pipe, elbows, couplings, tees, and trench costs. Production pipeline prices were obtained from the Means Mechanical Cost Data, 1989. For higher temperature applications in Animas, fiberglass reinforced plastic material is assumed, for Las Cruces and Truth or Consequences, PVC pipe is assumed. All pipelines are assumed to be uninsulated.

**INJECTION PIPELINE:** The length of each injection pipeline varies by location depending upon specific local factors (e.g., terrain, geology, roads, etc.).

**INJECTION PIPELINE COST:** Estimated injection pipeline costs include pipe, elbows, couplings, tees, and trench costs. Injection pipeline prices were obtained from the Means Mechanical Cost Data, 1989. Uninsulated PVC or FRP pipe is used.

**REQUIRED PRODUCTION CAPACITY:** The required production capacity is based upon calculations derived from a computer-assisted energy simulation model. The model simulates thermal loads for a commercial greenhouse.

**NUMBER OF DISPOSAL WELLS:** It is assumed that at least one disposal well will be necessary. The number of disposal wells required is one less than the number of production wells required for any given location and greenhouse size. The disposal wells do not require injection pumping.

**NUMBER OF REPLACEMENT PUMPS:** A replacement pump is assumed to be on-site at all times for immediate service. Only one pump is available at any time.

**REPLACEMENT PUMP COST:** The replacement pump is assumed to cost 80% of the cost of a new pump. It is assumed that it is not necessary to replace the entire pump and pump assembly when the replacement pump is placed in service. Rather, laterals, bowls, or other equipment in the well, and

included in the pump cost category, are assumed to be salvageable to a small degree.

**ROYALTY PAYMENT:** It is assumed that the geothermal fluids are produced from a Federal lease. Royalty payments are made to the U.S. Bureau of Land Management and are a given percentage of the estimated value of geothermal resources.

**GEOTHERMAL LEASE FEES:** It is assumed that the developer pays the U.S. BLM a one-time lease bid fee for the rights to the geothermal resource. No annual rentals are made for the lease because it is assumed that the annual royalty payment exceeds the rental fee.

**VALUE OF GEOTHERMAL RESOURCES:** The value of geothermal resources, for royalty payment purposes, is determined by calculating the amount of fuel (in Btu's) displaced by the geothermal resource and multiplying it by the dollars per Btu of the alternative energy source. The energy consumption is determined from the heat loss model and divided by the assumed efficiency of the boiler. This calculation gives the total energy consumption. The assumed alternative energy source is natural gas and is valued at \$4.10 per MMBtu. The efficiency of the natural gas boiler is assumed to be 80%.

### **Fresh Water System Assumptions**

**FRESH WATER PUMP SIZE:** The size (horsepower) of the fresh water pump will vary by location and depends upon specific pumping depths and flow rates. Pump sizes were calculated based upon the methodology outlined in the Geothermal Direct Use Engineering and Design Guidebook, page 180.

**NUMBER OF FRESH WATER PUMPS:** The number of fresh water pumps required is based on the number of fresh water wells.

**FRESH WATER PUMP LIFE:** Fresh water pumps are assumed to have ten year lives and are thus replaced every ten years.

**INSTALLED COST OF FRESH WATER PUMP:** The installed cost of each fresh water pump includes the bowl assembly, wellhead, enclosed lineshaft, motor, the motor electrical equipment, and lateral adjustments. Pump prices were obtained from the Geothermal Direct Use Engineering and Design Guidebook, page 179.

**NUMBER OF REPLACEMENT PUMPS:** A replacement pump is assumed to be on-site at all times for immediate service. Only one pump is available at any time.

**REPLACEMENT PUMP COST:** The replacement pump is assumed to cost 80% of the cost of a new pump. It is assumed that it is not necessary to replace the entire pump and pump assembly when the replacement pump is placed in service. Rather, laterals, bowls, or other equipment in the well, and included in the pump cost category, are assumed to be salvageable to a small degree.

**WELL DEPTH:** The well depth was based upon depths of known fresh water wells in the area.

**PUMPING DEPTH:** The pumping depth refers to the depth at which the pump was set and was based upon known local conditions.

**NUMBER OF FRESH WATER WELLS:** It is assumed that one fresh water well at each of the Animas and Las Cruces sites will provide a sufficient flow rate for the four greenhouse sizes.

**SYSTEM LOAD FACTOR:** The system load factor represents the percentage annual time that the fresh water system will operate. This estimate was used to calculate the annual energy consumption.

**FRESH WATER PIPELINE:** The length of each fresh water pipeline varies by location depending upon specific factors (e.g., location of aquifer relative to the geothermal field).

**INSTALLED COST OF FRESH WATER PIPELINE:** Estimated fresh water pipeline costs include PVC pipe, elbows, couplings, tees, and trench costs. Fresh water pipeline prices were obtained from the Means Mechanical Cost Data, 1989.

**STORAGE TANK CAPACITY:** An arbitrary size of 200,000 gallons is assumed for the storage tank.

**STORAGE TANK COST:** The cost of the storage tank is based on data obtained from Means Mechanical Cost Data, 1989, page 42.

**REQUIRED PRODUCTION CAPACITY:** The production capacity is based upon greenhouse requirements for irrigation and evaporative cooling. The capacity is estimated from data obtained from the NMSU geothermally-heated greenhouse complex measured over several years (SWTDI, 1990).

**FRESH WATER RIGHTS REQUIRED:** The fresh water rights required, stated in terms of acre feet, are estimates and vary by location.

**WATER RIGHTS COST:** The cost of obtaining fresh water rights is estimated at a given amount per acre foot and varies by location.

### **Economic Operating Assumptions**

**SALVAGE VALUE:** A salvage value of a given percent of capital costs is assumed.

**CONTINGENCY RATE:** A contingency rate of a given percent is assumed for capital costs.

**GENERAL INFLATION RATE:** The financial model allows for the projection of costs and revenues adjusted for inflation. A zero inflation rate implies a constant dollar analysis over the given time horizon.

**REPAIRS & MAINTENANCE:** An allowance of a given percentage of total capital costs is assumed for repairs and maintenance.

### **Utility Operating Assumptions**

**ELECTRICITY ENERGY RATE:** Electricity rates were determined by contacting local electric utility companies and are calculated in terms of dollars per kilowatt hour. The rates for a greenhouse operation typically fall under the "Commercial User" category. Cost calculations in this model are based on flat base rates with no allowances for factors such as deposits, minimum monthly customer charges, taxes, or meter sizes.

**ELECTRICITY DEMAND RATE:** Electricity demand rates were determined by contacting local electric utility companies and are calculated in terms of dollars per kilowatt per month. Whether or not demand charges are assessed depends upon the electricity load.

**ELECTRICITY DEMAND LOAD, GEOTHERMAL:** The electricity load for the geothermal system is based on the size (horsepower) of the geothermal production pump and is converted from horsepower to kilowatts.

**ELECTRICITY DEMAND LOAD, FRESH WATER:** The electricity load for the fresh water system is based on the size (horsepower) of the fresh water production pump and is converted from horsepower to kilowatts.

**ELECTRICITY ENERGY LOAD, GEOTHERMAL PUMP:** The electricity energy load for the geothermal pump is calculated by multiplying the demand load by the geothermal load factor and hours per year and is stated in terms of kilowatt hours per year.

**ELECTRICITY ENERGY LOAD, FRESH WATER PUMP:** The electricity energy load for the fresh water pump is calculated by multiplying the demand load by the fresh water load factor and hours per year and is stated in terms of kilowatt hours per year.

**ELECTRICITY INFLATION RATE:** The financial model allows for the projection of costs and revenues adjusted for inflation. A zero inflation rate implies a constant dollar analysis over the given time horizon.

**ANNUAL HEATING LOAD:** Greenhouse size is used as a proxy for establishing a thermal energy load. The peak annual heating load is the total heating load for the number of acres of greenhouse for a one year period. The load is calculated with a computer-assisted energy simulation model for each location, and is reported in terms of millions of Btu's per acre. A printout of the computer inputs is included in Appendix B.

**FRESH WATER CONSUMPTION:** An estimate of the number of gallons of water per acre of covered area per year per location is assumed based on data obtained from the NMSU geothermally-heated greenhouse complex and from "Greenhouse Roses," published by Roses Inc.

**NATURAL GAS RATE:** The cost for natural gas is the rate prevailing in Las Cruces, New Mexico in January, 1990.

**NATURAL GAS-FIRED BOILER EFFICIENCY:** The natural gas boiler is assumed to be maintained on a regular basis and the average annual efficiency is assumed to be 80%.

**NATURAL GAS-FIRED BOILER COST:** Natural gas boilers were sized to meet the peak heating loads for the four greenhouse sizes. Costs for the boilers were obtained from Means Mechanical Cost Data, 1989. The boilers were assumed to have dual fuel (both oil and natural gas) capability.

**NATURAL GAS INFLATION RATE:** It is assumed that natural gas prices will inflate above general inflation rates over the horizon of the analysis. A conservative 0.5% annual escalation rate is assumed.

### **Amortization Assumptions**

**PRINCIPAL:** A debt to assets ratio of 80% is assumed. Total capital costs (see Tables A-4 through A-6) were multiplied by 80% to obtain the principal for the amortization calculation.

**INTEREST RATE:** A given interest rate is assumed. This rate is used for the calculation of the loan payment and for the levelized life-cycle cost calculation. The interest rate is also referred to as the discount rate.

**YEARS:** The loan is amortized for a given time period.

**ANNUAL LOAN PAYMENT:** The annual loan payment is a sum of the principal and interest calculated for the specific year. Annual interest is calculated by multiplying the total loan balance at the beginning of the year by the interest rate. The principal is calculated by subtracting the interest from the annual payment.

#### **TABLES A-4 through A-6**

#### **PROJECT CAPITAL COSTS-GEOTHERMAL SYSTEM**

Capital cost estimates for the geothermal system are shown in Tables A-4 through A-6. The estimates were obtained either from conversations with local developers or from published reports.

**EXPLORATION COSTS:** Exploration costs include geology, water geochemistry and geothermometry, soil gas surveys, temperature gradient and heat flow tests, seismic surveys, and electrical geophysics.

**PRODUCTION WELL COSTS:** Included in production well category are costs for site surveys: location, archaeological, and access road surveys; site preparation: drill pads, mud and reserve pits, and road construction maintenance; drilling: mobilization, operation, standby, welding, air compressors, water and water trucks, and labor. Also included are costs for geotechnical services such as on-site supervision and geology: geologist and engineer; monitoring instrumentation, well design, borehole geophysics, geochemistry and petrophysics, and reservoir testing. Costs for materials and related services include casing, liners, bits, hole-openers, drilling fluids, gravel pack, cement, a disposal pit, and other items. Allowances must also be made for rentals, freight costs, insurance and bonding, and filing fees.

**INJECTION WELL COSTS:** Injection well costs include site surveys, site preparation, drilling, site supervision, well design, injection tests and monitoring, rentals, freight, insurance and bonding, filing fees, and a disposal pit.

**PRODUCTION & INJECTION EQUIPMENT COSTS:** The production and injection equipment category includes costs for production pumps, the

production pipeline, injection pipeline, an insulated hot water storage tank, power hook-up, a control system, and miscellaneous items.

### **PROJECT CAPITAL COSTS-FRESH WATER SYSTEM**

Capital cost estimates for the fresh water system are also shown in Tables A-4 through A-6. The estimates were obtained either from conversations with local developers or from published reports.

**FRESH WATER WELL COSTS:** Included in the fresh water well category are costs for site surveys (location, archaeological, and access road surveys); site preparation (drill pads, mud and reserve pits, and road construction maintenance); drilling (mobilization, operation, standby, welding, air compressors, water and water trucks, and labor). Also included are costs for geotechnical services such as on-site supervision and geology: geologist and engineer, monitoring instrumentation, well design, and reservoir testing. Costs for materials and related services include casing, liners, bits, hole-openers, drilling fluids, gravel pack, cement, and other items. Allowances must also be made for rentals, freight costs, insurance and bonding, and filing fees.

### **TABLES A-7 through A-17 OPERATING EXPENSES**

**PRODUCTION EXPENSES:** Production expenses include electricity costs which are generated by the geothermal and fresh water pumps and are based on the assumed rates of usage (see Tables A-4 through A-6).

**FIXED OPERATING EXPENSES:** Repairs and maintenance, and insurance and royalty payments are assumed to be fixed.

**OTHER FIXED EXPENSES:** Other fixed expenses include the breakdown of principal and interest in the total annual loan payment.

**LEVELIZED COSTS (TABLES C-1 through C-26) see page 87**

**LEVELIZED LIFE-CYCLE COST:** The levelized life-cycle cost calculation considers the present value of all capital, operating, and salvage costs for each system for a twenty year period and the assumed interest rate. The general expression for calculating levelized life-cycle cost, LLC, is the following:

$$LLC = \frac{\sum_{n=1}^N \frac{C_n}{(1+i)^n}}{\sum_{n=1}^N \frac{X_n}{(1+i)^n}}$$

where

- $C_n$ = costs incurred in year n,
- $X_n$ = total MMBtu used in year n (annual heating load);  
or, total number of gallons fresh water used in  
year n divided by 1,000
- $i$  = discount rate, and
- $N$  = total number of years (lifetime).

**\$/MMBtu:** The dollars per million Btu calculation is determined by dividing the levelized life-cycle cost for the geothermal system by the total heating load.

**\$/1,000 GALLONS:** The dollars per 1,000 gallons calculation is determined by dividing the levelized life-cycle cost for the fresh water system by the total fresh water consumption.

Table A-1. Assumptions, Animas

	1 Acre	4 Acres	10 Acres	15 Acres
<b><u>Geothermal System Assumptions</u></b>				
Production pump size (hp)	5	20	20	20
Number of production pumps	1	1	3	4
Production pump life (years)	7.5	7.5	7.5	7.5
Installed cost of prod. pump, etc. (ea)	\$19,450	\$22,750	\$22,750	\$22,750
Well depth (ft)	300	300	300	300
Pumping depth (ft)	200	200	200	200
Number of production wells	1	1	3	4
System load factor (% per yr)	35%	35%	35%	35%
Production pipeline (ft)	500	500	1,000	1,000
Installed cost of prod. pipeline (\$/ft)	\$21	\$21	\$29	\$43
Injection pipeline (ft)	1,500	1,500	1,500	1,500
Injection pipeline cost (\$/ft)	\$21	\$21	\$29	\$43
Required production capacity (gpm)	80	300	730	1,100
Number of disposal wells	1	1	2	3
Number of replacement pumps	1	1	1	1
Replacement pump cost (80% of pump)	\$15,560	\$18,200	\$18,200	\$18,200
Royalty payment (% per yr)	10%	10%	10%	10%
Geothermal lease fees (one-time pymt)	\$10,000	\$10,000	\$10,000	\$10,000
Value of geoth. resources (\$/MMBtu)	\$20,715	\$81,006	\$201,592	\$302,078
<b><u>Fresh Water System Assumptions</u></b>				
Fresh water pump size (hp)	10	15	30	50
Number of fresh water pumps	1	1	1	1
Fresh water pump life (years)	10	10	10	10
Installed cost of fr. water pump, etc. (ea)	\$16,800	\$18,025	\$20,775	\$24,625
Number of replacement pumps	1	1	1	1
Replacement pump cost (80% of pump)	\$13,440	\$14,420	\$16,620	\$19,700
Well depth (ft)	500	500	500	500
Pumping depth (ft)	200	200	200	200
Number of fresh water wells	1	1	1	1
System load factor (% per yr)	20%	20%	20%	20%
Fresh water pipeline (ft)	10,000	10,000	10,000	10,000
Installed cost of fr. water pipeline cost (\$/ft)	\$20	\$20	\$20	\$20
Storage tank capacity (gal)	200,000	200,000	200,000	200,000
Storage tank cost (\$/gal)	\$1.20	\$1.20	\$1.20	\$1.20
Required production capacity (gpm)	40	160	440	660
Fresh water rights required (acre ft)	50	50	200	200
Water rights (\$/acre ft)	\$1,500	\$1,500	\$1,500	\$1,500

Table A-1, Continued

	1 Acre	4 Acres	10 Acres	15 Acres
<b><u>Economic Operating Assumptions</u></b>				
Salvage value (% of capital costs)	10%	10%	10%	10%
Contingency rate	7.5%	7.5%	7.5%	7.5%
General inflation rate	0%	0%	0%	0%
Repairs & maintenance (% of capital costs)	3%	3%	3%	3%
<b><u>Utility Operating Assumptions</u></b>				
Electricity energy rate (\$/kWh)	\$0.09	\$0.09	\$0.09	\$0.09
Electricity demand rate (\$/kW/Mo)	\$13.00	\$13.00	\$13.00	\$13.00
Electricity demand load, geothermal (kW)	3.75	15	45	60
Electricity demand load, fresh water (kW)	8	11	23	38
Elect. energy load, geoth. pump (kWh/yr)	11,498	45,990	137,970	183,960
Elect. energy load, fr wtr pump (kWh/yr)	13,140	19,710	39,420	65,700
Electricity inflation rate	0%	0%	0%	0%
Annual heating load (MMBtu)	4,042	15,806	39,335	58,942
Fr. water consumption (gal/acre/yr)	3,259,000	3,259,000	3,259,000	3,259,000
Natural gas rate (\$/MMBtu)	\$4.10	\$4.10	\$4.10	\$4.10
Natural gas-fired boiler efficiency	80%	80%	80%	80%
Natural gas-fired boiler cost	\$19,900	\$86,400	\$236,000	\$472,500
Natural gas inflation rate	.5%	.5%	.5%	.5%
<b><u>Amortization Assumptions</u></b>				
Principal	\$657,481	\$681,685	\$1,072,770	\$1,204,67
Interest rate	7.5%	7.5%	7.5%	7.5%
Years	10	10	10	10
Annual loan payment (P & I)	\$95,786	\$99,312	\$156,288	\$175,505

Table A-2. Assumptions, Las Cruces

	1 Acre	4 Acres	10 Acres	15 Acres
<b><u>Geothermal System Assumptions</u></b>				
Production pump size (hp)	30	125	150	150
Number of production pumps	1	1	2	3
Production pump life (years)	7.5	7.5	7.5	7.5
Installed cost of prod. pump, etc. (ea)	\$38,900	\$55,725	\$64,075	\$64,075
Well depth (ft)	1,000	1,000	1,000	1,000
Pumping depth (ft)	500	500	500	500
Number of production wells	1	1	2	3
System load factor (% per yr)	35%	35%	35%	35%
Production pipeline (ft)	500	500	1,000	1,000
Installed cost of prod. pipeline (\$/ft)	\$20	\$20	\$41	\$47
Injection pipeline (ft)	2,000	2,000	2,000	2,000
Injection pipeline cost (\$/ft)	\$20	\$20	\$41	\$47
Required production capacity (gpm)	170	650	1,600	2,400
Number of disposal wells	1	1	1	2
Number of replacement pumps	1	1	1	1
Replacement pump cost (80% of pump)	\$31,120	\$44,580	\$51,260	\$51,260
Royalty payment (% per yr)	10%	10%	10%	10%
Geothermal lease fees (one-time pymt)	\$10,000	\$10,000	\$10,000	\$10,000
Value of geoth. resources (\$/MMBtu)	\$20,777	\$81,257	\$202,217	\$303,016
<b><u>Fresh Water System Assumptions</u></b>				
Fresh water pump size (hp)	10	15	30	50
Number of fresh water pumps	1	1	1	1
Fresh water pump life (years)	10	10	10	10
Installed cost of fr. water pump, etc. (ea)	\$16,800	\$18,025	\$20,775	\$24,625
Number of replacement pumps	1	1	1	1
Replacement pump cost (80% of pump)	\$13,440	\$14,420	\$16,620	\$19,700
Well depth (ft)	500	500	500	500
Pumping depth (ft)	200	200	200	200
Number of fresh water wells	1	1	1	1
System load factor (% per yr)	20%	20%	20%	20%
Fresh water pipeline (ft)	8,000	8,000	8,000	8,000
Installed cost of fr. water pipeline cost (\$/ft)	\$20	\$20	\$20	\$20
Storage tank capacity (gal)	200,000	200,000	200,000	200,000
Storage tank cost (\$/gal)	\$1.20	\$1.20	\$1.20	\$1.20
Required production capacity (gpm)	40	160	440	660
Fresh water rights required (acre ft)	50	50	200	200
Water rights (\$/acre ft)	\$3,000	\$3,000	\$3,000	\$3,000

Table A-2, Continued

	1 Acre	4 Acres	10 Acres	15 Acres
<b><u>Economic Operating Assumptions</u></b>				
Salvage value (% of capital costs)	10%	10%	10%	10%
Contingency rate	7.5%	7.5%	7.5%	7.5%
General inflation rate	0%	0%	0%	0%
Repairs & maintenance (% of capital costs)	3%	3%	3%	3%
<b><u>Utility Operating Assumptions</u></b>				
Electricity energy rate (\$/kWh)	\$0.08	\$0.08	\$0.08	\$0.08
Electricity demand rate (\$/kW/Mo)	\$14.00	\$14.00	\$14.00	\$14.00
Electricity demand load, geothermal (kW)	22.5	93.75	225	337.5
Electricity demand load, fresh water (kW)	8	11	23	38
Elect. energy load, geoth. pump (kWh/yr)	68,985	287,438	689,850	1,034,775
Elect. energy load, fr wtr pump (kWh/yr)	13,140	19,710	39,420	65,700
Electricity inflation rate	0%	0%	0%	0%
Annual heating load (MMBtu)	4,054	15,855	39,420	59,125
Fr. water consumption (gal/acre/yr)	3,259,000	3,259,000	3,259,000	3,259,000
Natural gas rate (\$/MMBtu)	\$4.10	\$4.10	\$4.10	\$4.10
Natural gas-fired boiler efficiency	80%	80%	80%	80%
Natural gas-fired boiler cost	\$19,900	\$86,400	\$236,000	\$472,500
Natural gas inflation rate	.5%	.5%	.5%	.5%
<b><u>Amortization Assumptions</u></b>				
Principal	\$771,491	\$815,789	\$1,422,266	\$1,641,673
Interest rate	7.5%	7.5%	7.5%	7.5%
Years	10	10	10	10
Annual loan payment (P & I)	\$112,395	\$118,849	\$207,204	\$239,169

Table A-3. Assumptions, Truth or Consequences

	1 Acre	4 Acres	10 Acres	15 Acres
<b><u>Geothermal System Assumptions</u></b>				
Production pump size (hp)	15	15	15	N/A
Number of production pumps	2	6	15	N/A
Production pump life (years)	7.5	7.5	7.5	N/A
Installed cost of prod. pump, etc. (ea)	\$19,500	\$19,850	\$19,850	N/A
Well depth (ft)	200	200	200	N/A
Pumping depth (ft)	150	150	150	N/A
Number of production wells	2	6	15	N/A
System load factor (% per yr)	35%	35%	35%	N/A
Production pipeline (ft)	1,300	1,300	1,800	N/A
Installed cost of prod. pipeline (\$/ft)	\$41	\$41	\$83	N/A
Injection pipeline (ft)	1,300	1,300	1,800	N/A
Injection pipeline cost (\$/ft)	\$41	\$41	\$83	N/A
Required production capacity (gpm)	440	1,720	4,260	N/A
Number of disposal wells	1	5	14	N/A
Number of replacement pumps	1	1	1	N/A
Replacement pump cost (80% of pump)	\$15,600	\$15,880	\$15,880	N/A
<b><u>Fresh Water System Assumptions</u></b>				
Fresh water pipeline (ft)	2,600	2,600	2,600	N/A
Installed cost of fr. water pipeline cost (\$/ft)	\$20	\$20	\$20	N/A
Fresh water rate (\$/1,000 gal)	\$0.88	\$0.88	\$0.88	N/A
<b><u>Economic Operating Assumptions</u></b>				
Salvage value (% of capital costs)	10%	10%	10%	N/A
Contingency rate	7.5%	7.5%	7.5%	N/A
General inflation rate	0%	0%	0%	N/A
Repairs & maintenance (% of capital costs)	3%	3%	3%	N/A

Table A-3, Continued

	1 Acre	4 Acres	10 Acres	15 Acres
<b><u>Utility Operating Assumptions</u></b>				
Electricity energy rate (\$/kWh)	\$0.06	\$0.06	\$0.06	N/A
Electricity demand rate (\$/kW/Mo)	\$6.00	\$6.00	\$6.00	N/A
Electricity demand load, geothermal (kW)	22.5	67.5	168.75	N/A
Elect. energy load, geoth. pump (kWh/yr)	68,985	206,955	517,388	N/A
Electricity inflation rate	0%	0%	0%	N/A
Annual heating load (MMBtu)	4,042	15,806	39,335	N/A
Fr. water consumption (gal/acre/yr)	3,259,000	3,259,000	3,259,000	N/A
Natural gas rate (\$/MMBtu)	\$4.10	\$4.10	\$4.10	N/A
Natural gas-fired boiler efficiency	80%	80%	80%	N/A
Natural gas-fired boiler cost	\$19,900	\$86,400	\$236,000	N/A
Natural gas inflation rate	.5%	.5%	.5%	N/A
<b><u>Amortization Assumptions</u></b>				
Principal	\$323,790	\$641,285	\$1,549,144	N/A
Interest rate	7.5%	7.5%	7.5%	N/A
Years	10	10	10	N/A
Annual loan payment (P & I)	\$47,172	\$93,426	\$225,688	N/A

Table A-4. Project Capital Costs, Animas

	1 Acre	4 Acres	10 Acres	15 Acres
<b>Capital Costs-Geothermal System</b>				
<i>Exploration costs:</i>	\$0	\$0	\$0	\$0
Geology	0	0	0	0
Geochemistry	0	0	0	0
Geophysics	0	0	0	0
Subtotal	\$0	\$0	\$0	\$0
<i>Production well costs:</i>				
Site surveys	\$500	\$500	\$500	\$500
Site preparation	500	500	500	500
Drilling	20,000	20,000	20,000	20,000
Site supervision	500	500	500	500
Reservoir testing	15,000	15,000	15,000	15,000
Materials and related services	5,000	5,000	5,000	5,000
Rentals	0	0	0	0
Insurance-bonding	1,000	1,000	1,000	1,000
Disposal pit	0	0	0	0
Filing fees	100	100	100	100
Subtotal	\$42,600	\$42,600	\$42,600	\$42,600
<i>Injection well costs:</i>				
Site surveys	\$500	\$500	\$500	\$500
Site preparation	500	500	500	500
Drilling	20,000	20,000	20,000	20,000
Site supervision	500	500	500	500
Injection test & monitoring	5,000	5,000	5,000	5,000
Rentals	1,000	1,000	1,000	1,000
Insurance-bonding	1,000	1,000	1,000	1,000
Disposal pit	0	0	0	0
Filing fees	100	100	100	100
Subtotal	\$28,600	\$28,600	\$28,600	\$28,600
<i>Production &amp; Injection Equipment:</i>				
Production pump(s) & replace. pump	\$35,010	\$40,950	\$86,450	\$109,200
Production pipeline	10,500	10,500	29,000	43,000
Injection pipeline	31,500	31,500	43,500	64,500
Power hook-up	15,000	15,000	35,000	45,000
Control system	10,000	10,000	15,000	17,500
Miscellaneous (valves, gauges, etc)	15,000	15,000	25,000	30,000
Subtotal	\$117,010	\$122,950	\$233,950	\$309,200
Contingency	14,116	14,561	31,421	42,405
Geothermal lease fee	10,000	10,000	10,000	10,000
<b>TOTAL GEOTHERMAL CAPITAL COSTS</b>	<b>\$212,326</b>	<b>\$218,711</b>	<b>\$460,371</b>	<b>\$617,805</b>

Table A-4, Continued

	1 Acre	4 Acres	10 Acres	15 Acres
<b>Capital Costs-Fresh Water System</b>				
Water rights	\$75,000	\$75,000	\$300,000	\$300,000
Site surveys	500	500	500	500
Site preparation	250	250	250	250
Drilling	10,000	30,000	30,000	30,000
Materials and related services	1,000	1,000	1,000	1,000
Fresh water pump	16,800	18,025	20,775	24,625
Fresh water pipeline	200,000	200,000	200,000	200,000
Fresh water storage tank	240,000	240,000	240,000	240,000
Power hook-up	10,000	10,000	10,000	10,000
Subtotal	\$567,000	\$589,205	\$819,155	\$826,085
Contingency	42,525	44,190	61,437	61,956
<b>TOTAL WATER SYSTEM CAPITAL COSTS</b>	<b>\$609,525</b>	<b>\$633,395</b>	<b>\$880,592</b>	<b>\$888,041</b>
<b>TOTAL COMBINED CAPITAL COSTS</b>	<b>\$821,851</b>	<b>\$852,107</b>	<b>\$1,340,963</b>	<b>\$1,505,846</b>

Table A-5. Project Capital Costs, Las Cruces

	1 Acre	4 Acres	10 Acres	15 Acres
<b>Capital Costs-Geothermal System</b>				
<i>Exploration costs:</i>				
Geology	\$2,500	\$2,500	\$5,000	\$7,500
Geochemistry	2,500	2,500	5,000	\$7,500
Geophysics	5,000	5,000	7,500	10,000
Subtotal	\$10,000	\$10,000	\$17,500	\$25,000
<i>Production well costs:</i>				
Site surveys	\$500	\$500	\$500	\$500
Site preparation	500	500	500	500
Drilling	50,000	50,000	50,000	50,000
Site supervision	500	500	500	500
Reservoir testing	20,000	20,000	20,000	20,000
Materials and related services	5,000	5,000	5,000	5,000
Rentals	2,500	2,500	2,500	2,500
Insurance-bonding	1,000	1,000	1,000	1,000
Disposal pit	250	250	250	250
Filing fees	100	100	100	100
Subtotal	\$80,350	\$80,350	\$80,350	\$80,350
<i>Injection well costs:</i>				
Site surveys	\$500	\$500	\$500	\$500
Site preparation	500	500	500	500
Drilling	50,000	\$50,000	50,000	50,000
Site supervision	500	500	500	500
Injection test & monitoring	5,000	5,000	5,000	5,000
Rentals	1,000	1,000	1,000	1,000
Insurance-bonding	1,000	1,000	1,000	1,000
Disposal pit	250	250	250	250
Filing fees	100	100	100	100
Subtotal	\$58,850	\$58,850	\$58,850	\$58,850
<i>Production &amp; Injection Equipment:</i>				
Production pump(s) & replace. pump	\$70,020	\$100,305	\$179,410	\$243,485
Production pipeline	10,000	10,000	41,000	47,000
Injection pipeline	40,000	40,000	82,000	94,000
Power hook-up	15,000	20,000	25,000	35,000
Control system	10,000	10,000	12,500	15,000
Miscellaneous (valves, gauges, etc)	10,000	10,000	15,000	15,000
Subtotal	\$155,020	\$190,305	\$354,910	\$449,485
Contingency	22,817	25,463	44,397	62,493
Geothermal lease fee	10,000	10,000	10,000	\$10,000
<b>TOTAL GEOTHERMAL CAPITAL COSTS</b>	<b>\$337,037</b>	<b>\$374,968</b>	<b>\$646,357</b>	<b>\$905,728</b>

Table A-5, Continued

	1 Acre	4 Acres	10 Acres	15 Acres
<b><u>Capital Costs-Fresh Water System</u></b>				
Water rights	\$150,000	\$150,000	\$600,000	\$600,000
Site surveys	500	500	500	500
Site preparation	250	250	250	250
Drilling	10,000	25,000	25,000	35,000
Materials and related services	1,000	1,000	1,000	1,000
Fresh water pump	16,800	18,025	20,775	24,625
Fresh water pipeline	160,000	160,000	160,000	160,000
Fresh water storage tank	240,000	240,000	240,000	240,000
Power hook-up	5,000	5,000	5,000	5,000
Subtotal	\$583,560	\$599,785	\$1,052,535	\$1,066,385
Contingency	43,767	44,984	78,940	79,979
<b>TOTAL WATER SYSTEM CAPITAL COSTS</b>	<b>\$627,327</b>	<b>\$644,769</b>	<b>\$1,131,475</b>	<b>\$1,146,364</b>
<b>TOTAL COMBINED CAPITAL COSTS</b>	<b>\$964,364</b>	<b>\$1,019,737</b>	<b>\$1,777,832</b>	<b>\$2,052,092</b>

Table A-6. Project Capital Costs, Truth or Consequences

	1 Acre	4 Acres	10 Acres	15 Acres
<b><u>Capital Costs-Geothermal System</u></b>				
<i>Exploration costs:</i>				
Geology	\$0	\$0	\$0	N/A
Geochemistry	2,500	2,500	5,000	N/A
Geophysics	5,000	5,000	7,500	N/A
Subtotal	\$7,500	\$7,500	\$12,500	N/A
<i>Production well costs:</i>				
Site surveys	\$500	\$500	\$500	N/A
Site preparation	500	500	500	N/A
Drilling	20,000	20,000	20,000	N/A
Site supervision	500	500	500	N/A
Reservoir testing	15,000	15,000	15,000	N/A
Materials and related services	5,000	5,000	5,000	N/A
Rentals	1,000	1,000	1,000	N/A
Insurance-bonding	1,000	1,000	1,000	N/A
Disposal pit	0	0	0	N/A
Filing fees	100	100	100	N/A
Subtotal	\$43,600	\$43,600	\$43,600	N/A
<i>Injection well costs:</i>				
Site surveys	\$500	\$500	\$500	N/A
Site preparation	500	500	500	N/A
Drilling	20,000	20,000	20,000	N/A
Site supervision	500	500	500	N/A
Injection test & monitoring	5,000	5,000	5,000	N/A
Rentals	1,000	1,000	1,000	N/A
Insurance-bonding	1,000	1,000	1,000	N/A
Disposal pit	0	0	0	N/A
Filing fees	100	100	100	N/A
Subtotal	\$28,600	\$28,600	\$28,600	N/A
<i>Production &amp; Injection Equipment:</i>				
Production pump(s) & replace. pump	\$54,600	\$134,980	\$313,630	N/A
Production pipeline	53,300	53,300	149,400	N/A
Injection pipeline	53,300	53,300	149,400	N/A
Power hook-up	15,000	15,000	25,000	N/A
Control system	10,000	10,000	25,000	N/A
Miscellaneous (valves, gauges, etc)	15,000	15,000	20,000	N/A
Subtotal	\$201,200	\$281,580	\$682,430	N/A
Contingency	24,338	52,026	131,200	N/A
<b>TOTAL GEOTHERMAL CAPITAL COSTS</b>	<b>\$348,838</b>	<b>\$745,706</b>	<b>\$1,880,530</b>	<b>N/A</b>

Table A-6, Continued

	1 Acre	4 Acres	10 Acres	15 Acres
<b><u>Capital Costs-Fresh Water System</u></b>				
Fresh water pipeline	\$52,000	\$52,000	\$52,000	N/A
Subtotal	\$52,000	52,000	52,000	N/A
Contingency	3,900	3,900	3,900	N/A
<b>TOTAL WATER SYSTEM     CAPITAL COSTS</b>	\$55,900	\$55,900	\$55,900	N/A
<b>TOTAL COMBINED CAPITAL COSTS</b>	\$404,738	\$801,606	\$1,936,430	N/A

Table A-7. Operating Budget Cash Flow-Animas One Acre Greenhouse

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$1,620	\$1,620	\$1,620	\$1,620	\$1,620	\$1,620	\$1,620	\$1,620	\$1,620	\$1,620
Water	\$2,353	\$2,353	\$2,353	\$2,353	\$2,353	\$2,353	\$2,353	\$2,353	\$2,353	\$2,353
<b>Subtotal</b>	<b>\$3,972</b>	<b>\$3,972</b>	<b>\$3,972</b>	<b>\$3,972</b>	<b>\$3,972</b>	<b>\$3,972</b>	<b>\$3,972</b>	<b>\$3,972</b>	<b>\$3,972</b>	<b>\$3,972</b>
 <i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Royalty payment	\$2,072	\$2,072	\$2,072	\$2,072	\$2,072	\$2,072	\$2,072	\$2,072	\$2,072	\$2,072
Repairs & maintenance	\$24,656	\$24,656	\$24,656	\$24,656	\$24,656	\$24,656	\$24,656	\$24,656	\$24,656	\$24,656
<b>Subtotal</b>	<b>\$27,727</b>	<b>\$27,727</b>	<b>\$27,727</b>	<b>\$27,727</b>	<b>\$27,727</b>	<b>\$27,727</b>	<b>\$27,727</b>	<b>\$27,727</b>	<b>\$27,727</b>	<b>\$27,727</b>
 <i>Other Fixed Expenses</i>										
Principal	\$46,475	\$49,960	\$53,707	\$57,735	\$62,065	\$66,720	\$71,724	\$80,452	\$86,486	\$92,973
Interest	\$49,311	\$45,825	\$42,078	\$38,050	\$33,720	\$29,065	\$24,061	\$20,141	\$14,107	\$7,620
<b>Total Other Fixed Expenses</b>	<b>\$95,786</b>	<b>\$95,786</b>	<b>\$95,786</b>	<b>\$95,786</b>	<b>\$95,786</b>	<b>\$95,786</b>	<b>\$95,786</b>	<b>\$100,593</b>	<b>\$100,593</b>	<b>\$100,593</b>
<b>Total Fixed Operating Expenses</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$128,320</b>	<b>\$128,320</b>	<b>\$128,320</b>
<b>TOTAL EXPENSES</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$123,513</b>	<b>\$128,320</b>	<b>\$128,320</b>	<b>\$128,320</b>

09

Table A-8. Operating Budget Cash Flow-Animas Four Acre Greenhouse

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$6,479	\$6,479	\$6,479	\$6,479	\$6,479	\$6,479	\$6,479	\$6,479	\$6,479	\$6,479
Water	\$3,529	\$3,529	\$3,529	\$3,529	\$3,529	\$3,529	\$3,529	\$3,529	\$3,529	\$3,529
<b>Subtotal</b>	<b>\$10,008</b>	<b>\$10,008</b>	<b>\$10,008</b>	<b>\$10,008</b>	<b>\$10,008</b>	<b>\$10,008</b>	<b>\$10,008</b>	<b>\$10,008</b>	<b>\$10,008</b>	<b>\$10,008</b>
 <i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Royalty payment	\$8,101	\$8,101	\$8,101	\$8,101	\$8,101	\$8,101	\$8,101	\$8,101	\$8,101	\$8,101
Repairs & maintenance	\$25,563	\$25,563	\$25,563	\$25,563	\$25,563	\$25,563	\$25,563	\$25,563	\$25,563	\$25,563
<b>Subtotal</b>	<b>\$34,664</b>	<b>\$34,664</b>	<b>\$34,664</b>	<b>\$34,664</b>	<b>\$34,664</b>	<b>\$34,664</b>	<b>\$34,664</b>	<b>\$34,664</b>	<b>\$34,664</b>	<b>\$34,664</b>
 <i>Other Fixed Expenses</i>										
Principal	\$48,186	\$51,799	\$55,684	\$59,861	\$64,350	\$69,177	\$74,365	\$83,859	\$90,148	\$96,910
Interest	\$51,126	\$47,512	\$43,628	\$39,451	\$34,962	\$30,135	\$24,947	\$21,076	\$14,787	\$8,025
<b>Total Other Fixed Expenses</b>	<b>\$99,312</b>	<b>\$99,312</b>	<b>\$99,312</b>	<b>\$99,312</b>	<b>\$99,312</b>	<b>\$99,312</b>	<b>\$99,312</b>	<b>\$104,935</b>	<b>\$104,935</b>	<b>\$104,935</b>
<b>Total Fixed Operating Expenses</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$139,599</b>	<b>\$139,599</b>	<b>\$139,599</b>
<b>TOTAL EXPENSES</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$133,976</b>	<b>\$139,599</b>	<b>\$139,599</b>	<b>\$139,599</b>

Table A-9. Operating Budget Cash Flow-Animas Ten Acre Greenhouse

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$19,437	\$19,437	\$19,437	\$19,437	\$19,437	\$19,437	\$19,437	\$19,437	\$19,437	\$19,437
Water	\$7,058	\$7,058	\$7,058	\$7,058	\$7,058	\$7,058	\$7,058	\$7,058	\$7,058	\$7,058
<b>Subtotal</b>	<b>\$26,495</b>	<b>\$26,495</b>	<b>\$26,495</b>	<b>\$26,495</b>	<b>\$26,495</b>	<b>\$26,495</b>	<b>\$26,495</b>	<b>\$26,495</b>	<b>\$26,495</b>	<b>\$26,495</b>
<i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Royalty payment	\$20,159	\$20,159	\$20,159	\$20,159	\$20,159	\$20,159	\$20,159	\$20,159	\$20,159	\$20,159
Repairs & maintenance	\$40,229	\$40,229	\$40,229	\$40,229	\$40,229	\$40,229	\$40,229	\$40,229	\$40,229	\$40,229
<b>Subtotal</b>	<b>\$61,388</b>	<b>\$61,388</b>	<b>\$61,388</b>	<b>\$61,388</b>	<b>\$61,388</b>	<b>\$61,388</b>	<b>\$61,388</b>	<b>\$61,388</b>	<b>\$61,388</b>	<b>\$61,388</b>
<i>Other Fixed Expenses</i>										
Principal	\$75,830	\$81,517	\$87,631	\$94,203	\$101,268	\$108,863	\$117,028	\$137,556	\$147,872	\$158,963
Interest	\$80,458	\$74,771	\$68,657	\$62,084	\$55,019	\$47,424	\$39,259	\$35,601	\$25,284	\$14,194
<b>Total Other Fixed Expenses</b>	<b>\$156,288</b>	<b>\$156,288</b>	<b>\$156,288</b>	<b>\$156,288</b>	<b>\$156,288</b>	<b>\$156,288</b>	<b>\$156,288</b>	<b>\$173,157</b>	<b>\$173,157</b>	<b>\$173,157</b>
<b>Total Fixed Operating Expenses</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$234,545</b>	<b>\$234,545</b>	<b>\$234,545</b>
<b>TOTAL EXPENSES</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$217,676</b>	<b>\$234,545</b>	<b>\$234,545</b>	<b>\$234,545</b>

62

~~Operating Budget - Cash Flow - Annals - Fifteen-Acre Greenhouse~~

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$25,916	\$25,916	\$25,916	\$25,916	\$25,916	\$25,916	\$25,916	\$25,916	\$25,916	\$25,916
Water	\$11,763	\$11,763	\$11,763	\$11,763	\$11,763	\$11,763	\$11,763	\$11,763	\$11,763	\$11,763
<b>Subtotal</b>	<b>\$37,679</b>	<b>\$37,679</b>	<b>\$37,679</b>	<b>\$37,679</b>	<b>\$37,679</b>	<b>\$37,679</b>	<b>\$37,679</b>	<b>\$37,679</b>	<b>\$37,679</b>	<b>\$37,679</b>
 <i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Royalty payment	\$30,208	\$30,208	\$30,208	\$30,208	\$30,208	\$30,208	\$30,208	\$30,208	\$30,208	\$30,208
Repairs & maintenance	\$45,175	\$45,175	\$45,175	\$45,175	\$45,175	\$45,175	\$45,175	\$45,175	\$45,175	\$45,175
<b>Subtotal</b>	<b>\$76,383</b>	<b>\$76,383</b>	<b>\$76,383</b>	<b>\$76,383</b>	<b>\$76,383</b>	<b>\$76,383</b>	<b>\$76,383</b>	<b>\$76,383</b>	<b>\$76,383</b>	<b>\$76,383</b>
 <i>Other Fixed Expenses</i>										
Principal	\$85,154	\$91,540	\$98,408	\$105,786	\$113,720	\$122,249	\$131,418	\$156,941	\$168,712	\$181,365
Interest	\$90,351	\$83,964	\$77,099	\$69,718	\$61,784	\$53,255	\$44,087	\$41,055	\$29,285	\$16,631
<b>Total Other Fixed Expenses</b>	<b>\$175,505</b>	<b>\$175,505</b>	<b>\$175,505</b>	<b>\$175,505</b>	<b>\$175,505</b>	<b>\$175,505</b>	<b>\$175,505</b>	<b>\$197,996</b>	<b>\$197,996</b>	<b>\$197,996</b>
<b>Total Fixed Operating Expenses</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$274,380</b>	<b>\$274,380</b>	<b>\$274,380</b>
<b>TOTAL EXPENSES</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$251,888</b>	<b>\$274,380</b>	<b>\$274,380</b>	<b>\$274,380</b>

3

Table A-11. Operating Budget Cash Flow-Las Cruces One Acre Greenhouse

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$9,299	\$9,299	\$9,299	\$9,299	\$9,299	\$9,299	\$9,299	\$9,299	\$9,299	\$9,299
Water	\$2,311	\$2,311	\$2,311	\$2,311	\$2,311	\$2,311	\$2,311	\$2,311	\$2,311	\$2,311
<b>Subtotal</b>	<b>\$11,610</b>	<b>\$11,610</b>	<b>\$11,610</b>	<b>\$11,610</b>	<b>\$11,610</b>	<b>\$11,610</b>	<b>\$11,610</b>	<b>\$11,610</b>	<b>\$11,610</b>	<b>\$11,610</b>
<i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Royalty payment	\$2,078	\$2,078	\$2,078	\$2,078	\$2,078	\$2,078	\$2,078	\$2,078	\$2,078	\$2,078
Repairs & maintenance	\$28,931	\$28,931	\$28,931	\$28,931	\$28,931	\$28,931	\$28,931	\$28,931	\$28,931	\$28,931
<b>Subtotal</b>	<b>\$32,009</b>	<b>\$32,009</b>	<b>\$32,009</b>	<b>\$32,009</b>	<b>\$32,009</b>	<b>\$32,009</b>	<b>\$32,009</b>	<b>\$32,009</b>	<b>\$32,009</b>	<b>\$32,009</b>
<i>Other Fixed Expenses</i>										
Principal	\$54,534	\$58,624	\$63,020	\$67,747	\$72,828	\$78,290	\$84,162	\$95,832	\$103,019	\$110,745
Interest	\$57,862	\$53,772	\$49,375	\$44,649	\$39,567	\$34,105	\$28,234	\$24,256	\$17,068	\$9,342
<b>Total Other Fixed Expenses</b>	<b>\$112,395</b>	<b>\$112,395</b>	<b>\$112,395</b>	<b>\$112,395</b>	<b>\$112,395</b>	<b>\$112,395</b>	<b>\$112,395</b>	<b>\$120,087</b>	<b>\$120,087</b>	<b>\$120,087</b>
<b>Total Fixed Operating Expenses</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$152,096</b>	<b>\$152,096</b>	<b>\$152,096</b>
<b>TOTAL EXPENSES</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$144,404</b>	<b>\$152,096</b>	<b>\$152,096</b>	<b>\$152,096</b>

Table A-12. Operating Budget Cash Flow-Las Cruces Four Acre Greenhouse

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$38,745	\$38,745	\$38,745	\$38,745	\$38,745	\$38,745	\$38,745	\$38,745	\$38,745	\$38,745
Water	\$3,467	\$3,467	\$3,467	\$3,467	\$3,467	\$3,467	\$3,467	\$3,467	\$3,467	\$3,467
<b>Subtotal</b>	<b>\$42,212</b>	<b>\$42,212</b>	<b>\$42,212</b>	<b>\$42,212</b>	<b>\$42,212</b>	<b>\$42,212</b>	<b>\$42,212</b>	<b>\$42,212</b>	<b>\$42,212</b>	<b>\$42,212</b>
 <i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Royalty payment	\$8,126	\$8,126	\$8,126	\$8,126	\$8,126	\$8,126	\$8,126	\$8,126	\$8,126	\$8,126
Repairs & maintenance	\$30,592	\$30,592	\$30,592	\$30,592	\$30,592	\$30,592	\$30,592	\$30,592	\$30,592	\$30,592
<b>Subtotal</b>	<b>\$39,718</b>	<b>\$39,718</b>	<b>\$39,718</b>	<b>\$39,718</b>	<b>\$39,718</b>	<b>\$39,718</b>	<b>\$39,718</b>	<b>\$39,718</b>	<b>\$39,718</b>	<b>\$39,718</b>
 <i>Other Fixed Expenses</i>										
Principal	\$57,665	\$61,990	\$66,639	\$71,637	\$77,010	\$82,785	\$88,994	\$103,344	\$111,095	\$119,427
Interest	\$61,184	\$56,859	\$52,210	\$47,212	\$41,839	\$36,064	\$29,855	\$26,524	\$18,773	\$10,441
<b>Total Other Fixed Expenses</b>	<b>\$118,849</b>	<b>\$118,849</b>	<b>\$118,849</b>	<b>\$118,849</b>	<b>\$118,849</b>	<b>\$118,849</b>	<b>\$118,849</b>	<b>\$129,868</b>	<b>\$129,868</b>	<b>\$129,868</b>
<b>Total Fixed Operating Expenses</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$169,585</b>	<b>\$169,585</b>	<b>\$169,585</b>
<b>TOTAL EXPENSES</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$158,567</b>	<b>\$169,585</b>	<b>\$169,585</b>	<b>\$169,585</b>

59

Table A-13. Operating Budget Cash Flow-Las Cruces Ten Acre Greenhouse

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$92,988	\$92,988	\$92,988	\$92,988	\$92,988	\$92,988	\$92,988	\$92,988	\$92,988	\$92,988
Water	\$6,934	\$6,934	\$6,934	\$6,934	\$6,934	\$6,934	\$6,934	\$6,934	\$6,934	\$6,934
<b>Subtotal</b>	<b>\$99,922</b>	<b>\$99,922</b>	<b>\$99,922</b>	<b>\$99,922</b>	<b>\$99,922</b>	<b>\$99,922</b>	<b>\$99,922</b>	<b>\$99,922</b>	<b>\$99,922</b>	<b>\$99,922</b>
<i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Royalty payment	\$20,222	\$20,222	\$20,222	\$20,222	\$20,222	\$20,222	\$20,222	\$20,222	\$20,222	\$20,222
Repairs & maintenance	\$53,335	\$53,335	\$53,335	\$53,335	\$53,335	\$53,335	\$53,335	\$53,335	\$53,335	\$53,335
<b>Subtotal</b>	<b>\$74,557</b>	<b>\$74,557</b>	<b>\$74,557</b>	<b>\$74,557</b>	<b>\$74,557</b>	<b>\$74,557</b>	<b>\$74,557</b>	<b>\$74,557</b>	<b>\$74,557</b>	<b>\$74,557</b>
<i>Other Fixed Expenses</i>										
Principal	\$100,534	\$108,074	\$116,180	\$124,893	\$134,260	\$144,330	\$155,155	\$184,441	\$198,275	\$213,145
Interest	\$106,670	\$99,130	\$91,024	\$82,311	\$72,944	\$62,874	\$52,050	\$48,102	\$34,269	\$19,398
<b>Total Other Fixed Expenses</b>	<b>\$207,204</b>	<b>\$207,204</b>	<b>\$207,204</b>	<b>\$207,204</b>	<b>\$207,204</b>	<b>\$207,204</b>	<b>\$207,204</b>	<b>\$232,543</b>	<b>\$232,543</b>	<b>\$232,543</b>
<b>Total Fixed Operating Expenses</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$307,100</b>	<b>\$307,100</b>	<b>\$307,100</b>
<b>TOTAL EXPENSES</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$281,761</b>	<b>\$307,100</b>	<b>\$307,100</b>	<b>\$307,100</b>

Table A-14. Operating Budget Cash Flow-Las Cruces Fifteen Acre Greenhouse

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$139,482	\$139,482	\$139,482	\$139,482	\$139,482	\$139,482	\$139,482	\$139,482	\$139,482	\$139,482
Water	\$11,556	\$11,556	\$11,556	\$11,556	\$11,556	\$11,556	\$11,556	\$11,556	\$11,556	\$11,556
<b>Subtotal</b>	<b>\$151,038</b>	<b>\$151,038</b>	<b>\$151,038</b>	<b>\$151,038</b>	<b>\$151,038</b>	<b>\$151,038</b>	<b>\$151,038</b>	<b>\$151,038</b>	<b>\$151,038</b>	<b>\$151,038</b>
<i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Royalty payment	\$30,302	\$30,302	\$30,302	\$30,302	\$30,302	\$30,302	\$30,302	\$30,302	\$30,302	\$30,302
Repairs & maintenance	\$61,563	\$61,563	\$61,563	\$61,563	\$61,563	\$61,563	\$61,563	\$61,563	\$61,563	\$61,563
<b>Subtotal</b>	<b>\$92,864</b>	<b>\$92,864</b>	<b>\$92,864</b>	<b>\$92,864</b>	<b>\$92,864</b>	<b>\$92,864</b>	<b>\$92,864</b>	<b>\$92,864</b>	<b>\$92,864</b>	<b>\$92,864</b>
<i>Other Fixed Expenses</i>										
Principal	\$116,043	\$124,746	\$134,102	\$144,160	\$154,972	\$166,595	\$179,090	\$218,997	\$235,422	\$253,078
Interest	\$123,125	\$114,422	\$105,066	\$95,009	\$84,197	\$72,574	\$60,079	\$58,181	\$41,756	\$24,099
<b>Total Other Fixed Expenses</b>	<b>\$239,169</b>	<b>\$239,169</b>	<b>\$239,169</b>	<b>\$239,169</b>	<b>\$239,169</b>	<b>\$239,169</b>	<b>\$239,169</b>	<b>\$277,178</b>	<b>\$277,178</b>	<b>\$277,178</b>
<b>Total Fixed Operating Expenses</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$370,042</b>	<b>\$370,042</b>	<b>\$370,042</b>
<b>TOTAL EXPENSES</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$332,033</b>	<b>\$370,042</b>	<b>\$370,042</b>	<b>\$370,042</b>

Table A-15. Operating Budget Cash Flow-Truth or Consequences One Acre Greenhouse

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$5,759	\$5,759	\$5,759	\$5,759	\$5,759	\$5,759	\$5,759	\$5,759	\$5,759	\$5,759
Water	\$2,868	\$2,868	\$2,868	\$2,868	\$2,868	\$2,868	\$2,868	\$2,868	\$2,868	\$2,868
<b>Subtotal</b>	<b>\$8,627</b>	<b>\$8,627</b>	<b>\$8,627</b>	<b>\$8,627</b>	<b>\$8,627</b>	<b>\$8,627</b>	<b>\$8,627</b>	<b>\$8,627</b>	<b>\$8,627</b>	<b>\$8,627</b>
 <i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Repairs & maintenance	\$12,142	\$12,142	\$12,142	\$12,142	\$12,142	\$12,142	\$12,142	\$12,142	\$12,142	\$12,142
<b>Subtotal</b>	<b>\$13,142</b>	<b>\$13,142</b>	<b>\$13,142</b>	<b>\$13,142</b>	<b>\$13,142</b>	<b>\$13,142</b>	<b>\$13,142</b>	<b>\$13,142</b>	<b>\$13,142</b>	<b>\$13,142</b>
 <i>Other Fixed Expenses</i>										
Principal	\$22,887	\$24,604	\$26,449	\$28,433	\$30,565	\$32,858	\$35,322	\$43,343	\$46,594	\$50,088
Interest	\$24,284	\$22,568	\$20,722	\$18,739	\$16,606	\$14,314	\$11,849	\$11,540	\$8,290	\$4,795
<b>Total Other Fixed Expenses</b>	<b>\$47,172</b>	<b>\$47,172</b>	<b>\$47,172</b>	<b>\$47,172</b>	<b>\$47,172</b>	<b>\$47,172</b>	<b>\$47,172</b>	<b>\$54,883</b>	<b>\$54,883</b>	<b>\$54,883</b>
<b>Total Fixed Operating Expenses</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$68,025</b>	<b>\$68,025</b>	<b>\$68,025</b>
<b>TOTAL EXPENSES</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$60,314</b>	<b>\$68,025</b>	<b>\$68,025</b>	<b>\$68,025</b>

9  
8

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$17,277	\$17,277	\$17,277	\$17,277	\$17,277	\$17,277	\$17,277	\$17,277	\$17,277	\$17,277
Water	\$11,472	\$11,472	\$11,472	\$11,472	\$11,472	\$11,472	\$11,472	\$11,472	\$11,472	\$11,472
<b>Subtotal</b>	<b>\$28,749</b>	<b>\$28,749</b>	<b>\$28,749</b>	<b>\$28,749</b>	<b>\$28,749</b>	<b>\$28,749</b>	<b>\$28,749</b>	<b>\$28,749</b>	<b>\$28,749</b>	<b>\$28,749</b>
<i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Repairs & maintenance	\$24,048	\$24,048	\$24,048	\$24,048	\$24,048	\$24,048	\$24,048	\$24,048	\$24,048	\$24,048
<b>Subtotal</b>	<b>\$25,048</b>	<b>\$25,048</b>	<b>\$25,048</b>	<b>\$25,048</b>	<b>\$25,048</b>	<b>\$25,048</b>	<b>\$25,048</b>	<b>\$25,048</b>	<b>\$25,048</b>	<b>\$25,048</b>
<i>Other Fixed Expenses</i>										
Principal	\$45,330	\$48,730	\$52,384	\$56,313	\$60,537	\$65,077	\$69,958	\$91,608	\$98,479	\$105,865
Interest	\$48,096	\$44,697	\$41,042	\$37,113	\$32,890	\$28,349	\$23,469	\$25,368	\$18,497	\$11,111
<b>Total Other Fixed Expenses</b>	<b>\$93,426</b>	<b>\$93,426</b>	<b>\$93,426</b>	<b>\$93,426</b>	<b>\$93,426</b>	<b>\$93,426</b>	<b>\$93,426</b>	<b>\$116,976</b>	<b>\$116,976</b>	<b>\$116,976</b>
<b>Total Fixed Operating Expenses</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$142,024</b>	<b>\$142,024</b>	<b>\$142,024</b>
<b>TOTAL EXPENSES</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$118,474</b>	<b>\$142,024</b>	<b>\$142,024</b>	<b>\$142,024</b>

69

Table A-17. Operating Budget Cash Flow-Truth or Consequences Ten Acre Greenhouse

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<i>Production Expenses</i>										
Electricity:										
Geothermal	\$43,193	\$43,193	\$43,193	\$43,193	\$43,193	\$43,193	\$43,193	\$43,193	\$43,193	\$43,193
Water	\$28,679	\$28,679	\$28,679	\$28,679	\$28,679	\$28,679	\$28,679	\$28,679	\$28,679	\$28,679
<b>Subtotal</b>	<b>\$71,872</b>	<b>\$71,872</b>	<b>\$71,872</b>	<b>\$71,872</b>	<b>\$71,872</b>	<b>\$71,872</b>	<b>\$71,872</b>	<b>\$71,872</b>	<b>\$71,872</b>	<b>\$71,872</b>
<i>Fixed Operating Expenses</i>										
Insurance	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Repairs & maintenance	\$58,093	\$58,093	\$58,093	\$58,093	\$58,093	\$58,093	\$58,093	\$58,093	\$58,093	\$58,093
<b>Subtotal</b>	<b>\$59,093</b>	<b>\$59,093</b>	<b>\$59,093</b>	<b>\$59,093</b>	<b>\$59,093</b>	<b>\$59,093</b>	<b>\$59,093</b>	<b>\$59,093</b>	<b>\$59,093</b>	<b>\$59,093</b>
<i>Other Fixed Expenses</i>										
Principal	\$109,503	\$117,715	\$126,544	\$136,035	\$146,237	\$157,205	\$168,996	\$222,680	\$239,381	\$257,335
Interest	\$116,186	\$107,973	\$99,144	\$89,654	\$79,451	\$68,483	\$56,693	\$61,883	\$45,182	\$27,229
<b>Total Other Fixed Expenses</b>	<b>\$225,688</b>	<b>\$225,688</b>	<b>\$225,688</b>	<b>\$225,688</b>	<b>\$225,688</b>	<b>\$225,688</b>	<b>\$225,688</b>	<b>\$284,563</b>	<b>\$284,563</b>	<b>\$284,563</b>
<b>Total Fixed Operating Expenses</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$343,656</b>	<b>\$343,656</b>	<b>\$343,656</b>
<b>TOTAL EXPENSES</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$284,781</b>	<b>\$343,656</b>	<b>\$343,656</b>	<b>\$343,656</b>

70

**Appendix B**  
**Greenhouse Heat Loss Simulations**

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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset (no side walls)	
Multiple arched roof	1
Heating Degree Days (65°F)	3,213
No. of house sections	20
Infiltration airchange/hour	1.00
Temperature difference, °F	50

<b>DIMENSIONS</b>	<b>FEET</b>
Single material wall height	7.0
House width	21.8
House length	100.0
Rafter/arch length	23.7
Lower wall height	
Upper wall height	
Gable height, peaked roof	
Gable height, arched roof	4.0

<b>AREA</b>	<b>SQ. FT.</b>
Single material wall	7,504
Lower wall section	0
Upper wall section	0
Gable end peaked roof	0
Roof area peaked roof	0
Gable end arched roof	2,384
Roof area arched roof	47,400
Perimeter	1,072

<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	375,200
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	119,202
Roof	Double Poly	0.7	1,659,000
Perimeter	Not insulated	0.8	42,880
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>2,196,282</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	424,402	424,402
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>424,402</b>

<b>TOTAL HEAT LOSS</b>	<b>2,620,685 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>4,042 Million BTU</b>

Geothermal Supply, °F	190
Return Temperature, °F	120

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>7.5 GALLONS PER MIN</b>
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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset (no side walls)	
Multiple arched roof	1
Heating Degree Days (65°F)	3,213
No. of house sections	80
Infiltration airchange/hour	1.00
Temperature difference, °F	50

<b>DIMENSIONS</b>	<b>FEET</b>
Single material wall height	7.0
House width	21.8
House length	100.0
Rafter/arch length	23.7
Lower wall height	
Upper wall height	
Gable height, peaked roof	
Gable height, arched roof	4.0

<b>AREA</b>	<b>SQ. FT.</b>
Single material wall	25,816
Lower wall section	0
Upper wall section	0
Gable end peaked roof	0
Roof area peaked roof	0
Gable end arched roof	9,536
Roof area arched roof	189,600
Perimeter	3,688

<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	1,290,800
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	476,810
Roof	Double Poly	0.7	6,636,000
Perimeter	Not insulated	0.8	147,520
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>8,551,130</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	1,697,610	1,697,610
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>1,697,610</b>

<b>TOTAL HEAT LOSS</b>	<b>10,248,740 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>15,806 Million BTU</b>

Geothermal Supply, °F	190
Return Temperature, °F	120

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>293 GALLONS PER MIN</b>
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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset (no side walls)	
Multiple arched roof	1
Heating Degree Days (65°F)	3,213
No. of house sections	200
Infiltration airchange/hour	1.00
Temperature difference, °F	50

<b>DIMENSIONS</b>	<b>FEET</b>
Single material wall height	7.0
House width	21.8
House length	100.0
Rafter/arch length	23.7
Lower wall height	
Upper wall height	
Gable height, peaked roof	
Gable height, arched roof	4.0

<b>AREA</b>	<b>SQ. FT.</b>
Single material wall	62,440
Lower wall section	0
Upper wall section	0
Gable end peaked roof	0
Roof area peaked roof	0
Gable end arched roof	23,840
Roof area arched roof	474,000
Perimeter	8,920

<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	3,122,000
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	1,192,024
Roof	Double Poly	0.7	16,590,000
Perimeter	Not insulated	0.8	356,800
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>21,260,824</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	4,244,024	4,244,024
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>4,244,024</b>

<b>TOTAL HEAT LOSS</b>	<b>25,504,849 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>39,335 Million BTU</b>

Geothermal Supply, °F	190
Return Temperature, °F	120

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>730 GALLONS PER MIN</b>
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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset (no side walls)	
Multiple arched roof	1
Heating Degree Days (65°F)	3,213
No. of house sections	300
Infiltration airchange/hour	1.00
Temperature difference, °F	50

<b>DIMENSIONS</b>	<b>FEET</b>
Single material wall height	7.0
House width	21.8
House length	100.0
Rafter/arch length	23.7
Lower wall height	
Upper wall height	
Gable height, peaked roof	
Gable height, arched roof	4.0

<b>AREA</b>	<b>SQ. FT.</b>
Single material wall	92,960
Lower wall section	0
Upper wall section	0
Gable end peaked roof	0
Roof area peaked roof	0
Gable end arched roof	35,761
Roof area arched roof	711,000
Perimeter	13,280

<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	4,648,000
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	1,788,037
Roof	Double Poly	0.7	24,885,000
Perimeter	Not insulated	0.8	531,200
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>31,852,237</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	6,366,037	6,366,037
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>6,366,037</b>

<b>TOTAL HEAT LOSS</b>	<b>38,218,273 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>58,942 Million BTU</b>

Geothermal Supply, °F	190
Return Temperature, °F	120

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>1,094 GALLONS PER MIN</b>
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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset	
Multiple arched roof	1
Heating Degree Days (65°F)	3,223
No. of house sections	20
Infiltration airchange/hour	1.00
Temperature difference, °F	47

<b>DIMENSIONS</b>	<b>FEET</b>	<b>AREA</b>	<b>SQ. FT.</b>
Single material wall height	7.0	Single material wall	7,504
House width	21.8	Lower wall section	0
House length	100.0	Upper wall section	0
Rafter length	23.7	Gable end peaked roof	0
Lower wall height		Roof area peaked roof	0
Upper wall height		Gable end arched roof	2,384
Gable height, peaked roof		Roof area arched roof	47,400
Gable height, arched roof	4.0	Perimeter	1,072

<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	352,688
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	112,050
Roof	Double Poly	0.7	1,559,460
Perimeter	Not insulated	0.8	40,307
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>2,064,505</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	424,402	398,938
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>398,938</b>

<b>PEAK HEAT LOSS</b>	<b>2,463,444 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>4,054 Million BTU</b>

Geothermal Supply, °F	150
Return Temperature, °F	120

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>164 GALLONS PER MIN</b>
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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset	
Multiple arched roof	1
Heating Degree Days (65°F)	3,223
No. of house sections	80
Infiltration airchange/hour	1.00
Temperature difference, °F	47

<b>DIMENSIONS</b>	<b>FEET</b>
Single material wall height	7.0
House width	21.8
House length	100.0
Rafter length	23.7
Lower wall height	
Upper wall height	
Gable height, peaked roof	
Gable height, arched roof	4.0

<b>AREA</b>	<b>SQ. FT.</b>
Single material wall	25,816
Lower wall section	0
Upper wall section	0
Gable end peaked roof	0
Roof area peaked roof	0
Gable end arched roof	9,536
Roof area arched roof	189,600
Perimeter	3,688

<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	1,213,352
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	448,201
Roof	Double Poly	0.7	6,237,840
Perimeter	Not insulated	0.8	138,669
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>8,038,062</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	1,697,610	1,595,753
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>1,595,753</b>

<b>PEAK HEAT LOSS</b>	<b>9,633,815 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>15,855 Million BTU</b>

Geothermal Supply, °F	150
Return Temperature, °F	120

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>643 GALLONS PER MIN</b>
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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset	
Multiple arched roof	1
Heating Degree Days (65°F)	3,223
No. of house sections	200
Infiltration airchange/hour	1.00
Temperature difference, °F	47

<b>DIMENSIONS</b>	<b>FEET</b>
Single material wall height	7.0
House width	21.8
House length	100.0
Rafter length	23.7
Lower wall height	
Upper wall height	
Gable height, peaked roof	
Gable height, arched roof	4.0

<b>AREA</b>	<b>SQ. FT.</b>
Single material wall	62,440
Lower wall section	0
Upper wall section	0
Gable end peaked roof	0
Roof area peaked roof	0
Gable end arched roof	23,840
Roof area arched roof	474,000
Perimeter	8,920

<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	2,934,680
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	1,120,503
Roof	Double Poly	0.7	15,594,600
Perimeter	Not insulated	0.8	335,392
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>19,985,175</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	4,244,024	3,989,383
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>3,989,383</b>

<b>PEAK HEAT LOSS</b>	<b>23,974,558 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>39,457 Million BTU</b>

Geothermal Supply, °F	150
Return Temperature, °F	120

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>1,601 GALLONS PER MIN</b>
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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset	
Multiple arched roof	1
Heating Degree Days (65°F)	3,223
No. of house sections	300
Infiltration airchange/hour	1.00
Temperature difference, °F	47

<b>DIMENSIONS</b>	<b>FEET</b>
Single material wall height	7.0
House width	21.8
House length	100.0
Rafter length	23.7
Lower wall height	
Upper wall height	
Gable height, peaked roof	
Gable height, arched roof	4.0

<b>AREA</b>	<b>SQ. FT.</b>
Single material wall	92,960
Lower wall section	0
Upper wall section	0
Gable end peaked roof	0
Roof area peaked roof	0
Gable end arched roof	35,761
Roof area arched roof	711,000
Perimeter	13,280

<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	4,369,120
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	1,680,754
Roof	Double Poly	0.7	23,391,900
Perimeter	Not insulated	0.8	499,328
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>29,941,102</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	6,366,037	5,984,074
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>5,984,074</b>

<b>PEAK HEAT LOSS</b>	<b>35,925,177 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>59,125 Million BTU</b>

Geothermal Supply, °F	150
Return Temperature, °F	120

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>2,399 GALLONS PER MIN</b>
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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset (no side walls)	
Multiple arched roof	1
Heating Degree Days (65°F)	3,394
No. of house sections	20
Infiltration airchange/hour	1.00
Temperature difference, °F	50

<b>DIMENSIONS</b>	<b>FEET</b>
Single material wall height	7.0
House width	21.8
House length	100.0
Rafter/arch length	23.7
Lower wall height	
Upper wall height	
Gable height, peaked roof	
Gable height, arched roof	4.0

<b>AREA</b>	<b>SQ. FT.</b>
Single material wall	7,504
Lower wall section	0
Upper wall section	0
Gable end peaked roof	0
Roof area peaked roof	0
Gable end arched roof	2,384
Roof area arched roof	47,400
Perimeter	1,072

<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	375,200
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	119,202
Roof	Double Poly	0.7	1,659,000
Perimeter	Not insulated	0.8	42,880
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>2,196,282</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	424,402	424,402
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>424,402</b>

<b>TOTAL HEAT LOSS</b>	<b>2,620,685 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>4,269 Million BTU</b>

Geothermal Supply, °F	107
Return Temperature, °F	95

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>437 GALLONS PER MIN</b>
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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset (no side walls)	
Multiple arched roof	1
Heating Degree Days (65°F)	3,394
No. of house sections	80
Infiltration airchange/hour	1.00
Temperature difference, °F	50

<b>DIMENSIONS</b>	<b>FEET</b>
Single material wall height	7.0
House width	21.8
House length	100.0
Rafter/arch length	23.7
Lower wall height	
Upper wall height	
Gable height, peaked roof	
Gable height, arched roof	4.0

<b>AREA</b>	<b>SQ. FT.</b>
Single material wall	25,816
Lower wall section	0
Upper wall section	0
Gable end peaked roof	0
Roof area peaked roof	0
Gable end arched roof	9,536
Roof area arched roof	189,600
Perimeter	3,688

<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	1,290,800
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	476,810
Roof	Double Poly	0.7	6,636,000
Perimeter	Not insulated	0.8	147,520
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>8,551,130</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	1,697,610	1,697,610
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>1,697,610</b>

<b>TOTAL HEAT LOSS</b>	<b>10,248,740 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>16,696 Million BTU</b>

Geothermal Supply, °F	107
Return Temperature, °F	95

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>1,711 GALLONS PER MIN</b>
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**GREENHOUSE HEAT LOSS CALCULATION**

<b>GREENHOUSE TYPE</b>	
Peaked roof	
Quonset (no side walls)	
Multiple arched roof	1
Heating Degree Days (65°F)	3,394
No. of house sections	200
Infiltration airchange/hour	1.00
Temperature difference, °F	50

<b>DIMENSIONS</b>	<b>FEET</b>
Single material wall height	7.0
House width	21.8
House length	100.0
Rafter/arch length	23.7
Lower wall height	
Upper wall height	
Gable height, peaked roof	
Gable height, arched roof	4.0

<b>AREA</b>	<b>SQ. FT.</b>
Single material wall	62,440
Lower wall section	0
Upper wall section	0
Gable end peaked roof	0
Roof area peaked roof	0
Gable end arched roof	23,840
Roof area arched roof	474,000
Perimeter	8,920

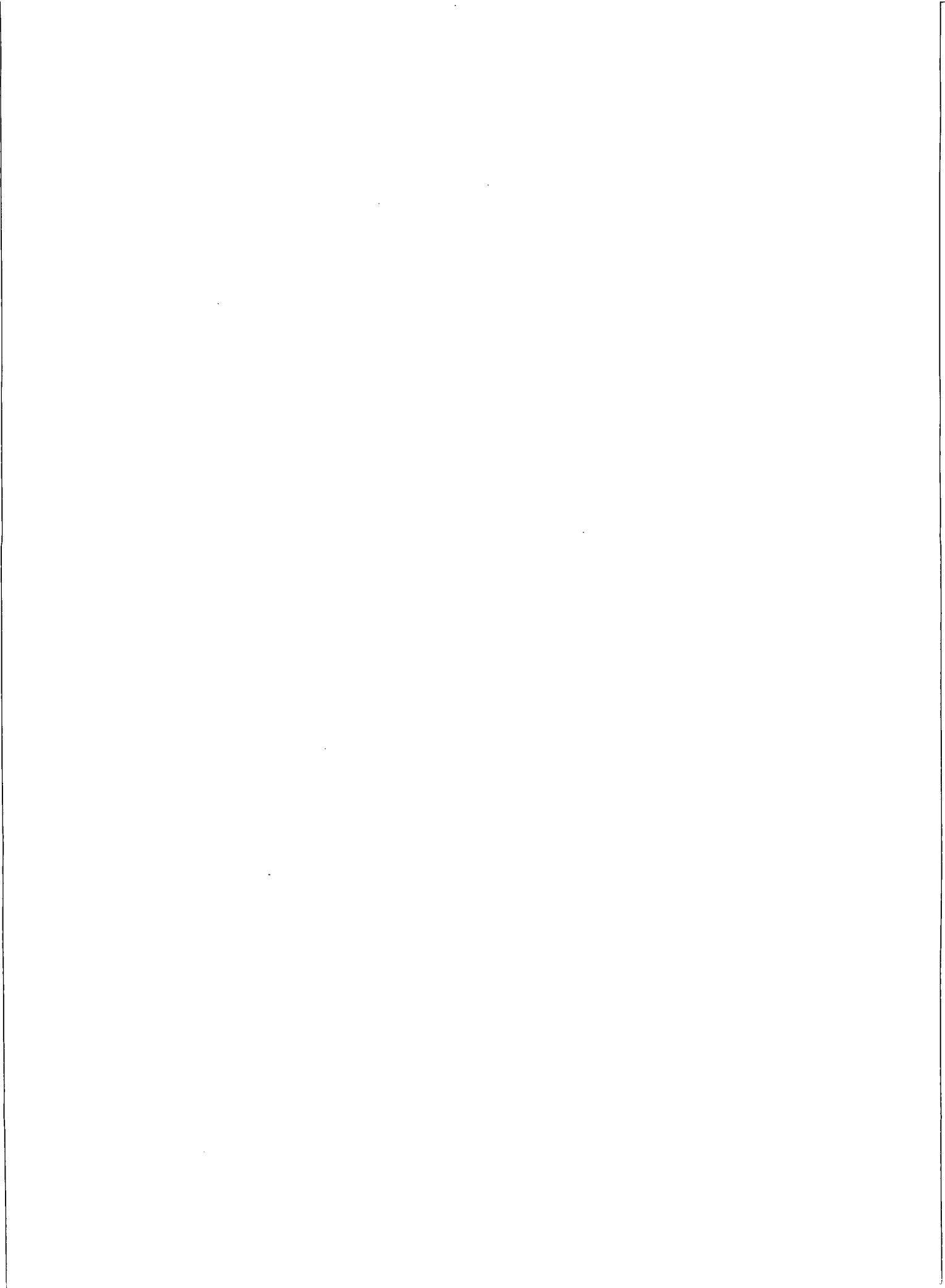
<b>CONDUCTION HEAT LOSS</b>			
<b>LOCATION</b>	<b>MATERIALS</b>	<b>U-FACTOR</b>	<b>HEAT LOSSES</b>
Single material wall	Fiberglass	1.0	3,122,000
Lower wall			0
Upper wall			0
End area	Fiberglass	1.0	1,192,024
Roof	Double Poly	0.7	16,590,000
Perimeter	Not insulated	0.8	356,800
<b>TOTAL CONDUCTION HEAT LOSS</b>			<b>21,260,824</b>

<b>INFILTRATION HEAT LOSS</b>		
<b>GREENHOUSE TYPE</b>	<b>VOLUME, CF</b>	<b>INFILTRATION LOSS</b>
Peaked roof house	0	0
Quonset house	0	0
Multiple arched roof	4,244,024	4,244,024
<b>TOTAL INFILTRATION HEAT LOSS</b>		<b>4,244,024</b>

<b>TOTAL HEAT LOSS</b>	<b>25,504,849 BTU PER HOUR</b>
<b>ANNUAL HEAT REQUIREMENT</b>	<b>41,550 Million BTU</b>

Geothermal Supply, °F	107
Return Temperature, °F	95

<b>REQUIRED GEOTHERMAL FLOWRATE</b>	<b>4,258 GALLONS PER MIN</b>
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**Appendix C**  
**Levelized Life-Cycle Cost Data**

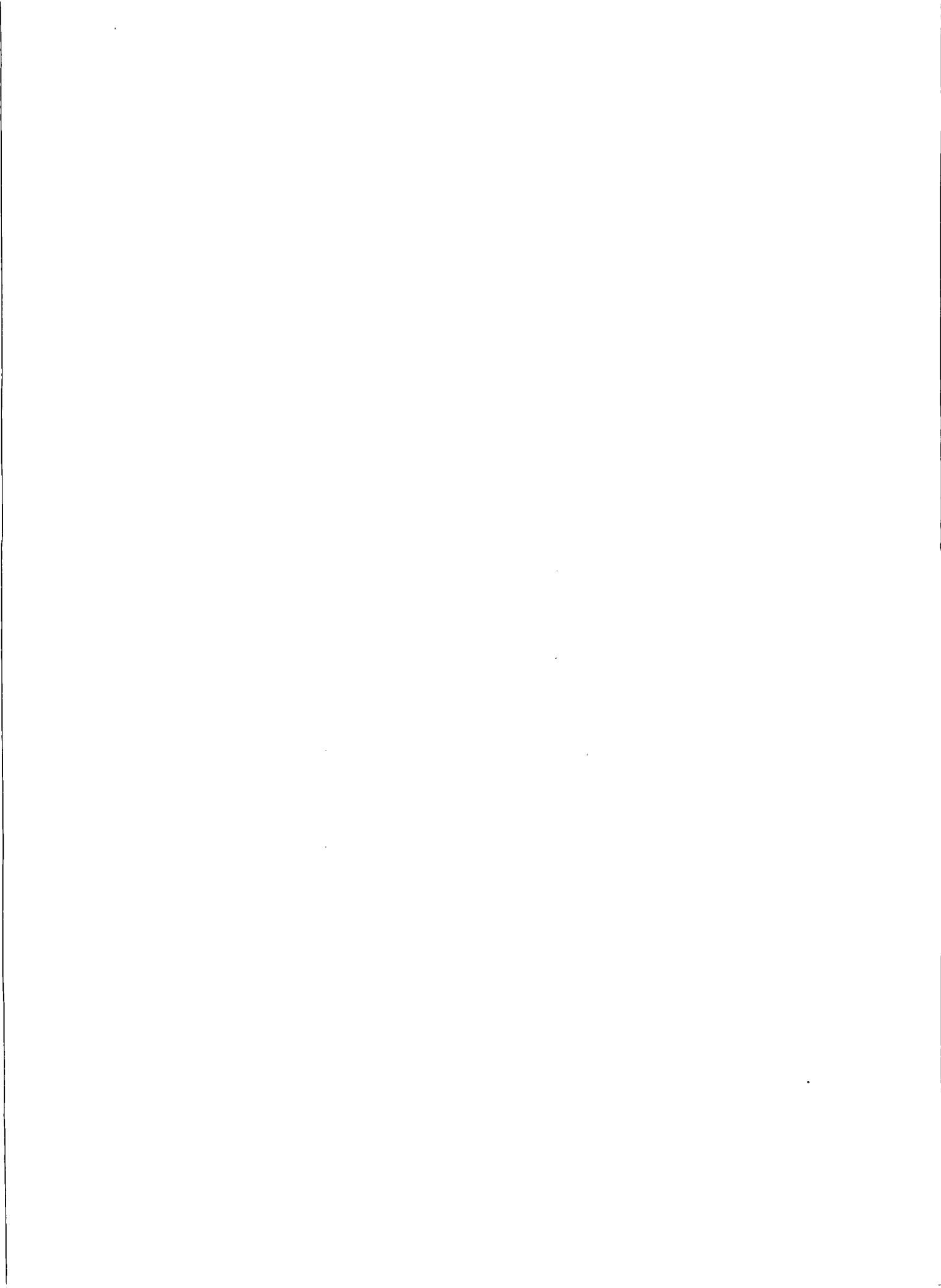


Table C-1. Levelized Geothermal System Costs, Animas,  
One Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 254,192	\$ 219,346	\$ 21,516
Annual Operating Cost	240,864	122,774	12,043
Salvage Value **	34,419	18,103	1,776
<b>TOTAL COSTS</b>	<b>\$ 460,637</b>	<b>\$ 324,018</b>	<b>\$ 31,784</b>
Levelized cost (\$/MMBTU)			\$7.86

\* Includes pump replacement costs

\*\* Geothermal lease fees salvaged at original cost

Table C-2. Levelized Geothermal System Costs, Animas,  
Four Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 269,378	\$ 228,620	\$ 22,426
Annual Operating Cost	546,068	278,344	27,303
Salvage Value **	35,938	18,460	1,811
<b>TOTAL COSTS</b>	<b>\$ 779,508</b>	<b>\$ 488,503</b>	<b>\$ 47,918</b>
Levelized cost (\$/MMBTU)			\$3.03

\* Includes pump replacement costs

\*\* Geothermal lease fees salvaged at original cost

Table C-3. Levelized Geothermal System Costs, Animas,  
Ten Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 632,371	\$ 510,096	\$ 50,036
Annual Operating Cost	1,296,256	660,734	64,813
Salvage Value **	72,237	27,006	2,649
<b>TOTAL COSTS</b>	<b>\$ 1,856,391</b>	<b>\$ 1,143,824</b>	<b>\$112,200</b>
Levelized cost (\$/MMBTU)			\$2.85

\* Includes pump replacement costs

\*\* Geothermal lease fees salvaged at original cost

Table C-4. Levelized Geothermal System Costs, Animas,  
Fifteen Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 850,472	\$ 687,438	\$ 67,432
Annual Operating Cost	1,730,277	881,964	86,514
Salvage Value **	94,047	32,140	3,153
<b>TOTAL COSTS</b>	<b>\$ 2,486,701</b>	<b>\$ 1,537,263</b>	<b>\$150,793</b>
Levelized cost (\$/MMBTU)			\$2.56

\* Includes pump replacement costs

\*\* Geothermal lease fees salvaged at original cost

Table C-5. Levelized Geothermal System Costs, Las Cruces,  
One Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 420,023	\$ 364,269	\$ 35,732
Annual Operating Cost	527,220	268,737	26,361
Salvage Value **	51,002	22,007	2,159
<b>TOTAL COSTS</b>	<b>\$ 896,241</b>	<b>\$ 610,999</b>	<b>\$ 59,934</b>
Levelized cost (\$/MMBTU)			\$14.78

\* Includes pump replacement costs

\*\* Geothermal lease fees salvaged at original cost

Table C-6. Levelized Geothermal System Costs, Las Cruces,  
Four Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 493,848	\$ 413,979	\$ 40,608
Annual Operating Cost	1,388,470	707,737	69,423
Salvage Value **	58,385	23,745	2,329
<b>TOTAL COSTS</b>	<b>\$ 1,823,933</b>	<b>\$ 1,097,972</b>	<b>\$ 107,702</b>
Levelized cost (\$/MMBTU)			\$6.79

\* Includes pump replacement costs

\*\* Geothermal lease fees salvaged at original cost

Table C-7. Levelized Geothermal System Costs, Las Cruces,  
Ten Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 919,744	\$ 736,071	\$ 72,203
Annual Operating Cost	3,092,331	1,576,237	154,617
Salvage Value **	100,974	33,771	3,313
<b>TOTAL COSTS</b>	<b>\$ 3,911,100</b>	<b>\$ 2,278,538</b>	<b>\$ 223,507</b>
Levelized cost (\$/MMBTU)			\$5.66

\* Includes pump replacement costs

\*\* Geothermal lease fees salvaged at original cost

Table C-8. Levelized Geothermal System Costs, Las Cruces,  
Fifteen Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 1,315,808	\$ 1,040,299	\$ 102,045
Annual Operating Cost	4,408,346	2,247,042	220,417
Salvage Value **	140,581	43,095	4,227
<b>TOTAL COSTS</b>	<b>\$ 5,583,573</b>	<b>\$ 3,244,246</b>	<b>\$ 318,235</b>
Levelized cost (\$/MMBTU)			\$5.38

\* Includes pump replacement costs

\*\* Geothermal lease fees salvaged at original cost

Table C-9. Levelized Geothermal System Costs,  
Truth or Consequences, One Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 432,038	\$ 376,140	\$ 36,896
Annual Operating Cost	321,481	163,867	16,074
Salvage Value	43,204	10,171	998
<b>TOTAL COSTS</b>	<b>\$710,315</b>	<b>\$ 529,836</b>	<b>\$ 51,973</b>
Levelized cost (\$/MMBTU)			\$12.86

\* Includes pump replacement costs

Table C-10. Levelized Geothermal System Costs,  
Truth or Consequences, Four Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 999,786	\$ 829,085	\$ 81,327
Annual Operating Cost	723,419	368,744	36,171
Salvage Value	99,979	23,536	2,309
<b>TOTAL COSTS</b>	<b>\$ 1,623,226</b>	<b>\$ 1,174,292</b>	<b>\$ 115,189</b>
Levelized cost (\$/MMBTU)			\$7.29

\* Includes pump replacement costs

Table C-11. Levelized Geothermal System Costs,  
Truth or Consequences, Ten Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 2,515,730	\$ 2,088,976	\$ 204,912
Annual Operating Cost	1,771,522	902,988	88,576
Salvage Value	251,573	59,224	5,809
<b>TOTAL COSTS</b>	<b>\$ 4,035,679</b>	<b>\$ 2,932,741</b>	<b>\$ 287,679</b>
Levelized cost (\$/MMBTU)			\$7.31

\* Includes pump replacement costs

Table C-12. Levelized Fresh Water System Costs, Animas,  
One Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 626,325	\$ 617,108	\$ 60,533
Annual Operating Cost	393,125	200,385	19,656
Salvage Value **	130,133	87,979	8,630
<b>TOTAL COSTS</b>	<b>\$ 889,317</b>	<b>\$ 729,514</b>	<b>\$ 71,560</b>
Levelized cost (\$/1000 gal)			\$21.96

\* Includes pump replacement costs

\*\* Water rights salvaged at original cost

Table C-13. Levelized Fresh Water System Costs, Animas,  
Four Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 651,420	\$ 641,531	\$ 62,929
Annual Operating Cost	347,368	177,062	17,368
Salvage Value **	132,642	88,570	8,688
<b>TOTAL COSTS</b>	<b>\$ 866,146</b>	<b>\$ 730,023</b>	<b>\$ 71,610</b>
Levelized cost (\$/1000 gal)			\$5.49

\* Includes pump replacement costs

\*\* Water rights salvaged at original cost

Table C-14. Levelized Fresh Water System Costs, Animas,  
Ten Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 901,367	\$ 889,968	\$ 87,229
Annual Operating Cost	461,407	235,191	23,070
Salvage Value **	360,137	314,157	30,816
<b>TOTAL COSTS</b>	<b>\$1,002,637</b>	<b>\$ 811,002</b>	<b>\$ 79,553</b>
Levelized cost (\$/1000 gal)			\$2.44

\* Includes pump replacement costs

\*\* Water rights salvaged at original cost

Table C-15. Levelized Fresh Water System Costs, Animas,  
Fifteen Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost*	\$ 912,666	\$ 899,156	\$ 88,200
Annual Operating Cost	550,975	280,845	27,549
Salvage Value **	361,267	314,423	30,842
<b>TOTAL COSTS</b>	<b>\$1,102,375</b>	<b>\$ 865,578</b>	<b>\$ 84,906</b>
Levelized cost (\$/1000 gal)			\$1.74

\* Includes pump replacement costs

\*\* Water rights salvaged at original cost

Table C-16. Levelized Fresh Water System Costs, Las Cruces,  
One Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 660,927	\$634,910	\$62,280
Annual Operating Cost	365,902	175,932	17,258
Salvage Value **	201,093	162,028	15,894
<b>TOTAL COSTS</b>	<b>\$ 825,737</b>	<b>\$648,814</b>	<b>\$63,644</b>
Levelized cost (\$/1000 gal)			\$19.53

\* Includes pump replacement costs

\*\* Water rights salvaged at original cost

Table C-17. Levelized Fresh Water System Costs, Las Cruces,  
Four Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 680,819	\$ 652,904	\$ 64,045
Annual Operating Cost	296,622	127,493	12,506
Salvage Value **	203,082	162,496	15,940
<b>TOTAL COSTS</b>	<b>\$ 774,359</b>	<b>\$ 617,902</b>	<b>\$ 60,611</b>
Levelized cost (\$/1000 gal)			\$4.65

\* Includes pump replacement costs

\*\* Water rights salvaged at original cost

Table C-18. Levelized Fresh Water System Costs, Las Cruces,  
Ten Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$1,173,025	\$1,140,852	\$111,909
Annual Operating Cost	493,463	202,480	19,862
Salvage Value **	657,303	613,490	60,179
<b>TOTAL COSTS</b>	<b>\$1,009,186</b>	<b>\$ 729,842</b>	<b>\$ 71,592</b>
Levelized cost (\$/1000 gal)			\$2.20

\* Includes pump replacement costs

\*\* Water rights salvaged at original cost

Table C-19. Levelized Fresh Water System Costs, Las Cruces,  
Fifteen Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$1,195,614	\$1,157,478	\$ 113,540
Annual Operating Cost	585,254	239,418	23,485
Salvage Value**	659,561	614,022	60,231
<b>TOTAL COSTS</b>	<b>\$1,121,307</b>	<b>\$ 782,874</b>	<b>\$76,794</b>
Levelized cost (\$/1000 gal)			\$1.57

\* Includes pump replacement costs

\*\* Water rights salvaged at original cost

Table C-20. Levelized Fresh Water System Costs,  
Truth or Consequences, One Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 55,900	\$ 55,900	\$ 5,483
Annual Operating Cost	113,902	58,059	5,695
Salvage Value	5,590	1,316	129
<b>TOTAL COSTS</b>	<b>\$ 164,212</b>	<b>\$112,643</b>	<b>\$ 11,049</b>
Levelized cost (\$/1000 gal)			\$3.39

\* Includes pump replacement costs

Table C-21. Levelized Fresh Water System Costs,  
Truth or Consequences, Four Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 55,900	\$ 55,900	\$ 5,483
Annual Operating Cost	352,525	179,690	17,626
Salvage Value	5,590	1,316	129
<b>TOTAL COSTS</b>	<b>\$ 402,835</b>	<b>\$ 234,274</b>	<b>\$ 22,980</b>
Levelized cost (\$/1000 gal)			\$1.76

\* Includes pump replacement costs

Table C-22. Levelized Fresh Water System Costs,  
Truth or Consequences, Ten Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost *	\$ 55,900	\$ 55,900	\$ 5,483
Annual Operating Cost	847,785	432,137	42,389
Salvage Value	5,590	1,316	129
<b>TOTAL COSTS</b>	<b>\$ 898,095</b>	<b>\$ 486,721</b>	<b>\$ 47,744</b>
Levelized cost (\$/1000 gal)			\$1.46

\* Includes pump replacement costs

Table C-23. Levelized Natural Gas System Costs,  
All Locations, One Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost	\$ 19,900	\$ 19,900	\$ 1,952
Annual Operating Cost	487,718	246,032	24,134
Salvage Value	1,990	468	46
<b>TOTAL COSTS</b>	<b>\$ 505,628</b>	<b>\$ 265,464</b>	<b>\$ 26,040</b>
Levelized cost (\$/MMBTU)			\$6.42

Table C-24. Levelized Natural Gas System Costs,  
All Locations, Four Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost	\$ 86,400	\$ 86,400	\$ 8,475
Annual Operating Cost	1,756,537	885,301	86,841
Salvage Value	8,640	2,034	200
<b>TOTAL COSTS</b>	<b>\$1,834,297</b>	<b>\$ 969,667</b>	<b>\$ 95,117</b>
Levelized cost (\$/MMBTU)			\$6.00

Table C-25. Levelized Natural Gas System Costs,  
All Locations, Ten Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost	\$ 236,000	\$ 236,000	\$ 23,150
Annual Operating Cost	4,294,176	2,163,839	212,256
Salvage Value	23,600	5,556	545
<b>TOTAL COSTS</b>	<b>\$ 4,506,576</b>	<b>\$ 2,394,283</b>	<b>\$ 234,860</b>
Levelized cost (\$/MMBTU)			\$5.95

Table C-26. Levelized Natural Gas System Costs,  
All Locations, Fifteen Acre Greenhouse

Parameter	Total Costs	Present-Value Costs	Levelized Annual Costs
Capital Cost	\$ 472,500	\$ 472,500	\$ 46,349
Annual Operating Cost	6,408,840	3,229,269	316,766
Salvage Value	47,250	11,123	1,091
<b>TOTAL COSTS</b>	<b>\$ 6,834,090</b>	<b>\$ 3,690,646</b>	<b>\$ 362,024</b>
Levelized cost (\$/MMBTU)			\$6.12