FINAL REPORT
of the
UTILIZATION OF GEOTHERMAL ENERGY
for
METHANE PRODUCTION
for
J. A. ALBERTSON LAND AND CATTLE COMPANY

CH2M ■■■ HILL

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PREFACE

The data contained in this report was generated using currently available information and was prepared for the site-specific use of the J. A. Albertson Land and Cattle Co. No warranty is expressed or implied. Prior to facility design, all information and assumptions used in the preparation of this report should be updated and/or verified. This work was sponsored and funded by the United States Department of Energy Geothermal Energy Program under PRDA 03-79-ET-27004.

CONTENTS

<u>Chapter</u>		<u>Page</u>
1	INTRODUCTION	1-1
	Background	1-1
	Scope of Study	1-1
2	SUMMARY AND CONCLUSIONS	2-1
3	GEOLOGICAL ASSESSMENT	3-1
	General	3-1
	Survey of Wells	3-2
	Water Quality	3-3
	Temperature Gradient Holes	3-4
4	ENGINEERING	4-1
	Approach	4-1
	Process Description	4-2
	Facility Description	4-3
	General Design Criteria	4-6
	Material Balance	4-7
	Heat Balance	4-8
	Centrifuge Residue Utilization	4-10
	Legal Implications of Using	
	Digester Residue for Cattle Feed	4-13
	Digester Gas Utilization	4-15
	Centrate Disposal, Storage,	
	and Reuse	4-22
	Plant Layout, Land and Water	
	Requirements	4-24
5	ENVIRONMENTAL AND INSTITUTIONAL	
	ASSESSMENT	5-1
	Description of the Proposed Action	5-1
	Site Location and Surface Features	5-1
	Description of Existing Environment	5-2
	Historical and Archaeological	
	Sites and Natural Landmarks	5-10
	Land Use	5-11
	Land Use Regulations and Permits	5-13
	Noise	5-20
	Social Profile	5-20
	Aesthetics	5-24
	Potential Environmental Impacts	5-24
	Alternatives	5-33
	Irreversible and Irretrievable	
	Commitment of Resources	5-34

CONTENTS (continued)

<u>Chapter</u>		<u>Page</u>
	Relationship Between Short-Term Use and Long-Term Productivity	5-34
	Compliance with Applicable Regulations	5-35
6	COST ESTIMATE, FINANCIAL AND ECONOMIC ANALYSIS	6-1
	Methane Generation Facility	
	Cost Estimate	6-1
	Operation and Maintenance Costs	6-1
	Ethanol Plant Cost Estimate	6-5
	Financial and Economic Analysis of the Methane Generation Facilities	6-8

Bibliography

Figures

4-1	Preliminary Process Schematic	4-4
4-2	100% Design Mass Balance With Recycle	4-9
4-3	Heat Balance-100% Design With No Recycle	4-11
4-4	Heat Balance-50% Design With No Recycle	4-12
4-5	Integrated Biogas-Ethanol Process Schematic	4-20
4-6	Preliminary Site Layout A	4-25
4-7	Preliminary Site Layout B	4-26
4-8	Methane Generation Facility Site Plan	4-28

CONTENTS (continued)

<u>Tables</u>		<u>Page</u>
4-1	Anaerobic Digestion Residue	4-10
5-1	Feedlot Well Depths, Yield, and Temperature	5-4
5-2	Temperature (°F) and Precipitation (in.) Averages in Nyssa-Vale Area	5-6
5-3	Albertson Land & Cattle Company Geothermal Land Use/Permit Requirements	5-14
5-4	High-Low Population Projections Malheur County 1980-2000	5-21
5-5	1975 Estimate Malheur County Agriculture Income	5-22
6-1	50% Design Study Cost Estimate Methane Generation Facility	6-2
6-2	100% Design Study Cost Estimate Methane Generation Facility	6-3
6-3	Annual Operating and Maintenance Costs	6-4
6-4	Study Cost Estimate Ethanol Production Plant	6-6
6-5	Economic Analysis of Ethanol Production Plant and Simple Payback Period	6-7
6-6	Financial and Economic Analysis Summary	6-9

Appendices

A	GeothermEx, Inc. Geological Report
B	Major Equipment Outline Specifications

CONTENTS (continued)

Appendices

- C Refeeding Value of Solids From Methane Generators:
 A Bonanza???
- D Feeding Regulations for Colorado and Oregon
- E Wildlife of Northern Malheur County
- F Information on Endangered Species

■ ■ Chapter 1
■ ■ INTRODUCTION

BACKGROUND

The J. A. Albertson Land and Cattle Company owns and operates a cattle feedlot between Nyssa and Vale in Malheur County, Oregon. Previous investigations indicate the presence of subsurface geothermal water in this area.

The company is considering the development of an integrated system to utilize the geothermal resource for a bioconversion plant. This integrated facility would use the manure from approximately 30,000 head of feedlot cattle as a feedstock for an anaerobic digestion plant.

Anaerobic digestion of manure produces methane gas which can serve as an energy source for numerous end uses. The process also produces a digester residue which can be fed to the cattle as a supplemental feed.

SCOPE OF STUDY

The U.S. Department of Energy (DOE) has accepted a J. A. Albertson proposal for CH2M HILL to study the feasibility of developing a bioconversion facility at the Albertson feedlot site. The study is to include a preliminary process schematic to utilize the geothermal resource directly in an integrated feedlot and farming operation.

The following final report summarizes CH2M HILL's findings on engineering design, geological assessment, environmental, economic, and institutional requirements of the proposed project.

Chapter 2

SUMMARY AND CONCLUSIONS

The Albertson Land and Cattle Company feedlot is within a high temperature gradient and heat flow area associated with the Western Snake River Basin. A gradient of 5°F/100 feet is expected to persist to at least 2,000 feet depth in the vicinity of the feedlot. Between the depths of 1,200 and 2,000 feet, the temperature of fluids encountered is expected to be from 120° to 150°F. A mix of waters produced from this zone is expected to average at least 135°F.

Fluids from aquifers in the area provide chemical geothermometry which suggests that reservoir base temperatures are between 200°F and 220°F. Fluids have generally less than 1,000 parts per million (ppm) of total dissolved solids. Fluids are sulfate-carbonate in composition.

The aquifers beneath the surface at the Albertson feedlot are likely to be sandy interbeds within the upper parts of the Chalk Butte Formation of the Idaho Group. The formation is likely to persist to a depth below 2,000 feet.

There are no valid production tests from the targeted zone of completion. Several wells in the area have produced more than 400 gallons per minute (gpm) from perforated zones in the Chalk Butte Formation.

Critical to success of a well will be completion technique. A graded filter and gravel packing behind perforated liner is most likely to prevent sanding of the hole.

Geophysical information suggests several faults trending north and northwest within 1 mile of the Albertson property. There do not appear to be faults at the property which would be drilling objectives at depths to 2,000 feet.

Photogeology and field geology reconnaissance did not identify linear features which may be faults on the Albertson property. Linears northward of the property appeared to be cut off by another structure.

A site about 0.1 mile north of Albertson well No. 8, in SE1/4, SW1/4, Section 21, T. 19 S., R. 46 E., is likely to be the best location for a geothermal test well.

The size of the proposed bioconversion facility is dependent upon production requirements. If energy (methane gas) production is to be maximized, a facility must be designed that can digest all of the manure produced from the 30,000 head of cattle (100 percent design). If the major emphasis of the project is to produce the maximum onsite usable cattle feed (digester residue) without maximizing energy production, a smaller facility can be built (50 percent design). Since these facilities would differ mainly in size and not in unit operation, this study addresses both alternatives.

The anaerobic digesters were designed for mesophilic operation at 98°F and an approximate 20-day digestion period. Three digesters of equal size are proposed for the facility. The 100 percent design will utilize 110-foot-diameter digesters and the 50 percent design will utilize 80-foot-diameter digesters. Both designs have 35-foot sidewall depths. To make up total digesters heat losses, the hot water source

will need to be in the 135°F range at a flow rate of 240 gpm for the 100 percent design, and 120 gpm for the 50 percent design.

Based on current feeding trials, the digester residue has comparable feed energy values to average quality alfalfa hay. If the digester residue replaces the alfalfa hay in the finishing ration presently being used at the feedlot, the value of the replacement is $\$1.15 \times 10^6$ per year, based on the current price of alfalfa hay.

The legal implications of feeding digester residue to cattle has been subject to questions and confusion. It is anticipated that a set of regulations for registering animal wastes will soon be developed and will facilitate the registration process in all states. Current Federal Drug Administration (FDA) policy does not sanction the feeding of animal wastes to animals which will be used for human consumption. However, these restrictions are in the process of being lifted.

Although Albertson's preliminary incentive for the facility is to generate a cattle feed supplement, the digester gas as a byproduct of the process will add significantly to the economic return of the project. The gas can be used to produce electricity or provide process energy.

If the gas is burned in engine/generator sets to produce electricity, it is anticipated that 1,970 kilowatts (kW) of power can be generated for the 100 percent design facility and 985 kW can be generated for the 50 percent design facility. Because of the new rules dealing with electrical energy generation by small facilities, the power can be sold

at a rate substantially above present purchased power rates. The difference between the rates provides a means of income which will add to the economic payback of the facility. If all the digester gas is burned in the engine/generation sets, then sufficient heat can be recovered from the jacket water cooling system to heat the digestion process, thereby eliminating the requirements for a geothermal resource except for startup and periods of low gas production.

If the gas is used for process heat, an attractive alternative is an alcohol production plant. Based on the gas production of the 100 percent design anaerobic digestion facility, sufficient process heat energy will be available to produce 5 million gallons of alcohol per year. This plant will produce enough distillers grains to be used as a feed supplement for 18,000 head of cattle per day. With this alternative, a geothermal resource would be required for the digestion facility.

An environmental and institutional assessment of the project was performed and provides a summary of impact, laws, ordinances, and regulatory guidelines applicable to the project site.

A cost estimate for the methane generation facility was prepared and revealed an engineering and construction cost of \$9,049,000 and \$13,258,000 for the 50 percent design and 100 percent design facilities, respectively.

Financial and economic analyses performed show an after-tax internal rate of return of 89 percent and 104 percent for the 100 percent and 50 percent designs, respectively.

Chapter 3

GEOLOGICAL ASSESSMENT

GENERAL

Surface materials at the proposed project site of the Albertson Land and Cattle Company feedlot, S. 21 and S-1/2 16, T. 19 S., R. 46 E., are comprised of silts, sands, and clays of the Chalk Butte Formation. The materials are part of the Upper Idaho Group of formations of Pliocene age.

Chalk Butte lacustrine sediments and minor interbedded volcanic rocks are as much as 3,000 feet in thickness in the vicinity of the feedlot. The nearest deep hole, located on the H. K. Riddle Kiesel Estate about 5 miles northeast of the feedlot, indicates that volcanic flow rocks of the Grassy Mountain Basalt or equivalent volcanic rocks underlie the Chalk Butte Formation unconformably at a depth of about 3,000 feet.

A possible northwest-trending fault, inferred from geophysical data, occurs between the feedlot and the Kiesel Estate well. No estimation of offset or displacement along the inferred fault can be made. Therefore, the 3,000 foot thickness estimate for the Chalk Butte Formation must be assumed correct. A potential 2,000-foot-deep well at the feedlot would bottom in the Chalk Butte Formation.

There is a suggestion from gravity mapping and topography that a northern northwest-trending fault occurs near the western boundary of the feedlot. The probable movement on the fault is west side up, but strike-slip motion may have

occurred. The age and persistence of movement on the fault is unknown. McIntyre (1980) has speculated that important bounding faults of the western Snake River Plain occur in the area. There is no reliable evidence that the basalts of Grassy Mountain and/or Owyhee formations are close to surface at the feedlot.

There are significant gravity highs immediately northwest of the feedlot. The faults and gravity highs west of the feedlot have two-fold importance. First, the faults may provide conduits for hydro-thermal fluids. Second, the effect of positive (upward) movement of crustal blocks west of the faults and close to the western margin of the feedlot area would be to bring Miocene and Pliocene basalts surface-ward and cause deposition of the coarsest fractions of eroded material from highlands on the west into the area at the edge of the subsiding basin to the east. The coarser materials would provide the greatest opportunity to encounter permeable sediments such as sands and coarser silts, rather than thick plastic clays, deep in the section at the feedlot.

SURVEY OF WELLS

A survey of the records of wells in T. 19 S., R. 46 E. and T. 18 S., R. 46 E. (south one-half) provided production data from less than 20 wells more than 300 feet in depth. None of the wells penetrated to 1,000 feet in depth. The maximum production was 1,000 gpm with a drawdown of 85 feet, from a well in S. 16, T. 19 S., R. 46 E. The well is 520 feet in depth. Most deep wells in this township produce between 100 and less than 400 gpm. The deep wells in the township to the north produce upwards of 400 to more than 900 gpm; these

wells apparently draw from the Malheur River sediments. Some wells in sections 13 and 16, T. 19 S., R. 46 E., produced very low volumes of water or were dry to depths of as much as 600 feet. It is not known whether impermeable sediments, poor completion techniques, or both were responsible. We may conclude that the production capacity of new deep wells drilled to between 1,000- and 2,000-foot depth may intercept permeable formations capable of supporting production flow of as much as 1,000 gpm. The locations of the drill holes (wells) at the Albertson feedlot area which appear to be most productive are at well No. 8 (T. 19 S., R. 46 E., 21ccd) and well No. 1 (T. 10 S., R. 46 E., 21bad). Both have been pumped at rates in excess of 1,000 gpm. Of these, well No. 8 has the higher gradient, and is located near a topographic break which may follow a structural guide. A site less than 0.1 mile north of well No. 8 is suggested as the location for a geothermal test hole.

WATER QUALITY

Four of the wells in S. 21, T. 19 S., R. 46 E. were sampled in December 1979. These wells are actively used for stock water supply and are frequently pumped. The wells sampled were No. 2, in the NE-1/2 of the NE-1/4 of the section; No. 6, in the NE-1/4 of the NW-1/4 of the section; No. 8, in the SE-1/4 of the SW-1/4 of the section; and No. 9, in the NW-1/4 of the SW-1/4 of the section.

Drillers logs were available for wells 2, 6, and 9. All the wells were drilled in the succession of blue and brown clays and dark gray sands, characteristic of the Chalk Butte Formation. Sampling was done by Anderson & Kelly, using instructions and equipment provided by GeothermEX, Inc. All field data is as reported by Anderson & Kelly.

The waters are characterized by sulfate-carbonate composition, with calcium the principal cation, except well No. 2, where sodium is the principal cation. Magnesium is high in all the wells except No. 9 which is also the warmest and deepest of the wells. Nitrate in three of the wells is high enough to indicate contamination from surface sources or long-term infiltration into the production zone. Well No. 6 is the exception. Silica content of the wells is high, and suggests a thermal aquifer source for part of the fluids produced.

Several generally significant statements can be made about the chemistry of the well waters. Silica concentrations are higher than cation concentrations. This is the reverse of normal circumstances where mixing has occurred. The resultant moderately high reservoir base temperatures calculated by silica geothermometry are therefore encouraging. The quartz (chalcedony) temperatures fall within the range of 203° to 249°F. Of these, all are between 203° and 211°F with the exception of well No. 9 which has a chalcedony temperature of 249°F. The alkali geothermometers for the four wells provide scattered and inconsistent results from the computer-programmed analyses of the data. Generally, the base temperatures indicated by alkali geothermometry are lower than those derived from silica, except that of well No. 9 which coincidentally shows nearly the same temperature, 221°F.

TEMPERATURE GRADIENT HOLES

The analysis of temperature gradients was approached in two ways. First, gradients from holes drilled to deliberately

obtain temperature information as part of geothermal resources exploration programs were plotted and used to contour the area in the vicinity of the J. A. Albertson facility. There were some 15 such drill holes within 10 miles of the facility, excluding the area near Vale, Oregon, where a significant geothermal anomaly has resulted in drilling many local gradient holes.

A significant geothermal anomaly was detected in the vicinity of northeast Cow Hollow, T. 19 S., R. 45 E. and became the object of investigation about 10 years ago. Ten temperature gradient holes in T. 19 and 20 S., R. 45 E. provided gradients which ranged from 3.9°F/100 ft to 12.8°F/100 ft. The highest gradients were located in Sections 11, 14, and 25 of T. 19 S., R. 45 E. These locations are along a northerly trending line about 3 miles west of the J. A. Albertson feedlot.

On the Albertson feedlot, wells 6, 8, and 9 clearly have gradients of greater than 5°F/100 ft indicated by the water temperatures. It is difficult to assess well No. 2 because it was perforated at widely different levels. Well No. 1 also appeared to have a gradient of 5°F/100 ft from maximum temperature recorded while the well was not pumping.

From these calculations it appears that, were the gradient to hold to 2,000 feet depth, the water temperatures would rise to about 150°F. A zone of completion between 1,000 and 2,000 feet might provide a mix of water between 120° and 135°F. None of these estimations requires direct interception of a fault with thermal fluids.

Appendix A contains the full text report of the geological and geophysical assessment as prepared by GeothermEx, Inc.

APPROACH

The size of the proposed bioconversion facility is dependent upon production requirements. If energy (methane gas) production is to be maximized, a facility must be designed that can digest all of the manure produced from the 30,000 head of cattle each day. If the major emphasis of the project is to produce all the usable onsite cattle feed without regard to energy production, a smaller facility can be built.

Feeding studies indicate that digester residue can comprise approximately 10 percent on a dry weight basis of the finishing cattle feed ration. At this rate, the manure from 15,000 head will produce enough digester residue to feed 30,000 head. Therefore, a facility designed primarily to produce cattle feed (50 percent design) needs to be only half as large as a facility in which energy production is a major design criterion (100 percent design). Since these facilities would differ mainly in size and not in unit operation, this study addresses both alternatives. The comparative data resulting from this study can assist management in selecting the most cost-effective operation.

PROCESS DESCRIPTION

The 100 percent design bioconversion facility will be capable of processing 465,000 pounds of wet manure per day. The manure is composed of dissolved solids, suspended solids,

and water. It is expected that approximately 6 percent of the collected manure will be comprised of grit (packed earth, sand, dust, gravel, etc.).

The manure will first be mixed with geothermal or engine jacket cooling water and/or centrate recycle to produce a mixture which is approximately 6 percent volatile solids (9 percent total solids). This mixture is continuously fed to the digesters where heat and bacteria will destroy nearly half of the volatile solids and produce methane and carbon dioxide (biogas). This process also produces a trace of hydrogen sulfide which exits with the biogas.

The biogas has a conservative heating value of approximately 500 Btu per cubic foot and may be burned directly or treated to remove the hydrogen sulfide. The biogas can also be treated to remove a portion of the carbon dioxide, which increases the unit heating value.

During the 20-day digestion period, the viscosity of the manure mixture drops, allowing at least half of the grit to settle out on the bottom of the digester vessel. The remaining grit is kept in suspension throughout all process unit operations. To accomodate grit accumulation, the nominal digester capacity is increased by 5 percent. It is expected that the digesters will be cleaned annually to remove the settled grit.

The effluent is pumped from the digesters to a centrifuge where the concentration of residue is increased to approximately 25 percent solids. This high-solids residue can be mixed with other feeds and fed directly to the cattle or dried and stored for future use. The average detention time for the manure in the digester is 20 days.

FACILITY DESCRIPTION

Figure 4-1 shows a process schematic for the proposed bio-conversion plant.

Raw Manure Preparation and Mixing

Raw manure from the feedlot will be transported to the raw manure preparation and mixing basin area as the pens are cleaned periodically. Front-end loaders will load raw manure from the storage pile into a loading hopper. A clump breaker mechanism at the bottom of the hopper will break up large clumps of manure before they enter the screw feeder. Water under high pressure will further break up the manure and wash it into the screw feeder. The screw feeder mixes and feeds the manure and water together into the grit chamber where large rocks, gravel, etc. are collected and removed periodically. The manure slurry is then passed through the comminutor channel where the solids are cut up and reduced to a smaller uniform size. From the comminutor channel, the manure slurry enters the mixing basin. The mixing basin is essentially a large wet pit where water is added to further reduce the mixture to approximately 6 percent volatile solids. Mixing in the basin is accomplished by air blowers and aeration type mixing tubes. From the mixing basin, the manure slurry is pumped to the anaerobic digesters.

Anaerobic Digesters, Gasholder Tank, and Degas Column

Three anaerobic digesters of equal size were selected for this facility. The sludge digestion for each digester is carried out as a continuous single-stage process. The

digesters are made of prestressed concrete with fixed concrete covers. The sludge is mixed by gas recirculation through bubble draft tube type mixers. A hot water jacket around each draft tube allows the sludge to be heated as the sludge rises up through the tube. The gas, as it is formed, is piped off to either the gasholder tank or engine/generator sets; or it is flared. The gasholder tank provides some gas storage and allowance for volumetric changes in the digesters. The digested sludge is drawn off and pumped to the degas column where entrained gas is removed from the sludge. The sludge is then pumped to the dewatering centrifuges.

Centrifuges, Sludge Bunker, Centrate Lagoon

Two solid bowl centrifuges will be used to dewater and thicken the sludge to approximately 25 percent solids. The sludge is fed at a constant flow rate into the centrifuge where it separates into a cake containing most of the solids and a liquid stream called centrate. The cake, which contains approximately 75 percent moisture, is discharged from the centrifuge onto a belt conveyor where it is carried to a sludge bunker outside the centrifuge building. From the sludge bunker, the sludge is fed by screw conveyor to dump trucks where it is transported either to the feeding station or sludge storage beds. The centrate flows from the centrifuge into a wet well where it is either pumped to the centrate lagoon, pumped to the irrigation equipment, or recycled to the mixing basin as described above.

Power Generation

Gas generated in the digesters is piped to the gas engine/generator sets where the gas is burned and electrical energy

is produced. The gas can normally be burned directly with no cleaning or conditioning required. The electricity produced can be sold directly to Idaho Power Company. Cooling of the gas engines is accomplished by using well water in conjunction with external heat exchangers. The primary heat exchanger in the engine cooling loop provides heat to the jacketed draft mixing tubes in the digester, supplying primary digester heating. An auxiliary heat exchanger using well water provides final temperature control for the gas engine cooling loop. The well water, when heated, is piped to the mixing basin to preheat the incoming manure slurry, or to the irrigation equipment for disposal.

GENERAL DESIGN CRITERIA

The major design criteria for an anaerobic digester are the temperature of operation and the solids loading rate.

Anaerobic fermentation has two temperature ranges at which different bacteria operate most efficiently. Mesophilic operation has an optimum temperature of 98°F and requires approximately a 20-day digestion period, while thermophilic operation is optimized at 135°F and requires about a 10-day digestion period. Although the thermophilic operation requires a much smaller digester, this process is less stable than the mesophilic operation. It is also believed that the lower temperature range of mesophilic digestion will be more readily maintained by the available geothermal and engine jacket cooling water. In addition, the nutritional value of mesophilic digester residue is greater than thermophilic digester residue resources. For these reasons, the anaerobic digesters were designed for mesophilic operation.

The digester loading rate is a major criterion for determining the size of a bioconversion plant. The design loading rate for the proposed plant is 0.20 pound of volatile solids per day for each cubic foot of digester volume. Although studies have indicated the feasibility of loading from 0.1 to 0.4 pounds of organic material per cubic foot, digester operation is more sensitive at higher loadings and the chance of upsetting the digesters and interrupting the digestion process is increased.

MATERIAL BALANCE

The biogas yield from the conversion process is based on the amount of volatile solids in the manure which enters the digesters. Samples taken from pilot studies by CH2M HILL for the Lamar Company Plant indicate the manure will be comprised of 43.30 percent volatile solids, 21.35 percent nonvolatile solids, and 35.35 percent water.

Approximately 346,000 gallons of water are mixed with the manure daily to produce the desired solids concentration. This mixture is fed to the digester where about 41 percent of the volatile solids are destroyed in the digestion process to produce methane ($700,000 \text{ ft}^3/\text{day}$), carbon dioxide ($484,000 \text{ ft}^3/\text{day}$), and a small amount of hydrogen sulfide. This gas production rate is equivalent to 3.54 ft^3 of methane and 2.41 ft^3 of carbon dioxide per pound of volatile solids added to the digester per day.

The digester effluent is then pumped to a centrifuge where 652,000 pounds of residue are separated from 315,000 gallons of centrate per day. A portion of the centrate is pumped back to the mixing basin for reuse. The remaining makeup

water to the mixing basin is provided by the geothermal source or engine jacket cooling water. The residue is either directly utilized as a portion of the cattle feed ration or stored.

A preliminary mass balance design for a 100 percent manure processing facility with a 50 percent recycle of centrate is shown on Figure 4-2.

HEAT BALANCE

Based on general design criteria, three digesters of equal size are proposed for this bioconversion facility. Each digester will be in operation at the maximum design flow rate.

For 100 percent manure processing (maximizing energy production), each digester will be designed at 110 feet in diameter with a sidewall depth of 35 feet. For 50 percent manure processing, each digester will be designed at 80 feet in diameter with a 35-foot sidewall depth.

Assuming an all-concrete digester design, earth-covered sidewalls, and an ambient winter design air temperature of 0°F, the three 110-foot diameter digesters are estimated to experience a 3.1×10^6 Btu/hr total heat loss. Using the same assumptions, the three 80-foot diameter digesters may experience a total heat loss of 1.6×10^6 Btu/hr. It is assumed that the total heat loss will be made up by utilizing the geothermal water source for total makeup water to the mixing basin, the temperature of this water resource will need to be in the 135°F range at a flow rate of 240 gpm for the 100 percent manure processing design and 120 gpm for the 50 percent manure processing design.

FIGURE 4-2 CH₂M HILL
100% DESIGN MASS BALANCE WITH RECYCLE

The preliminary heat balances for a 100 percent and 50 percent manure processing facility with a 0°F ambient temperature are shown in Figures 4-3 and 4-4 respectively.

Major equipment outline specifications for the proposed facility are listed in Appendix B.

CENTRIFUGE RESIDUE UTILIZATION

The centrifuge residue is a protein-rich mixture composed of approximately 25 percent dry matter and 75 percent moisture. On a dry basis, this residue contains about 18 percent protein, as shown in Table 4-1, and has proven value as a cattle feed supplement. Various studies,^(1,2) through actual feeding trials, have shown the feasibility of using digested cattle manure as a successful replacement for such feeds as cottonseed meal, barley, and high-grade alfalfa hay.

Table 4-1
ANAEROBIC DIGESTER RESIDUE
(Centrifuged Digester Cake)

Moisture	76.62
Dry Matter	23.38
Dry Basis:	
Protein	18.15
Calcium	4.20
Phosphorus	.85
Fat	3.52
Fiber	15.29
Ash	36.44

The economic value of the residue will depend upon the present feed material (silage, hay, grains, etc.) and the

FIGURE 4-3

HEAT BALANCE — 100% DESIGN WITH NO RECYCLE

FIGURE 4-4

HEAT BALANCE — 50% DESIGN WITH NO RECYCLE

percentage of that material the residue replaces. Currently, it is expected that the residue can constitute approximately 10 percent of a feedlot finish ration on a dry weight basis and will have comparable energy values to average quality alfalfa hay. A paper summarizing the feeding trials using digester residue from the PGD/SoCAL Gas pilot plant located in Brawley, California is shown in Appendix C.

A typical finish ration currently being used at the feedlot consists of approximately 30 percent barley, 30 percent corn, 25 percent molasses beet pulp, 10 percent silage or alfalfa hay, and 5 percent molasses. Each animal is fed about 28 to 30 pounds per day of the ration. If it is assumed that the residue provides a complete replacement of the alfalfa (current market value = \$70 per ton), then the value of the replacement can be established as follows:

$$\frac{3 \text{ lb}}{\text{day}} \times 30,000 \text{ head} \times 365 \text{ days} \times \text{ton}/2,000 \text{ lb} \times \$70/\text{ton} =$$
$$\$1.15 \times 10^6 \text{ per year}$$

LEGAL IMPLICATIONS OF USING DIGESTER RESIDUE FOR CATTLE FEED

The regeneration of cattle feed by anaerobic digestion of manure using geothermal energy is the primary motivating factor behind the Albertson study. Residue nutrient value equates to that of alfalfa at a current market value of \$70 per ton. However, the legal implications of feeding residue material to cattle have recently been subject to questions and confusion. State, regional, and national FDA officials and numerous State Feed Control Officers were contacted to resolve this issue.

The Feed Control Officers for the States of Idaho, Oregon, Washington, Colorado, and Utah were contacted to determine the current status of state regulations for registering animal waste feeds. While only Colorado had animal wastes registered as feeds, all of the states have regulations in place to allow such registration. Regulations for Colorado and Oregon are included in Appendix D.

A majority of the State Feed Control Officers belong to the American Association of Feed Control Officers (AAFCO). While this organization has no legal status, its recommendations are usually followed by the states. A future meeting is planned between the AAFCO and the American Feed Management Association (AFMA). It is anticipated that a standard set of regulations for registering animal wastes as feeds will be developed at this meeting and that these regulations will be adopted by all of the states. This standardization of regulations will facilitate the registration process by allowing the required test data to be applicable in all states.

The only state requirement for interstate shipment of animal waste feeds or cattle that have been fed these materials is that the feed be registered in both states. However, the interstate shipment of feed or cattle is subject to FDA inspection and approval. Discussions with numerous FDA officials indicate that current FDA policy does not sanction feeding any animal wastes to animals that will be used for human consumption. These officials indicate, however, that because the preponderance of feeding study data show animal wastes to be a viable and economic animal feed, this restriction is in the process of being lifted. It is anticipated that the necessary requirements for lifting the restriction will be completed within the near future. Once

the restriction is lifted, animal waste feeds and cattle fed with these materials will only be subject to the normal FDA inspection. That is, if the animals or feeds are inspected and found to be adulterated with heavy metals, pesticides, etc., they will be subject to the same rules and regulations that apply to conventional feed materials. The animal waste feeds must be thoroughly tested before state registration, reducing the likelihood that FDA inspection of registered material will be a problem for the cattle feeder.

Because the economic viability of the Albertson project is dependent upon the regeneration of cattle feed for the feedlot operation, the status of state and Federal regulations on the registration of this material should be followed closely. It would be prudent for Albertson representatives to contact the appropriate local, state, and Federal officials to express an interest in this issue. It is also advisable to contact AAFCO and AFMA members to express an interest in this issue. While it appears that the legal snarls associated with feeding animal wastes are being resolved, close monitoring and appropriate input should continue until all of the ramifications are successfully resolved.

DIGESTER GAS UTILIZATION

Although Albertson's primary incentive for pursuing anaerobic digestion of manure is to generate a cattle feed supplement, the byproduct of the process - biogas - could significantly add to the economic return of the project. The digester gas is a mixture of approximately 60 percent methane and 40 percent carbon dioxide, with a conservative heating value estimated at 500 Btu per cubic foot. The

energy value in this gas could be used to produce electricity or provide process heat. Both of these alternatives are discussed as follows:

A. Electric Power Generation and Heat Utilization

The anaerobic digesters produce gas at a rate of 49,800 standard cubic feet per hour (Scfh) and 24,900 Scfh for the 100 percent and 50 percent designs, respectively. The digester gas can be utilized directly for electrical power generation by burning it to gas engine driven generator sets. Digester gas has been used for many years to produce electrical power in wastewater treatment plants. As such, the technology and equipment for its use is well proven. Gas engines which burn digester gas are available from several manufacturers (Waukesha, White-Superior, Caterpillar, and others). Generally, the digester gas can be burned directly with little or no preparation. Hydrogen sulfide in the digester gas may need control, but has been successfully burned in concentrations of 1,000 to 3,000 milligrams per litre with no adverse engine effect. Hydrogen sulfide can be easily removed by the use of an "iron sponge" if required. Sufficient pressure is usually available from the digestion process itself to provide the gas line pressure needed for operation of engine control devices. Therefore, no gas compressors are required.

If an engine efficiency of 30 percent and a generator efficiency of 90 percent are assumed, the power generation capacity can be determined as follows:

100 Percent Design

$$\frac{49,800 \text{ Scfh} \times 500 \text{ Btu/hr} \times 0.30 \times 0.90}{3,413 \text{ Btu/kWh}} = \begin{matrix} 1,970 \text{ kW} \\ (2,640 \text{ hp}) \end{matrix}$$

50 Percent Design

$$\frac{24,900 \text{ SCFH} \times 500 \text{ Btu/hr} \times 0.30 \times 0.90}{3,413 \text{ Btu/kWh}} = \begin{matrix} 985 \text{ kW} \\ (1,320 \text{ hp}) \end{matrix}$$

On October 18, 1979, the Federal Energy Regulatory Commission released rules dealing with electrical energy generation by small facilities. These rules were required by Section 210 of the Public Utility Regulatory Policies Act of 1978 (PURPA). These rules require electric utilities to "(1) sell electrical energy to qualifying cogeneration facilities and qualifying small power production facilities, and (2) purchase electrical energy from such facilities." The power would be purchased at whatever rate the utility pays for its "newest" power.

The electrical power generated by the engine/generator sets as calculated above would be available for sale to the Idaho Power Company electrical grid. All the electrical power generated would be sold at a negotiated "avoided cost" rate. The "avoided cost" is defined as the reduction in cost from the original plant that will be realized from the utilization of the alternate plant. The "avoided cost" rate is substantially above present purchased power rates for industrial customers. For the purpose of this report, the "avoided cost" rate was assumed to be 4.5 cents per kWh. This rate is consistent with projected new power plant rates for Idaho Power Company.

The Idaho Public Utilities Commission is conducting hearings at the present time to determine how these rates will be calculated and regulated.

The difference between the "avoided cost" rate and the present purchase rate for electrical power provides the facility a means of income which will add to the economic payback of the facility.

By using the digester gas to power engine/generator sets, large amounts of heat are available for alternate uses via waste heat recovery. Heat can be recovered from the engine jacket water and engine exhaust systems. The amount of heat that is recoverable from the engine jacket water system alone is greater than the heat requirements of the methane generation facility and, as such, could be used for this purpose. This removes the requirement except for startup and periods when no gas is being generated for a geothermal resource to heat the facility if engine/generator sets are the option chosen to utilize the digester gas. Waste heat from the engine jacket water system is estimated at 4.2×10^6 Btu/hr for the 50 percent design and 8.4×10^6 Btu/hr for the 100 percent design. The engine exhaust heat could be used for drying the digester sludge, if desired. The added capital expense for drying equipment is significant and cannot be justified. Therefore, drying equipment is not included in the cost estimate.

B. Energy for Alcohol Production

The mass balance of the digestion process for the 100 percent design indicates that 49,800 Scfh of digester gas will be generated per day. A particularly

attractive alternative for utilizing this source of energy is to provide process heat for a fuel alcohol production plant.

Figure 4-5 is a schematic representation of an integrated biogas-alcohol facility.

The production of alcohol via fermentation is a well-established process consisting of four basic steps: saccharification, fermentation, distillation, and dehydration. Figure 4-5 shows a schematic representation of this process along with the mass balance for a 1 million-gallon-per-year plant.

Grain is rolled or ground to increase its surface exposure in the cooking process. This slurry is cooked in order to rupture the cell walls in the grain and expose the starch contained in the cells to conversion enzymes. Conversion enzymes are added to carry out the saccharification process in which the starch is converted into simple sugar. Upon completion of the saccharification step, yeast is added to the mixture which is then pumped to the fermenter. Fermentation converts the sugars into alcohol and carbon dioxide. The resulting mixture of alcohol, water, and spent grain is called beer.

When fermentation is complete, the solution is pumped to the distillation column where all of the alcohol and some water is removed from the beer. Continued refining and dehydration of the alcohol-water mixture produces anhydrous (100 percent) alcohol which can be mixed with gasoline to make gasohol.

The mixture of water and spent grain that is removed from the distillation column is called whole stillage. Studies have found that the spent grain in the whole stillage is an excellent cattle feed. Figure 4-5 shows that approximately 60 percent of these solids can be retrieved by screening the whole stillage. The remaining solution, called thin stillage, can either be evaporated to retrieve the remaining solids or processed in the anaerobic digesters to produce more methane. Figure 4-5 shows the thin stillage being sent to the anaerobic digester.

Approximately 3 pounds of solids removed from the whole stillage can be fed per head each day. A million-gallon-per-year alcohol plant, which produces approximately 3,030 gallons of alcohol per day (330 day/yr), yields approximately 11,000 pounds of these solids per day. On this basis, an alcohol plant of this size can produce a portion of the feed ration for 3,600 head of cattle.

Cooking and distillation account for the majority of energy required in the alcohol production process. The total thermal energy input required to produce a gallon of alcohol is approximately 40,000 Btu. This energy requirement assumes that no energy is expended in drying the distiller's grains in thin stillage. Based upon the energy produced by the anaerobic digestion of the cow manure from 30,000 head and assuming an 80 percent boiler efficiency, sufficient energy is available to produce 5 million gallons of alcohol per year with no additional thermal energy input. This plant would produce enough distiller's grains to feed 18,000 head of cattle per day (3 lb/head).

An alcohol plant designed to produce feed for 30,000 head of cattle would have a production capacity of 8 million gallons per year. At this capacity, the biogas facility could supply approximately 65 percent of the alcohol plant's thermal energy requirements.

A cursory evaluation of utilizing biogas to drive a fuel alcohol production facility found this alternative to be feasible and attractive. The ramifications associated with integrating these processes were not explored in depth and are beyond the scope of this study. The alternative appears worthy of further study, in which advantages and disadvantages of the integrated process would be identified and quantified.

CENTRATE DISPOSAL, STORAGE, AND REUSE

Disposal

The biogas design which processes 100 percent of the manure generated each day produces approximately 300,000 gallons of centrate daily. Land application is the usual means for disposing of this type of material. Based on the analysis of the centrate stream, the nitrogen concentration appears to be the limiting factor in land application. Nitrogen in the form of ammonia ranges from 280 to 560 mg/l and averages approximately 420 mg/l. Nitrogen in the form of nitrate ranges from 75 to 85 mg/l and averages 80 mg/l. Therefore, these two sources of nitrogen approximate 500 mg/l. Approximately 20 percent of the nitrogen that is applied is expected to volatilize which reduces the nitrogen remaining on the land to 400 mg/l. Assuming the above concentration, and 365 days per year application with a maximum application

rate of 250 pounds of nitrogen per year, approximately 1,500 acres are required for land application of centrate.

Two alternatives for land application were studied. One alternative studied was to use a tank truck to remove the centrate from the site and apply it to the land. Assuming a 6,000 gallon tank truck, approximately 51 trips would be required to remove the centrate accumulation each day. Assuming that one truck can make 10 trips per day, which is estimated to cost \$360,000, six trucks would be required for centrate removal. In addition, three applicators and associated equipment would cost approximately \$200,000, which results in a total capital expenditure of approximately \$560,000. Assuming a typical hauling cost of \$40 per load, the annual operating cost is approximately \$750,000.

The second alternative studied the possibility of pumping the centrate to the irrigation site and applying the centrate through conventional irrigation equipment. For the purpose of this study, it was assumed that present irrigation equipment at the feedlot is adequate for disposal of centrate by this alternative. However, if additional equipment is required, the estimated capital cost for piping, Big Gun applicators, and pump station total approximately \$600,000. The annual operating costs for this system, including labor electricity and supplies, total approximately \$30,000. This alternative assumed that the land to be irrigated was already owned by Albertson and, therefore, land purchase costs were not included.

Storage

It is anticipated that inclement weather will prohibit centrate removal occasionally, and that this material will

have to be stored for a period of time. Assuming that ponds 10 feet deep are used to store the centrate, approximately 4 acres of ponds are required to store 6 weeks of centrate production. Total capital cost to construct these ponds is estimated at \$105,000.

Centrate Reuse

The above schemes for centrate disposal and storage assume that 100 percent of the manure produced each day is digested and that no centrate is recycled back to the process. Centrate can be used, however, to dilute and slurry the manure prior to entering the digester. The extent to which centrate can be used for this purpose depends upon the degree of toxic ion buildup in the system as the level of centrate recycle increases. Experiments are currently in progress to determine the optimum centrate recycle ration, which will allow for maximum centrate reuse while maintaining the ions that are toxic to the anaerobic bacteria of an acceptable level. As the level of centrate reuse increases, the amount of centrate that must be stored or disposed of is reduced accordingly.

Therefore, the above schemes for centrate storage and disposal should be considered as being conservative.

PLANT LAYOUT, LAND AND WATER REQUIREMENTS

Two potential site layouts are shown in Figures 4-6 and 4-7. In Figure 4-6, Site Layout A features the digesters in a line and a separate centrifuge building. Access to all sides of the digesters and to the separate centrifuge building is greater with this layout. In Figure 4-7, Site Layout B features the centrifuge building centered between the

FIGURE 4-6
PRELIMINARY SITE LAYOUT A

digesters. This will help reduce heat loss and piping distances. Some reduction in construction costs will also be realized. In both layouts, the digesters are constructed by excavating about 15 feet and building up a 20-foot embankment around the digesters. If site conditions permit, the digesters could be constructed in the side of a hill to further reduce costs and heat loss.

Location of the centrate lagoon and sludge storage beds (100 percent design only) is shown close to the digesters, but actually may be sited away from this area some distance based on land availability and desirability.

Land requirements for the 50 and 100 percent designs are approximately 10 acres without the sludge storage beds or centrate lagoon. The sludge storage beds required for the 100 percent design add an additional 12 to 15 acres. The centrate lagoon would add an additional 3 to 6 acres, depending upon the facility and lagoon design.

Figure 4-8 illustrates a potential methane generation facility plant layout, geothermal well, and pipeline route for the Albertson feedlot. The proposed site of the geothermal well lies approximately 0.1 mile north of Well No. 8.

Total well water requirements for the facility varies with the design, water temperatures, amount of centrate recycle, and use of the digester gas. Assuming no recycle of centrate to the mixing basin, full power generation, and well water temperature similar to existing wells located on the site, approximately 340 gpm will be required for the 100 percent design. If a 50 percent recycle of centrate can be utilized, the water requirements for the 100 percent design

FIGURE 4-8
METHANE GENERATION
FACILITY SITE PLAN

can be reduced to 220 gpm. The 50 percent design water requirements will be approximately half that required for the 100 percent design.

Chapter 5

ENVIRONMENTAL AND INSTITUTIONAL ASSESSMENT

DESCRIPTION OF THE PROPOSED ACTION

General

The proposed project will explore the feasibility of developing an integrated system to combine the geothermal resource with a bioconversion plant. The plant will use the manure from approximately 30,000 head of feedlot cattle as a fuel source for an anaerobic digestion plant. The geothermal fluids will provide the required digester heat and water for the manure slurry pipeline. The anaerobic digestion plant will produce methane gas which would be used for gas engine/generators for electrical power generation.

SITE LOCATION AND SURFACE FEATURES

The proposed project site, including potential well sites, is entirely owned by J. A. Albertson Land and Cattle Company. The property is located about 4 miles northwest of Nyssa and 8 miles southeast of Vale in Malheur County, Southeastern Oregon. The company owns approximately 950 acres, and a portion of the property is used as a feedlot that can accommodate up to 50,000 head of cattle. The proposed development area is located in Township 19S, Range 46E, Section 21 (approximately 43°59'N by 117°15'W).

Sheep Creek runs through the north end of the property, and South Sheep Creek runs across the southern portion of the property. The North Canal, providing water for some of the

irrigated agricultural land to the south and east of the feedlot, runs through the southeastern end of the property. Primary land uses in the surrounding area include private and Bureau of Land Management (BLM) rangeland and irrigated agriculture. The area is sparsely populated, and most of the residences are associated with agricultural operations.

DESCRIPTION OF EXISTING ENVIRONMENT

Hydrology

Surface Water

The project area lies within the boundaries of the Malheur River drainage basin. There are no major perennial water features in the project area. Surface water features are the intermittent streams and creeks which emerge from canyons in the winter and spring, irrigation and drainage ditches, and ponds. North Sheep Creek traverses the northern portion of the property (just north of the feedlot), and South Sheep Creek crosses the southwestern portion of the property. The North Canal supplies irrigation water to the area and crosses the southeastern edge of the property; it is drained yearly for maintenance purposes. Flooding of streams and creeks is a natural seasonal occurrence caused by snow melt and rapid runoff of spring precipitation.

Ground Water

There are two principal ground water aquifer units in northern Malheur County. These aquifers are associated with the Recent Alluvium and the underlying Chalk Butte geologic formations.

The 50- to 100-foot-thick Recent Alluvium formation represents the chief aquifer unit for domestic and irrigation wells; wells typically produce 20 to 350 gallons per minute from this aquifer. Water is recharged to these surficial sand and gravel deposits from rainfall and, probably to a greater degree, through hydrologic connection with the flow of the adjacent Malheur and Snake Rivers. Irrigation water distribution has a significant influence on raising ground water levels during the summer months.

Underlying this unit is the Chalk Butte formation of the Idaho formation. This unit can be up to 3,000 feet thick, with wells extending to as much as 1,000 feet. However, yields may vary from dry holes to 1,000 gallons per minute. In general, the farther east of Vale, the greater the production rate from this aquifer unit. Recharge to this aquifer is predominately from rainfall.

From a brief analysis conducted by the Oregon State Water Resources Department in November, 1976, the ground water system is seen to be in a state of equilibrium and receives adequate recharge to replace waters withdrawn each year.

A summary of well logs in T19S-R46W were analyzed by the State Water Resources Department in November, 1976, and indicated the following:

Deepest well	- 600 feet	
Shallowest well	- 37 feet	Average 272 feet
Deepest water level	- 372 feet	
Shallowest water level	- 7 feet	Average 120 feet
Greatest yield	-1,070 gpm	Average 164 gpm
Least yield	- 9 gpm	(one well dry)

There are currently nine wells at the feedlot site. Four are actively used for stock water supply, four are unused and are essentially abandoned, and one is used only as a domestic supply for personnel. A summary of well data is presented in Table 5-1.

Table 5-1
FEEDLOT WELL DEPTHS, YIELD, AND TEMPERATURE

<u>Well</u>	<u>Depth (feet)</u>	<u>Yield (gpm)</u>	<u>Temperature (°F)</u>
1	761	600	74
2	880	800+	80.6
3	600	dry	-
4 (abandoned)	520	250	71
5	610	small	unknown
6	575	360	86.6
7	950	unknown	unknown
8	592	est. 200-300	77.6
9	870	145	94.1

Meteorology

The area's climatic characteristics are particularly significant for effects on land uses. Rainfall, wind direction, evaporation rates, temperatures, and length of day are critical for crops and livestock to reach their optimal yields and production levels. Climatic conditions affect crop diversity, animal densities, and agricultural expansions. Climatic conditions also have an important effect on location, design, and operational costs of various land uses. The distribution of odors, dust, smoke, agricultural sprays, and other air pollutants by winds can have impacts on other nearby land uses. Because of the extremes in the Eastern Oregon climate, increased energy usage and costs are incurred.

The climate of the project area is typical of semi-arid Eastern Oregon, with hot, dry summers and cold winters. Average annual precipitation ranges from 9 to 11 inches, with 60 percent of this precipitation falling October through March. Forty-five percent of this precipitation falls as snow, but rarely becomes a hazard. Wind occurrence and velocities increase considerably during this same season, reaching maximum intensities in April. Summers are hot, usually with low humidity. Fall months are mild, with the first freeze coming in late September or early October. There is an average of 156 frost-free days a year. Temperature and precipitation averages are shown in Table 5-2.

Predominant winds are from the north and the west, but do not bring much precipitation. Average velocity is from 5 to 6 mph, but may reach 40 mph. Most of the precipitation comes with a southwest wind and is frontally caused. High intensity winds generally occur during March, April, and May.

Malheur County, especially in the Snake River Plain area, experiences severe air pollution problems, particularly during fall. The dust from harvesting and plowing, ditch burning, application of chemicals, increased agricultural food processing, and frequent temperature/air inversions create severe air quality problems. With increases in population and agricultural production in Western Idaho and Eastern Oregon, the air pollution potential is expected to increase.

The feedlot operation was required to install a sprinkling system in the stockyards to minimize dust caused by milling tile during dry summer months. This water is drawn from

Table 5-2
TEMPERATURE (°F) AND PRECIPITATION
(in.) AVERAGES IN NYSSA-VALE AREA*

	J	F	M	A	M	J	J	A	S	O	N	D
Maximum Temp.	34	43	52	61	72	81	92	86	79	66	49	39
Mean Temp.	28	34	40	49	58	66	75	70	62	51	38	30
Minimum Temp.	20	23	27	36	43	51	58	54	45	37	28	22
Precipitation	1.22	1.15	.77	.91	.75	.82	.41	.84	.65	.78	1.00	1.19

*Averages from 1975, 1965, 1955, 1945. Data stations located in Nyssa, Vale, and near Cariro Junction

Source: Malheur County Comprehensive Planning Program.
Land Capabilities and Natural Resources Background Report, 1977.

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Source: Malheur County Comprehensive Planning Program.
Land Capabilities and Natural Resources Background Report, 1977.

wells and from the wastewater ponds and has been very effective in controlling the dust and odor problems created by minute airborne manure particles.

Terrestrial Ecology

Soils

The primary soil association found in the project area is Nyssa-Virtue. The major soils in this association are Nyssa and Virtue silt loams. Minor soils in the association consist of Chilcotts silt loam, McLaughlin silt loam, terrace escarpments, and Wwyee silt loam/Malheur-Nyssa complex soils. These soils are susceptible to wind and water erosion, especially when there is elimination or removal of surface vegetation or cuts into steep slopes. The high seasonal erosion potential, slow permeability, steep slope areas, and low bearing strength moderately limit building and road construction. There is a potential that waste materials can leach out along tops and faces of benchland terrace edges and steep slopes if wastes are filtered through these soils.

With irrigation and reclamation programs, these soils have good agricultural ratings. Their major limiting factors are cemented pan and steep slopes. Many have underlying terrace gravel deposits.

Natural Vegetation

The proposed well sites are near the current feedlot operation. Much of this area has been disturbed for the feedlot and supplementary operations (roads, effluent ponds, etc.). The remainder of the area is uplands (desert shrub and

canyons and gullies) and agricultural croplands. The uplands desert shrub dominant plant association is Big Sagebrush (*Artemisia tridentata*) and many perennial grasses. Much of the area provides low vegetative cover for animals. Many upland areas adjacent to lower agricultural areas are used by animals as winter range.

The uplands canyons and gullies are intermittent water drainage areas, narrow canyons, and gullies (usually with steep sides). The water source in some cases is supplied by runoff or seepage from higher elevation irrigation projects. These habitat areas are important links or corridors through which animals move from the uplands to the lower riparian or agricultural areas. This habitat also supplies important water, food, and shelter areas in the midst of arid lands.

In the agricultural croplands, agriculture has provided water, food, and shelter in areas that would not normally have these habitat qualities. The edges of agricultural lands, fences, hedge rows, and irrigation and drainage ditches are all collectors for many species of wildlife. Also, when an agricultural land use is adjacent to another habitat type, this provides an extra portion of diversity to the biological character of the area, offering increased potential for greater numbers and varieties of wildlife.

Of the total 950 acres owned by Albertsons, approximately 300 acres are irrigated for hay (primarily). The feedlot encompasses about 250 acres, with an additional 50 acres for supplementary operations (maintenance, storage, ponds, etc.) The remainder of the property is in sagebrush and associated vegetation.

Wildlife

The same disruptive land uses affecting natural vegetation at the site also affect wildlife. The wells are proposed to be developed within the area already disrupted by the feed-lot operation and facilities. Although there is some undeveloped land to the west and south of the operation, it is not anticipated that digesters and well construction will encroach on any habitats for this area.

A list of mammals, birds, amphibians and reptiles, and insects that occur in this area of Oregon is presented in Appendix E. The fauna of much of the area is typical of the big sagebrush-grass association. A portion of the area is irrigated farmland which provides an additional diversity of habitats. The valley quail (*Lophortyx californica*) and the Chinese or ringneck pheasant (*Phasianus colchicus*) are two common game birds in the irrigated areas.

Big game species (mule deer, pronghorn antelope, Rocky Mountain elk) occasionally visit the area from the rangeland on the west. The project area, however, is not within a critical deer winter habitat, and it is not expected that large game habitat reduction will occur from the proposed project.

Aquatic Ecology

The larger rivers and some creeks in the county support a sport fishery. North and South Sheep Creeks, however, because of their intermittent nature, are not of particular value for fisheries habitat. In any event, North and South Sheep Creeks should not be affected by the proposed project.

Threatened or Endangered Species

The U.S. Fish and Wildlife was consulted during the preparation of this report regarding the presence of threatened or endangered plant and wildlife in the study area. A letter documenting this consultation is included in Appendix F. According to the U.S. Fish and Wildlife Service, no wildlife species of concern exist in the study area. The following four plant species, however, have a possibility of occurring in the area:

- o Astragalus purshii var. ophiogenes - endangered
- o A. mulfordae - threatened
- o A. sterilis - endangered
- o Haplopappus radiatus - endangered

No sitings of these species have been documented in the study area. The U.S. Fish and Wildlife suggests that the area be surveyed for the species if a bioconversion project is undertaken.

HISTORICAL AND ARCHAEOLOGICAL SITES AND NATURAL LANDMARKS

The National Register of Historic Places lists no sites in the immediate area as having important national historical value worthy of preservation. No sites worthy of nomination to the National Register have been identified in the immediate area. Significant archaeological or historical resource finds are not expected if the production wells are located within the feedlot operation's area. No regional landmarks are located near the feedlot.

LAND USE

Site Land Use

The area considered for the production well(s) lies within the confines of an active cattle feedlot operation. The feedlot encompasses approximately 250 acres and can accommodate up to 50,000 head of cattle. North of the immediate stockyards are wastewater disposal ponds which are pumped for irrigation use in the growing season. These ponds have recently been expanded to adequately handle all cattle wastewater during peak precipitation months when irrigation is not practiced.

Approximately 300 acres to the northeast of the site is in irrigated hay. A portion of the property to the southeast of the stockyards is used as a manure depository. This manure is not used onsite for fertilizer, particularly since the wastewater pumped for irrigation is high in nitrogen. Most of the manure is trucked offsite.

One residence is in close proximity to the feedlot; that is directly across from the complex office and is used by the feedlot manager and operator. A grain mill and other maintenance/storage structures are located on the site.

Surrounding Land Use

The Albertson property and the area north and south is in private rangeland. Immediately west of the property is BLM rangeland. Much of this rangeland is in undeveloped sagebrush-grass vegetation. To the east and southeast, the area

is agricultural land, irrigated from the major canals in the area. Several smaller feedlots also stretch south along Idaho Avenue.

Most of the scattered residential development in the area is related to agricultural operations.

Prime and Unique Farmland

Prime farmlands are those whose value derives from their general advantage as cropland due to soil and water conditions. Unique farmlands are those whose value derives from their particular advantages for growing specialty crops. Paragraph 101(b) (4) of NEPA establishes a Federal policy to preserve and maintain, wherever possible, an environment that supports diversity and variety of individual choice; this includes the preservation of highly productive farmlands.

The Council of Environmental Quality (CEQ) has directed Federal agencies to strive to assure such farmlands are not irreversibly converted to other uses unless other national interests override the importance of preservation or otherwise outweigh the environmental benefits derived from their protection. These benefits stem from the capacity of such farmland to produce relatively more food with less erosion and with lower demands for fertilizer, energy, and other resources. In addition, the preservation of farmland, in general, provides the benefits of open space, protection of scenery, wildlife habitat, and, in some cases, recreation opportunities and controls on urban sprawl. Federal agencies are directed to determine the existence of prime and

unique farmlands in the areas of impact analyzed in environmental impact statements, including threats to the continued use and viability of these farmlands from direct construction activities, urbanization, or other changes in land use that might be induced by the Federal action.

The primary soil association on the property is Nyssa-Virtue. These are considered prime farmlands soils when irrigated. Because of the agricultural nature of the proposed project, and its complementary use of onsite agricultural wastes, the project would enhance rather than inhibit the integrity of the feedlot and surrounding agricultural land uses.

LAND USE REGULATIONS AND PERMITS

Regulatory and land use requirements for private geothermal development in Oregon exist at local and state levels.

Permit requirements identified for the J. A. Albertson project are summarized in Table 5-3.

Local

The property lies within the jurisdiction of Malheur County, Oregon and is subject to the Malheur County Zoning Ordinance and Geothermal Ordinance. The area is zoned for farm use and requires a conditional use permit approval by the County Planning Commission at a public hearing. Approval of a conditional use permit would result in issuance of "Exploratory Geothermal Well" and "Geothermal Production Project" permits for the project. An indemnity bond for \$5,000 per well (or \$25,000 for a blanket bond) must be filed with the county before these permits will be issued.

Table 5-3
ALBERTSON LAND & CATTLE COMPANY
GEOTHERMAL LAND USE/PERMIT REQUIREMENTS

<u>Agency</u>	<u>Permit</u>	<u>Fee</u>	<u>Bond</u>	<u>Estimated Processing Time</u>
Malheur County Planning Comission	Conditional Use Permit (Exploratory Geothermal Well & Geothermal Production Project Permits)	\$20	\$5,000/well (\$25,000 blanket)	30-60 days
Malheur County Building Department	Agricultural Building Permit Waiver	None	None	1 day
*Oregon Water Resources Department	Ground Water Appropriation Permit	\$20 plus recording fees	None	30 days
*Oregon Water Resources Department	Ground Water Well Drilling Start Card	None	\$2,000	1 day
*Oregon Department of Geology and Mineral Industries	Geothermal Prospect Well Drilling Permit	\$100	\$5,000/well (\$25,000 blanket)	30 days
*Oregon Department of Geology and Mineral Industries	Geothermal Production Well Drilling Permit	\$100	\$10,000/well (\$25,000 blanket)	45 days
*Oregon Department of Environmental Quality	Water Pollution Control Facilities Permit (waste water, solid waste disposal)	no charge**	None	45 days
*Oregon Department of Environmental Quality	Notice of Construction	no charge	None	60 days

*All these permits may not be required depending on further resource assessment.

**This assumes the existing Water Pollution Control Facilities Permit is modified and no new application is required.

The Malheur County Comprehensive Plan is still in the public hearing process and has not been formally adopted. However, policy statements in the draft plan strongly support geothermal development in the county.

Since the project is in conjunction with an agricultural operation, a building permit will probably not be required. Upon submission of a zoning permit from the County Planning Department, an agricultural waiver would be issued by the County Building Inspector. This would take less than one day and would require no fee.

State

Geothermal resources in Oregon are defined as those resources with temperatures greater than 250°F and/or taken from wells deeper than 2,000 feet. The Department of Geology and Mineral Industries (DOGAMI) was given authority to regulate geothermal drilling by the 1971 Geothermal Resource Act. Geothermal resources not included in the above definition were excluded from DOGAMI jurisdiction through 1975 amendments to the Act. These shallow, low temperature wells are now essentially undifferentiated from common water wells and are regulated by the State Water Resources Department (WRD).

Water Resources Department

The Water Resources Department requires application for a permit to appropriate ground water for all ground water wells. The Albertson well would be considered similar to an irrigation or municipal well for review purposes. The permit is issued by the Water Resources Director and requires certification that the applicant has existing ground

water rights for the proposed purpose and will use the water for beneficial use. The property is not within a "critical ground water" area; if it were, it may be more difficult to acquire an appropriation permit. The Water Resources Department, in considering ground water appropriation applications, may impose conditions on approval as deemed necessary to protect public health, safety, and welfare.

No other Water Resources Department permits are required prior to drilling. The licensed well contractor will file a start card with the local Watermaster describing location, proposed use, and expected depth of well(s). A \$2,000 penal bond is required and drilling procedures must conform to ORS Chapter 690 "Rules and Regulations Prescribing General Standards for the Construction and Maintenance of Water Wells in Oregon".

Department of Geology and Mineral Industries

Prospect wells are defined as any well drilled as a geophysical test well, seismic shot hole, mineral exploration drilling, core drilling, or temperature gradient test well less than 2,000 feet in depth and drilled in prospecting for geothermal resources. Prospect well permit applications, with a plan of operation and hole locations, must be submitted to DOGAMI with a \$100 filing fee and a \$5,000 bond or security deposit (\$25,000 for a blanket bond). This application is then circulated to the Water Resources Director, the Director of the Department of Environmental Quality, the Director of the Department of Land Conservation and Development, the Director of the Division of State Lands, and other appropriate agencies.

Agencies have 15 days in which to comment. The permit can be issued in 30 days and conditions can be imposed, including provision for the proper and safe abandonment of each prospect well.

Casing and abandonment requirements are made a condition of each prospect well permit. Permitting of shallow holes is done on a blanket basis and up to 100 holes may be drilled under one permit. Formation logs and notations of water zones encountered are required of every operator. Hole temperatures must also be monitored, and if the temperature exceeds 125 degrees, drilling must cease and the hole be completed as an observation hole, abandoned, or equipped with safety devices as prescribed by the Blow-out Prevention Rules. A final statement describing the plugging procedure and final locations must be submitted by the operator. Sites are inspected for cleanup and to check for ground water leakage. If all permit conditions are met, the drilling bond is released.

Geothermal Production Well drilling permits must be obtained from DOGAMI if the well will be over 2,000 feet or greater than 250°F. The application must contain a detailed plan of operation including hole location, estimated drilling depth, blow-out prevention equipment, waste mud and drill cuttings disposal, emergency plans, and site and road construction. A \$100 filing fee is required for each well. This application is then referred to the State Water Resources Director, the State Fish and Wildlife Director, the State Forester, the Director of the Department of Environmental Quality, the Administrative Officer of the State Soil and Water Conservation Commission, the State Parks Superintendent, the Water Policy Review Board, the State Highway Engineer, the Director of the Department of Land Conservation and Development,

the Director of the Division of State Lands, and the Malheur County Commissioners. A permit can be denied or conditioned upon responses from any of these agencies. If it is determined that the project meets all applicable regulations, DOGAMI will issue a drilling permit within 45 days, upon receipt of an indemnity bond for \$10,000 for each well (or \$25,000 for a blanket bond).

Inspections are made yearly to test blow-out prevention equipment, see that mud is properly handled, and that records are kept and drill samples collected. Inspections are also made when fluid tests or subsequent casing strings are run, when subsequent cementing or casing operations are completed, and for well completion and site restoration. All records related to drilling must be filed with DOGAMI within 20 days after completion or abandonment. When all requirements are met, the drilling bond is released.

Department of Environmental Quality

Depending on the wastewater disposal method proposed, review by the State Department of Environmental Quality (DEQ) may be required. If the wastewater is discharged to public waters (such as Sheep Creek), a new or modified State Water Pollution Control Facilities (WPCF) permit would be required from DEQ. (The feedlot operation already operates under a WPCF permit.) No permits are required for reinjection if the water is of good quality and if it is reinjected into the same aquifer from which it was drawn. If the discharge water is placed in the existing holding ponds or is used for irrigation near the site, a modification to the current WPCF permit may be necessary.

WRD and DOGAMI are both currently preparing legislation for consideration during the 1981 Legislative session on disposal of geothermal effluents. This information is still being drafted and it is not certain what additional regulations may be required in 1981.

In Eastern Oregon, agricultural operations are exempt from DEQ air quality regulations. Although this project may be a borderline agricultural/commercial operation, no permits should be required if few people are impacted. Solid waste disposal may also require a modification to the existing WPCF permit for the feedlot.

Although there were no specific permits identified for air, water, or solid waste by DEQ, a Notice of Construction application should be filed with DEQ to gain preliminary certification for energy-saving tax credit eligibility. This process requires no fee and takes about 60 days to process. Tax credits are available under solid waste, air quality, and water quality programs (see ORS 468).

Land Conservation and Development Commission

The Oregon Land Conservation and Development Commission (LCDC) has adopted 19 statewide planning goals that guide development of city and county comprehensive plans. Although Malheur County is preparing a comprehensive plan, it has not been recognized by LCDC as being in compliance with the statewide planning goals. This project, therefore, must be considered in light of these goals. Applicable goals include Goal 3, Agricultural Lands; Goal 5, Open Spaces, Scenic and Historic Areas, and Natural Resources; Goal 6, Air, Water, and Land Resources Quality; and Goal 13, Energy

Conservation. The Albertson project should not conflict with any of these goals, and they will be addressed in the environmental report prepared for the project. No specific permits are required to ensure compliance with this land use requirement.

NOISE

Noise is any undesirable sound, and, for analytical purposes, is assumed to decrease in desirability as loudness increases. Loudness, or intensity, of sound is measured in decibels (dB), a logarithmic scale of comparative intensity with respect to the threshold of human hearing. Using this scale, an increment of 1 dB corresponds to an increase of 26 percent in intensity. Since the human ear perceives high-frequency sounds at lower intensity than it does intermediate- and low-frequency sounds, noise measurements are usually weighted to account for this by using the "A" scale (dBA). The primary noise sources near the site are the cattle and feedlot operations. Because of the low density of population in this portion of Eastern Oregon, no noise-monitoring stations have been established in the area by the Oregon Department of Environmental Quality, and no current data exists on background noise levels at the site or in the immediate vicinity.

SOCIAL PROFILE

Community Characteristics

A summary of the population projections that have been made for Malheur County to the year 2000 is presented in Table 5-4. Projections for small areas are difficult,

however, primarily because incremental changes have greater impact in such areas. The accuracy of this projected population range for Malheur County is highly dependent on future developments within the county. Although major increases in irrigated land in the county are not forecast, increased demand for productive land may warrant new irrigation projects. Approximately 85 percent of the total population of Malheur County currently lives in and around the cities of Nyssa, Ontario, and Vale.

Table 5-4
HIGH-LOW POPULATION PROJECTIONS
MALHEUR COUNTY 1980-2000

	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
High	25,600	27,100	28,200	29,200	29,800
Low	24,975	25,875	26,675	27,325	27,800

Unemployment rates are lower in Malheur County than in Oregon in general. In 1975, average unemployment in the county was 7.4 percent of the labor force. In the same year, employment in the county in the agricultural, forestry, and fisheries industries dropped from 36.9 percent to 23.9 percent. Although this industry employment has been declining in the county, farm income has risen in the past years as a result of increased productivity and favorable market prices.

A 1975 estimate of Malheur County agriculture income is presented in Table 5-5. The economic base of the county is primarily agriculture and related industries with livestock production the largest single component, contributing about

Table 5-5
1975 ESTIMATE
MALHEUR COUNTY AGRICULTURE INCOME

<u>Crop</u>	<u>Acreage</u>	<u>Yield/ Per Acre</u>	<u>Estimated Sales</u>
Sugar Beets	16,600	24.0 ton	\$11,952,000.00
Potatoes	10,300	330.0 cwt.	10,712,000.00
Onions	5,650	420.0 cwt.	10,678,000.00
Alfalfa Hay	61,000	4.5 ton	4,804,000.00
Other Hay	45,300		186,000.00
Alfalfa Seed	7,100	460 lbs	2,177,000.00
Wheat	32,000	80 lbs	8,847,000.00
Barley	10,000	75 lbs	1,547,000.00
Oats & Rye	2,400		124,000.00
Corn	5,000	95 bu	770,000.00
Corn Silage	7,000	20 tons	1,428,000.00
Sweet Corn	4,625	7.3 tons	1,813,000.00
Peppermint & Spearment	3,100	60 lbs	2,640,000.00
Misc. Crops (fruit, hops, misc. veg. & misc. seed crops)			4,434,000.00
Livestock (cattle, sheep, & hogs)			17,879,000.00
Dairy (milk & cream)			6,673,000.00
All Other Livestock & Livestock Products			<u>719,000.00</u>
			\$87,383,000.00
Agriculture Income - 1974 (Adjusted)			82,035,000.00
1973 (Adjusted)			79,943,040.00

Source: Malheur County Comprehensive Planning Program.
Economics and Population Background Report, 1977.

\$18 million or 20 percent of the total annual county income. Malheur County livestock trends since 1920 typify those observed in many parts of the Intermountain West, with cattle numbers nearly tripled between 1920 and 1970. Ranches in the county are typically small, with an average herd size of 280 head in 1961 and 320 head in 1974. Although the total number of ranches has been decreasing in the county, this reflects a trend towards consolidation of smaller ranches into larger operations.

Water availability, energy costs, and competition from areas more easily irrigated are some of the major deterrents to rapid economic growth in the county. Malheur County maintains a comparative advantage for agriculture with its established supporting retail, wholesale, processing, and service industries. Therefore, the county supports projects to develop alternative energy resources and to more wisely use its agricultural products and wastes.

Community Services

Generally, the project area has only a basic or rural level of services. Water in the area is supplied by private wells, and sanitary sewerage is disposed of through private subsurface sewage disposal systems. The project site is within the Nyssa Road District, and roads are maintained with district equipment and personnel. Although the property is near the Owyhee Irrigation District and the Owyhee North Canal crosses the southeastern corner of the property, the feedlot provides its own irrigation water from feedlot wastewater, and imported make-up water as necessary.

Electrical energy is provided by Idaho Power Company. The use of electricity for irrigation pumping in Eastern Oregon and Western Idaho has shown a marked increase over the years. In 1976 nearly 100,000 additional acres were irrigated. This brought the total to 1.6 million acres. Electrical power usage is highest in the summer months in the Snake River Valley due to irrigation needs.

The county maintains the second largest solid waste dump in the region at the Lytle Blvd. site, located between Nyssa and Vale on BLM property. There is no caretaker, burning is a common occurrence, and the county road crews cover the site whenever they can. The only sanitary landfill site in the county is in a canyon about 6 miles northwest of Ontario. There is no solid waste disposal requirement anticipated with the proposed project. Manure from the feedlot is currently trucked offsite, or stockpiled onsite. Approximately 85,000 tons of manure must be disposed of yearly, and it has become more difficult in recent years to find adequate disposal opportunities.

AESTHETICS

The visual quality of the project site is characterized by the feedlot operation and supplementary facilities. The general visual character of the site is one of an intensive agricultural operation, consistent with surrounding land uses.

POTENTIAL ENVIRONMENTAL IMPACTS

Hydrology

Adverse impacts to surface and ground water systems are a concern both during drilling of the wells and operation of

the facility. It is imperative that domestic and irrigation aquifers not be contaminated with geothermal fluids should the quality of the geothermal fluid be poor. Water contamination can result from casing leaks, seepage from holding ponds, uncontrolled discharge from wells, and improper disposal of spent fluids.

Regulations require that geothermal wells be cased and cemented through the shallow ground water aquifers to prevent geothermal fluids leaking into the aquifers from the well bore. Drilling muds help to reduce the seepage from holding ponds and these ponds can be lined if the geothermal fluid is of low quality. Proper design of the systems should reduce contamination potential from these systems.

The producing operation should have no effect on the shallow ground water aquifers in the area if proper well-completion procedures are followed. The well(s) will be drilled into a deeper aquifer than is used for domestic water supply and no drawdown of existing domestic wells is expected.

It is anticipated that the use of the geothermal fluid for beneficial secondary purposes will eliminate the need for reinjection of the spent fluid and will cause no adverse impacts on water systems in the area. Since the fluid will be either mixed with existing wastewater in the ponds onsite or will be used for other water supplement in the stockyard operations, no impacts on surface waters are anticipated.

Mitigations

Because of the low temperature and pressure of the geothermal resource, blow-outs during well drilling are unlikely.

However, if necessary, blow-out preventers could be installed during drilling and should remain until the well head equipment is installed upon completion of the well. This would minimize the potential for uncontrolled well discharge. Pipelines should be designed to prevent leakage or rupture and should be regularly checked and maintained. Surface contamination should be prevented through the use of a sump to contain all fluids generated during drilling and testing of the well. Ultimate disposal of the fluids contained in the sump will be determined based on the water quality of the fluid. No fluids should be allowed to reach existing waterways until the compatibility of the two resources is assured. The sump should be contoured and sloped toward the sump to provide onsite control of the surface runoff.

Amount and quality of water produced will determine disposal methods most suitable for the project. Possible alternatives include secondary uses for stock watering, make-up water for wastewater ponds for irrigation purposes, use in the stockyard sprinkling system to control dust, or, if necessary, reinjection. In all cases, state and Federal water standards will be assured through the permitting processes.

Air Quality

Noncondensable gases are released during drilling and well testing. Although well blow-outs are not anticipated because of the low temperature and pressure of the resource, a blow-out would cause a venting of steam which would release additional gases to the air. This is highly unlikely at the 135°F temperature.

Particulates released with the geothermal fluids or raised by construction equipment should not add significantly to the background level of particulates already caused by agricultural operations or dust-raised wind. Although there are occasional mild inversions in northern Malheur County, air flow is generally good and assists in particulate dispersion. Dust and particulate impacts should be felt only during construction, and will be a short-term impact.

Digester gases usually contain about 60 to 70 percent methane, 30 to 40 percent carbon dioxide and other gases including ammonia, hydrogen sulfide, mercaptans and other noxious gases. It also is saturated with water vapor. Operational impacts are not expected to be significant, particularly considering the agricultural odors already present.

Mitigations

Watering of construction areas during excessively dry periods would reduce air quality impacts during construction. Depending on the amount of gases emitted during drilling and operation, abatement equipment may be necessary to reduce impacts.

Noise

Noise production will occur during site preparation, well drilling, and well testing. Site preparation includes clearing, leveling and compacting areas to provide drill pads, and construction of minor access roads. Peak noise levels should range from 85 to 95 dBA at 50 feet from the source.

Drilling of the wells presents noise levels from 65 to 105 dBA. The drill rig will probably operate for 24 hours a day since the noise will cause minimal disruption to humans in the relatively undeveloped rural area. The venting of geothermal fluids during well testing is potentially the greatest source of noise associated with the project. Noise levels could reach 133 dBA, but may be reduced with appropriate mufflers. Operational noise should be consistent with existing ambient noise of the feedlot facility.

General drilling noises should not adversely affect cattle at the feedlot. However, sudden, unexpected noises may cause the cattle to startle and mill about. This could increase dust and particulate emissions in the area if the stockyards are dry. The existing sprinkler system installed to control this problem, however, should minimize such impacts.

Mitigations

Mufflers on construction and well drilling equipment would reduce noise impacts. No operational mitigating measures should be necessary.

Terrestrial Ecology

During construction, erosion potential will increase where soils are disturbed. This should be confined to the required access roads, the well and digesters site, and pipeline corridors. Because of the desert-type vegetation in the area, disturbed areas may not rapidly revegetate naturally after disturbance. Reseeding to existing vegetation would somewhat reduce this impact, but some erosion will be unavoidable.

Because of the present disturbed nature of the site and the surrounding land uses, impacts on the terrestrial ecology of the area should be minimal. Little vegetation and habitat would be removed relative to other available habitat in the area.

Wildlife or vegetation on the site or in the immediate vicinity are unlikely to be significantly impacted by resultant changes in noise or air quality. Temporary impacts may be felt on some wildlife because of noise and drilling activity causing local fauna to move temporarily out of the construction area.

Mitigations

Disturbance to existing vegetation should be minimized as much as possible. Upon completion of the construction phase of the project, disturbed areas should be regraded to natural contours. Reseeding or replanting of native vegetation would further reduce long-term erosion potential.

Land Use

The project will occur on private land currently used for feedlot and supplementary operations. No more than 1 to 2 acres should be required for drilling operations. Other surrounding land uses, which are in irrigated agriculture or rangeland, would not be adversely impacted by the project. Geothermal fluids will be contained onsite and no adverse effects on land use are anticipated.

The proposed project would provide an opportunity for better utilization of agricultural waste products and would enhance agricultural operations for this and similar facilities.

Anaerobically digested sludges can be stored and spread on land with less risk of creating conditions for odor and insect breeding problems than exists with similar handling procedures for untreated organic waste materials. The digested material will still contain most of the organic nitrogen, phosphorus, and potassium and in a form that may be more readily available to plants. A small portion of the nitrogen may be lost to the gas portion of the system, thus reducing the amount of nitrogen initially available.

If geothermal production results in land subsidence, an irreversible process, the subsidence would constitute a long-term effect on land resources. Agricultural systems of irrigation, drainage, etc., are based on existing slopes and have little tolerance for change. However, these facilities in the immediate area are owned and operated by the Albertson Company and would be confined to the subject property if subsidence did occur. This impact, however, is not expected.

Mitigations

If it appears that either induced seismicity or subsidence are occurring as a result of the project, monitoring programs should be established to predict the long-term occurrence and mitigations efforts required.

Socioeconomics

As much as possible, the driller will use local manpower during well drilling and construction. Because of the short and indefinite duration of the project, workers from outside the area would probably not relocate their families to the

area. Most of this crew would use motel or other temporary housing facilities in Nyssa. The economic effects of construction of the project will not be significant, and demand for social services should be small. A maximum of eight additional employees may be required for the feedlot operation to maintain and operate the digester.

Long-term economic effects of the project include better utilization of agricultural products and waste materials, and effective energy and waste recovery systems to reduce energy requirements of the feedlot operation. The methodology for completing this study could be readily applied to other area feedlot operations with available geothermal resources. In the long run, the availability of geothermal energy would be an advantage to similar types of operations, as well as to future agribusiness operations.

Mitigations

No mitigation measures should be necessary.

Historical and Archaeological Sites and Natural Landmarks

As there are no known historic or archaeologically significant sites in the area, and long as the drill sites are contained in the generally disrupted stockyard area, there should be no impacts on historical or archaeological sites.

Mitigations

Prior to construction or drilling activities, a competent archaeologist should be contracted to conduct a detailed walk to identify surficial finds of cultural value in the pipeline and construction areas.

Accident Potential

During the drilling program, the most likely problems will be cave-ins, tools lost to the well, and drilling fluid problems. The potential for blow-out is not high since the resource is expected to be low temperature, low pressure. Precautions can also be taken to ensure that the surface casing is properly cemented and sealed and that appropriate equipment is established on the well head prior to drilling into the thermal zone to minimize ground water contamination accidents.

Accidental release of geothermal fluids could create noise nuisance, air contamination from gaseous emissions, pollution of water resources, and hazards to health and safety of workers at the site. With proper construction procedures, however, this potential should be minimal. Although the well is proposed for location near the stock pens, it is not anticipated that they will be close enough to affect the animals.

Methane in a concentration of 6 to 15 percent with air is an explosive mixture. Since it is lighter than air, it will collect in rooftops and other enclosed areas. It is relatively odorless and detection of its presence may be difficult. Extreme caution and special safety features are necessary in the digester design and storage tank, especially if the gas is compressed.

Mitigations

With proper construction and operation procedures, accident potential can be minimized. During operation, the digester building should be properly signed to warn of potential hazards.

ALTERNATIVES

Alternatives being considered during the planning and design of this project include alternative well sites, digester system design, and fluid disposal options.

The production well site will be selected based on geologic and geophysical information obtained from resource assessment. The site will be located on the project property where there is the best possibility of locating a suitable geothermal resource, and which would require the least effort for transport of raw materials and spent fluid. Impacts of development at other sites would be similar, but with increased expense involved in drilling for a less certain resource and more transportation costs.

Design of the digester system will depend upon the quality of the geothermal resource and the most efficient and practical method of manure utilization. The purpose of this project is to demonstrate the feasibility of applying the geothermal resource to an agricultural operation. Success of this project will reduce the requirement for present fuel resources at similar agricultural operations, and will further the knowledge of use of geothermal resources as an alternative and supplemental energy resource.

The final decision on fluid disposal methods will be made upon assessment of the quality and quantity of geothermal fluids. At this time, it is anticipated that the clean effluent run through the digester heat exchanger will be used secondarily for stock watering, make-up water for effluent ponds (and ultimately irrigation), and/or supplemental water for the sprinkling system in the stockyard. Depending on the quality of the geothermal resource, this

water may require treatment prior to the secondary use. If excess water is generated from the project, reinjection of the spent fluid will be investigated.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Human energy, money, and construction materials will be irretrievably committed for development of the project. To the extent that these resources represent a commitment to supplementing or replacing existing energy needs, their consumption would be necessary regardless of the method or technology used in the generating process.

Some onsite or related ecological features, such as plant and animal life, may be minimally affected by clearing and construction activities. The extent of such alterations will depend upon the ultimate site chosen for the facility and the pipeline and access roads necessary for operation and maintenance. While these may not be irreversible commitment of land resources, it will provide a commitment for the life of the project.

RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

By developing potential geothermal resources, a previously unused natural resource will be tapped to help meet the nation's growing energy needs. In terms of total energy requirements, the contribution of this type of project may be relatively small, but it can be important, particularly on a local or regional basis. Secondary use of the resource will also supplement a valuable commodity, and will reinforce the agricultural integrity and nature of the local economy.

To the extent that geothermal fluids are withdrawn from the subsurface reservoir and not replaced by reinjection or natural recharge, the waters so consumed represent depletion of water in storage. However, if the secondary uses are replacing current water requirements, the probability of use of the resource would be high with or without the project.

The area is already in an intensive agricultural operation and the small amount of additional land required for the project will not greatly impact natural systems. Small localized loss of wildlife habitat in the immediate vicinity of installations may occur; however, this is not expected to be significant.

In the long term, the site could be converted back to its present use upon termination of the project. The long-term productivity of the area should not be adversely affected by the short-term effects of the project.

COMPLIANCE WITH APPLICABLE REGULATIONS

There are no known conflicts with state, local, or regional plans. The project has been coordinated by requests for opinions from state and county agencies having jurisdiction or interest in the area. Further contacts will occur when permitting requests are submitted. Agency contacts include:

Oregon State Historic Preservation Office
Oregon State Department of Fish & Wildlife
Oregon Natural Heritage Program
Oregon Water Resources Department
Oregon Department of Environmental Quality
Oregon Department of Geology & Mineral Industries
Oregon Department of Energy
Malheur County Planning Department
Malheur County Building Department

Chapter 6 COST ESTIMATE, FINANCIAL AND ECONOMIC ANALYSIS

METHANE GENERATION FACILITY COST ESTIMATE

Methane generation facility cost estimates were prepared for the 50 percent design based on feed supplement production sufficient for 30,000 head and the 100 percent design based on maximum energy production. The cost estimates are based on June 1980 dollars and are presented in Tables 6-1 and 6-2. The total direct and indirect costs of construction and startup, including engineering and contingency, are \$9,049,000 for the 50 percent design and \$13,258,000 for the 100 percent design.

In preparing the estimate, the facility was broken down into unit operations and estimated based on relative sizes. In most cases, equipment prices were obtained from prospective vendors. Concrete structures were estimated based on size and actual related costs of previous similar structures indexed to current costs. Other costs were prepared using flow sheet data with some section estimates arrived at by factoring. The expected accuracy of the estimates is considered to be ± 30 percent of the total investment.

OPERATION AND MAINTENANCE COSTS

Shown in Table 6-3 is a summary of the annual operating and maintenance costs for the 50 percent design and 100 percent design methane generation facility. All costs are in June 1980 dollars.

Table 6-1
50% DESIGN^a
STUDY COST ESTIMATE
METHANE GENERATION FACILITY

A. Direct Costs

Well Pump and Controls	\$ 307,800
Raw Manure Preparation and Mix	312,200
Anaerobic Digesters	2,278,000
Degas Column and Cent. Pumps	41,300
Centrifuges and Building	542,200
Convr. and Sludge Bunker	77,300
Power Gen. and Substation	753,500
Centrate Lagoon	105,000
General Sitework	172,500
Piping	424,200
Electrical	495,200
Instrumentation	233,400
Insulation	<u>250,000</u>
Subtotal	5,992,600

B. Indirect Costs

Constr. Overhead and Profit (@25%)	1,498,200
Startup	<u>50,000</u>
Subtotal	7,540,800

C. Engineering, Legal, CMS, and Contingency (@20%)	<u>1,508,200</u>
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TOTAL	\$9,049,000
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^aDesign based on feed supplement production sufficient for 30,000 head feedlot.

Table 6-2
100% DESIGN^a
STUDY COST ESTIMATE
METHANE GENERATION FACILITY

A. Direct Costs

Well Pump and Controls	\$ 325,400
Raw Manure Prep. and Mix	312,200
Anaerobic Digesters	3,826,900
Degas Column and Cent. Pumps	44,200
Centrifuges and Building	697,700
Convr. and Sludge Bunker	116,700
Power Gen. and Substation	1,341,000
Centrate Lagoon & Sludge Beds	213,800
General Sitework	172,500
Piping	636,300
Electrical	566,000
Instrumentation	233,400
Insulation	<u>312,500</u>
Subtotal	8,798,600

B. Indirect Costs

Constr. Overhead and Profit (@25%)	2,199,700
Startup	<u>50,000</u>
Subtotal	11,048,300

C. Engineering, Legal, CMS, and Contingency (@20%)	<u>2,209,700</u>
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TOTAL	\$13,258,000
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^aDesign based on maximum energy production

Table 6-3
ANNUAL OPERATING AND MAINTENANCE COSTS
JUNE 1980

<u>Item</u>	<u>50% Design</u>	<u>100% Design</u>
Labor	\$190,000	\$206,800
Fuel and Vehicle Maintenance & Replacement	51,200	60,400
Chemicals*	20,200	39,300
Digester Cleaning	8,000	10,000
Power	113,000	174,700
Plant Maintenance	138,800	160,000
G&A & Operating Supplies	<u>22,800</u>	<u>24,800</u>
	\$535,200	\$666,000

*Optional use of polymers to aid dewatering of digested sludge.

Labor costs were developed assuming nine operators, one mechanic, and two truck operators would be required for the 100 percent design. For the 50 percent design one less operator was assumed.

The fuel and vehicle maintenance costs were developed by estimating the fuel consumption of the various vehicles for the facility. Allowances were made for raw manure transportation and loading and sludge hauling. A yearly amount for periodic vehicle replacement was also included.

The cost of potable polymers in the dewatering centrifuge operation will be an optional item and most likely will not be required if lower quality dewatering results can be tolerated. However, the costs were included in the overall economic analysis.

An allowance was made for costs associated with cleaning accumulated grit from each digester once a year.

Power costs were estimated based on local power rates and power requirements of 550 hp for the 50 percent design facility and 850 hp for the 100 percent design facility.

Plant maintenance costs, general and administrative costs, and operating supplies were also included for the overall economic analysis.

ETHANOL PLANT COST ESTIMATE

Shown in Table 6-4 is a cost estimate for an ethanol production plant based on utilization of gas production from the 100 percent design Methane Generation Facility. The ethanol plant production capacity is approximately 5 million gallons per year. The estimated project cost would be \$5,490,000 including engineering and contingency. The costs of labor, enzymes, chemicals, and utilities are typical costs associated with alcohol facilities of this size. The feedstock cost is based on corn priced at \$3.16 per bushel and a conversion rate of 2.5 gallons of anhydrous alcohol per bushel.

Anhydrous alcohol is currently selling for \$1.80 per gallon in Idaho. Based upon this price, the sale of 5 million gallons of alcohol will result in an annual income of \$9 million.

Table 6-4
STUDY COST ESTIMATE
ETHANOL PRODUCTION PLANT

A. Direct and Indirect Construction Costs

Process Equipment and Accessories	\$ 2,100,000
Electrical and Instrumentation	610,000
Boiler System, Utility Piping	615,000
Stillage Belt Press	210,000
Liquid Storage	275,000
Grain Handling and Storage	259,000
Sitework, Utilities, and Miscellaneous	115,000
Building	<u>390,000</u>

Subtotal 4,574,000

B. Engineering, Legal, CMS, and Contingency
(20%)

915,000

TOTAL PROJECT COST

\$ 5,490,000

Notes:

- A. 5 million gallon per year plant production capacity
- B. Utilizes methane from Methane Generation Facility
based on 100% design

The byproduct from the alcohol production process, distillers dried grains, is a high protein concentrate suitable for cattle feed, dairy herd feed supplement, and swine feed. The value of this material, based upon percent protein content, should be much greater than that of the corn from which it is derived. However, this analysis will conservatively assume that the value of the distillers dried grains is equivalent to that of corn. Based on a value of \$3.16 per bushel and a 20 percent yield of distillers dried grain, the value of this material is \$1,265,000 per year.

Based upon the above assumptions, the total revenue from the proposed alcohol plant is \$10,265,000.

Table 6-5 summarizes the economic factors associated with the proposed alcohol facility. Subtracting the total annual operating costs from the total annual revenue results in an annual operating profit of \$2,160,000. Based on an estimated project cost of \$5,448,000, the simple payback period is 2.5 years.

Table 6-5
ECONOMIC ANALYSIS OF ETHANOL PRODUCTION PLANT
AND SIMPLE PAYBACK PERIOD

Total Annual Revenue	\$10,265,000
Total Annual Operating Cost*	8,105,000
Total Annual Operating Profit	2,160,000
ESTIMATED PROJECT COST	\$ 5,490,000
Payback Period	2.5 years

*Operation cost before tax, depreciation. and debt service.

FINANCIAL AND ECONOMIC ANALYSIS OF THE METHANE GENERATION FACILITIES

In order to provide a means of evaluating the economic viability of the proposed methane generation facilities, a financial and economic analysis was performed. The analysis chosen was the Internal Rate of Return (IRR) because of its universal use as a method of comparing investment alternatives. The IRR is defined as the interest rate at which the present worth of the cash flows on the proposed project equal zero. The IRR provides a percentage figure that indicates the relative yield on different uses of capital. The analysis was performed for both the 50 percent design and the 100 percent design facilities. Internal Rates of Return were determined for both designs with and without inflation. Information was generated to determine IRR to capital (equity and debt) and IRR to equity only for both designs. The results of these analyses are presented in Table 6-6.

In preparing the analyses, certain assumptions were made as described below:

- o Schedule - Engineering was assumed to take place from July 1980 to March 1981; construction, including startup, was assumed to take place from March 1981 to December 1982. Facility operations were assumed to start in January 1983.
- o Escalation Rates - Yearly escalation rates were assumed to be 12 percent through 1982 and 8 percent per year thereafter.

Table 6-6
FINANCIAL AND ECONOMIC ANALYSIS SUMMARY

<u>Facility</u>	<u>Total Investment Through 1982</u>	<u>Internal Rate of Return to Capital (Equity & Debt)</u>	<u>Internal Rate of Return to Equity</u>
100 Percent Design			
- without inflation	\$15,852,000	13.1%	negative
- with inflation	18,476,000	23.1%	84.2%
50 Percent Design			
- without inflation	10,815,000	14.0%	negative
- with inflation	12,608,000	24.2%	104.2%

- o Capital - Capital was assumed to be available at a 12 percent interest rate with a 70/30 percent debt to equity financing structure.
- o A beginning of year convention was assumed for all analyses.
- o Investment Tax Credits - In addition to the permanent business investment tax credit of 10 percent, an additional Energy Investment Tax Credit of 10 percent is applicable. Under the Energy Tax Act of 1978 (Public Law 95-618) "equipment that converts alternate substances like biomass into a synthetic solid, liquid, or gaseous fuel" are eligible for the additional tax credit. A 20 percent total Investment Tax Credit was therefore assumed in the analyses and was used in the first year of plant operation. Additionally, a venture type analysis was assumed whereby the benefits of the tax credits would be available for use elsewhere in the Albertson operations.
- o Revenue - Revenue generated from the sale of electrical power was assumed to escalate at rates projected by the Department of Energy for Region 10 for Industrial Customers as printed in the Federal Register dated January 23, 1980. Revenue generated by "avoiding" the purchase of alfalfa hay was based on a current market price of \$70 per ton and was escalated 12 percent per year through 1982 and 8 percent per year thereafter.

- o Property Taxes - Property taxes were applied at a rate of \$17.44 per \$1,000 of true cash value.
- o Insurance - Insurance costs were assumed to be \$50,000 per year for both facilities.
- o Depreciation - A double declining balance method was assumed over a 20-year period.
- o Income Tax Rate - A total income tax rate of 49.5 percent was used for the analyses (46 percent Federal tax and 3.5 percent state tax).

As shown in Table 6-6, the 100 percent design with inflation case analysis indicates that the after tax IRR to capital (equity and debt) is 23.1 percent and the after tax IRR to equity is 84.2 percent. The 50 percent design with inflation case analysis indicates that the after tax IRR to capital (equity and debt) is 24.2 percent and the IRR to equity is 104.2 percent. These returns provide a means for management to determine if the proposed project is economically viable and financially attractive.

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ASSESSMENT OF THE GEOTHERMAL POTENTIAL OF
THE J. A. ALBERTSON FACILITY AT
NYSSA, MALHEUR COUNTY, OREGON

for
CH2M-HILL
BOISE, IDAHO

by
GeothermEx, Inc.
Murray C. Gardner
James R. McIntyre

July 1980

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CONTENTS

	Page
CONCLUSIONS	1
RECOMMENDATIONS	2
INTRODUCTION	3
Preface	3
Scope of Work	4
Location	5
ANALYSIS OF GEOLOGICAL AND GEOPHYSICAL DATA	6
Introduction	6
Geologic Setting	7
Regional Stratigraphy	7
Predicted Stratigraphy at the Wellsite	11
Regional Structure	13
Structure at the Wellsite	14
Water Well Information-Hydrology	15
Geochemistry	16
Temperature Gradients and Heat Flow	16
REFERENCES	19

APPENDIX

1. Chemical Analyses of Well Water

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ILLUSTRATIONS

Plate

1. Topographic map of the area near the Albertson Land & Cattle Company, Nyssa, Malheur County, Oregon, with wells and gradient holes, structure and proposed geothermal wellsite.
2. Geologic map of a portion of the western Snake River Basin, Oregon
3. Lithologic section of H. K. Riddle Kiesel Estate No. 1 exploratory drill hole

Figure

After Page

1. Location map of the Albertson Land & Cattle Company property, Nyssa, Owyhee County, Oregon	5
2. Stratigraphy in the western Snake River Plain	7
3. Bouguer gravity map of the area near Nyssa, Owyhee County, Oregon	14
4. Heat flow map of the area near Vale, Owyhee County, Oregon	17

JAMES B. KOENIG (415) 527-9876
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CONCLUSIONS

1. The Albertson Land and Cattle Company feedlot near Nyssa, Malheur County, Oregon is within a high temperature gradient and heat flow area associated with the Western Snake River Basin. A gradient of 5°F/100 feet is expected to persist to at least 2,000 feet depth in the vicinity of the feedlot. Between the depths of 1,200 and 2,000 feet, the temperature of fluids encountered is expected to be from 120°F to 150°F. A mix of waters produced from this zone is expected to average at least 135°F.
2. Fluids from aquifers in the area provide chemical geothermometry that suggests that reservoir base temperatures are between 200°F and 220°F. Fluids have generally less than 1,000 ppm of total dissolved solids. Fluids are sulfate-carbonate in composition.
3. The aquifers beneath the surface at the Albertson feedlot are likely to be sandy interbeds within the upper parts of the Chalk Butte Formation of the Idaho Group. The formation is likely to persist to a depth below 2,000 feet.
4. There are no valid production tests from the targeted zone of completion. Several wells in the area have produced more than 400 gpm from perforated zones in the Chalk Butte Formation.
5. Critical to success of a well will be completion technique. A graded filter and gravel packing behind perforated liner is most likely to prevent sanding of the hole.
6. Geophysical information suggests several faults trending north and northwest within one mile of the Albertson property. There do not appear to be faults at the property which would be drilling objectives at depths to 2,000 feet.
7. Photogeology and field geology reconnaissance did not identify linear features which may be faults on the Albertson property. Linears northward of the property appeared to be cut off by another structure.
8. A site about 0.1 miles north of Albertson well No. 8, in SE $\frac{1}{4}$, SW $\frac{1}{4}$, Section 21, T. 19 S., R. 46 E. is likely to be the best location for a geothermal test well.

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RECOMMENDATIONS

1. Prepare a drillsite at the location in SE $\frac{1}{4}$, SW $\frac{1}{4}$, Section 21, T. 19 S., R. 46 E., contract a qualified water well driller, and drill toward a target depth of 2,000 feet. Be certain to have a drilling plan and rig capability which will not damage the potential producing formation. Air drilling may be preferred.
2. Maintain close observation of the lithology of the hole to permit stratigraphic correlation with adjacent deep wells.

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INTRODUCTION

Preface

CH2M-Hill was engaged by J. A. Albertson (Albertson Land and Cattle Company) to determine the feasibility of use of geothermal water to accelerate methane gas production from waste products of cattle at the Albertson Land and Cattle Company at Nyssa, Oregon, feedlot facility, and to design, engineer and construct appropriate wells, collection and processing plant. In October, 1979, CH2M-Hill and GeothermEx engineers and geologists met and inspected the Albertson feedlot and surrounding area. It was agreed that GeothermEx would undertake to perform resource assessment services as consultant to CH2M-Hill.

As consultant, GeothermEx was to accomplish two phases of work. The tasks of the first phase included:

- a) literature review of existing geological and geophysical studies of the Nyssa-Vale area, and
- b) interpretation of temperature gradient and heat flow potential within the land area of the Albertson facilities northwest of Nyssa.

The tasks of the second phase of work included extension of the existing data to include:

- a) a reconnaissance of the geology of the area including and immediately adjacent to the Albertson feedlots,
- b) coordination of collection, analysis and interpretation of new chemical data from water samples from deep wells on the Albertson property,
- c) location of "High Probability" geothermal production well sites,
- d) evaluation and assessment of temperatures and permeabilities of fluids at the prospective well locations and production depths, and
- e) assessment of the impact of thermal water production on the hydrology and environment of the Nyssa-Vale area.

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The information developed for both phases of work were to be included in a "concise geological report" which documents the efforts of the consultant. These items were made part of a consultant agreement between CH2M and GeothermEx dated 6 December, 1979.

Work was initiated by collection of information from library sources, the Oregon Department of Geology and Mineral Industries (Baker, Oregon) and the Owyhee County Watermaster (Vale, Oregon). Additional information was obtained from GeothermEx's files of data.

In December, 1979, the hydrological consultant, Anderson & Kelly, by agreement with CH2M-Hill and after coordination with GeothermEx, visited the Albertson Land and Cattle Company feedlots at Nyssa to obtain information from the existing wells on the property. As part of the field operation, Anderson & Kelly collected four new water samples from wells 2, 6, 8 and 9, using equipment and instructions furnished by GeothermEx. The samples were subsequently sent for chemical analysis to a qualified laboratory in California. The results are appendix 1 of this report.

In May, 1980, GeothermEx accomplished original photogeologic studies and field reconnaissance inspection of the area southeastward from Vale to Nyssa. The existing and new data have been used to form the interpretations, conclusions and recommendations of this report.

Scope of Work

The agreement between CH2M and GeothermEx calls for certain specific items to be part of the deliverable reports. Activities of GeothermEx, including preliminary calculations of geochemical thermometry, well distributions and character of temperature gradients, have been provided as informal interim reports to CH2M-Hill during the progress of this program. The final report as required of the consultant is hereby submitted.

The technical scope of work was described in the preface to this report. The description of the scope of work in the agreement dated 6 December, 1979, stipulated that the data and recommendations presented shall include a discussion of absolute probabilities and/or confidence levels as they relate to the data. This kind of discussion is appropriate to the stratigraphic succession to be expected in new drill holes, but there is less absolute information about the permeabilities and transmissibilities of the formations at production levels. We have discussed the probabilities in

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each case -- in other words attempted to determine the risk factor, and state a probability of success. It should be emphasized that a risk factor, for example, 50%, means that each hole would have such a risk, not that one out of every two holes would be a success.

This project has as its objective evaluation of the pertinent geological, geophysical, hydrological and geochemical information for the area surrounding the property of the J. A. Albertson feedlot and processing plants near Nyssa, Oregon.

The most important factors in assessing the geothermal potential for processing cattle wastes toward production of methane gas are:

1. temperatures are required in the 125° to 135°F range, at depths less than 2,000 feet;
2. reservoir rocks must occur at depths less than 2,000 feet, capable of yielding water at a minimum rate of 400 gallons per minute (gpm), in the zone of favorable temperature;
3. formation water with total dissolved solids content and particularly silica and sulfate content low enough to permit its use and disposal without special engineering and environmental problems.

Location

The Albertson Land and Cattle Company feedlot and processing plant is located in Township 19 South, Range 46 East, Sections 21 (all) and 16 (south ½), Malheur County, Oregon (figure 1, plate 1). This site is about 5 miles west-northwest of the town of Nyssa and about 10 miles south-southwest of Ontario, Oregon. The Snake River flows northward, about 5 miles east of the site. The Malheur River flows northeastward, about 8 miles from the site. The site is about 3 miles west-southwestward from the deep gas and oil exploratory drill hole H. K. Riddle Kiesel Estate No. 1.

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ANALYSIS OF GEOLOGICAL AND GEOPHYSICAL DATA

Introduction

The evaluation of a site for a low-temperature geothermal test well program at the Albertson Cattle and Land Company site was based on a large volume of regional and local geological and geophysical data from published and unpublished sources. Some of these data were originally summarized in the Ore-Ida Technical Proposal, Volume I (Ore-Ida, 1977), and were supplemented in reports by CH2M-Hill (1978) and by Gardner and Koenig (1978) and Gardner and others (1980). The data have been presented here as background against which to evaluate the potential for a successful drill hole west of Nyssa, Oregon.

The site is located at the west-central part of the western Snake River Plain geomorphic province (plate 2). The Snake River Plain province is an arcuate structural and topographic depression which extends from about 25 miles (45 km) northwest of Ontario, Oregon, eastward and northeastward across southern Idaho, to the vicinity of Yellowstone Park, Wyoming. The western part of the depression is referred to as the Snake River Basin. The basin is bounded on the north by the mountainous region of central Idaho including the Idaho batholith, and on the south by the Owyhee uplift. At its northwest end, the basin is terminated against the Blue Mountains uplift of east-central Oregon. The Albertson site is nearest the Owyhee uplift boundary; Blue Mountain geomorphic features are quite close north and west of the site.

The existence of geothermal potential in the Snake River Basin is suggested by the history of late Cenozoic volcanism and tectonic activity. This general evidence is supported by the occurrence of thermal waters in many locations including springs and shallow water wells around the basin margins; particularly pertinent are Cow Hollow (Bowen and Blackwell, 1975), the Owyhee River Canyon and Vale on the northwest (Couch, 1976; Blackwell *et al.*, 1978), and Boise and Weiser on the north (Brott, Blackwell and Mitchell, 1976; Young and Whitehead, 1975). Further evidence of a geothermal anomaly occurs in the relatively high geothermal gradients encountered in some deep hydrocarbon exploratory test wells drilled within the basin, including Chevron's Highland Land and Livestock Co. No. 1 and Ore-Ida Foods' Ore-Ida No. 1.

Geothermal exploration has taken place in the basin, consisting of temperature-gradient hole drilling, geochemical studies

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of thermal waters and regional and local geological and geophysical work. One deep test, the Phillips Petroleum Company Chrestesen A-1 in the northwest quarter of Section 29, T. 11 N., R. 3 W., near Weiser, Idaho, has been drilled exclusively as a deep geothermal test. Apart from local uses of thermal waters from hot springs and shallow wells for greenhouses, space heating and other activities, no significant geothermal production has yet been established.

Geologic Setting

Predictions concerning the subsurface geology at the site are dependent on data derived from regional stratigraphy (figure 2) and structure. The regional data is derived from outcrop areas at the margins of the basin and from the scattered deep hydrocarbon and geothermal exploratory test wells drilled within the basin.

Regional Stratigraphy

The oldest rocks in the area consist of a great thickness of intensely deformed metasedimentary and metavolcanic rocks of Permian through Middle Jurassic age. They have been intruded by granitic stocks of Late Cretaceous and possibly Early Cenozoic age in the Owyhee and Blue Mountains and by the Idaho Batholith in central Idaho. The Owyhee and central Idaho plutons appear to be part of a continuous, or formerly continuous, north-trending zone, now disrupted by the Snake River depression.

One deep well, the Phillips Petroleum Chrestesen A-1, drilled near Weiser, at the northern edge of the Snake River basin, penetrated granitic rocks at a depth of about 7,000 feet. None of the wells in the axial part of the basin have reached pre-Tertiary horizons, and the nature of the basement there is speculative. It may consist of downdropped granitic and metamorphic rocks, or it may be a wedge of new basaltic crust emplaced in a zone of rifting as the basin developed, partially or wholly replacing the granitic and metamorphic terrain (Hill, 1963).

The pre-Tertiary basement is separated from the overlying section by a profound unconformity. Plutonic rocks of the Eocene epoch, from 39 to 54 million years old, have been identified in the Owyhee and central Idaho regions. Early Cenozoic sedimentary and volcanic rocks have not been reported in those parts of the surrounding uplifts adjacent to the basin, and none of the deep wells in the basin have penetrated rocks recognized to be older than Miocene.

FIGURE 2.

STRATIGRAPHY NEAR NYSSA, OREGON

Pleistocene Holocene	Composite Section of Surface Formations in the Region	Principal Lithology	Informal Subsurface Lithologic Units
	Quaternary alluvium and terrace deposits	Gravel, sand, silt	
Pliocene Idaho Group	Chalk Butte Fm.	Tuffaceous claystone, tuffaceous siltstone, sandstone	Tuffaceous claystone, siltstone and sand- stone with arkosic sandstone
	Grassy Mountain Fm.	Dense basalt, inter- bedded sandstone and siltstone	Interbedded thin basalt flows and sedimentary rocks, 2,000 feet ±
	Kern Basin Fm.	Tuffaceous sediments, tuff	750 feet ±
	Deer Butte Fm.	Tuffaceous sediments, interbedded basalt	
Upper Miocene	Silicic volcanics	Rhyolite flows, welded tuffs	Absent
	Owyhee Basalt	Basalts	major seismic reflectors- Predominantly massive basalt
	Sucker Creek Fm.	Tuffs, lacustrine sediments	Tuffaceous sedimen- tary rocks, basalt flows and intrusives, acidic tuffs

Generalized from Riddle Kiesel No. 1 and Chevron Highland Livestock No. 1 wells. Thickness inferred, in part, from geophysical data.

JAMES B. KOENIG (415) 527-9876
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Deposition of sedimentary and volcanic rocks was widespread throughout the region, beginning in Middle or Late Miocene time. Assemblages of these rocks from several of the outcrop areas border the present basin. The section on the north side of the basin, near Weiser, consists of a thick section of lava flows interbedded with variable but subordinate amounts of altered tuff. The lavas are chiefly basalt. Some flows contain olivine or plagioclase phenocrysts, but most units are non-porphyritic. Two textural types are common. One is uniformly fine-grained and the other is ophitic. These rocks have commonly been referred to as Columbia River Basalt in early publications. The best evidence for the thickness and character of the section occurs in the Phillips Chrestesen A-1 well, where about 6,850 feet of basalt flows interbedded with thin tuffs were penetrated.

In the southern part of the Basin, the section appears to consist of three units. The lowest is basalt, referred to as "Lower Columbia River Basalt". The middle unit is the Payette Formation, composed of fine-grained tuff, clay, silt, diatomite and coarse-grained arkosic sandstone. This formation is highly lenticular. It is overlain by basalt flows referred to as the "Upper Columbia River Basalt". The basalts in both the upper and lower sequence range from fine-equigrained rocks to coarse-grained diabase and porphyry. Many flows are vesicular or amygdaloidal.

The Miocene rocks in the Owyhee uplift, flanking the south side of the basin, are composed of more diverse lithologic types than those to the north. The section in the Silver City, Idaho, area consists of a "Lower Basalt" containing more than 2,500 feet of alkali olivine basalt. This basalt, dated provisionally at 16.6 m.y., is equivalent in age but mineralogically distinct from the tholeiitic Columbia River Basalt. This section is overlain by a thick sequence of rhyolite and latite flows, tuffs and minor volcaniclastic sediments. The upper part of the section has been dated 15.6 to 15.7 m.y. (Panze, 1975).

The Sucker Creek Formation occurs along the northern end of the Owyhee uplift. It is a thick assemblage of volcaniclastic sedimentary rocks of Barstovian age, and is made up of interbedded ash flow tuffs and basalts. It appears to be equivalent to the Silver City volcanic section (Panze, 1975). Rhyolite flows locally overlie the Sucker Creek Formation near Owyhee Dam. Both formations are overlain by the Owyhee Basalt.

The Owyhee Basalt is about 1,300 feet thick. It contains numerous flows interbedded with abundant lenticular scoria and tuff

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beds. A wide variety of basalt textures are present, with the lower part of the section being more olivine-rich and ophitic, while the upper part is micro-porphyrritic and contains some flows with trachytic texture (Kittleman et al., 1965; Corcoran et al., 1962). The abundance of dikes and pyroclastic material indicates that many if not all of the flows were erupted from local vents, and the unit does not extend areally very far.

Although it is difficult to typify the earlier parts of the upper Miocene rock suite in this region, it appears to be distinctive from post-Miocene rocks in containing a high proportion of predominantly volcanic units. As a whole, sedimentary units make up a smaller proportion of the total rock volume than they do in the younger parts of the section.

Miocene volcanic rocks appear to be the units most likely to contain extensive aquifers with flow potentials capable of supporting geothermal development. By analogy with basalt aquifers explored in areas of Oregon and Washington, two types of initial porosity may occur. One consists of zones of high porosity and good permeability associated with flow breccias, interflow scoria zones and vesicular and brecciated flow tops. The other type of porosity is contained in a diffuse network of cooling joints and fractures in the lava flow interiors. In sections of this type, the porosity and permeability are specifically low and the volume of fluids produced is proportional to the thickness of the flow section penetrated. Data on the porosity actually encountered in these rocks are limited. A few zones of lost circulation have been reported, but they are not sufficient to outline regional aquifers. Formation tests were generally not carried out in oil and gas test wells because the basalts were not associated with the most important shows of hydrocarbons. Thus, there is no direct evidence concerning the nature and distribution of reservoir potential in the Snake River Basin basalts.

The data now available do not determine whether the Miocene volcanic section is thicker in the Snake River Basin than in the flanking uplifts. However, by late Miocene time a major period of basin subsidence began, continuing episodically into the Pleistocene. During this period, subsidence took place along northwest-trending fault zones along the basin margins, while 8,000 feet or more of lacustrine and fluvial sediments, interbedded with subordinate amounts of basalt flows, were deposited in the basin. The original depositional basin extended onto the edges of the Owyhee, Central, Idaho and Blue Mountains. Subsequent uplift and erosion has removed much of the section and exposed the older rocks of the mountains.

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MURRAY C. GARDNER

Although the sedimentary and volcanic rock types are similar throughout the basin, the proportions of each vary rapidly from one area to another. This has given rise to difficulties in correlation and to the use of different formational nomenclature in the main outcrop areas. The best-defined and most completely described stratigraphic section in the region is that in the Vale-Owyhee Reservoir area, Malheur County, Oregon (Kittleman et al., 1965; Corcoran et al., 1963). These stratigraphic units have been used by Newton and Corcoran (1962) in subsurface studies of the basin and appear to be the most appropriate nomenclature to utilize in the present study.

The section pertinent to the Albertson Land and Cattle Company site consists of three formations making up the Idaho Group, as defined by Kittleman et al. (1965). The oldest of these is the Deer Butte Formation. This unit rests on the Owyhee Basalt along an erosional and possibly angular unconformity. In the Owyhee River Canyon area, it consists of about 1,000 to possibly 3,000 feet of volcanic sandstone, siltstone, claystone, vitric ash, arkosic sandstone, conglomeratic sandstone, thin basalt flows and shallow basaltic intrusions. The outcrop areas are probably close to the original edge of the depositional basin and coarse-grained sediments, representing a relatively high energy environment of deposition, are well-represented. Characteristic features of the sediments are the abundance of feldspar in the coarse sandstones and abundant glass shards and pumice in the volcanic sandstones. The associated basalt flows are generally coarse-grained, holocrystalline, with ophitic texture. Flow tops are more or less vesicular.

The Grassy-Mountain Formation is the middle formation of the Idaho Group as defined by Kittleman et al. (1965). It reaches a maximum thickness of about 1,100 feet in the type area west of the Owyhee River, but is generally thinner in other outcropping sections. It consists of interbedded pumice, arkosic and tuffaceous sandstone, thin granite-cobble conglomerate, altered volcanic sandstone and flows of olivine basalt. The arkosic and tuffaceous sandstones resemble those of the Deer Butte Formation. The percentage of basalt flows interbedded in the total section varies greatly in different localities, are generally coarse-grained holocrystalline and ophitic. Porphyritic flows with very large plagioclase phenocrysts occur, and vesicular flow tops are common. The flow units are mostly less than 100 feet thick.

The Chalk Butte Formation is the uppermost unit of the Idaho Group recognized by Corcoran et al. (1962) in the western Snake River Basin. It is the formation most likely to be encountered in the uppermost 1,000 or more feet of a hole drilled at the Albertson site.

JAMES B. KOENIG (415) 527-9876
MURRAY C. GARDNER

According to Newton and Corcoran (1963), Chalk Butte rocks persist to below 4,000 feet depth (plate 3) but according to Corcoran et al. (1962), the Chalk Butte rocks may be between 1,200 and 2,000 feet in thickness north of Nyssa. The Chalk Butte Formation unconformably overlies Sucker Creek Formation and Owyhee Basalt, as well as the older units of the Idaho Group at exposures around the edges of the basin. In surface exposures at the basin margin, the Chalk Butte sediments are several hundred feet thick. These sections are not representative of thickness and lithology due to erosion at the top, and to their position near the edge of the original depositional basin. The lithologic types present in surface outcrops consist of tuffaceous conglomerate, sandstone and siltstone, with smaller amounts of fine ash, clay, diatomite and limestone. Both fluvial and lacustrine environments are represented. No basalt flows are observed to be interbedded with the sedimentary rocks in the outcrops in this part of the basin. A Pliocene age has been assigned to the formation on the basis of vertebrate fossils found in it. Additional thin fluvial gravels and silts overlie the Chalk Butte Formation equivalents.

Several deep oil and gas exploratory wells have been drilled in the Idaho Group, and correlations between some of the subsurface sections identified in the wells and the surface outcrop units have been made by Newton and Corcoran (1963). In the subsurface, the upper, non-volcanic part of the Idaho Group can be tentatively correlated with the Chalk Butte Formation. Only a few wells have been drilled into the sedimentary and volcanic rocks underlying Chalk Butte strata. Correlations in the older part of the section are uncertain.

The section in the H. K. Riddle Kiesel Estate No. 1 well (plate 3) (Section 8, T. 19 S., R. 47 E.), was divided into two parts by Newton and Corcoran (1963). The interval from the surface to a depth of 4,230 feet was assigned to the "Upper Idaho Sediments" (Chalk Butte Formation). In this well, some interbedded basalt flows were included in the lower part of the unit. Below 4,270 feet, the section was designated "Grassy Mountain Basalt Series". It consists of interbedded basalt flows and sedimentary rocks from 4,270 to 4,550 feet, and mainly basalt from 4,550 to the total depth of 5,106 feet.

Predicted Stratigraphy at the Wellsite

The thickness and character of the section likely to be encountered at a site in the vicinity of the Albertson Land and Cattle Company property is summarized below. It is based on regional stratigraphic data and on the correlation possible with H. K. Riddle Kiesel Estate No. 1. Some modification from the H. K. Riddle Kiesel

JAMES B. KOENIG (415) 527-9876
MURRAY C. GARDNER

Estate is warranted by the geophysical suggestions of faults (Couch, 1977; Bowen and Blackwell, 1975) (plate 1). These faults are drawn from gravity and seismic survey anomalies and steep gradients, as well as topographic evidence and may have the effect of stepping the Grassy Mountain formation and Kern Basin Formation up to the west. This, in turn, would mean that basalts of the Grassy Mountain formation may be found at shallower than 2,000 feet depths at the Albertson site. Sections drawn by Corcoran *et al.* (1962) indicate that Grassy Mountain basalts may be as shallow as 1,500 feet below surface near the Albertson site. A fault "inferred from geology" (Lienan, 1978; Couch, 1977) is shown to strike northwestward past the southwest corner of Section 21. This would not affect depth to the basalt at the site but may provide a conduit for ascending warm waters. The proposed fault dips northeastward under the Albertson property. Couch (1977) also proposed that a right-lateral strike slip fault (Willow Creek fault) with northwest strike, occurs about 0.5 mile east of the east side of Section 16. It is unclear what effect this may have on the subsurface stratigraphy. There would be little displacement in rocks dipping northeast, unless a component of dip-slip is also present with west-side down. Couch proposed that a west-side down component occurred along the strike-slip fault north of the Vale area. In any event, Idaho Group Formations would be encountered at the site.

The Idaho Group is characteristically made up of an upper unit of sedimentary rocks and a lower unit, consisting of interbedded sediments and basalt flows. The best-defined base of the Idaho Group is the top of a thick, massive basalt flow sequence.

Internally the Idaho Group can be subdivided in several ways, but correlations with standard surface outcrop members is difficult. The upper part of the section, above the first occurrence of basalt, varies from 3,820 feet in thickness in the Riddle Kiesel well to over 4,011 feet in thickness in the Ohio Kramlich No. 1 (Section 5, T. 9 N., R. 4 W.). Most, if not all of this part of the section appears to be equivalent to the Chalk Butte Formation. The lower part of the Idaho Group, consisting of variable proportions of relatively thin basalt flows interbedded with sediments, is believed to be equivalent to the Grassy Mountain and Deer Butte Formations of the surface section in the Owyhee uplift. This section is interpreted here to extend from 3,820 to 4,550 feet in the Riddle Kiesel well, a thickness of 730 feet. Based on regional gravity data, the Kiesel well appears to be high structurally. It is located eastward from the strike-slip fault proposed by Couch (1977). If there is a component of dip-slip on the fault, west-side down, it would explain the high structural position. The Albertson site would then have at least equal thickness of the upper section of Idaho Group.

JAMES B. KOENIG (415) 527-9876
MURRAY C. GARDNER

The massive basalt sequences encountered in the Riddle Kiesel well from a depth of 4,500 to the total depth of 5,106 feet (606+ feet), and in the Chevron Highland Livestock well from a depth of 4,170 to about 5,375 feet (1,200 feet +) are tentatively interpreted to be the most likely correlative of thick basalt flow sequences found outcropping in the Owyhee Basalt and the Columbia River Group. Too few complete penetrations of the massive basalts occur to establish thickness trends in the subsurface.

Interbedded basalt, tuff, claystone, siltstone and sandstone underlie the main basalt sequence in the Chevron Highland Livestock well, from a depth of 5,375 feet to the total depth of 11,963 feet. This section contains more abundant basalt flows than is characteristic of the surface outcrops of the Sucker Creek Formation and its true relationship to the established stratigraphic units in the area is uncertain. Sucker Creek Formation has been mapped by Corcoran and others (1962) about 15 miles southward of the Albertson site.

Regional Structure

The Snake River Basin is the western limb of an arcuate rift or compound graben extending across southern Idaho. Regional seismic surveys indicate that although the upper or granitic layer of the crust appears to be either absent, to thin and intermittent, the total crust is thicker than that in the Basin and Range province to the south. This thick crust consists of a thin, hot intermediate layer on top of a thick, hot, lower crust. It appears that the granitic layer has been altered, remelted, or is absent because of rifting, and has been replaced by upward-moving mantle differentiate (Prodehl, 1970; Hill and Pakiser, 1967). This crustal model provides an explanation for the regionally high heat flow.

The Snake River Basin axis and most of the major structures associated with it trend in a northwest direction. This structural trend is strongly discordant to the north to northeast strike of the majority of the structures in the Basin and Range province southward from the basin and the central Idaho uplift to the northward of the basin. The basin has apparently developed during several episodes of downfaulting, followed by sedimentation which has sometimes transgressed over the fault zones. Unconformities occur between all of the major formations along the south side of the basin, but the most notable occurs at the base of the Chalk Butte Formation (Idaho Upper Group), which rests on the Sucker Creek Formation, the Owyhee Basalt, and the Grassy Mountain Formation from place to place. Important structures in the older units may be buried beneath this unconformity

JAMES B. KOENIG (415) 527-9876
MURRAY C. GARDNER

and lack expression in younger beds.

Gravity data indicate that there is considerable structural relief within the basin (figure 3). The largest positive gravity anomaly is a long complex feature with several culminations, extending for about 50 miles from the vicinity of Nampa, Idaho, toward Malheur Butte, Oregon. This feature is paralleled on both the north and south by gravity lows. Stratigraphic changes, particularly an increase of basalt in the section in this area, could contribute to the anomaly, but some of the effect is probably due to a large structural uplift in which the Miocene basalts are brought closer to the surface than in surrounding areas.

It is assumed that the deep structure is a complex horst ridge bounded by important faults. The Upper Idaho Group sediments may be anticlinal over it. Several hydrocarbon test wells have been drilled on this structural trend, but the off-structure well control is too limited to demonstrate the amount of structural relief and to compare the amount of basalt in the on- and off-structure sites.

Structure at the Wellsite

The surface in the vicinity is covered by varying amounts of alluvium, overlying poorly-lithified sediments of the Upper Idaho Group. Exposures of bedrock do not indicate that any significant structures might be present. The site appears to be located off the west flank of the north-trending Fruitvale-Payette regional gravity high, and a few miles west of the major northwest-trending Nampa-Malheur Butte anomaly. Geophysical work by Couch and others (1977) included this location as part of the Vale Known Geothermal Resources Area. The faults mentioned in previous discussions of stratigraphy were mainly determined at zones of high gravity gradients on the complete Bouguer anomaly maps. Several warm springs (Mitchell Butte, Deer Butte, North Black Willow and South Black Willow Springs) are aligned along the north-trending fault that appears to run about one (1) mile west of the Albertson site. Lienau (1978) used the fault as an eastern boundary for thermal waters of the Vale-Cow Hollow area. The area west of the fault is a large, positive gravity anomaly, probably resulting from both alteration and uplift to a horst block. Nearly all surface manifestations of hydrothermal activity in the western Snake River plain are associated with major structural features. The geothermal manifestations are associated with deep circulation along faults. Townships 18 and 19 South, Range 46 East were examined on stereo air photographs in the U.S.B.L.M. offices at Vale, Oregon. The faults proposed by Lienau (1978) were not clearly evident on the

JAMES B. KOENIG (415) 527-9876
MURRAY C. GARDNER

photographs. However, a group of linears trending nearly north-south in Sections 28, 29, 32 and 33 of T. 18 S., R. 46 E., and Sections 4, 5, 8 and 9 of T. 19 S., R. 46 E. were observed. These linears ended on their southward side in the vicinity of the proposed strike-slip fault of Couch (1977). Sediments observed in the photographs were nearly eastward-dipping, north of the proposed strike-slip fault, and northeastward-dipping south of the proposed strike-slip fault. None of these features provide sufficient data to target a drill hole to take advantage of complementary tension faults that may occur on the Albertson property.

Field observations of the area from Cow Hollow to the Big Sage Flats (which include the Albertson property) failed to clarify structures in the area.

Water Well Information-Hydrology

A survey of the records of wells in T. 19 S., R. 46 E. and T. 18 S., R. 46 E. (south one-half) provided production data from less than 20 wells drilled to more than 300 feet in depth (plate 1). None of the wells penetrated to 1,000 feet in depth. The maximum production was 1,000 gallons per minute (gpm) with a drawdown of 85 feet, from a well in S. 16, T. 19 S., R. 46 E. The well is 520 feet in depth. Most deep wells in this township produce between 100 and less than 400 gpm. The deep wells in the townships to the north produce upwards of 400 to more than 900 gpm; these wells apparently draw from the Malheur River sediments. Some wells in Sections 13 and 16, T. 19 S., R. 46 E., produced very low volumes of water or were dry, to depths of as much as 600 feet. It is not known whether impermeable sediments or poor completion techniques or both were responsible. We may conclude that the production capacity of new deep wells drilled to between 1,000 and 2,000 feet depth may intercept permeable formations, capable of supporting production flow of as much as 1,000 gpm. The locations of the drillholes (wells) at the Albertson feedlot area which appear to be most productive are at well No. 8 (T. 19 S., R. 46 E., 21ccd) and well No. 1 (T. 10 S., R. 46 E., 21bad). Both have been pumped at rates in excess of 1,000 gpm, but later production fell to only 400 gpm. Of these, well No. 8 has the higher gradient, and is located near a topographic break which may follow a structural guide. A site less than 0.1 mile north of well No. 8 is suggested therefrom as the location of a geothermal test hole.

JAMES B. KOENIG (415) 527-9876
MURRAY C. GARDNER

Geochemistry

Four of the wells in S. 21, T. 19 S., R. 46 E. were sampled in December, 1979. These wells are actively used for stock water supply and are frequently pumped. The wells sampled were No. 2, in the NE-1/2 of the NE-1/4 of the section, No. 6, in the NE-1/4 of the NW-1/4 of the section, No. 8, in the SE-1/4 of the SW-1/4 of the section, and No. 9, in the NW-1/4 of the SW-1/4 of the section. Drillers logs were available for wells 2, 6 and 9. All the wells were drilled in the succession of blue and brown clays and dark gray sands, characteristic of the Chalk Butte Formation. Sampling was done by Anderson and Kelly, using instructions and equipment provided by GeothermEx.

The waters are characterized (appendix 1) by sulfate-carbonate composition, with calcium the principal cation, except well No. 2, where sodium is the principal cation. Magnesium is high in all the wells except No. 9 which is also the warmest and deepest of the wells. Nitrate in three of the wells is high enough to indicate contamination from surface sources or long-term infiltration into the production zone. Well No. 6 is the exception. Silica content of the wells is high, and suggests a thermal aquifer source for part of the fluids produced.

Several generally significant statements can be made about the chemistry of the well waters. Silica concentrations are higher than cation concentrations. This is the reverse of normal circumstances where mixing has occurred. The resultant moderately high reservoir base temperatures calculated by silica geothermometry are therefore encouraging. The quartz (chalcedony) temperatures fall within the range of 203° to 249°F. Of these, all are between 203° and 211°F with the exception of well No. 9, which has a chalcedony temperature of 249°F. The alkali geothermometers for the four wells provide scattered and inconsistent results from the computer programmed analyses of the data. Generally, the base temperatures indicated by alkali geothermometry are lower than those derived from silica, except that of well No. 9 which shows coincidentally nearly the same temperature, 221°F.

Temperature Gradients and Heat Flow

The analysis of temperature gradients was approached in two ways. First, gradients from holes drilled to deliberately obtain temperature information as part of geothermal resources exploration programs were plotted in the vicinity of the J. A. Albertson facility

JAMES B. KOENIG (415) 527-9876
MURRAY C. GARDNER

(plate 1). There were some 15 such drill holes within 10 miles of the facility, excluding the area near Vale, Oregon, where a significant geothermal anomaly has resulted in drilling many local gradient holes. Second, temperature, lithology and water flow information were collected for about 75 wells within 10 miles of the Albertson facility. These data were again used to assist in plotting gradients calculated from the well depths for use with the gradient contour map.

A significant geothermal anomaly was detected in the vicinity of northeast Cow Hollow, T. 19 S., R. 45 E. and became the object of investigation about ten years ago, and were reported by Hull (1975) and Bowen and Blackwell (1975) (figure 4). Ten temperature gradient holes in T. 19 and 20 S., R. 45 E. provided gradients which ranged from 3.9°F/100 feet to 12.8°F/100 feet. The highest gradients were located in Sections 11, 14 and 25 of T. 19 S., R. 45 E. These locations are along a northerly trending line about 3 miles west of the J. A. Albertson feedlot. Couch (1977) associated the surface manifestations along this line with a probable fault.

On the Albertson feedlot, wells 6, 8 and 9 clearly have gradients of greater than 5°F/100 feet indicated by the water temperatures. It is difficult to assess well No. 2 because it was perforated at widely different levels. Well No. 1 also appeared to have a gradient of 5°F/100 feet from maximum temperature recorded while the well was not pumping.

From these calculations it appears that were the gradient to hold to 2,000 feet depth, the water temperatures would rise to about 150°F. A zone of completion between 1,000 and 2,000 feet might provide a mix of water between 120° and 135°F. None of these estimations requires direct interception of a fault with thermal fluids.

Temperature gradient holes continued to be drilled and measured in the Vale area by the state of Oregon and were reported by Hull et al. (1977) and interpreted by Blackwell et al. (1978). The Vale thermal manifestation was used by Blackwell et al. (1978) to illustrate a typical Basin and Range normal-fault bounded geothermal system. The illustration is reproduced here as figure 4. It may be observed that T. 19 S. R. 46 E. is eastward of the principal anomaly at Vale and Cow Hollow, but clearly has temperature gradients greater than 100°C/km. It is not clear, but there is possibly shallow underflow eastward from the principal anomalies through East Cow Hollow toward hydrologic base level at the Snake River. The Malheur River near Vale is at an elevation of 2,210 feet, while the elevation of the Snake River near Nyssa is 2,180 feet. Possibly, a warm water

FIGURE 4.

Heat flow map of the area near Vale, Owyhee County, Oregon

JAMES B. KOENIG (415) 527-9876
MURRAY C. GARDNER

flow occurs at the base of less permeable sediments in the Chalk Butte Formation and is seen in elevated temperatures in some wells and temperature gradient holes.

Reservoir and Storage

The water wells drilled at the Albertson feedlots and on adjacent acreages in the area provide some evidence of production capacities of the shallow subsurface rocks. Wells from a few hundred to a thousand feet deep vary in production rates from 10 to more than 1,000 gpm. Within the area including the Albertson property and those sections within about 2 miles northward and eastward, there are about 15 wells, and production data were available from 12 (plate 1). These produce from zones between less than 50 feet and more than 800 feet deep. Production figures range from 20 gpm in wells less than 200 feet deep to several hundred gpm in deeper wells. Production records are so inconsistent, and records of perforated and open intervals so ambiguous that it is unwise to calculate transmissivities.

The records of deep wells on the Albertson property indicate that there are aquifers present capable of producing more than 400 gpm from sandy interbeds in the depth interval between 1,200 and 2,000 feet depth at which temperatures may be expected to range conservatively between 120°F and 150°F. This would meet or exceed the program requirements. This is not contingent upon intercepting a fractured basalt. The well would require careful development, gravel packing and graded filters behind perforated lining to maintain production.

JAMES B. KOENIG (415) 527-9876
MURRAY C. GARDNER

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JAMES B. KOENIG (415) 527-9876
MURRAY C. GARDNER

APPENDIX 1

Chemical Analyses of Well Water

LABORATORY NO:
DATE OF REPORT:
IDENTIFICATION:

0103-80
January 31, 1980
Well #2

GEOTHERMEX
1760 SOLANO SUITE 209
BERKELEY, CA. 94707

T=27°C
PHF=7.0+ (paper)
DATE 12/13/79

.036-3

SPECIES	mg/L	eq/L
Ca	57.9	2.89-3
Mg	18.3	1.51-3
Na	65.9	2.87-3
K	17.7	4.53-4
HCO ₃	319.	5.23-3
CO ₃		
CO ₂ (FREE)		
SO ₄	96.9	2.02-3
Cl	13.4	3.78-4
TDS'		
pH	7.44	
Ec μ mhos/cm @25°	776.(1:7)	
Ec μ mhos/CALC	812.	
Ec OBS/CALC	0.956	
CATIONS Σ +		7.71-3
ANIONS Σ -		7.81-3
NO ₃	11.4	1.84-4

SPECIES	mg/L	eq/L
B	0.384	6.14-6 (a)
SiO ₂	82.8	1.37-3 (a)
NH ₄	1.09	6.04-5
F	0.501	2.64-5
S ²⁻		
Fe ³⁺		
Mn ²⁺		
Rb		
Li	0.0638	9.19-6
Sr		
Cs		
Ba		
Hg		

(a) MOLES/L

Analysis by:

AMTECH

American Technical Laboratories, Inc.

30 8909 Complex Drive — Suite F San Diego, California 92123

LABORATORY NO:
DATE OF REPORT:
IDENTIFICATION:

0103-80
January 31, 1980
Well #6

GEOOTHERMEX
1760 SOLANO SUITE 209
BERKELEY, CA. 94707

T = 28.5°C DATE 12/13/79
PHF = 7.5 (paper)

SPECIES	mg/L	eq/L
Ca	131.	6.54-3
Mg	39.0	3.21-3
Na	57.5	2.50-3
K	18.4	4.70-4
HCO ₃	381.	6.24-3
CO ₃		
CO ₂ (FREE)		
SO ₄	229.	4.77-3
Cl	11.6	3.27-4
TDS		
pH	7.28	
Ec μ mhos/cm @25°	1250. (1:11)	
Ec μ mhos/CALC	1296.	
Ec OBS/CALC	0.964	
CATIONS Σ^+		1.27-2
ANIONS Σ^-		1.14-2
NO ₃	1.09	1.76-5

(a) MOLES/L

SPECIES	mg/L	eq/L
B	0.259	4.14-5 ^{0.024-3} (a)
SiO ₂	76.0	1.26-3 (a)
NH ₄	0.237	1.31-5
F	0.561	2.95-5
S ²⁻		
Fe ³⁺		
Mn ²⁺		
Rb		
Li	0.0860	1.24-5
Sr		
Cs		
Ba		
Hg		

Analysis by:

AMTECH

American Technical Laboratories, Inc.

31

8909 Complex Drive — Suite F San Diego, California 92123

LABORATORY NO:
DATE OF REPORT:
IDENTIFICATION:

0103-80
January 31, 1980
Well #8

GEOOTHERMEX
1760 SOLANO SUITE 209
BERKELEY, CA. 94707

T=24°C DATE 12/13/79

PHF=7.0+(p_{app})

SPECIES	mg/L	eq/L
Ca	130.	6.49-3
Mg	29.0	2.39-3
Na	45.0	1.96-3
K	16.1	4.12-4
HCO ₃	346.	5.67-3
CO ₃		
CO ₂ (FREE)		
SO ₄	174. [*] 42.5	3.62-3 8.87-4
Cl	25.8	7.28-4
TDS		
pH	7.54	
Ec μ mhos/cm @25°	1065. (1:10)	
Ec μ mhos/CALC	1156.	
Ec OBS/CALC	0.921	
CATIONS Σ^+		1.12-2
ANIONS Σ^-		1.02-2
NO ₃	10.2	1.65-4

SPECIES	mg/L	eq/L
B	0.225	0.21-3 2.60-5 (a)
SiO ₂	79.2	1.31-3 (a)
NH ₄	0.192	1.06-5
F	0.343	1.81-5
S ²⁻		
Fe ³⁺		
Mn ²⁺		
Rb		
Li	0.0850	1.22-5
Sr		
Cs		
Ba		
Hg		

(a) MOLES/L

* correction 2/11/80

Analysis by:

AMTECH

American Technical Laboratories, Inc.

8909 Complex Drive — Suite F San Diego, California 92123

LABORATORY NO:
DATE OF REPORT:
IDENTIFICATION:

0103-80
January 31, 1980
Well #9

T=34°C

DATE 12/13/79

PHF = 7.0 + (paper)

GEOOTHERMEX
1760 SOLANO SUITE 209
BERKELEY, CA. 94707

SPECIES	mg/L	eq/L
Ca	40.8	2.04-3
Mg	7.73	6.36-4
Na	62.4	2.71-3
K	23.2	5.93-4
HCO ₃	281.	4.61-3
CO ₃		
CO ₂ (FREE)		
SO ₄	49.3	1.03-3
Cl	8.85	2.50-4
TDS		
pH	7.38	
Ec μ hos/cm @25°	556.(1:5)	
Ec μ hos/CALC	619.	
Ec OBS/CALC	0.898	
CATIONS Σ^+		5.98-3
ANIONS Σ^-		6.06-3
NO ₃	10.8	1.74-4

(a) MOLES/L

SPECIES	mg/L	eq/L
B	0.280	0.26-3 4.48-5 (a)
SiO ₂	106.	1.76-3 (a)
NH ₄	0.618	3.43-5
F	0.678	3.57-5
S ²⁻		
Fe ³⁺		
Mn ²⁺		
Rb		
Li	0.143	2.06-5
Sr		
Cs		
Ba		
Hg		

34°C

Analysis by:

AMTECH

American Technical Laboratories, Inc.

8909 Complex Drive — Suite F

San Diego, California 92123

TABLE

ANALYSIS IN MILLIEQUIVALENTS,
CALCULATED CONDUCTIVITY,
IONIC BALANCE,
IONIC RATIOS

ALBERTSON

TABLE HEADINGS:

N=SAMPLE NUMBER. CA THROUGH CL, F AND NH3=CONCENTRATION IN
MILLIEQUIVALENTS/L. E=CONCENTRATION IN MMOL/L. ECCBS=
MEASURED CONDUCTIVITY (LAB). ECCAL=CALCULATED CONDUCTIVITY.
OBCA=ECCBS/ECCAL. SCAT=SUM OF CATIONS (MEQ/L). SAN=SUM OF ANIONS
(MEQ/L). DIF=((SCAT-SAN)/(SCAT+SAN))*100. CAF=CA/SCAT. MGF=
MG/SCAT. MKF=(NA+K)/SCAT. HCF=(HCO3+CO3)/(HCO3+CO3+SO4+CL). CLF=CL/
SO4/(HCO3+CO3+SO4+CL). BCL=(B/CL)*100. FCL=(F/CL)*100. NHCL=
(HCO3+CO3+SO4+CL). I=IONIC STRENGTH (CALC. WITH MOLAR CONCENTRA
TIONS).

ALL 9'S MEANS NO DATA OR INSUFFICIENT DATA TO PERMIT
CALCULATION

2/07/80

ME013

PAGE 1

N	CA	MG	NA	K	HCO3	CO3	SO4	CL
1.0	2.89	1.50	2.87	0.45	5.22	0.00	2.02	0.38
2.0	6.54	3.21	2.50	0.47	6.24	0.00	4.77	0.33
3.0	6.49	2.38	1.96	0.41	5.66	0.00	0.00	0.73
4.0	2.04	0.64	<u>2.71</u>	0.59	4.60	<u>0.00</u>	1.03	0.25

N	B	F	NH3	NO3
1.0	0.036	0.026	0.0640	0.184
2.0	0.024	0.030	0.0139	0.018
3.0	0.021	0.018	0.0113	0.165
4.0	0.026	0.036	0.0363	0.174

N	ECOB	ECCL	OECA	SCAT	SAN	DIF	I
1.0	776	799	0.972	7.712	7.802	-0.58	0.011
2.0	1250	1295	0.966	12.715	11.350	5.67	0.019
3.0	1065	942	1.431	11.240	7.444	20.32	0.014
4.0	556	606	0.917	5.978	6.051	-0.60	0.008

1156 .21 10.015 4.67

N	CAF	MGF	NKF	HCF	SOF	CLF	BCL	FCL	FSAN	NHCL
1.0	0.37	0.20	0.43	0.69	0.26	0.05	9.40	6.98	0.34	16.93
2.0	0.51	0.25	0.23	0.55	0.42	0.03	7.32	9.03	0.26	4.25
3.0	0.58	0.21	0.21	0.25	0.42	0.10	2.86	2.48	0.24	1.55
4.0	0.34	0.11	0.55	0.78	0.17	0.04	10.38	14.30	0.59	14.53

TABLE

CHEMICAL ANALYSES IN MG/L.

ALBERTSON

TABLE HEADINGS:

N=SAMPLE NUMBER. DATE=SAMPLE COLLECTION DATE, YR-MO-DAY.
TC=TEMPERATURE IN DEGREES CENTIGRADE. PHF=FIELD PH. PHL=
LAB PH. CA---CL=IONIC SPECIES, CONCENTRATIONS IN MG/L.
SIO2=SILICA IN MG/L. TDSS=CALCULATED TDS.
EC=CONDUCTIVITY AT 25 DEGREES, MICROMHOS/L. B=ATOMIC BORON IN
MG/L. F---NO3=IONIC SPECIES, MG/L. S=SULFIDE MG/L, LAB.
H2SF=H2S MG/L, FIELD. CO2F=FIELD MEASUREMENT OF CO2, MG/L.
COM=LINE NUMBER OF COMMENTARY TO THE ANALYSIS (IN
SEPARATE TABLE).

NOTE: ALL 9'S MEANS NO DATA AVAILABLE. 0.0 MEANS BELOW
DETECTION LIMIT OF ANALYSIS.

Note: PHF was determined with pH papers and is likely accurate
to only 0.5 pH units.

2/07/80

ANA1;

PAGE 1

N	NAME	DATE	TC	PHF	PHL	CA	MG	MA	K
1.0	WELL #2	791213	27	7.00	7.44	57.9	18.3	65.9	17.7
2.0	WELL #6	791213	28	7.50	7.28	131.0	39.0	57.5	18.4
3.0	WELL #8	791213	24	7.00	7.54	130.0	29.0	45.0	16.1
4.0	WELL #9	791213	34	7.00	7.38	40.8	7.7	62.4	23.2

N	LI	HC03	SO4	CL	SI02	TDSS	EC	B	F	NH3	NO3
1.0	0.06	319.0	96.9	13.4	83	511	776	0.38	0.50	1.090	11.40
2.0	0.09	381.0	229.0	11.6	76	751	1250	0.26	0.56	0.237	1.09
3.0	0.08	346.0	42.0	25.8	79	539	1065	0.22	0.34	0.192	10.20
4.0	0.14	281.0	49.3	8.8	106	438	556	0.28	0.68	0.618	10.80

TABLE

ANALYSIS IN MILLIEQUIVALENTS,
CALCULATED CONDUCTIVITY,
IONIC BALANCE,
IONIC RATIOS

ALBERTSON

TABLE HEADINGS:

N=SAMPLE NUMBER. CA THROUGH CL, F AND NH3=CONCENTRATION IN MILLIEQUIVALENTS/L. B=CONCENTRATION IN MMOLES/L. ECOBS=MEASURED CONDUCTIVITY(LAB). ECCAL=CALCULATED CONDUCTIVITY. OBCA=ECOBS/ECCAL. SCAT=SUM OF CATIONS(MEQ/L). SAN=SUM OF ANIONS(MEQ/L). DIF=((SCAT-SAN)/(SCAT+SAN))*100. CAF=CA/SCAT. MGF=MG/SCAT. NKF=(NA+K)/SCAT. HCF=(HCO3+CO3)/(HCO3+CO3+SO4+CL). SOF=SO4/(HCO3+CO3+SO4+CL). CLF=CL/(HCO3+CO3+SO4+CL). CLF=CL/(HCO3+CO3+SO4+CL). BCL=(B/CL)*100. FCL=(F/CL)*100. NHCL=(NH3/CL)*100. I=IONIC STRENGTH (CALC. WITH MOLAR CONCENTRATIONS).

ALL 9'S MEANS NO DATA OR INSUFFICIENT DATA TO PERMIT CALCULATION

2/07/80

MEQ13

PAGE 1

	N	CA	MG	MA	K	HCO3	CO3	SO4	CL
1.0	2.89	1.50	2.87	0.45	5.22	0.00	2.02	0.38	
2.0	6.54	3.21	2.50	0.47	6.24	0.00	4.77	0.33	
3.0	6.49	2.38	1.96	0.41	5.66	0.00	0.00	0.73	
4.0	2.04	0.64	2.71	0.59	4.60	0.00	1.03	0.25	

	N	B	F	NH3	NO3
1.0	0.036	0.026	0.0640	0.184	
2.0	0.024	0.030	0.0139	0.018	
3.0	0.021	0.018	0.0113	0.165	
4.0	0.026	0.036	0.0363	0.174	

	N	ECCAL	OBOR	SCAT	SAN	DIF	I
1.0	776	799	0.972	7.712	7.802	-0.58	0.011
2.0	1250	1295	0.966	12.715	11.350	5.67	0.019
3.0	1065	846	1.124	11.240	7.444	22.32	0.014
4.0	556	606	0.917	5.978	6.051	-0.60	0.008
		1156	.921		10.018	4.67	

	N	CAF	MGF	NKF	HCF	SOF	CLF	BCL	FCL	FSAN	NHCL
1.0	0.37	0.20	0.43	0.69	0.26	0.05	9.40	6.98	0.34	16.93	
2.0	0.51	0.25	0.23	0.55	0.42	0.03	7.32	9.03	0.26	4.25	
3.0	0.58	0.21	0.21	0.72	0.12	0.10	2.86	2.48	0.24	1.55	
4.0	0.34	0.11	0.55	0.78	0.17	0.04	10.38	14.30	0.59	14.53	

TABLE

CHEMICAL GEOTHERMOMETERS

ALBERTSON

TABLE HEADINGS:

N=SAMPLE NUMBER.

GEOTHERMOMETERS--QTZC=QUARTZ CONDUCTIVE,
 QTZA=QUARTZ ADIABATIC, BCR=BETA CRISTOBALITE, CHAL=CHALCEDONY,
 AMOR=AMORPHOUS SILICA, SQ=SQ(CA)/NA, B43=NA-K-CA WITH B=4/3,
 B13=NA-K-CA WITH B=1/3, NKC=NA-K-CA VALUE OF CHIOCE, NAK=NA-K

CMG=MG-CORRECTED NKC, PCC=PCO2-CORRECTED NKC

R=FRACTION MG FOR CMG. DMG=MG-CORRECTION. C43 AND C13=
 PCO2-CORRECTED NKC WITH B=4/3 AND B=1/3.

PH=SAMPLE PH. HCO3=MEQ/L HCO3. PCO2=PARTIAL PRESSURE OF CO2
 AT 25 DEGREES C. (PCO2=10^{17.82}*(H+)*(HCO3)).

ALL TEMPERATURES IN DEGREES CENTIGRADE. ALL 9'S MEANS NO DATA
 OR GEOTHERMOMETER INAPPLICABLE.
 REFERENCES: FOURNIER (1976, 1978 AND 1979), PACES (1975).

2/07/80

GTEMP1;

PAGE 1

	N	QTZC	QTZA	BCR	CHAL	AMOR	SO	B43	B13	NKC	NAK
1.0	127	124	28	99	8	13.26	90	209	90	260	
2.0	122	120	24	94	4	22.87	72	209	72	278	
3.0	125	122	26	97	6	29.10	65	211	65	290	
4.0	140	135	41	114	20	11.76	107	233	233	295	

	N	NKC	CMG	PCC
1.0	90	62	999	
2.0	72	69	15	
3.0	65	999	14	
4.0	233	105	999	

	N	R	DMG	CMG	C43	C13	PCC
1.0	31.0	28	62	999	999	999	
2.0	31.4	3	69	15	105	15	
3.0	99.9	999	999	14	113	14	
4.0	19.5	127	105	999	999	999	

	N	PH	HC03	PC02
1.0	7.44	5.22	0.0125	
2.0	7.28	6.24	0.0216	
3.0	7.54	5.66	0.0108	
4.0	7.38	4.60	0.0127	

Plates 1, 2 and 3

pages 43-48

in back of report

MAJOR EQUIPMENT OUTLINE SPECIFICATIONS

Manure Hopper, Clump Breaker, Screw Feeder

The manure hopper shall be fabricated from hot dipped galvanized sheet metal with flange connection compatible for attachment to screw feeder trough described below. The clump breaker shall be of dual rotating bar design with carbon steel elements. The clump breaker shall be incorporated into the lower portion of the manure hopper. The screw conveyor and trough shall receive the manure from the bottom of the hopper and shall convey the manure to bottom discharge port. Materials shall be hot dipped galvanized carbon steel components as manufactured by Screw Conveyor Corporation or Anderson Crane Co.

Comminutor

The comminutor shall be two shaft channel style design. The shafts shall counter-rotate and be equipped with cutters that intermesh. All parts exposed to the process materials shall be constructed of corrosion resistant materials. Cutters shall be 17-4 pH steel. The comminutor shall be as manufactured by Disposable Waste Systems, Inc. or Chicago Pump Co.

Mixing Basin Blowers

The mixing basin blowers will be positive displacement rotary lobe type design complete with air intake filters and silencers. Blowers shall be as manufactured by Gardner-Denver Co. or Dresser Industries.

Digester Centrifuge and Centrate Feed Pumps

The digester centrifuge and centrate feed pumps shall be heavy duty vertical wet pit, direct coupled, nonclog centrifugal type pumps. Pumps shall be as manufactured by Cornell Pump Co. or Pacific Pump Co.

Digesters

The digesters shall be prestressed concrete tanks designed for a 50-year maintainance free life. Digesters shall be suitable for buried service. The tank and roof shall be designed to provide support for the draft tube mixers in addition to normal dead and other live load conditions. Steel pretensioning wires shall be hot dip galvanized. Digesters shall be as manufactured and designed by DYK BBR Prestressed Tanks, Inc.

Digester Draft Tube Mixing Equipment

The digester draft tube mixing equipment shall consist of nonclog piston bubble generator, 18 inch diameter jacketed draft tube mixing guns, designed for ceiling support, gas recycle compressors, thermostats and controls suitable to mix and maintain the digester contents within $\pm 1^{\circ}\text{F}$ of design temperature. Mixing equipment shall be as manufactured by Atura Incorporated or Walker Process of Chicago Bridge and Iron Co.

Gasholder Tank

The gasholder tank shall be an aboveground steel tank design with a floating internal piston. The tank shall be as manufactured by GATX Tank Erection Corporation or United States Steel Corp.

Gas Handling and Safety Equipment

The gas handling and safety equipment shall consist of a waste gas burner (flare) with automatic pilot ignition, sediment traps, manual and automatic drip traps, pressure/vacuum relief valves complete with flame arrester, pressure regulator, flame trap and check assembly, and digester roof manhole covers and sampling port covers. Equipment shall be as manufactured by Varec Corp or PFT.

Digested Sludge Pumps

Pumps shall be duplex plunger type, equipped with variable stroke. Pumps shall be as manufactured by ITT Marlow or Sludgemaster.

Degasifier Column

The degasifier columns shall be fabricated from fiberglass reinforced plastic complete with internal splash plate and column mounting flange.

Centrifuges

Centrifuges shall be solid bowl continuous discharge design with stainless steel bowl construction and cast iron base. Casing to have replaceable liner. Centrifuges shall be as manufactured by Sharples-Stokes or Bird.

Centrifuge Conveyor

The centrifuge conveyor shall be a flat belt conveyor, suitable supported, complete with rectangular carbon steel tubular framework. The framework shall be mounted on wheels

to allow the conveyor to be moved. Conveyor shall be as manufactured by Anderson Crane Co.

Bunker Conveyor

The bunker conveyor shall be a live bottom type screw conveyor with screw lift to the point of discharge. Conveyor shall be as manufactured by Screw Conveyor Corp or Anderson Crane Co.

Cenetrade Lagoon Pump

The centrate lagoon pump shall be a vertical turbine constant speed centrifugal pump. Pump shall be as manufactured by Johnston Pump Co. or Peerless Pump Co.

Gas Engine/Generator Sets

The package sets shall consist of the gas engine/generator units, silencers, engine accessories, safety devices, governor, water pump, and control equipment. The engine shall be four cycle, water cooled, and shall be capable of operating on digester gas at a synchronous speed. Engine/generator sets shall be as manufactured by Waukesha or Caterpillar Co.

Waste Heat Exchangers

The waste heat exchangers shall be plate and frame type sized to transfer the engine jacket water heat to the digester heating water. Exchangers shall be of stainless steel construction. Exchangers shall be as manufactured by American Standard or Patterson Kelley Co.

Summary of Paper
entitled
REFEEDING VALUE OF SOLIDS FROM METHANE
GENERATORS: A BONANZA ? ?

by
Dr. Mike Prokop
University of California
Imperial Valley Field Station

to
National Cattlemens Association
Environmental Management Committee

January 22, 1980
San Diego, CA.

The bottom line for our current understanding of manure fermentation is simply stated. At present market values the gas produced from the fermentation of feedlot waste will not pay for the system. To make the system pay the fermentation residue must have a value and be a marketable feedstuff.

The fermentation residue will not become a major replacement for energy or protein in our conventional beef rations. However, it is a valuable resource or by-product for which we must develop its full potential.

To gain acceptability the residue must offer the opportunity to reduce our cost of production. However, its greatest value may be in such areas as: reduced energy costs to operate our feedlot, improved lot management, improved animal health, and improved environmental relationships within our communities.

History tells us that the Europeans, in the post-World War II era, failed to develop a lasting methane generation industry because of economic conditions. As our renewed efforts in this area gain interest, we must be careful to insure that our economic conditions will justify its growth.

In our research efforts to evaluate the concept of methane generation from feedlot waste, the Imperial Valley appears to be an ideal testing grounds. Along with the nature of the feedlot industry, the use of solar energy in this area offers a unique environmental advantage. If the concept is to work, it must work well under these favorable conditions.

Research conducted at the Imperial Valley Field Station was designed to evaluate the caloric content of both the Thermophilic and Mesophilic fermentation residues produced at the BioGas pilot plant adjoining the Kershaw and Sons Feedyard in Brawley,

California. Although the quantity and quality of the residual protein is important, the marketability of large quantities of the residue depends upon it's energy value.

A barley replacement trial was used in which a 90% concentrate control ration was compared to rations containing either 6 or 12 percent of the mesophilic residue, or 6 and 12 percent of the thermophilic residue. After 109 days on feed the animals were presented for slaughter at a net weight of 990 pounds. Carcass data along with carcass specific gravities were determined. In that the composition of the carcasses was not affected by the fermentation residue fed, the conditions necessary to directly calculate the net energy values of the fermentation residues were present.

In summary, the mesophilic residue when fed at 6% of the diet was shown to contain 71.0 Mcal NEm/cwt and 46.4 Mcal NEg/cwt, on a dry matter basis. Similar values for the thermophilic residue were 50.0 and 32.7, respectively. Increasing the residues to 12% of the diet reduced the caloric values by approximately one half. In that these residues contain a high percentage of ash, the actual organic portion of the refed is of relatively high nutritional value.

At an average level of 9% in the diet the mesophilic residue is comparable in energy value to an average quality alfalfa hay. A comparable evaluation of the thermophilic residue would be made with cottonseed hulls.

Whereas, this and other similar research has shown the fermentation residues to be of potential value, they do not assure the economic success of methane generation from feedlot wastes.

CHEMICAL COMPOSITION OF RAW MANURE AND THE
FERMENTATION RESIDUES.

PARAMETER	RAW MANURE	MESOPHILIC RESIDUE	THERMOPHILIC RESIDUE
PERCENT ON DRY MATTER BASIS			
CRUDE PROTEIN	14.40	15.51	14.28
FAT	1.47	0.63	1.21
CRUDE FIBER	15.74	16.77	24.07
ASH	31.86	34.90	34.00
NFE	36.53	33.81	30.70
CALCIUM	2.43	2.84	2.75
PHOSPHORUS	0.65	0.94	0.84
SODIUM	1.10	0.42	0.42

EXPERIMENTAL DESIGN FOR STEER
FINISHING TRIAL

	CONTROL	<u>MESOPHILIC</u>		<u>THERMOPHILIC</u>	
		6%	12%	6%	12%
	- - NUMBER ANIMALS/PEN - -				
REP 1	4	4	4	4	4
REP 2	4	4	4	4	4
REP 3	4	4	4	4	4
REP 4	4	4	4	4	4
REP 5	4	4	4	4	4
TOTAL No. STEERS/TRT	20	20	20	20	20

COMPOSITION OF TEST RATIONS FOR STEER FINISHING TRIAL, % AS FED.

INGREDIENT	CONTROL	M-6%	M-12%	T-6%	T-12%
ALFALFA HAY	7.0	7.0	7.0	7.0	7.0
SUDANGRASS HAY	3.0	3.0	3.0	3.0	3.0
BEET PULP	3.5	3.5	3.5	3.5	3.5
ROLLED BARLEY	73.0	67.0	61.0	67.0	61.0
MESOPHILIC RESIDUE	-.-	6.0	12.0	-.-	-.-
THERMOPHILIC RESIDUE	-.-	-.-	-.-	6.0	12.0
FAT	3.0	3.0	3.0	3.0	3.0
MOLASSES	7.0	7.0	7.0	7.0	7.0
UREA	1.0	1.0	1.0	1.0	1.0
LIMESTONE	1.0	1.0	1.0	1.0	1.0
RUMENSIN PREMIX	1.0	1.0	1.0	1.0	1.0
TM SALT	0.5	0.5	0.5	0.5	0.5
VITAMIN A		1000 I.U./	.45	KG	

LIVE ANIMAL AND CARCASS WEIGHTS FOR STEER FINISHING TRIAL.

PARAMETER	RATION				
	CONTROL	M-6%	M-12%	T-6%	T-12%
NUMBER OF ANIMALS	20	20	20	20	20
AVERAGE DAYS ON FEED	139	139	139	139	139
INITIAL WEIGHT, LB.	639	647	647	633	640
FINAL WEIGHT, LB.	996	934	976	999	989
HOT CARCASS WEIGHT, LB.	625	641	625	640	651
DRESSING PERCENT	63	65	64	64	65

PERFORMANCE DATA FOR STEER FINISHING TRIAL

PARAMETER	RATION				
	CONTROL	M-6%	M-12%	T-6%	T-12%
AVERAGE DAILY GAIN, LB.	2.50	2.52	2.40	2.72	2.54
AVERAGE DAILY FEED, LB.					
AS FED BASIS	17.41	16.93	17.70	18.19	18.60
DRY MATTER BASIS	14.73	14.11	14.73	15.13	15.52
FEED / GAIN RATIO					
AS FED BASIS	6.80	7.01	7.53	6.81	7.44
DRY MATTER BASIS	5.77	5.82	6.27	5.68	5.94

STEER SLAUGHTER AND CARCASS COMPOSITION DATA FOR FINISHING TRIAL

PARAMETER	RATION				
	CONTROL	M-6%	M-12%	T-6%	T-12%
QUALITY GRADE	12.4	12.4	11.6	11.8	12.3
MARBLING SCORE	11.9	11.6	10.9	10.7	11.8
YIELD GRADE	2.1	2.1	1.9	2.2	2.0
KIDNEY FAT, %	3.0	2.6	2.6	2.7	2.7
SPECIFIC GRAVITY	1.0419	1.0418	1.0463	1.0440	1.0466

ESTIMATION OF MESOPHILIC RESIDUE VALUE RELATIVE TO BARLEY

ITEM	MESOPHILIC LEVEL, %		
	0	6	12
KG/DAY			
<u>EXPECTED GAIN:</u>			
MESOPHILIC @ 100% OF BARLEY	1.1617	1.1331	1.2152
MESOPHILIC @ 75% OF BARLEY	1.1617	1.1051	1.1572
MESOPHILIC @ 50% OF BARLEY	1.1617	1.0763	1.0936
MESOPHILIC @ 25% OF BARLEY	1.1617	1.0475	1.0393
MESOPHILIC @ 0% OF BARLEY	1.1617	1.0199	0.9794
<u>OBSERVED GAIN:</u>	1.1621	1.1058	1.0723
RESIDUE AS A PERCENT			
OF BARLEY	- -	75.6%	38.9%

ESTIMATION OF THERMOPHILIC RESIDUE VALUE RELATIVE TO BARLEY

ITEM	THERMOPHILIC LEVEL. %		
	0	6	12
	KG/DAY		
<u>EXPECTED GAIN:</u>			
THERMOPHILIC @ 100% OF BARLEY	1.1617	1.2621	1.3010
THERMOPHILIC @ 75% OF BARLEY	1.1617	1.2328	1.2412
THERMOPHILIC @ 50% OF BARLEY	1.1617	1.2032	1.1808
THERMOPHILIC @ 25% OF BARLEY	1.1617	1.1726	1.1198
THERMOPHILIC @ 0% OF BARLEY	1.1617	1.1436	1.0580
<u>OBSERVED GAIN:</u>	1.1621	1.2115	1.0580
RESIDUE AS A PERCENT OF BARLEY	- -	57.0%	32.3%

CALIFORNIA NET ENERGY SYSTEM

PREDICT THE

NET ENERGY OF MAINTENANCE = NE_M

AND

NET ENERGY OF PRODUCTION = NE_G

$$NE_M = 0.077 (WT_{KG})^{.75}$$

$$NE_G = (0.052675G + 0.005947G^2) (WT_{KG})^{.75}$$

$$NE_M = 0.8973 + 0.1302 NE_G + 0.4369 NE_G^2$$

CALCULATION OF NET ENERGIES FOR COMPLETE MESOPHILIC RATION

ITEM	RATION		
	CONTROL	M-6%	M-12%
MEAN BODY WEIGHT, Kg.	374	370	368
DAILY GAIN, Kg.	1.1621	1.1058	1.0723
DAILY INTAKE, Kg (90% DM)	7.45	7.11	7.42
NEM INTAKE, MEGCAL/DAY	6.5532	6.4959	6.4702
NEG INTAKE, MEGCAL/DAY	6.0081	5.6306	5.4175
<u>NET ENERGY CONCENTRATION NECESSARY TO</u>			
<u>ACHIEVE OBSERVED PERFORMANCE, Kcal/GM, AS FED</u>			
NEM	1.9357	1.9053	1.7357
NEG	1.3320	1.3111	1.2294
<u>NET ENERGY OF MESOPHILIC RESIDUE, Kcal/GM, AS FED</u>			
NEM		1.3549	0.6032
NEG		0.8744	0.3677

NET ENERGY VALUES FOR FERMENTED MANURE RESIDUES AND
SELECTED FEEDSTUFFS.

ITEM	AS FED		DM BASIS	
	NEM	NEg	NEM	NEg
	MEG CAL/CWT			
6% - MESOPHILIC	61.5	39.6	71.9	46.4
12% - MESOPHILIC	27.4	16.7	32.0	19.5
6% - THERMOPHILIC	43.8	28.1	50.9	32.7
12% - THERMOPHILIC	12.4	10.0	14.4	11.7

OTHER SELECTED FEEDSTUFFS:

BARLEY	87.3	57.6	97.0	64.0
CORN	89.4	57.6	104.0	67.0
ALFALFA HAY	50.4	16.2	56.0	18.0
BROMEGRASS HAY	54.0	16.2	60.0	18.0
CORN COBS	43.2	12.6	48.0	14.0
CORN STOVER	47.9	12.6	55.0	14.0
COTTONSEED HULLS	42.3	9.0	47.0	10.0
PRAIRIE HAY	54.0	12.6	60.0	14.0
CORN SILAGE	21.0	11.4	70.0	38.0
SORGHUM SILAGE	16.5	8.7	57.0	30.0

PERFORMANCE OF STEERS FED 0, 5, 10 AND 15 PERCENT
FEEDLOT WASTE.

ITEM	TREATMENT			
	0	5	10	15
HEAD	120	120	120	120
DAYS ON FEED	120	120	120	120
INITIAL WT.	744	747	756	757
FINAL WT.	1105	1117	1107	1100
AVE DAILY GAIN	2.87	2.74	2.74	2.82
DAILY FEED	23.53	23.13	23.81	23.90
FEED/GAIN	8.19	8.44	8.69	8.47

AUGHTRY, J.D., 1977.

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CHAM HILL
BOISE

COLORADO DEPARTMENT OF AGRICULTURE
DIVISION OF INSPECTION AND CONSUMER SERVICES
FEED SECTION

RULES AND REGULATIONS
REGARDING
PROCESSED ANIMAL WASTE PRODUCTS

RULES AND REGULATIONS
REGARDING PROCESSED ANIMAL WASTE PRODUCTS

TABLE OF CONTENTS

	<u>Page</u>
I. LEGAL AUTHORITY.....	1
II. DEFINITIONS.....	1
III. REGISTRATION REQUIRED.....	2
IV. REGISTRATION PROCEDURE.....	2
V. REGISTRATION REFUSED.....	2
VI. QUALITY STANDARDS.....	3
VII. LABELING REQUIREMENTS.....	4
VIII. TESTING REQUIRED.....	5
IX. RECORDS REQUIRED.....	5
X. REGISTRATION REVOCATION, SUSPENSION, ANNULMENT, LIMITATION OR MODIFICATION.....	5
XI. DEVIATION FROM RULES.....	6
XII. LICENSE AND BOND REQUIREMENTS.....	6
XIII. LIABILITY AND PENALTIES.....	6
XIV. EFFECTIVE DATE AND DURATION OF REGULATION.....	6

COLORADO DEPARTMENT OF AGRICULTURE
RULES AND REGULATIONS
REGARDING PROCESSED ANIMAL WASTE PRODUCTS

I. Legal Authority:

Title 35, Article 60, Section 107, Colorado Revised Statutes 1973, as amended.

II. Definitions:

- A. "Animal Waste" means a product composed of excreta, with or without bedding materials and/or animal drugs, and collected from poultry, ruminants, or other animals, except humans.
- B. "Processed Animal Waste Product" means a processed animal waste product.
- C. "Processed", as applied to animal waste, means thermally dehydrated, dry stacked, ensiled, oxidized, chemically treated, microbiologically digested, chemically or physically fractionated, or treated by other processes which will enable the product to comply with the standards set forth in Section V. A. 2.
- D. "Dried Poultry Waste (DPW)" means a processed animal waste product composed of feces from commercial poultry, which has been thermally dehydrated to a moisture content not in excess of 12.00 percent.
- E. "Dried Poultry Litter" means a processed animal waste product composed of a processed combination of feces from commercial poultry together with litter that was present in the flock production of poultry, which has been thermally dehydrated to a moisture content not in excess of 12.00 percent.
- F. "Dried Ruminant Waste" means a processed animal waste product composed of processed ruminant excreta which has been thermally dehydrated to a moisture content not in excess of 12.00 percent.
- G. "Undried Processed Animal Waste Product" means a processed animal waste product composed of excreta, with or without litter, from poultry, ruminants or any other animal and which contains in excess of 12.00 percent moisture.
- H. "Processed Animal Waste Derivative" means a product resulting from the complete chemical or microbiological alteration of an animal waste. The product must be free of the original unaltered animal waste except moisture. Examples of processed animal waste derivatives are yeasts, algae or other organisms produced and harvested from non-human animal wastes. The specific name of each such animal waste derivative product must be descriptive and be approved by the Commissioner of Agriculture before being registered or offered for sale.

II. Definitions (continued):

- I. "Person" means an individual, corporation, partnership, association, or any other business entity.
- J. References to statutes or agency rules or regulations shall mean the statute or rule or regulation as they may be amended subsequent to the adoption of these rules and regulations.

III. Registration Required:

No person shall sell, offer or expose for sale, or distribute, in this state, any processed animal waste product intended, promoted, represented, advertised or distributed for use as a commercial feed as defined in Article 60, Title 35, C.R.S. 1973, prior to registering same with the Commissioner of Agriculture.

IV. Registration Procedure:

- A. Application for registration shall be made to the Commissioner on forms provided by the Commissioner, and shall be accompanied by payment of the statutory registration fee as set forth in Section 35-60-105, C.R.S. 1973.
- B. Applications for registration shall be accompanied by the following:
 - 1. A certified copy of the label or tag required by Section 35-60-104, C.R.S. 1973, which the applicant proposes to use for the processed animal waste product.
 - 2. A detailed description, in affidavit form, of the facilities, equipment, and method of manufacture to be used in the processing, manufacturing, and testing of the processed animal waste product, a sampling schedule and a full description of all tests made, and the results, thereof purporting to show the processed animal waste product meets the standards of these rules and regulations for registration.
 - 3. Upon request of the Commissioner of Agriculture, a sealed package of the processed animal waste product, containing at least one pound of the processed animal waste product to be sold, offered or exposed for sale, or distributed, in this state, together with the applicant's affidavit that said sample is representative of the processed animal waste product offered for registration.

V. Registration Refused:

- A. General: Registration of a processed animal waste product will be refused if:
 - 1. Applicant or the processed animal waste product is determined to be in violation of any federal or Colorado statute or Colorado agency rule or regulation affecting or relating to the sale of commercial feeds.

V. Registration Refused (continued):

2. The processed animal waste product contains any pathogenic organisms, drug residues, pesticide residues, harmful parasites, or other toxic or deleterious substances above levels permitted by Section 35-60-102 (1) (a) (b) (c) (d) (e), C.R.S. 1973, Federal Food, Drug, and Cosmetic Act, Sections 406, 408, 409, and 706, agency rules or agency regulation or which could be harmful to animals, or which could result in residue in the tissue of by-products of animals of a level determined and promulgated by the Commissioner of Agriculture to be harmful; or which contains aflatoxins in excess of 20 ppb; or which contains more than a total of 500 ppm as mercury, lead, bismuth, copper, cadmium, arsenic, antimony, or tin.
 3. The processed animal waste product does not meet the Quality Standards as set forth in Section VI of the rules.
 4. The processed waste product is not labeled in compliance with law, including agency rules and regulations, including Section VII of these rules.
- B. Registration may be refused pursuant to and in compliance with any statutory provisions authorizing the Commissioner of Agriculture to refuse registration.

VI. Quality Standards:

- A. No processed animal waste product shall contain any extraneous materials such as, but not limited to, metal, glass, wire or nails, except as set forth in Section VI (D) (4) or (E) below.
- B. Dried Poultry Waste shall not contain
1. less than 20.00 percent crude protein, or
 2. in excess of 15.00 percent crude fiber, or
 3. in excess of 30.00 percent ash, or
 4. in excess of 1.00 percent feathers, or
 5. in excess of 12.00 percent moisture, or
 6. in excess of 20.00 percent litter.
- C. Dried Poultry Litter shall not contain
1. less than 18.00 percent crude protein, or
 2. in excess of 40.00 percent crude fiber, or
 3. in excess of 30.00 percent ash, or
 4. in excess of 5.00 percent feathers, or
 5. in excess of 12.00 percent moisture.
- D. Dried Ruminant Waste shall not contain
1. less than 12.00 percent crude protein, or
 2. in excess of 30.00 percent crude fiber, or
 3. in excess of 30.00 percent ash, or

VI. Quality Standards (continued):

4. in excess of 40.00 percent straw, wood, wood shavings, litter, dirt, sand, rocks or other similar extraneous materials, or
 5. in excess of 12.00 percent moisture.
- E. Undried Processed Animal Waste Products shall not contain in excess of 40.00 percent straw, wood, wood shavings, litter, dirt, sand, rocks or other extraneous materials.
- F. Any product labeled as or containing dried animal waste products shall be 12.00 percent moisture or less to aid in maintaining stable microbiological quality.

VII. Labeling Requirements:

- A. General: The label or tag required by Section 35-60-104, C.R.S. 1973, shall, in addition to being in compliance therewith, state:
1. If the product contains drugs, then the label should contain the following statement in boldface type at least one-half as large as any other type appearing on the label:
 - (a) "WARNING: THIS PRODUCT CONTAINS DRUG RESIDUES. DO NOT USE WITHIN 30 DAYS OF SLAUGHTER AND DO NOT USE 30 DAYS PRIOR TO OR DURING THE FOOD PRODUCTION PERIOD OF DAIRY ANIMALS AND LAYING HENS."
 - (b) If the product contains high levels (15 ppm or greater) of copper: "WARNING: CONTAINS HIGH LEVELS OF COPPER: DO NOT FEED TO SHEEP."
 2. In percentages in the following order:
 - (a) minimum protein
 - (b) maximum equivalent crude protein from non-protein nitrogen
 - (c) minimum fat
 - (d) maximum fiber
 - (e) maximum ash
 - (f) maximum and minimum calcium (Ca)
 - (g) minimum phosphorus (P)
 - (h) maximum sodium (Na)
 - (i) maximum moisture
 - (j) maximum lignin, if the processed animal waste product is Dried Poultry Litter and if the product contains wood-based bedding materials.
 - (k) maximum copper (Cu), if the processed animal waste product is Dried Poultry Waste or Dried Poultry Litter and does not contain the warning "DO NOT FEED TO SHEEP".
 3. The maximum percentage, and type, of processed animal waste product, when used in mixed feed.
 4. As part of the product name, the animal source and product type.

VIII. Testing Required:

- A. Any person seeking or receiving registration of any processed animal waste product shall test, by representative sampling and assaying of such samples, and keep accurate records thereof, the processed animal waste product for which registration is sought or received, at least as often as required by the Commissioner. The manufacturer shall do such additional testing to assure that products are non-contaminated as set forth by the Colorado Feeding Stuffs Law, Article 60, Title 35, C.R.S. 1973, and the Rules and Regulations of the Food and Drug Administration.
- B. The sample shall be of sufficient size so as to provide meaningful data statistically reliable in carrying out the purpose of such sampling and analysis.
- C. The purpose of such sampling shall be to determine the presence of any materials specified in Section V. 2. and compliance with the Quality Standards as set forth in Section VI of these rules in the processed animal waste product.

IX. Records Required:

Any person seeking or receiving registration of any processed animal waste product shall keep for a period of two (2) years, accurate records of:

- A. All sources of raw materials and date acquired.
- B. All production, including a code or other method to identify the date of production.
- C. All sales and distribution, including the name and address of the purchaser or to whom distributed, date, quantity and production code.
- D. Sampling and assay records of the testing required by Section VIII of these rules.

X. Registration Revocation, Suspension, Annulment, Limitation or Modification:

- A. Procedure: The procedures as specified in Article 4 of Title 24, C.R.S. 1973, for revocation, suspension, annulment, limitation or modification of licenses shall be followed in any proceeding to take any such actions with regard to the registration of any processed animal waste product.
- B. Grounds:
 - 1. In addition to the specific provisions herein, the registration of any processed animal waste product shall be subject to revocation, suspension, annulment, limitation, or modification pursuant to any statutory provision directing or authorizing such action with regard to an agency license, as license is defined in Section 24-4-102 (7), C.R.S. 1973.
 - 2. The registration of any processed animal waste product determined

X. Registration Revocation, Suspension, Annulment, Limitation or Modification (continued):

- (a) to be in violation of any federal or Colorado statute, or Colorado agency rule or regulation affecting or relating to the sale of commercial feeds; or
- (b) to be in violation of the standards specified in Sections V, VI, or VII of these rules;

shall be subject to being revoked, suspended, annuled, limited or modified as may be deemed appropriate by the Commissioner of Agriculture.

- 3. Failure of any person to perform the testing as specified in Section VIII of these rules, or to accurately maintain and display to the Commissioner of Agriculture or the Commissioner's designee upon demand, the records required to be maintained as specified in Section IX of these rules, shall be grounds for revocation, suspension, annulment, limitation or modification of the registration of any affected processed animal waste product, as may be deemed appropriate by the Commissioner of Agriculture.

XI. Deviation From Rules:

For good cause shown, if not contrary to statute and if determined by the Commissioner of Agriculture not to pose a danger to the public, the Commissioner of Agriculture, upon written request, may permit deviation from these rules insofar as the Commissioner of Agriculture finds compliance therewith to be impossible, impracticable or unreasonable for any person or persons.

XII. License and Bond Requirements:

None.

XIII. Liability and Penalties:

Prescribed by statute, Title 35, Article 60, C.R.S. 1973, as amended.

XIV. Effective Date and Duration of Regulation: To become effective on
November 19, 1975

An Act

HOUSE BILL NO. 1368. BY REPRESENTATIVES Younglund, Burns, Hinman, Powers, DeNier, Hamlin, Hastings, Hudson, Showalter, Theos, and Winkler; also SENATORS Clark, Anderson, Soash, and Woodard.

CONCERNING COMMERCIAL AGRICULTURAL FEEDS.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. Article 60 of title 35, Colorado Revised Statutes 1973, is REPEALED AND REENACTED, WITH AMENDMENTS, to read:

ARTICLE 60

Commercial Feeding Stuffs

35-60-101. Short title. This article shall be known and may be cited as the "Colorado Commercial Feed Law of 1979".

35-60-102. Definitions. As used in this article, unless the context otherwise requires:

(1) "Brand name" means any word, name, symbol, or device, or any combination thereof, identifying the commercial feed of a distributor or registrant and distinguishing it from that of others.

(2) (a) "Commercial feed" means all materials which are distributed for use as feed, or for mixing in feed, for animals other than human beings; except that "commercial feed" shall not include:

(I) Unmixed whole or processed seed made directly from the entire seed and not adulterated within the meaning of section 35-60-106;

(II) Individual chemical compounds when not mixed with

Capital letters indicate new material added to existing statutes; dashes through words indicate deletions from existing statutes and such material not part of act.

other materials;

(III) Commodities such as hay, straw, stover, cobs, husks, hulls, ensilage, and wet beet pulp when unground and when not mixed or intermixed with other materials, if such commodities are not adulterated within the meaning of section 35-60-106.

(b) The commissioner may, by regulation, exempt from this definition, or from specific provisions of this article, substances, compounds, or commodities which are not intermixed or mixed with other materials and which are not adulterated within the meaning of section 35-60-106.

(3) "Commission" means the state agricultural commission.

(4) "Commissioner" means the commissioner of agriculture or his authorized agent.

(5) "Contract feeder" means a person who, as an independent contractor, feeds commercial feed to poultry and animals pursuant to a contract whereby such commercial feed is manufactured by such person for poultry and animals other than those owned by such person or whereby such commercial feed is supplied, furnished, or otherwise provided to such person and whereby any part of the remuneration of such person is determined by feed consumption, poultry or animal mortality, profits, or amount or quality of product.

(6) "Customer-formula feed" means a feed which consists of a mixture of commercial feeds or feed ingredients:

(a) If all or any part of such feed is furnished by the person or distributor who processes, mixes, mills, or otherwise prepares such mixture;

(b) If such mixture is prepared according to the specific instructions of the final purchaser, with or without a guaranteed analysis of protein, vitamin, mineral, drug, or other nutritive components the purchaser specifies the feed shall contain; and

(c) If the feed is distributed only to the customer who requested it and is not redistributed.

(7) "Department" means the department of agriculture and includes the state agricultural commission, the commissioner of agriculture, and all employees and agents of the department.

(8) "Distribute" means to:

(a) Offer for sale, sell, exchange, or barter commercial feed;

(b) Supply, furnish, or otherwise provide commercial feed

to a contract feeder.

(9) "Distributor" means any person who distributes commercial feed.

(10) "Drug" means any substance intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease in animals other than human beings and substances other than feed intended to affect the structure or any function of the animal body.

(11) "'Federal Food, Drug, and Cosmetic Act'" means the "Federal Food, Drug, and Cosmetic Act", 21 U.S.C. sec. 301 et. seq. (1938), as amended.

(12) "Feed ingredient" means each of the constituent materials making up a commercial feed.

(13) "Label" means a display of written, printed, or graphic matter upon or affixed to the container in which a commercial feed is distributed or the invoice or delivery slip distributed with a commercial feed.

(14) "Labeling" means all labels or other written, printed, or graphic matter:

(a) On a commercial feed, its containers or wrapper; or

(b) Accompanying a commercial feed.

(15) "Manufacture" means to grind, mix, blend, or further process a commercial feed for distribution.

(16) "Metric ton" means one thousand kilograms or two thousand two hundred four and sixty-two hundredths pounds.

(17) "Mineral feed" means a commercial feed primarily intended to supply mineral elements or inorganic nutrients.

(18) "Official sample" means a sample of feed taken by the commissioner or his agent in accordance with the provisions of section 35-60-110.

(19) "Percent" or "percentages" means percentages by weights.

(20) "Pet" means any domesticated animal normally maintained in or near the household of the owner.

(21) "Pet food" means any commercial feed prepared and distributed for consumption by pets.

(22) "Product name" means the name of the commercial feed

which identifies it as to kind, class, or specific use.

(23) "Raw agricultural commodity" means any feed ingredient in its raw or natural state.

(24) "Specialty pet" means any domesticated animal pet normally maintained in a cage or tank, including, but not limited to, gerbils, hamsters, canaries, psittacine birds, mynahs, finches, tropical fish, goldfish, snakes, and turtles.

(25) "Specialty pet food" means any commercial feed prepared and distributed for consumption by specialty pets.

(26) "Ton" means a net weight of two thousand pounds avoirdupois, or .907 tonnes metric equivalent.

35-60-103. Registration. (1) (a) No person shall distribute in this state a commercial feed, except customer-formula feed, which has not been registered pursuant to this section. An application for registration shall be submitted to the commissioner in the manner he prescribes. If the application is approved by the commissioner, a registration shall be issued to the applicant.

(b) All registrations shall expire on December 31 of each year, and a registration shall continue in effect from the time of issuance until it expires, unless cancelled by the registrant or unless cancelled pursuant to subsection (4) of this section by the commissioner.

(2) (a) The following fees for registration shall be paid to the commissioner:

(I) Registration and reregistration of each product.....
.....\$2.00

(II) Changes in registration.....\$2.00

(b) A distributor shall pay a registration fee of ten dollars for each commercial feed product, except customer-formula feed distributed only in individual packages weighing ten pounds or less, and the distributor of such product shall not be required to pay the inspection fee on such packages of the product so registered.

(c) The fees required by this subsection (2) shall be deposited in the state treasury and credited to the general fund.

(3) The commissioner may refuse registration of any commercial feed not in compliance with the provisions of this article and may cancel the registration of any commercial feed which is not in compliance with the provisions of this article; except that no registration shall be refused or cancelled until

the registrant has been given an opportunity to be heard before the commissioner and to amend his application in order to comply with the requirements of this article.

(4) When a distributor is located outside of Colorado and is distributing commercial feed in Colorado, such distributor shall maintain, for at least two years, the records and information required by this section and section 35-60-104 and upon request shall furnish the commissioner with a certified audit performed by a recognized auditing firm. The commissioner may cancel all registrations of any person who fails to comply with this requirement.

35-60-104. Labeling. (1) A commercial feed, except a customer-formula feed or feed produced by a contract feeder, shall be accompanied by a label bearing the following information:

(a) The net weight or liquid volume when metered through an approved metering system;

(b) The product name and the brand name, if any, under which the commercial feed is distributed;

(c) The guaranteed analysis of the commercial feed, stated in such terms as the commissioner may require by regulation to advise the user of the composition of the feed or to support claims made in the labeling of such feed. In all cases the composition of the feed must be determinable by laboratory methods published by the association of official analytical chemists or by such other methods as are acceptable to the commissioner.

(d) The common name of each ingredient used in the manufacture of the commercial feed; except that the commissioner by regulation may permit the use of a collective term for a group of ingredients which perform a similar function, or he may exempt commercial feeds from this requirement of an ingredient listing if he finds that such listing is not necessary to protect the interests of consumers;

(e) The name and principal mailing address of the manufacturer or the distributor;

(f) Adequate directions for the use of a commercial feed which contains drugs and for the use of such other feeds as the commissioner may deem necessary for their safe and effective use;

(g) Such precautionary statements as the commissioner determines are necessary for the safe and effective use of the commercial feed.

(2) A customer-formula feed shall be accompanied by a

label, invoice, delivery slip, or other shipping document which identifies the feed as a customer-formula feed. A copy of the specifications of any customer-formula feed, if not furnished the customer at time of delivery, shall be on file at the manufacturing facility.

35-60-105. Mislabeled. (1) A commercial feed is mislabeled if:

- (a) Its labeling is false or misleading in any particular;
- (b) It is distributed under the registered name of another commercial feed;
- (c) It is not labeled as required by section 35-60-104;
- (d) It is represented as a commercial feed or is represented as containing a commercial feed ingredient and such commercial feed or feed ingredient does not conform to the definition of such feed or feed ingredient, if any, prescribed by regulation by the commissioner.
- (e) Any word, statement, or other information required by or pursuant to this article to appear on the label or labeling is not prominently placed thereon with such conspicuousness, as compared with other words, statements, designs, or devices in the labeling, and in such terms as to render it likely to be read and understood by the ordinary individual under customary conditions of purchase and use.

35-60-106. Adulteration. (1) A commercial feed shall be deemed to be adulterated if:

- (a) It bears or contains any poisonous or deleterious substance which may render it injurious to health, but if the substance is not an added substance, such commercial feed shall not be considered adulterated if the quantity of such substance in the feed does not ordinarily render it injurious to health;
- (b) It bears or contains any added poisonous, deleterious, or nonnutritive substance which is unsafe within the meaning of section 406 of the "Federal Food, Drug, and Cosmetic Act", other than a substance which is a food additive or a pesticide chemical in or on a raw agricultural commodity;
- (c) It is, bears, or contains any food additive which is unsafe within the meaning of section 409 of the "Federal Food, Drug, and Cosmetic Act";
- (d) It is a raw agricultural commodity and it bears or contains a pesticide chemical which is unsafe within the meaning of section 408 (a) of the "Federal Food, Drug, and Cosmetic Act"; except that where a pesticide chemical has been used in or on a

raw agricultural commodity in conformity with an exemption granted or a tolerance prescribed under section 408 of the "Federal Food, Drug, and Cosmetic Act" and such raw agricultural commodity has been subjected to processing such as canning, cooking, freezing, dehydrating, or milling, the residue of such pesticide chemical remaining in or on such processed feed shall not be deemed unsafe if such residue has been removed to the extent possible in good manufacturing practice and if the concentration of such residue in the processed feed is not greater than the tolerance prescribed for the raw agricultural commodity, unless the feeding of such processed feed will result or is likely to result in a pesticide residue in the edible product of the animal which is unsafe within the meaning of section 408 (a), of the "Federal Food, Drug, and Cosmetic Act".

(e) It is, bears, or contains any color additive which is unsafe within the meaning of section 706 of the "Federal Food, Drug, and Cosmetic Act".

(f) Any valuable constituent has been wholly or partially omitted or abstracted therefrom or any less valuable substance substituted therefor;

(g) Its composition or quality falls below or differs from that which it is represented by its labeling to possess;

(h) It contains a drug and the methods used in or the facilities or controls used for its manufacture, processing, or packaging do not conform to current good manufacturing practice regulations promulgated by the commissioner to assure that the drug meets the requirement of this article as to safety, and it has the identity and strength and meets the quality and purity characteristics which it purports or is represented to possess. In promulgating such regulations, the commissioner shall adopt the current good manufacturing practice regulations for medicated feed premixes and for medicated feeds established pursuant to the "Federal Food, Drug, and Cosmetic Act" unless he determines that such regulations are not appropriate to the conditions which exist in this state.

(i) It contains viable weed seeds in amounts exceeding the limits which the commissioner shall establish by regulation.

35-60-107. Prohibited acts. (1) The following acts and the causing thereof within the state of Colorado are prohibited and shall be punished as provided in section 35-60-112 (1):

(a) Manufacture or distribution of any commercial feed that is adulterated or misbranded;

(b) Adulteration or misbranding of any commercial feed;

(c) Distribution of agricultural commodities such as whole

seed, hay, straw, stover, silage, cobs, husks, and hulls which are adulterated within the meaning of section 35-60-106;

(d) Removal or disposal of a commercial feed in violation of an order under section 35-60-111;

(e) Failure or refusal to register in accordance with section 35-60-103;

(f) Violation of section 35-60-112 (6);

(g) Failure to pay inspection fees and file reports as required by section 35-60-108.

35-60-108. Inspection fees and reports. (1) To raise additional revenue to defray the expenses of inspection, sampling, analysis, and other expenses necessary for the administration of this article, an inspection fee not to exceed twenty cents per ton on all commercial feeds, including feed ingredients defined pursuant to section 35-60-109 as commercial feeds, produced or distributed in this state shall be paid to the commissioner by the person who produces or distributes the commercial feed; except that:

(a) No fee shall be paid when inspected on customer-formula feed or feed which is produced by a contract feeder and used only in his feeding operation and except that commercial feeds used therein are not exempt from inspection fees. Customer-formula feed shall be subject to inspection pursuant to section 35-60-110 and no fee shall be charged. Inspection, sampling, and laboratory services shall be provided by the department at the request of producers of customer-formula feed, producers of contract feed, or the customer of these provisioners. The requestor shall pay for these services according to fees set forth in regulations issued by the commissioner.

(b) No inspection fee shall be paid on commercial feed if such fee has been paid by a previous distributor of the feed.

(c) Credit shall be allowed for payment of the inspection fee on commercial feeds which are used in the manufacture of other commercial feeds.

(d) An annual registration fee of ten dollars for each calendar year shall be paid pursuant to section 35-60-103 (2) (b) on a commercial feed which is distributed in the state only in packages of ten pounds or less in lieu of the inspection fee provided by this subsection (1).

(2) The per ton rate of the inspection fee may be adjusted by the commissioner, upon recommendation from a five-member committee comprised of representatives of the feed, livestock, and poultry industries, so that the fee collected shall cover the

cost of inspection, sampling, and analysis and shall not exceed that necessary to meet reasonable expenses for the administration of this article. Notice of any change in the rate of inspection fee shall be given to all registrants not later than sixty days prior to the beginning of the reporting period, pursuant to paragraph (a) of subsection (4) of this section, to which such change shall apply.

(3) Invoices or other shipping documents accompanying feed ingredients which are defined as commercial feeds shall state in legible form that the inspection fees imposed by this section have been paid.

(4) Each person who is liable for payment of an inspection fee pursuant to this section shall:

(a) Not later than the last day of January and of July of each year, file a semiannual statement reporting the number of net tons of commercial feed distributed in this state during the preceding six-month period; except that an instate manufacturer may elect to file on the net tons of commercial feed produced during the preceding six-month period;

(b) Upon filing such statement, pay the inspection fee on such feed. Inspection fees which have not been remitted to the commissioner within fifteen days following the due date shall be assessed a penalty of twenty-five dollars or the amount of the inspection fee, whichever is smaller. Such penalty shall be added to the inspection fee imposed pursuant to this section and shall be paid when such fee is paid. Assessment of a penalty pursuant to this paragraph (b) shall not preclude the commissioner from taking any other action against the producer or distributor of such feed which is authorized by this article.

(c) Keep such records as are necessary to accurately show the tonnage of commercial feed manufactured or distributed in this state. Such records shall be maintained for at least two complete fiscal years, and the commissioner shall be permitted to examine the records to verify statements of tonnage.

(5) Failure to make an accurate statement of tonnage, to pay the inspection fee, or to comply with the provisions of this article and regulations promulgated pursuant thereto shall be sufficient cause for cancellation of all registrations of the distributor which are on file with the commissioner.

(6) All fees and other moneys collected pursuant to this section shall be deposited in the state treasury and credited to the general fund.

35-60-109. Commissioner - authority. The commissioner shall promulgate, amend, and repeal, in accordance with the provisions of the "State Administrative Procedures Act", article

4 of title 24, C.R.S. 1973, such regulations as are necessary for the enforcement of this article, and, in the interest of uniform regulation, shall by regulation adopt the official definitions of feed ingredients and official feed terms adopted by the association of American feed control officials as published in the official publication of such association and the regulations promulgated pursuant to the "Federal Food, Drug, and Cosmetic Act"; except that if the commissioner determines that any of such definitions, terms, and regulations are inconsistent with the provisions of this article or are not appropriate to conditions in this state, he shall not adopt them.

35-60-110. Inspection, sampling, and analysis. (1) (a) To enforce the provisions of this article and regulations adopted pursuant thereto, the commissioner, upon presenting appropriate credentials to the owner, operator, or agent in charge, may enter and inspect, at reasonable times and during normal business hours if possible, within reasonable limits, and in a reasonable manner, any factory, warehouse, or establishment within the state in which commercial feeds, feed ingredients, or raw agricultural commodities for use in such feeds are manufactured, processed, packed, or held for distribution, and any vehicle being used to transport or hold such feeds, feed ingredients, or raw agricultural commodities, and may obtain samples of such feeds, feed ingredients, or raw agricultural commodities. Each inspection shall be commenced and completed with reasonable promptness, and, upon completion of the inspection, the person in charge of the facility or vehicle shall be so notified.

(b) If such entry, inspection, or sampling is denied or not consented to and no emergency exists, the commissioner is empowered to and shall obtain from the district or county court for the district or county in which such premises, property, or vehicle is located a warrant to enter and inspect such premises, property, or vehicle and to sample such commercial feeds, feed ingredients, or raw agricultural commodities prior to entry, inspection, and sampling. The district and county courts of this state are empowered to issue such warrants upon a proper showing of the need for such entry, inspection, and sampling. Any information concerning any method, records, formulations, or processes which is entitled to protection as a trade secret and which is obtained in the course of the inspection or sampling shall be kept confidential.

(2) (a) Sampling and analysis shall be conducted in accordance with methods published by the association of official analytical chemists or in accordance with other generally recognized methods.

(b) The results of all analyses of official samples shall be forwarded by the commissioner to the person named on the label and to the purchaser. If the inspection and analysis of an official sample indicates a commercial feed, other than

customer-formula feed, has been adulterated or misbranded, the commissioner shall furnish to the registrant, upon request made within thirty days following receipt by the registrant of the analysis, a portion of the sample concerned.

(c) In determining whether a commercial feed is deficient in any component, the commissioner shall utilize a sample obtained in accordance with the provisions of this section.

35-60-111. Detained commercial feeds. (1) When the commissioner or his authorized agent has reasonable cause to believe any lot of commercial feed is being distributed in violation of any of the provisions of this article or of any regulations promulgated pursuant thereto, he may issue and enforce a written or printed "withdrawal from distribution" order, warning the distributor not to dispose of the lot of commercial feed in any manner until written permission is given by the commissioner or the court. Within five days of the issuance of any such order, the commissioner shall hold a hearing to determine whether the order was correct. If the original withdrawal order was in error, the commissioner shall immediately release the lot of commercial feed so withdrawn. If the original withdrawal order is found to be correct, the commissioner shall release the lot of commercial feed so withdrawn when said provisions and regulations have been complied with. If compliance is not obtained within thirty days, the commissioner may begin, and upon request of the distributor or registrant shall begin, proceedings for condemnation.

(2) In no case shall the commissioner issue a "withdrawal from sale" order unless he furnishes, upon request, a sample of the feed or label believed to be in violation to the manufacturers or distributors involved.

(3) Any lot of commercial feed not in compliance with the provisions of this article and regulations promulgated pursuant thereto shall be subject to seizure on complaint of the commissioner to a court of competent jurisdiction in the area in which said commercial feed is located. In the event the court finds the commercial feed to be in violation of this article and orders the condemnation of said commercial feed, it shall be disposed of in any manner consistent with the quality of the commercial feed and the laws of the state; but in no instance shall the disposition of said commercial feed be ordered by the court without first giving the claimant an opportunity to apply to the court for release of said commercial feed or for permission to process or relabel said commercial feed to bring it into compliance with this article.

35-60-112. Penalties. (1) Any person convicted of violating any of the provisions of this article or who impedes, hinders, or otherwise prevents, or attempts to prevent, the commissioner or his duly authorized agent in performance of his

duty in connection with the provisions of this article is guilty of a misdemeanor and, except as provided in subsection (6) of this section, upon conviction thereof, shall be fined not less than one hundred dollars nor more than two hundred fifty dollars for the first violation and not less than two hundred dollars nor more than five hundred dollars for a subsequent violation.

(2) Nothing in this article shall be construed as requiring the commissioner or his representative to report for prosecution, to institute seizure proceedings, or to issue a withdrawal from distribution order, as a result of minor violations of this article when he believes the public interest will best be served by suitable notice of warning in writing.

(3) It is the duty of each district attorney to whom any violation is reported to cause proceedings to be instituted where appropriate and prosecuted in a court of competent jurisdiction without delay. Before the commissioner reports a violation for such prosecution, an opportunity shall be given the distributor to present his views to the commissioner.

(4) The commissioner is hereby authorized to apply for and the court to grant a temporary or permanent injunction restraining any person from violating or continuing to violate any of the provisions of this article or any rule or regulation promulgated under this article, notwithstanding the existence of other remedies at law, said injunction to be issued without bond.

(5) Any person adversely affected by acts of the commissioner or regulations promulgated pursuant to this article may have recourse through the procedures of the "State Administrative Procedure Act", article 4 of title 24, C.R.S. 1973.

(6) Any person who uses any information acquired under the authority of this article concerning any methods, records, formulations, or processes which are entitled to protection as trade secrets to his own advantage, or reveals such information to any person other than the commissioner, other state officials, or the courts when relevant in any judicial proceeding is guilty of a misdemeanor and, upon conviction thereof, shall be punished by a fine of not less than one hundred dollars or by imprisonment in the county jail for not less than thirty days, or by both such fine and imprisonment; except that this prohibition shall not be deemed to prohibit the commissioner from exchanging information of a regulatory nature with duly appointed officials of the United States government or of other states, if such officials are prohibited by law from revealing the information.

35-60-113. Cooperation with other entities. The commissioner may cooperate with and enter into agreements with governmental agencies of this state, other states, agencies of the federal government, and private associations in order to

carry out the purpose and provisions of this article.

35-60-114. Publications. The commissioner shall publish at least annually, in such form as he may deem proper and in accordance with fiscal rules promulgated by the controller pursuant to the provisions of section 24-30-208, C.R.S. 1973, information concerning the sales of commercial feeds, together with such data on their production and use as he may consider advisable, and a report of the results of the analyses of official samples of commercial feeds sold within the state as compared with the analyses guaranteed in the registration and on the label; but the information concerning production and use of commercial feeds shall not disclose the operations of any person.

SECTION 2. Effective date. This act shall take effect July 1, 1979.

SECTION 3. Safety clause. The general assembly hereby finds, determines, and declares that this act is necessary for the immediate preservation of the public peace, health, and safety.

Robert F. Burford
SPEAKER OF THE HOUSE
OF REPRESENTATIVES

Fred E. Anderson
PRESIDENT OF
THE SENATE

Lorraine F. Lombardi
CHIEF CLERK OF THE HOUSE
OF REPRESENTATIVES

Marjorie L. Rutenbeck
SECRETARY OF
THE SENATE

APPROVED June 7, 1979 10⁰⁸ AM

Richard D. Lamm
GOVERNOR OF THE STATE OF COLORADO

RECEIVED

APR 16 1980

CHAM HILL
SOISECOMMERCIAL ANIMAL
FEEDS

633.005 [1961 c.314 §1; repealed by 1967 c.591 §1
(633.005 enacted in lieu of 633.005)]

633.006 Definitions for ORS 633.006 to 633.089. As used in ORS 633.006 to 633.089 and 633.992, unless the context requires otherwise:

(1) "Animal feed manufacturing plant" means:

(a) Any business, establishment, building, plant or place where commercial feed for animals is manufactured, mixed, processed or packed.

(b) Vehicles used in transporting commercial feed or components or ingredients thereof, machinery, equipment, utensils, implements, or other items, articles or materials used in the business or operation.

(c) The ground upon which the operation or business is carried out and other ground not adjacent thereto which is a part of the business or operation under the same entity or ownership.

(2) "Brand" means any word, name, symbol or device or any combination thereof adopted or used by a person to identify commercial feeds manufactured, compounded, delivered, distributed, sold, offered for or exposed for sale in this state and to distinguish them from commercial feeds manufactured, distributed, offered for sale or sold by others.

(3) "Bulk" is the sale, offering or exposing for sale or delivery of commercial feeds, in:

(a) Open containers, closed or open tote boxes, closed or open tanks, closed or open trailers, all of which may be further described or defined by the department, or

(b) Other types of containers, vehicles or conveyances defined or recognized by the department.

(4) "Commercial feed" means any material which is distributed for use as feed, or as a feed ingredient for mixing in feed for animals, or any feed additive concentrate, feed additive supplement, feed additive premix, or premix, except:

(a) Unmixed seeds, whole or processed, made directly from the entire seed.

(b) Hay, straw, stover, cobs, husks, screenings and hulls, when unground or unmixed with other materials.

(c) Feed for dogs, cats, birds or fish maintained as household pets.

(d) Silage, or materials containing at least 60 percent of water.

(e) Individual chemical compounds when not mixed with other materials. This exemption, however, does not cover or extend to phosphate, urea or ammonium compounds which are recommended for animal feeding purposes.

(5) "Contract feeder" means an independent contractor, or any other person who feeds commercial feed to animals pursuant to an oral or written agreement whereby such commercial feed is supplied, furnished or otherwise provided to such person by any distributor and whereby such person's remuneration is determined all or in part by feed consumption, mortality, profits, or amount or quality of product. It does not include a bona fide employee of a manufacturer or distributor of commercial feed.

(6) "Customer-formula feed," "custom mix" or "custom mixed feed" means any mixture of materials, substances or ingredients described or set forth under the definition of commercial feed, each lot of which is mixed according to the specific instructions of, or prescribed for the specific use of, the final consumer or feeder. For the purpose of this subsection "final consumer" means a person who owns or who contracts for the feeding of animals under the control or ownership of that person.

(7) "Department" means the State Department of Agriculture.

(8) "Distribute" means to offer for sale, sell or barter, commercial feed or customer-formula feed; or to supply, furnish or otherwise provide commercial or customer-formula feed as a contract feeder.

(9) "Distributor" means any person who distributes.

(10) "Drug" or "drugs" means any substance intended or represented for the cure, mitigation, treatment or prevention of disease of animals, or intended to affect the structure of any function of the body of an animal or as prescribed by the department.

(11) "Feed ingredient" means each of the constituent materials making up a commercial feed.

(12) "Ground" means a condition resulting from crushing, rolling, chopping or grinding.

(13) "Label" means a display of written, printed, or graphic matter upon or affixed to the container, or immediate container, in which a commercial feed is distributed, or on

commercial feed or customer-formula feed is distributed.

(14) "Manufacture" means to grind chop, crush, roll, cube, flake, extrude, cook, pelletize, mix or otherwise process feed ingredients.

(15) "Mineral feed" means a substance or mixture of substances designed or intended to supply primarily mineral elements or inorganic nutrients.

(16) "Official sample" means any sample of feed taken by the department and designated as "official" by it.

(17) "Percent" or "percentage" means percentage by weight.

(18) "Sell" or "sale" includes exchange.
[1967 c.591 §2 (enacted in lieu of 633.005); 1973 c.342 §2]
1979 c.116, §1
633.010 [Repealed by 1961 c.314 §12]

633.011 [1967 c.591 §10; repealed by 1971 c.489 §11]

633.015 Registration of commercial feed required; fee. (1) No person shall distribute a nonregistered commercial feed. Every brand, and each formula or formulation thereof, of commercial feeds manufactured, compounded, delivered, distributed, sold, offered or exposed for sale in this state shall be registered with the department. Application for registration shall be submitted on forms furnished by the department, and, if the department so requests, shall be accompanied by the label or a facsimile of the label and other printed matter describing the product. Upon approval by the department, a certificate of registration shall be furnished to the applicant. All registrations expire on December 31 of each year. The application shall include the information required by paragraphs (b), (c), (d) and (e) of subsection (1) of ORS 633.025 and such other information as the department may require.

(2) A distributor shall not be required to register any brand of commercial feed which has been registered under ORS 633.006 to 633.089 and 633.992 by another person.

(3) Changes in the guarantee of either chemical or ingredient composition of a registered commercial feed may be permitted, if there is satisfactory evidence that such changes would not result in a lowering of the feeding value of the product for the purpose for which designed.

(4) The department may refuse registration of any commercial feed when the application is not in compliance with the provisions of ORS 633.006 to 633.089 and 633.992 and may cancel any registration subsequently found not to be in compliance with any provision of ORS 633.006 to 633.089 and 633.992, after the registrant has been given reasonable opportunity to be heard before the department

and to amend his application in order to comply with the requirements of ORS 633.006 to 633.089 and 633.992.

(5) Customer-formula feeds are exempt from registration.

(6) Each application for registration shall be accompanied by a fee to be established by the department not to exceed \$20 for each formula or formulation of commercial feed under each brand.

[1961 c.314 §2; 1967 c.591 §3; 1971 c.489 §1]

633.020 [Repealed by 1961 c.314 §12]

633.025 Labeling requirements. (1) Any commercial feed distributed in this state shall be accompanied by a legible label bearing the following information:

(a) The net weight.

(b) The name or brand under which the commercial feed is sold.

(c) The guaranteed analysis of the commercial feed, listing the minimum percentage of crude protein and crude fat, and the maximum percentage of crude fiber. For mineral feeds the list shall include the following specifications as to minerals present, expressed as herein indicated: Minimum and maximum percentages of calcium (Ca), minimum percentage of phosphorus (P), minimum percentage of iodine (I), and minimum and maximum percentages of salt (NaCl). Other substances or elements, determinable by laboratory methods, may be guaranteed by permission of the department. When other substances or elements are guaranteed, they shall be subject to inspection and analysis in accordance with methods and regulations prescribed by the department. Products sold solely as mineral or vitamin supplements, or both, need not show guarantees for protein, fat or fiber.

(d) The common or usual name of each ingredient used in the manufacture of the commercial feed, except as the department may, by regulation, permit the use of a collective term for a group of ingredients all of which perform the same function or, by regulation, permit the use of a statement of alternative ingredients of comparable feeding value. In lieu of the common or usual name of each ingredient used, or a collective term for a group of ingredients, or a statement of alternative ingredients, a statement may be made that the ingredients used in the manufacture of the commercial feed are in accordance with the registration with the department, and such list of ingredients shall be made avail-

able to the department.

(e) The name and principal business address of the person responsible for distributing the commercial feed.

(2) When a commercial feed is distributed in this state in bags or other containers, the label shall be placed on or affixed to the container; when a commercial feed is distributed in bulk the label shall accompany delivery and be furnished to the purchaser at time of delivery. Containers of commercial feed not containing a drug are exempt from the labeling provisions of this section when such containers are filled in the presence of the purchaser from retail bins or other retail bulk display containers if such bins or bulk display containers are labeled with the information otherwise required to be present on individual packages of such feed.

(3) If a commercial feed contains a drug, the department shall require the label to show the purpose, amount present, directions for use, and any necessary warning against misuse of the feed. In registering any commercial feed containing substances referred to in this subsection, the department shall adopt, in so far as practicable, and shall be in conformity with the rules, regulations and restrictions established by the Federal Government relating to such substances.

[1961 c.314 §3; 1967 c.591 §3a; 1971 c.489 §2]

1979 c. 116 § 2

633.027 Custom mixed feed labeling requirements. (1) A custom mixed feed shall be labeled by invoice. In addition to other information deemed necessary by the department, the invoice shall show:

(a) Name and address of the mixer.

(b) Name and address of the purchaser.

(c) Date of sale.

(d) The product name and brand name, if any, and the number of pounds or other recognized units of measurement of each registered commercial feed used in the mixing or mixture and the name and number of pounds of each other feed ingredient added.

(2) If a custom mixed feed contains a nonnutritive substance which is intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease or which is intended to affect the structure of any function of the animal body, the department may require the label and the invoice to show:

(a) The amount of the substance present.

(b) The directions for use and warnings against misuse of the feed.

(3) The invoice or information prescribed in this section shall be furnished by the seller to the user or purchaser at the time the custom mixed feed is delivered. The records of the seller from which the invoice and information is derived shall be maintained by the seller for a period of at least two years. Such

the purchaser, may be inspected by the department during business hours.

[1967 c.591 §9]

633.029 Registration required for animal feed manufacturers and sellers; exemption for persons not using drugs in feeds. (1)(a) No person shall operate an animal feed manufacturing plant, distribute commercial feeds other than at retail, be furnished a certificate of registration of a brand in this state, distribute a custom-formula feed manufactured for that person, or repackage or relabel a commercial feed manufactured by another person without having first obtained a license from the department. Application for license shall be on forms prescribed by the department and shall be accompanied by a license fee to be established by the department not to exceed \$500. All licenses shall expire December 31 of each year.

(b) In accordance with the provisions of ORS 183.310 to 183.500, the department may promulgate rules designating different license fees for various categories of persons described in paragraph (a) of this subsection, so as to recognize differences in types of activities or volumes of business.

(2)(a) A person who is a contract feeder is not subject to the provisions of subsection (1) of this section, provided no drugs in any form are utilized in the manufacturing, mixing or processing of such feed. In the event drugs are so utilized, the contract feeder or person using the same shall be subject to the provisions of subsection (1) of this section

(b) In accordance with the applicable provisions of ORS 183.310 to 183.500, the department shall promulgate rules designating the types or categories of persons described in paragraph (a) of this subsection to whom this section applies. In promulgating such rules, the department shall consider:

(A) The methods of manufacture, mixing or processing of feed used;

(B) The quantities and kinds of drugs used; and

(C) The number, ages and kinds of animals to which such feed is to be made available.

[1971 c.489 §7; 1973 c.342 §3] 1979 c. 166 § 3

633.037 Records required of licensees; records inspection by department. A person or contract feeder who manufactures, mixes or processes feeds in which drugs have been used so that he is not exempt from the provisions of ORS 633.029, shall maintain an accurate record for at least one year from the date the drugs were so used showing the name

or identity of each drug so used and its level of usage. The department is authorized to inspect the records of such persons to insure compliance with ORS 633.029 and this section.

(1967 c.591 §6a, 1973 c.242 §11)

633.040 [Repealed by 1961 c.314 §12]

633.045 Adulterated commercial feeds prohibited. No person shall distribute an adulterated commercial feed. A commercial feed shall be deemed to be adulterated:

(1) If any poisonous, deleterious or nonnutritive ingredient is therein present in sufficient amount to render it injurious to health when fed in accordance with directions for use shown on the label.

(2) If any valuable constituent has been in whole or in part omitted or abstracted therefrom or any less valuable substance substituted therefor.

(3) If its composition or quality falls below or differs from that which by its labeling it is purported or represented to possess.

(4) If it contains added hulls, screenings, refuse screenings, straw, cobs or other high fiber material, unless the name of each material is stated on the label.

(5) If it contains pesticide residues or other chemicals in excess of amounts which, by regulation, the department declares safe for feeding purposes. In adopting such regulations the department may take into consideration the commonly permitted amounts of chemicals authorized by:

(a) The United States and other states.

(b) Other recognized agencies or organizations experienced in the chemical field.

(6) If it contains a drug other than those permitted by regulations promulgated by the department. In promulgating such regulations the department shall consider the current good manufacturing practice regulations for medicated feed premixes and for medicated feeds established under authority of the Federal Food, Drug and Cosmetic Act.

(1961 c.314 §5; 1971 c.489 §3)

633.050 [Repealed by 1961 c.314 §12]

633.055 Misbranding commercial feed prohibited. No person shall distribute misbranded commercial feed. A commercial feed shall be deemed to be misbranded:

(1) If its labeling is false or misleading in any particular

(2) If it is distributed under the name of another feed.

(3) If it is not labeled as required by ORS 633.025 and by regulations adopted pursuant to ORS 633.006 to 633.089 and 633.992.

(4) If it purports to be or is represented as a feed ingredient or as containing a feed ingredient, unless such feed ingredient conforms to the definition of identity, if any, prescribed by regulation of the department. In adopting such regulations the department may take into consideration the commonly accepted definitions approved or authorized by:

(a) The United States and other states.

(b) Other recognized agencies or organizations experienced in such matters, such as the Association of American Feed Control Officials.

(5) If any word, statement, or other information required by ORS 633.006 to 633.089 and 633.992 or by regulation of the department to appear on the label is not prominently placed thereon with such conspicuousness, as compared with other words, statements, designs, or devices in the labeling, and in such terms as to render it likely to be read and understood by the ordinary individual under customary conditions of purchase and use.

(1961 c.314 §6)

633.060 [Amended by 1961 c.425 §17; repealed by 1961 c.314 §12]

633.065 Department to test commercial feeds. (1) It shall be the duty of the department to sample, inspect, make analyses of, and test commercial feeds distributed within this state, at such times and places and to such an extent as may be necessary to determine whether or not such feeds are in compliance with the provisions of ORS 633.006 to 633.089 and 633.992. The department is authorized to enter upon any public or private premises, including any vehicle of transport, during regular business hours, in order to have access to commercial feeds and to records relating to their distribution.

(2) The methods of sampling and analysis shall be those adopted by the department. In adopting such methods, the department may take into consideration:

(a) The methods scientifically developed and described in recognized official publications such as the Journal of the Association of Official Agricultural Chemists.

(b) The methods approved by the United States, other states, and other recognized

agencies or organizations experienced in such matters.

(3) In determining for administrative purposes whether or not a commercial feed is deficient in any component, the department shall be guided solely by the official sample as defined in subsection(15) of ORS 633.006 and obtained and analyzed as provided by subsection (2) of this section.

(4) When inspection and analysis of an official sample indicate that a commercial feed has been adulterated or misbranded, the results of analysis shall be forwarded by the department to the registrant. Upon request, within 30 days, the department shall furnish to the registrant a portion of the sample analyzed.

(5) Investigational samples which may be examined otherwise than by the official method required by this section may be taken by the department. For administrative purposes, only samples taken as directed by subsection (3) of this section may be used. [1961 c.314 §7; 1967 c.591 §4]

633.067 Rulemaking authority for commercial feed law administration and enforcement. The department may promulgate such rules and regulations for commercial feeds as are necessary for the administration and enforcement of ORS 633.006 to 633.089 and 633.992, including but not limited to additional definitions, licensing requirements, registration and license fee requirements, labeling requirements, inspection and enforcement procedures, testing and analysis procedures, and enforcement of federal commercial feed programs under agreement with federal agencies. [1971 c.489 §6]

633.070 [Repealed by 1961 c.314 §12]

633.075 [1961 c.314 §§8, 9; part renumbered 633.081; subsection (2) enacted as part of 1967 c.591 §13; repealed by 1971 c.489 §11]

633.077 Testing and analysis of bulk commercial feed and custom mixed feed; disclosure of test or analysis results. (1) The department shall establish and maintain a procedure, plan and system whereby a farmer, contract feeder or other person actually feeding bulk commercial feed or custom mixed feed to animals may request the department to sample and provide special official testing and analysis of such feeds. It is the purpose and intent of this section that the department desires to make its personnel, facilities and laboratories available to such persons and to determine if such feeds are in

compliance with the provisions of ORS 633.006 to 633.089 and 633.992 or for any other purpose which the department may determine is reasonable and necessary.

(2) The department may provide for the obtaining, handling and testing of samples of bulk commercial feed and custom mixed feed as provided in subsection (1) of this section, including split sampling thereof with portions of each sample being made available to the seller and to the contract feeder or person feeding the feed to animals. Copies of the final results of the tests or analysis, which shall not be a public record, shall be made available only to the seller and to the contract feeder or person feeding the feed to animals. [1967 c.591 §8]

633.080 [Repealed by 1961 c.314 §12]

633.081 [Formerly part of 633.075; repealed by 1969 c.131 §5]

633.083 Cooperation with governmental units. The department may cooperate with and enter into contracts and agreements with governmental agencies of this state, other states, the Federal Government, county governments of this state or municipalities in this state, in connection with the administration of ORS 633.006 to 633.089 and 633.992 and of the provisions of federal laws or regulations relating to the operation of animal feed manufacturing plants in Oregon. [1971 c.489 §8]

633.085 [1963 c.212 §2; repealed by 1967 c.591 §12]

633.087 [1967 c.591 §11; repealed by 1971 c.489 §11]

633.088 Withdrawal from distribution of feeds sold or distributed in violation of law; seizure of noncomplying feeds. (1) When the department has reasonable cause to believe any quantity or lot of commercial feed is being sold or distributed in violation of ORS 633.006 to 633.089 and 633.992 or regulations promulgated thereunder, it may, in accordance with ORS 561.605 and 561.620, issue and enforce a written "withdrawal from distribution" order, directing the distributor thereof not to dispose of the quantity or lot of commercial feed in any manner until written permission is first given by the department. The department shall release the quantity or lot of commercial feed so withdrawn when said law and regulations have been complied with.

(2) Any quantity or lot of commercial feed found by the department not to be in compliance with ORS 633.006 to 633.089 and 633.992 or regulations promulgated thereun-

der, may be seized by the department in accordance with the provisions of ORS 561.605 to 561.620.

[1971 c.489 §9]

633.089 Disposition of moneys received by department. The department shall deposit all fees and moneys paid to it under the provisions of ORS 633.006 to 633.089 and 633.992 in the General Fund in the State Treasury to the credit of the Department of Agriculture Account. Such account, and all other moneys collected by the department under ORS 633.005 to 633.085 (1965 Replacement Part) prior to the effective date of this 1967 Act, are continuously appropriated to the department for the purpose of administering and enforcing ORS 633.006 to 633.089 and 633.992.

[1967 c.591 §7]

633.090 [Repealed by 1961 c.314 §12]

633.100 [Repealed by 1961 c.314 §12]

633.110 [Repealed by 1961 c.314 §12]

633.120 [Repealed by 1961 c.314 §12]

633.130 [Repealed by 1961 c.314 §12]

633.140 [Repealed by 1961 c.314 §12]

633.210 [Repealed by 1961 c.314 §12]

633.220 [Repealed by 1961 c.314 §12]

633.230 [Repealed by 1961 c.314 §12]

633.240 [Repealed by 1961 c.314 §12]

633.250 [Repealed by 1961 c.314 §12]

633.260 [Repealed by 1961 c.314 §12]

AMENDMENTS TO OAR 603-58-065License Fees for Feed Manufacturers, Wholesale Distributors, Feed Registrants and Certain Feeders.

603-58-065. The license fees for any person operating a feed manufacturing plant (per location), or acting as a wholesale distributor of feeds, or registering feeds for distribution in Oregon, or acting as a contract feeder wherein drugs in any form are utilized in the manufacturing of such feed, shall be in accordance with the following:

- (1) A license fee of \$50 for:
 - (a) Feed Registrants who do not maintain feed manufacturing plants in Oregon; or
 - (b) Wholesale Distributors who are neither Feed Manufacturers or Feed Registrants.
- (2) A license fee of \$100 for:
 - (a) Feed Manufacturers, whether Contract Feeders or otherwise, whose annual production of commercial feed at one location is less than 10,000 tons;
 - (b) Feed Registrants who maintain feed manufacturing plants in Oregon whereat the annual production of commercial feed is less than 10,000 tons; or
 - (c) Contract Feeders who are not also Feed Manufacturers.
- (3) A license fee of \$200 for:
 - (a) Feed Manufacturers, whether Contract Feeders or otherwise, whose annual production of commercial feed at one location is at least 10,000 tons but less than 25,000 tons; or
 - (b) Feed Registrants who maintain feed manufacturing plants in Oregon whereat the annual production of commercial feed is at least 10,000 tons but less than 25,000 tons.
- (4) A license fee of \$300 for:
 - (a) Feed Manufacturers, whether Contract Feeders or otherwise, whose annual production of commercial feed at one location is 25,000 tons or more; or
 - (b) Feed Registrants who maintain feed manufacturing plants in Oregon whereat the annual production of commercial feed is 25,000 tons or more.

CERTIFICATE AND ORDER
for
FILING ADMINISTRATIVE RULES WITH THE SECRETARY OF STATE

I HEREBY CERTIFY that the attached copy is a true, full and correct copy of rule(s) adopted by the _____
State Department of Agriculture _____ on October 17, 1979
(Agency) (Date)
to become effective _____ upon filing _____
(Date)

The within matter having come before the _____ State Department of Agriculture as AD 14-79 _____ after
(Agency)
all procedures having been in the required form and conducted in accordance with applicable statutes and rules and being fully
advised in the premises:

NOW THEREFORE, IT IS HEREBY ORDERED THAT the following rule(s) be:
(List Rule Number(s) or Rule Title on Appropriate Lines Below)

Adopted:
(New Rules)

Temp.

☐

Amended:
(Existing Rules)

OAD 603-58-065 in accordance with Exhibit "A" attached hereto.

Suspended:
(Temporary Only)

Repealed:
(Existing Rules)

Administrative Rules of the State Department of Agriculture

DATED this 17th day of October _____, 19 79
(Agency)

By: Leonard Kungman
(Authorized Signer)

Title: Director

Statutory Authority: ORS 561.190 and 633.029, as amended by section 3 of chapter 116, Oregon Laws 1979.

Subject Matter: To provide different license fees for various categories of animal feed
manufacturers or distributors, recognizing the various types and volumes
of business activities.

Statement of Need Attached: Yes ☐ No ☒

DIVISION 58

FEEDS

Definitions

603-58-001 In addition to the definitions set forth in ORS 633.006, the following shall apply to ORS 633.015 to 633.089 and OAR 603-58-005 to 603-58-070:

(1) "Feed Additive Concentrate" means a substance which is:

(a) intended to be further diluted and mixed in order to produce a complete feed or a feed additive supplement;

(b) not suitable for using as a supplement or for direct feeding without dilution; and

(c) contains amounts of one or more feed additives, in a suitable feed base, so that from 100 to 1000 pounds of concentrate must be diluted in order to produce one ton of complete feed.

NOTE: It is unsafe if fed directly and undiluted or if used as a supplement, either because of the danger to the health of the animal or because of the production of residues in excess of established safe levels in the edible products from such animals.

(2) "Feed Additive Supplement" means a substance which contains one or more feed additives and which is intended to be:

(a) further diluted and mixed in order to produce a complete feed; or

(b) fed undiluted as a supplement to other feeds; or

(c) fed directly and undiluted with other parts of the rations separately available.

NOTE: It is safe for the animal and will not produce dangerous levels of residues in the edible products from such animals if fed according to directions.

(3) "Feed Additive Premix" means a substance which:

(a) is intended to be further diluted in order to produce a feed additive concentrate, a feed additive supplement, or a complete feed; and

(b) contains one or more feed additives in high concentration and in a suitable feed base, so that up to 100 pounds must be diluted to produce one ton of complete feed.

NOTE: It contains additives at levels for which safety to the animal has not been demonstrated, and if fed undiluted may result in residues in excess of established safe levels in the edible products from such animals.

(4) "Medicated Feed" means a commercial feed in combination with a drug, as defined in subsection (10) of ORS 633.006.

(5) "Liquid Feed" means a commercial feed of fluid or liquid consistency containing one or more feed ingredients, as defined in subsection (11) of ORS 633.006 and subsection (6) of this section.

(6) "Feed Ingredient" means any material as defined in subsection (11) of ORS 633.006 that provides nutritional benefits to the target species, but does not include anti-caking agents, color additives, condiments, grinding agents, pelleting agents, pigmentors, or stabilizing agents.

(7) "Vitamin Feed" means a commercial feed designed or intended to supply primarily vitamins, vitamin derivatives, or vitamin precursors.

Statutory Authority:

Hist: Filed and Eff. 2-3-76 as
AD 1080(4-76)

Form of Labeling

603-58-002 The information required by subsection (1) of ORS 633.025 and OAR 603-58-005 to 603-58-031 shall appear in its entirety on one side of a label or container. Such information shall be legible and not subordinated to other statements, nor obscured by designs, color, insufficient background contrast, or crowding with other graphic matter.

Statutory Authority:

Hist: Filed and Eff. 2-3-76 as
AD 1080(4-76)

Labeling as to Brands and Product Names

603-58-005 (1) Unless the department specifically designates otherwise, the product names and standards for commercial feeds shall be those adopted by the American Feed Control Officials as set forth in their publication entitled "Official Publication" dated 1974.

(2) The brand or product name shall not be misleading. If the brand or product name indicates the feed is for a specific use or purpose, the character of the feed shall conform therewith (i.e., a mixture labeled "dairy feed" shall be suitable for feeding dairy animals).

(3) The brand or product name of a non-medicated feed shall not be derived from one or more ingredients of a mixture to the exclusion of other ingredients, nor shall be one representing any component of a mixture unless all components are included in the name.

(4) The word "vitamin", or contraction thereof, or any word suggesting vitamin content, shall only be used in the brand or product name of a feed which is represented to be a vitamin supplement, and which is labeled with the guarantee prescribed in subsection (3) of OAR 603-58-010.

(5) The name of any drug or drug additive, or contraction thereof, or any word suggesting a drug or drug additive content shall only be used in the brand or product name of a feed which is represented to be a drug or drug additive supplement, and which is labeled with the guarantee prescribed in subsection (2) of OAR 603-58-010.

(6) The term "dehydrated" may precede the product name if such product has been artificially dried.

[Publications: The publication(s) referred to or incorporated by reference in this rule is available in the office of the Department of Agriculture or Secretary of State.]

Statutory Authority:

Hist: Filed 12-5-62 as AD 715,
Eff. 1-1-63
Renumbered from 603-26-051
Amended by AD 1080(4-76),
Filed and Eff. 2-3-76

Labeling as to Guarantees

603-58-010 (1) The sliding-scale method of expressing guarantees (i.e., protein 15-18%) is prohibited, unless specifically provided for by applicable law or rule.

(2) Drugs in commercial feeds shall be quantitatively guaranteed in terms of percentage by weight. Antibiotics in commercial feed shall be quantitatively guaranteed in terms of grams per pound for all

products which are to be diluted before feeding, and in terms of grams per ton in all products which are to be fed without further dilution or mixing. If the dosage is given in terms of milligrams per day in the feeding directions, the antibiotics may be guaranteed in terms of milligrams per pound.

(3)(a) Vitamins, when guaranteed in commercial feeds, shall be quantitatively guaranteed in terms of milligrams per pound of feed, except that vitamin A other than precursors of vitamin A, vitamin D, and vitamin E shall be in terms of International or USP units per pound, and vitamin D in products offered for poultry feeding shall be in terms of International chick units.

(b) Such guarantees of vitamin content shall be in terms of true vitamins rather than compounds with the exception of the compounds, Pyridoxine Hydrochloride, Choline Chloride, Thiamine, and d-Pantothenic Acid.

(c) Such guarantees, if on oils and premixes containing vitamin A or vitamin D or both, may be in terms of units per gram.

(4) Minerals in commercial feeds when guaranteed, except salt (NaCl), shall be quantitatively guaranteed in terms of percentage of the element. Salt shall be guaranteed as NaCl.

(5) In addition to the requirements set forth in ORS 633.025, liquid feeds shall be quantitatively guaranteed for:

(a) minimum percent of total sugars expressed as invert sugar;

(b) maximum percent of ash; and

(c) maximum percent moisture.

Statutory Authority:

Hist: Filed 12-5-62 as AD 715,
Eff. 1-1-63
Renumbered from 603-26-055
Amended by AD 1080(4-76),
Filed and Eff. 2-3-76

603-58-015 [Filed 3-18-68 as
AD 870(3-68), Eff. 4-1-68
Renumbered from 603-26-061
Repealed by AD 1080(4-76),
Filed and Eff. 2-3-76]

Labeling as to Ingredients

603-58-020 (1) Each individual ingredient

shall be specifically named by its common or usual name, without reference to the quality or grade thereof.

(2) In lieu of individual ingredient statement prescribed in subsection (1) of this section, the following collective terms for the specified groups of ingredients may be used:

(a) "Animal Protein Products" which includes one or more of the following:

- (A) Animal products;
- (B) Marine products;
- (C) Milk products;

(b) "Forage Products" which includes one or more of the following:

- (A) Alfalfa meals;
- (B) Entire plant meals;
- (C) Hays;
- (D) Stem meals;

(c) "Grain Products" which includes one or more of the following:

- (A) Barley;
- (B) Grain sorghums;
- (C) Maize (corn);
- (D) Oats;
- (E) Rice;
- (F) Rye;
- (G) Wheat.

(d) "Plant Protein Products" which includes one or more of the following:

- (A) Algae meals;
- (B) Coconut meals (copra);
- (C) Cottonseed meals;
- (D) Guar meal;
- (E) Linseed meals;
- (F) Peanut meals;
- (G) Safflower meals;
- (H) Soybean meals;
- (I) Sunflower meals;
- (J) Yeasts.

(e) "Processed Grain By-Products" which includes one or more of the following:

- (A) Brans;
- (B) Brewers dried grains;
- (C) Distillers grains;
- (D) Distillers solubles;
- (E) Flours;
- (F) Germ meals;
- (G) Gluten feeds;
- (H) Grits;
- (I) Groats;
- (J) Hominy feeds;
- (K) Malt sprouts;
- (L) Middlings;
- (M) Pearled;

(N) Polishings;

(O) Shorts;

(P) Wheat mill run.

(f) "Roughage Products" which includes one or more of the following:

- (A) Cobs;
- (B) Hulls;
- (C) Husks;
- (D) Pulp;
- (E) Straws.

(3) In lieu of the ingredient statements prescribed in subsections (1) and (2) of this section, a statement may be made that the ingredients used in the manufacture are in accordance with the registration with the department, but only if such registration shows the following groups:

(a) Corn, hominy feed, wheat, barley, and grain sorghums;

(b) Cottonseed meal, soybean meal, peanut meal, linseed meal, and corn gluten meal;

(c) Fish meal, meat and bone meal, tankage, and poultry by-product meal;

(d) Beet molasses, corn sugar molasses, citrus molasses, and cane molasses;

(e) Wheat bran, wheat mill run, and wheat middlings;

(f) Wheat shorts, wheat red dog, corn germ meal, corn gluten feed, and grain sorghum gluten feed.

(4) The names of all ingredients shall be shown in letters or type of the same size.

Statutory Authority:

Hist: Filed 3-18-68 as AD 870(3-68),

Eff. 4-1-68

Renumbered from 603-26-065

Amended by AD 1080(4-76),

Filed and Eff. 2-3-76

Labeling as to Drugs

603-58-021 The labeling requirements of livestock and poultry feeds containing drugs, chemical antibiotics, or hormone additives shall be those adopted and published by the Federal Food and Drug Administration in Title 21, Code of Federal Regulations, effective as of the date of this order.

[Publications: The publication(s) referred to or incorporated by reference in this rule is available in the office of the Department of Agriculture or Secretary of State.]

Statutory Authority:

Hist: Filed and Eff. 2-3-76 as
AD 1080(4-76)

Labeling as to Nonprotein Nitrogen

603-58-022 (1) Urea and ammonium salts of carbonic and phosphoric acids shall only be used in mixed feeds for cattle, sheep, and goats. In mixed feeds for other purposes, such compounds shall be considered adulterants and the feed as adulterated under ORS 633.045.

(2) The statement of the maximum percentage of equivalent protein from nonprotein nitrogen shall appear immediately below the statement of crude protein in the chemical guarantee, and the name of the substance supplying the nonprotein nitrogen shall be stated in the ingredient statement.

(3) If the feed contains more than 3 percent of urea (8.75% equivalent crude protein) or ammonium salts, or if the equivalent protein contributed by urea or ammonium salts exceeds one-third of the total crude protein, the label shall also include:

- (a) A statement of proper usage; and
- (b) The following statement in type of such conspicuousness as to render it likely to be read and understood by ordinary individuals under customary conditions of purchase and use:

"CAUTION: USE AS DIRECTED"

Statutory Authority:

Hist: Filed and Eff. 2-3-76 as
AD 1080(4-76)

603-58-025 [Filed 12-5-62 as
AD 715, Eff. 1-1-63
Amended 12-17-69 by
AD 911(17-69), Eff. 1-1-70
Renumbered from 603-26-071
Repealed by AD 1080(4-76),
Filed and Eff. 2-3-76]

Labeling of Custom-Formulated Feed

603-58-028 In addition to the labeling requirements set forth in ORS 633.027, each container of custom-formulated feed shall

have a label identifying the customer by either name or order number (i.e., "C.M. Jones" or "CM 1234"). Where the delivery is by bulk, such label shall be attached to each delivery ticket.

Statutory Authority:

Hist: Filed and Eff. 2-3-76 as
AD 1080(4-76)

Labeling of Medicated Custom-Formulated Feed

603-58-029 In addition to the labeling requirements set forth in ORS 633.027 and OAR 603-58-028, each container of medicated custom-formulated feed shall have a label identifying the purpose of the drug ingredient, the name of each active drug ingredient, and the amount of each drug ingredient. Any special feeding directions or withdrawal or caution statements shall also be included in the label.

Statutory Authority:

Hist: Filed and Eff. 2-3-76 as
AD 1080(4-76)

Labeling of Mineral Feeds

603-58-030 (1) Mineral phosphatic materials for feeding purposes shall be labeled with a guarantee of the minimum percentages of calcium and phosphorus, and the maximum percentage of fluorine.

(a) The maximum percentage of fluorine in any mineral or mineral mixture for the direct feeding of domestic animals shall be 0.30 percent for cattle, 0.35 percent for sheep, 0.45 percent for swine, and 0.60 percent for poultry.

(b) Soft rock phosphate with colloidal clay, rock phosphates, or other fluorine-bearing ingredients may be used only in such amounts that it will not raise the fluorine concentration of the total (grain) ration above the following amounts: 0.009 percent for cattle, 0.01 percent for sheep, 0.014 percent for swine, and 0.035 percent for poultry.

(2) Mineral feeds, and mixed feeds containing 8 percent or more added mineral ingredients, shall be labeled with a guarantee of the minimum and maximum percentages of calcium (Ca) and salt (NaCl) and the

minimum percentages of phosphorus (P), and iodine (I). The specific compound shall be stated in terms of the form used. The minimum and maximum guarantees for calcium and salt shall conform to the following:

(a) If the minimum percentage is 5 percent or less, then the maximum percentage shall not exceed the minimum percentage by more than 1 unit (i.e., if minimum 3 percent, then maximum 4 percent).

(b) If the minimum percentage is above 5 percent, then the maximum percentage shall not exceed the minimum percentage by more than 20 percent of such minimum (i.e., if minimum 10 percent, then maximum 12 percent).

Statutory Authority:

Hist: Filed 12-5-62 as AD 715,
Eff. 1-1-63
Renumbered from 603-26-076
Amended by AD 1080(4-76),
Filed and Eff. 2-3-76

Labeling of Processed Animal Waste

603-58-031 Animal waste products sold, held for sale, or offered for sale shall be identified in accordance with the definitions, and shall conform with the requirements of this section. Such products which are utilized for feeding on the premises where produced, by the person whose animals produced the same, shall conform generally to the provisions of this section.

(1) "Processed animal waste" is a processed product composed of total excreta, with or without litter, from poultry or ruminant animals. It shall not contain levels of drug residue, pesticide residue, or other toxic or deleterious substances that could be harmful to animals or result in harmful or unlawful residue levels in their tissue or by-products. The final moisture of the product shall not exceed 12 percent, except as provided in subsection (2) of this section. It shall not be used in feed for lactating dairy animals. If used in a mixed feed, the maximum percentage of processed animal waste shall be stated on the label of such mixed feed. It shall not be fed to animals within 15 days of slaughter. Processed animal waste includes the following:

(a) "Dried Poultry Waste" is processed undiluted poultry excreta collected from cage layer flocks. The product shall be uniform and contain not less than 25 percent crude protein, not more than 15 percent crude fiber, and not more than 30 percent ash. It shall be labeled to show minimum protein, maximum equivalent crude protein from nonprotein nitrogen, minimum fat, maximum fiber, maximum ash, maximum and minimum salt (NaCl), maximum and minimum calcium (Ca), and minimum phosphorus (P). The product shall not contain more than 1 percent feathers.

(b) "Dried Poultry Litter" is the processed combination of total poultry excreta and litter that occurs in the floor production of poultry. The product shall be uniform and contain not less than 18 percent protein. The type of litter shall be a part of the product name. It shall be labeled to show minimum protein, maximum equivalent crude protein from nonprotein nitrogen, minimum fat, maximum fiber, maximum ash, maximum and minimum calcium (Ca), minimum phosphorus (P), and maximum and minimum salt (NaCl).

(c) "Dried Ruminant Waste" is processed bovine excreta free of extraneous material such as straws, wood shavings, dirt, and similar materials. The product shall be uniform and contain not less than 12 percent crude protein and not more than 30 percent crude fiber and 20 percent ash. It shall be labeled to show minimum protein, maximum equivalent crude protein from nonprotein nitrogen, minimum fat, maximum fiber, maximum ash, and maximum and minimum salt (NaCl).

(2) Processed Animal Waste in excess of 12 percent moisture including slurries, silages, and other semidry products shall conform to the requirements of subsection (1) of this section except for the moisture limitation stated therein. If sold for feeding purposes, it shall be labeled to show type of process, maximum moisture, minimum protein, maximum equivalent crude protein from nonprotein nitrogen, minimum fat, maximum fiber, maximum ash, and maximum and minimum salt (NaCl).

Statutory Authority:

Hist: Filed and Eff. 2-3-76 as
AD 1080(4-76)

603-58-035 [Filed 3-18-68 as
AD 870(3-68), Eff. 4-1-68
Renumbered from 603-26-080
Repealed by AD 1080(4-76),
Filed and Eff. 2-3-76]

Methods of Sampling and Analysis

603-58-036 The methods of sampling and analysis shall be those adopted by and included in the "Journal of the Association of Official Analytical Chemists", or any other method approved by the department.

[Publications: The publication(s) referred to or incorporated by reference in this rule is available from the office of the Department of Agriculture or Secretary of State.]

Statutory Authority:

Hist: Filed and Eff. 2-3-76 as
AD 1080(4-76)

Artificial Color

603-58-040 An artificial color may only be used in commercial feeds if it has been recognized by the department as harmless to animals. However, no material shall be used to enhance or mask the natural color of a feed or feed ingredient if inferiority of the feed or feed ingredient would thereby be concealed.

Statutory Authority:

Hist: Filed 12-5-62 as AD 715,
Eff. 1-1-63
Renumbered from 603-26-085
Amended by AD 1080(4-76),
Filed and Eff. 2-3-76

603-58-045 [Filed 12-5-62 as AD 715,
Eff. 1-1-63
Renumbered from 603-26-090
Repealed by AD 1080(4-76),
Filed and Eff. 2-3-76]

Requirements for Registration of Contract Feeders, Integrated Feeder-Processors, or Feeders

603-58-046 (1) The provisions of ORS 633.015 and 633.029 shall apply to any person

who is a contract feeder or who mixes or processes medicated feed for his own animals, if the animals fed or intended to be fed are maintained for their production of milk, meat, or eggs for human consumption, if such person either:

(a) Uses a medicated feed additive premix as defined in subsection (3) of OAR 603-58-001 containing one of the following drugs either singularly or in combination:

Aklomide (greater than 0.1%)
Amprolium (greater than 0.05%)
Bambermycins
Fuquinolate
Carbadox (greater than 500 g/t)
Carbarsone (greater than 0.225%)
Clomidol
Coumaphos
Decoquate
DES
Dichlorvos (greater than 0.768%)
Dimethridazole (greater than 0.1%)
Erythromycin
Griseofulvin
Hygromycin B (greater than 32 g/t, poultry only)
Iprnidazole (greater than 0.0625%)
Levamisole HCL
MGA
Monensin sodium
Nequinat
Nihydrazone
Nitromide + Sulfantran
Oleandomycin
Poloxalene
Pryantel tartrate (greater than 800 g/t)
Robenidine HCL
Ronnel
Sulfadimethoxine + Ormetoprim
Thiabendazole
Tylosin (greater than 200 g/t poultry, greater than 500 g/t swine)
Tylosin + Sulfamethazine (each greater than 500 g/t)
Zoalene (greater than 0.0375%); or

(b) Uses a medicated feed additive premix containing drugs other than those listed in paragraph (a) of this section, and maintains and feeds animals in volumes greater than one or more of the following:

(A) Beef cattle: annual average of 200 head or more per year;

(B) Dairy cattle: annual average herd size of 200 head or more;

(C) Sheep: annual average of 200 head or more per year;

(D) Swine: annual average of 150 head or more per year;

(E) Chickens:

(i) Broilers: annual average of 40,000 birds or more per brood;

(ii) Layers: annual average of 10,000 birds or more per brood;

(F) Turkeys: annual average of 13,000 birds or more per brood;

(G) Fish: annual average of 750,000 lbs. or more of live weight per year.

(2) Any person meeting the criteria of paragraph (b) of subsection (1) of this section is exempted if the medicated feed additive premix used is "top-dressed" on a complete feed in a feeding receptacle, is not mixed or co-mingled prior to placement in such feeding receptacle, and is consistently not administered by such person within 14 days of slaughter of meat animals, milking or collection of eggs for human consumption.

(3) Every person subject to the provisions of ORS 633.015 and 633.029 under this section shall maintain records as required in ORS 633.037 and in addition shall maintain records as to:

(a) numbers of animals maintained and fed; and

(b) disposition of animals or products for human consumption therefrom.

(4) The fees payable by such persons shall be the same as established by OAR 603-58-065 and 603-58-070 and shall be assessed on each mixing or manufacturing location.

Statutory Authority:

Hist: Filed and Eff. 2-3-76 as
AD 1080(4-76)

603-58-050 [Filed 12-5-62 as AD 716,
Eff. 1-1-63
Amended by AD 813(1-66),
Filed and Eff. 1-13-66
Renumbered from 603-26-110
Repealed by AD 107(17-75),
Filed and Eff. 11-20-75]

Proof of Labeling Claims or Guarantees

603-58-051 (1) For the purpose of ORS

633.055, the department may investigate and require the submission of evidence to support any labeling claim or guarantee that is made, in accordance with ORS 633.025 or 633.027, in any label, invoice, or accompanying pamphlets or brochures intended to inform a purchaser of the product's use, value, quality, analysis, type, or composition.

(2) In its investigation and evaluation of evidence, the department may rely on experimental data, manufacturers' evaluations, and advice or data from agricultural experiment stations or other authoritative sources.

Statutory Authority:

Hist: Filed and Eff. 2-3-76 as
AD 1080(4-76)

Inspection Fees

603-58-055 [Filed 12-22-59 as AD 629
Amended by AD 813(1-66),
Filed and Eff. 1-13-66
Renumbered from 603-26-115
Repealed by AD 1071(17-75),
Filed and Eff. 11-20-75]

603-58-060 [Filed 3-18-68 as
AD 870(3-68), Eff. 4-1-68
Renumbered from 603-26-120
Repealed by AD 1080(4-76),
Filed and Eff. 2-3-76]

License Fee for Feed Manufacturers, Wholesale Distributors, Commercial Feed Registrants, and Feeders

603-58-065 The license fee for persons operating a feed manufacturing plant, or acting as a wholesale distributor of feeds, or registering feeds for distribution in Oregon, or acting as contract feeders, or feeders of their own stock and drugs in any form are utilized by them in the manufacturing, mixing, or processing of feed, shall be \$50, which fee is payable at the time an application for license is made to the department.

Statutory Authority:

Hist: Filed 11-26-71 as AD 958(24-71),
Eff. 12-15-71

Amended by AD 945(12-71),
Filed and Eff. 9-1-71
Renumbered from 603-26-530
Repealed by AD 7-1977,
Filed and Eff. 4-5-77]

Feed Registration Fee

603-58-070 The registration fee for each formula or formulation of commercial feed under each brand shall be \$20.00, which fee is payable at the time an application for registration is made to the department.

Statutory Authority:

Hist: Filed 11-26-71 as AD 958(24-71),
Eff. 12-15-71

603-58-515 [Filed and Eff. 1-13-66 as
AD 813(1-66)
Amended 12-20-66 by
AD 828(15-66), Eff. 1-1-67
Renumbered from 603-26-515
Repealed 8-20-74 by
AD 1036(26-74), Eff. 9-11-74]

603-58-500 [Filed and Eff. 7-1-63 as
AD 762
Renumbered from 603-26-507
Repealed 8-20-74 by
AD 1036(26-74), Eff. 9-11-74]

603-58-520 [Renumbered from 603-26-545
Renumbered to 603-57-215 by
AD 1036(26-74)]

603-58-505 [Filed 2-20-63 as AD 719
Amended 6-17-63 by AD 725
Amended 10-4-63 by AD 770,
Eff. 11-1-63
Renumbered from 603-26-516
Repealed 8-20-74 by
AD 1036(26-74), Eff. 9-11-74]

603-58-525 [Filed 7-23-70 as
AD 924(10-70), Eff. 8-25-70
Renumbered from 603-26-550
Repealed 8-20-74 by
AD 1036(26-74),
Eff. 9-11-74]

603-58-510 [Filed and Eff. 12-13-63
as AD 775
Amended by AD 805(12-65),
Filed and Eff. 8-20-65
Amended 6-14-67 by
AD 837(9-67),
Eff. 8-1-67
Amended by AD 885(15-68),
Filed and Eff. 7-18-68

603-58-530 [Filed 7-23-70 as
AD 924(10-70), Eff. 8-25-70
Renumbered from 603-26-555
Repealed 8-20-74 by
AD 1036(26-74), Eff. 9-11-74]

603-58-535 [Filed 7-23-70 as
AD 924(10-70), Eff. 8-25-70
Renumbered from 603-26-560
Repealed 8-20-74 by
AD 1036(26-74), Eff. 9-11-74]

APPENDIX

Mammals, Birds, Amphibians and Reptiles, and Insects
Found in Northern Malheur County.

Mammals

Shrews. Sorex merriami, S. vagrans, and S. preblei. Sorex preblei.

Bats. Six genera are known to occur in the general vicinity: Myotis, Pipistrelles, Eptesicus, Corynorhinus, Antrozous, and Tadarida.

Raccoon. Procyon lotor.

Weasel. Mustelia spp. Two species may be present, M. erminea and M. frenata.

Spotted Skunk. Spilogale putorius.

Striped Skunk. Mephitis mephitis.

Badger. Taxidea taxus.

Red Fox. Vulpes fulva.

Coyote. Canis latrans.

Bobcat. Lynx rufus.

Yellow-bellied marmot. Marmota flaviventris.

Townsend's Ground squirrel. Spermophilus townsendii.

Pocket gopher. Thomomys townsendii.

Kangaroo rat. Dipodomys ordii.

Harvest mouse. Reithrodontomys megalotis.

Deer mouse. Peromyscus maniculatus.

Bushy tailed woodrat. Neotoma cinerea.

Sagebrush vole. Lagurus curtatus.

Microtus vole. Microtus montanus and M. longicaudus.

Porcupine. Erethizon dorsatum.

Cottontailed rabbit. Sylvilagus nuttallii.

Black-tailed jackrabbit. Lepus californicus.

Mule deer. Dama hemionus (Odocoileus hemionus of some).

Pronghorn Antelope. (Antilocarpa americana).

Birds*

Falconiformes

Turkey vulture. Cathartes aura.
Western red-tailed hawk. Buteo jamaicensis.
American Rough-legged hawk. Buteo lagopus.
Ferruginous Rough-legged hawk. Buteo regalis.
Golden eagle. Aquila chrysaetos.
Prairie falcon. Falco mexicanus.
Sparrow hawk. Falco sparverius.
Bald Eagle. Haliaeetus leucocephalus.
Perigrine falcon. Falco peregrinus.

Galliformes

Hungarian partridge. Perdix perdix.
Chukar partridge. Alectoris chukar.
Valley quail. Lophortyx californicus.
Ring-necked pheasant. Phasianus colchicus.

Charadriiformes

California gull. Larus californicus. Other gulls are likely also present in the spring and summer.

Columbiformes

Rock dove. Columba livia.
Western Mourning dove. Zenaidura macroura.

Strigiformes

Great horned owl. Bubo virginianus.
Western burrowing owl. Speotyto cunicularia.

Caprimulgiformes

Pacific Nighthawk. Chordeiles minor.

Piciformes

Red-shafted flicker. Colaptes cafer.

*Scientific nomenclature for birds based upon BIRDS OF THE PACIFIC NORTHWEST, Ira N. Gabrielson and Stanley G. Jewett, republished by Dover, 1970; original publication entitled BIRDS OF OREGON published by Oregon State College, 1940.

Passeriformes

Western kingbird. Tyrannus verticalis.
Western flycatcher. Empidonax difficilis.
Horned lark. Eremophila alpestris.
Bank swallow. Riparia riparia.
Rough winged swallow. Stelgidopteryx ruficollis.
Cliff swallow. Petrochelidon pyrrhonota.
American magpie. Pica pica.
American raven. Coryus corax.
Western crow. Corvus brachyrhynchos.
Sage thrasher. Oreoscoptes montanus.
Western robin. Turdus migratorius.
Varied thrush. Ixoreus naevius.
Ruby-crowned kinglet. Regulus calendula.
Loggerhead Shrike. Lanius ludovicianus.
Starling. Sturnus vulgaris.
English sparrow. Passer domesticus.
Western meadowlark. Sturnella neglecta.
Red winged blackbird. Agelaius phoeniceus.
Brewer's blackbird. Euphagus cyanocephalus.
Nevada cowbird. Molothrus ater.
Common redpoll. Acanthis flammea.
Oregon junco. Junco oreganus.

Amphibians and Reptiles

Ambystomatidae

Eastern long-toed salamander. Ambystoma macrodactylum.

Pelobatidae

Great Basin spadefoot toad. Scaphiopus intermontanus.

Buфонidae

Western toad. Bufo boreas.
Woodhouse's toad. Bufo woodhousei.
Spotted frog. Rana pretiosa.

Iguanidae

Collared lizard. Crotaphytus collaris.
Leopard lizard. Crotaphytus wislizenii.
Sagebrush lizard. Sceloporus graciosus.
Western fence lizard. Sceloporus occidentalis.
Side-blotched lizard. Uta stansburiana.
Desert horned lizard. Phrynosoma platyrhinos.

Scincidae

Western skink. Eumeces skiltonianus.

Teiidae

Western whiptail. Cnemidophorus tigris.

Columbridae

Striped whipsnake. Masticophis taeniatus.

Gopher snake. Pituophis melanoleucus.

Garter snake. Thamnophis sirtalis.

Night snake. Hypsiglena torquata.

Viperidae

Western rattlesnake. Crotalus viridis.

Insects and Anthropods

Spiders.

Wood ticks.

Aphids.

Lice.

Red ants.

Stink beetles.

Grasshoppers.

Deer flies, horse flies, bot flies, house flies, and related species.

Sagebrush webworm. Aroga websteri.

Tent caterpillar.

Moths. (general)

Butterflies.

Lady bugs.

Wheatgrass bugs. Irbisia pacifica, other genera.

Alkali bees. Nomia sp.

Leaf cutter bees. Megachile spp.

Crickets.

Mormon Cricket.

Mosquitos.

Beet Leaf Hopper.

Source: U.S. Department of the Interior, Bureau of Land Management.
Vale Known Geothermal Resource Area (KGRA) EAR. Vale District,
Oregon.

PLATE 1. Topographic map of the area near the Albertson Land and Cattle Company, Nyssa, Malheur County, Oregon, with wells and gradient holes, structure, and proposed geothermal well site.

OREGON
(from Walker, 1977)

Qal	Alluvium; forms floodplains and fills channels of present streams.
Qpl	Playa deposits, clays, silts, sands, and some evaporites.
Qtg	Terrace, pediment, and lag gravels and glaci-fluvial deposits.
Qls	Landslides and debris-flow deposits; unstratified mixtures of basaltic, andesitic, tuffaceous, and sedimentary bedrocks.
Tab	Olivine basalt; thin, gray commonly open-textured (diktytaxitic), subophitic to intergranular olivine basalt flows.
Tp	Pyroclastic rocks of basaltic cinder cones.
Ts	Tuffaceous sedimentary rocks and tuffs; mostly sandstone and siltstone.
Tb	Basalt; gray basalt flows, flow breccias, and basaltic peperite.
Tvm	Mafic vent rocks, basaltic and andesitic agglomerate, breccia, scoria, cinders, flows and intrusive masses, mostly cones and shields.
Tvs	Silicic vent rocks; plugs and exogenous domal complexes of rhyolitic, rhyodacitic, and dacitic compositions.
Twt	Welded ash-flow tuffs and tuffaceous sedimentary rocks.
Tls	Lacustrine and fluvial deposits; bedded silicic ash and pumice, diatomite, tuff, and minor mudflows.
Tf	Basalt and andesite flows and breccia.
Trh	Flows and flow breccias of rhyolitic, rhyodacitic, and dacitic compositions.
Tre	Tuffaceous sedimentary rocks, tuffs, pumicites, and silicic flows.
KJl	Intrusive rocks in batholithic masses and large dike-like bodies; mainly hornblende and biotite diorite.
Js	Sedimentary rocks; mudstone, shale, siltstone, graywacke, and water-laid tuff.
JRsv	Sedimentary and volcanic rocks; volcanic wacke and siltstone, some conglomerate and slate.
Rv	Volcanic and metavolcanic rocks; spilite and keratophyre flows, flow breccias and some coarse volcanic sandstone.
Rgd	Granite and diorite; felsic to intermediate, granitoid albite- and quartz-rich intrusive rocks.
Ru	Ultramafic plutonic rocks and serpentized equivalents.
Rg	Mafic plutonic rocks and serpentized equivalents.
Rpv	Volcanic rocks, massive flows of porphyritic meta-andesite, metabasalt, spilite and keratophyre, and volcanic breccia.

TIME

T E R T I A R Y	C E N O Z O I C	
	Q U A T E R N A R Y	
P A L E O - Z O I C	M E S O Z O I C	
	T R I A S S I C	J U R A S S I C C R E T A C E O U S
P R E - C A M B R I A N		

IDAHO
(from Bond, 1978)

Qa	Alluvium; may contain some glacial deposits and colluvium in uplands.	
Qd	Detritus; generally basin-filling deposits of central and southern Idaho.	
Qg	Colluvium, fanglomerate and talus plus some glacial debris in upland valleys.	
Qrb	Basalt; relatively unweathered Snake Plain basalt flows and cinder cones.	
Qrw	Active sand dunes and eolian deposits.	
Qpa	Water-laid detritus; may be distal deposits of glacial floods and outwash.	
Qpg	Outwash, fanglomerate, flood and terrace gravels;	Qpmg Middle Pleistocene deposits.
Qpc	Upland valley deposits; commonly derived from alpine glaciation.	
Qpub	Snake Plain lava flows.	
Qpmb	Plateau- and canyon-filling basalt in and near the Snake Plain.	
Qpmd	Lava-dammed Snake Plain lake beds; silt, clay, and diatomite.	
QTs	Stream and lake deposits.	
Tpd	Stream and lake deposits; result from volcanic and block-faulting events.	
Tpb	Olivine basalt; flows and associated tuffs and detritus of southern Idaho.	
Tpf	Silicic welded tuff, ash, and flow rock, most common in southwestern Idaho.	
Tmd	Stream and lake deposits; generally associated with volcanic episodes.	
Tmb	Plateau basalt flows of western Idaho.	
Tmf	Silicic flows and tuffs; most common in southwestern Idaho.	
Ter	Mixed silicic and basaltic volcanic ejecta, flows and reworked debris.	
Kii	Plutons; probably includes unmapped older and younger crystalline bodies.	
Ki	Metamorphosed granitic intrusive rock; associated with pluton margins and stress areas.	
Km	Highly metamorphosed rock of central Idaho; age and origin of rock questionable.	
Jw	Mixed marine detrital and volcanic rocks of western Idaho.	
Rv	Metabasalt and submarine volcanoclastics of western Idaho.	
Pz	Metamorphic complex of probable Paleozoic units of southwestern Idaho.	
DS	Shallow water marine carbonate units of east-central Idaho.	
Ya	Sediments, mostly quartzite, of southern Idaho.	

R-4019