

ALASKA LEGISLATURE COMMITTEE FILES 1981-1982

2143 ST SB 294

3113

APPENDIX C

How To Cut Harvesting And Storage Losses

by Howard Voelker

You'll read later in this Research Bulletin how haylage will produce more energy (TDN) than silage, a faster rate of gain, more milk, more meat, more profit.

While haylage can do all that, it needs help from the farmer. To take *full advantage*, the farmer must:

- Follow the proper steps to *produce* quality forage. (See Dr. W.F. Hueg's "Establishing a Quality Forage Crop" on pages 20 and 21.)

- Make sure he *harvests* and *handles* his haylage crop for maximum benefits.

Storing is only one step to producing excellent forage. Other equally important steps are harvesting for maximum nutritional value, wilting to the proper moisture level, and chopping to sufficient fineness without losing protein-rich leaves.

One of the most common mistakes is waiting too late to cut the crop. When the alfalfa plant reaches full bloom, the nutritional value has greatly decreased. *Alfalfa should be cut at the boot stage or no later than 10% bloom.* By cutting earlier, many farmers are able to add an extra cutting to the growing season. But don't measure your crops by tonnage; quality is more important than quantity.

Alfalfa as a major forage crop produces high yields and has a high protein content. A multi-billion dollar forage, it is important we harvest efficiently to reduce field and storage losses.

Research conducted at South Dakota State University* gives us the following information about silage losses and what the causes are.

In early research with wood bunker silos it was found that carotene (which provides Vitamin A) in silage was higher at a 60.2% moisture level than at 73.8%. Here quality of feed was compared at two different moisture levels. (Moisture level of haylage is the lower). The higher moisture silage had a foul odor. Also, carotene values were higher in the bottom of bunkers than in the top after 5 to 7 months of storage, which suggested better preservation where there was less air.

Crude fiber and ash also increased at the higher moisture level. It was estimated that alfalfa silage preserved in a wood bunker lost 32.5% of its weight between filling and feeding.

However, in the oxygen-limiting Harvestore system, after several months there was a total loss of only 1.7%. In a repeated trial, the weight loss was approximately 6%.

In another experiment, alfalfa-brome was cut and left to dry. The plan was to dry half the crop to 50% moisture for concrete silo storage and the other 50% to a slightly drier level for the Harvestore. After each structure was only partially filled, rain delayed harvesting.

After the crop was stored in the concrete silo there was an overall loss of 16.1% of the dry matter in the rain damaged haylage. The dry matter loss in the bottom of the concrete silo, not rained on, was 11.6%.

In the Harvestore there was a loss of 4.2% of the material not rained on. In total weigh-ins and -outs, there was a 4.9% loss.

What about loss due to the formation of acids?

The acids which developed in the two systems were estimated. Moisture levels were 33% to 51%. Also, glass jars were used to prevent alfalfa silage at these levels and at 76% moisture. Note the results in Table 1.

As you can see there was no evidence of undesirable butyric acid development in the Harvestore. However, lactic acid (which gives haylage its good taste and pleasing odor) values were the highest!

Now let's look at a comparison of storage losses.

Alfalfa silage and haylage losses are summarized in Table 2.

Samples of the alfalfa from the above test were taken for chemical analysis. Averages of the compositions are listed in Table 3.

From Table 3 you will see that the greatest differences in the types of storage occurred in the ash and the nitrogen-free extract portions.

As the carbohydrates were used as energy in the silage fermentation, the proportion of ash increased. A storage loss of 11.6% occurred in the bunker over a three month period. *The Harvestore produced a loss of only 4%.*

What about losses in the field? Remember, it is important to get the alfalfa to the storage structure with maximum benefits.

Losses in the field as alfalfa dried were determined and samples were taken for chemical and dry matter analysis.

The alfalfa for haylage was chopped at 30% moisture. In mid-afternoon some of the hay was baled resulting in high leaf losses with a recovery of only 77.2% dry matter. Waiting until evening to bale the hay resulted in tougher leaves and a 90.2% recovery of dry matter.

One fact emerges — the higher the moisture content, the higher the percent of recovery. The recovery of dry matter in harvesting was 94.6% when moisture levels were 40.4% or higher.

Analysis of the field recovery indicated significant differences in dry matter recovery. Haylage and green alfalfa were significantly higher than hay in recovery of dry matter.

How about nutritional values? Samples were analyzed for carotene and protein.

The carotene decreased as the alfalfa dried. Protein was highest in the slightly wilted alfalfa.

What about non-protein nitrogen content?

Samples were taken as the alfalfa was harvested. The samples were sealed in glass jars and analyzed for ammonia, nitrates and nitrites. Nitrites may be toxic to animals. The moisture levels did not have a consistent effect on ammonia values.

Nitrites appeared to be lowest when there were no rains and the weather was favorable to drying alfalfa. A further test showed that green cut alfalfa tended to be highest in nitrites, with some trends towards reduced nitrites as the alfalfa dried.

Table 1. Average Acid Content of Hayage and Silage.

Type of storage and alfalfa	Kind of Acids					
	Butyric	Propionic	Acetic	Formic	Lactic	Succinic
Harvestore haylage	00	04	2 57	11	8 90	1 60
Concrete silo, haylage	14	05	1 84	08	5 30	00
Jars, silage	77	09	2 51	09	3 79	51

Table 2. Alfalfa Losses in Bunkers and Harvestore.

Structure	Moisture	Carotene as fed	Total weight losses
	(%)	(Mcg/g)	(%)
Bunker	66.6	38	32.4
Harvestore	48.9	72	3.4

Table 3. Changes in composition of alfalfa during preservation.

Structure	Ether extract	Crude fiber	Crude protein	Ash	Nitrogen free extract
	(% of dry matter)				
Bunker					
as ensiled	3.0	23.3	21.1	8.9	43.7
as fed	2.9	26.0	21.2	12.0	37.9
Change	- 1	+ 2.7	+ 1	+ 3.1	- 5.8
Harvestore					
as ensiled	2.9	22.0	22.6	9.7	42.2
as fed	3.2	25.3	21.2	9.0	41.3
Change	+ 3	+ 3.3	- 1.4	- 7	- 9

About the author . . .

HOWARD VOELKER is a professor of dairy science at South Dakota State University. He received his B.S. from Iowa State University, majoring in dairy production, and his M.S. from Kansas State University in dairy science. He received his doctor's degree from Iowa State in 1955. He has conducted research in forage preservation and published numerous articles relating to dairy production.

APPENDIX D

RESEARCH TEST - VITA FERM COW CALF

TO: Bio-Zyme Enterprises, Inc. St. Joseph, Missouri
 FROM: Dwight Albers, Hazen, North Dakota
 SUBJECT: 282 day feed trial with 15 head Simmental cross steers.
 RATION: Barley & Oats, Alfalfa Haylage, and VITA FERM COW CALF.

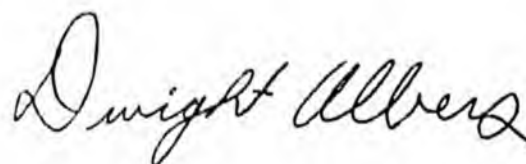
DATE	AVG. WT.	TOTAL 15 HEAD	AVG. DAILY GAIN	TOTAL LBS. FEED	TOTAL FEED COST	AVG. COST PER LB. GAIN
11-23-76	474	7,110	---	---	---	---
9-01-77	1,126	16,890	2.3#	175,559	\$2254.59	23.05c

KIND OF FEED	COST PER LB.	TOTAL LBS.	TOTAL COST	COST PER HEAD
Barley and Oats	3.4c	39,000	\$1326.00	\$ 88.40
Alfalfa Haylage	.5c	135,360	676.80	45.12
VITA FERM COW CALF	21.0c	1,199	251.79	16.79
		175,559	\$2254.59	\$150.31

Selling price	39c/#
Avg. cost per pound gain	23.05c
Total pounds gained	9,780#
Total lbs. feed to produce one lb. of beef	17.957
Total profit on gain	\$1559.91
Avg. profit per head on gain	\$ 103.99

The health record on this pen of steers was excellent. There was no evidence of runny or droopy eyes. The cattle did it all.

I feel that the proper vitamin-mineral balance provided by the VITA FERM COW CALF was a great factor in the feed efficiency in this high roughage ration.



Dwight Albers

For further information on the elements on the Vita Ferm System - nutrition, management and genetics - consult your Bio-Zyme representative or write to:



BIO-ZYME
ENTERPRISES, INC.

TOLL FREE 1-800-821-3070 IN MISSOURI CALL COLLECT (816) 238-3328
 1231 ALABAMA ST. JOSEPH, MISSOURI 64504

Outstanding Accomplishments of SMITH and MARSHALL HEREFORDS

NORCATUR, KANSAS

with VITA FERM SYSTEM

SMITH and MARSHALL HERFORDS have combined genetics management and the VITA FERM STEM to produce a herd of registered cattle that produce and perform the way every cattleman hopes to attain.

- fertility, calving ease, sound udders

Previous to the VITA FERM SYSTEM, the usual problems plagued the SMITH and MARSHALL herd, — dead calves, retained placenta, calf scours, late cycling after calving, poor conception, not enough milk, and weaning weights that were unsatisfactory. SMITH and MARSHALL started using the VITA FERM SYSTEM in May, 1978 and listed below are some of the results and benefits attained as of September 10, 1980:

1. Have completely eliminated calf scours.
2. Stronger calves at birth. They get up quicker and get to the colostrum milk.
3. Have had no retained placenta.
4. Cows cycle early after calving.
5. Good conception and cows calve on time.
6. Have eliminated 80% of the Veterinarian bill. Vet now concentrates on preventive medicine and vaccinations.
7. 30% better conversion of the grass and hay.
8. A herd bull that worked both fall and spring crops, weighed 2240 lbs. as a 3 yr. old in working conditions, off grass and VITA FERM (JOE, a living replica of his famous sire I.1 Domino 735.)
9. Superior development of replacement heifers and bull calves.
10. Even with 1980 adverse weather, cows had good hair coat and top bloom condition at all times.

PRODUCTION ACCOMPLISHMENTS on the VITA FERM SYSTEM

- A. Produced bull calf weaning weights of 660 lbs. in 1979.
- B. Produced 100 percent calf crop in 1979.
- C. Produced 97% calf crop date in 1980.
- D. Produced the heaviest and highest weight per day of age Senior Bull calf ever shown in Denver.
- E. First calf heifers showing full development, good fleshing with large calves at side.
- F. Fertility, calving ease, sound udders, and good milk production are now a trademark of SMITH and MARSHALL COWS.

***COMMENTS BY ROGER SCHLICK, Morland, Kansas Vita Ferm Serviceman:*

"Smith and Marshall have used the Vita Ferm products as they should be used. They used Vita Ferm 6:2:2 with poor quality roughage available to winter cows. They kept Vita Ferm Cow Call 5 out free-choice at all times. The results are an outstanding herd of Hereford cattle.

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Vita Ferm System brings out the Genetic Potential -
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TOLL FREE 1-800-821-3070 IN MISSOURI CALL COLLECT (816) 238-3326

1231 ALABAMA

ST. JOSEPH, MISSOURI 64504

September 25, 1978

Attn: Max Pearl
Ehlert's Feed & Supply Co.
Fairport, MO 64447

Dear Max:

In 1963, I first became acquainted with your Vita Ferm products. Having done business with you for many years, I decided to try this new product that you were so high on. I would like to pass on the results I have had feeding it continually for 15 years.

My beef-cow herd has averaged about 50 head in these 15 years. Up until the time I started feeding Vita Ferm, my calf crop percentage was about 85%. For the past 15 years, my average has been 97%. I have very little trouble with cows breeding, calving or cleaning. My face fly problems have been considerably less and my calves have averaged over 50# per head more at weaning time.

This herd has used from $\frac{1}{4}$ to $\frac{1}{3}$ less grass in the summertime, and also less hay in the wintertime. The calves at 30 days of age are already eating out of weather vane salt feeders and because of this the cows stay in much better flesh the year around. I am able to utilize much poorer roughages, such as stock fields and milo stubble. My cattle are contented and easy to handle.

I used to feed blocks and cubes at a cost of 12 to 14¢ per head per day. The past 15 years my investment has been from 5 to 6¢ per cow/calf unit. I feed this product the year around, and my consumption per cow/calf unit runs about 4 oz. per day. I'm completely satisfied with the Vita Ferm System. If anyone would like to contact me, I'd be glad to answer any questions.

Sincerely,

Signed: Leland Warner
Maysville, MO 64469
Ph: 816 449-5878

Blume Polled Hereford Farm

GORDON BLUME
Phone 472-0619

Redfield, S. Dak. 57469



August 21, 1978

Dear Mr. Ehlert:

We began feeding Vita Ferm nearly two years ago and we are amazed at the results that we have obtained. In our annual sale last February, we had so many people compliment us on how good the cattle looked. These bulls have received seven pounds of grain plus 1/2 pound of Vita Ferm 6:2 plus hay and silage.

We creep fed our calves last year on oats and Vita Ferm and then used Vita Charge when we weaned them. We never treated a calf (In a fall when death losses for many neighbors were running high). After two weeks on Vita Charge we put the bull calves on 1/2 pound of 6:2 plus 5 pounds of grain, 4 pounds of alfalfa, and corn silage. From when we weaned in October until we weighed again in April, we had several bulls gain over 3 lbs. per day, in one of the coldest and worst winters on record.

We feel that we have nearly eliminated any eye problem or breeding troubles since we began on the Vita Ferm System. I would truly recommend it to anyone.

Sincerely,

BLUMED POLLED HEREFORD FARM

Gordon + Thordys

Gordon & Thordys Blume

APPENDIX D Continued

Larry Ehler
Biozyme Enterprises
St. Joseph, Mo. 64504

Dear Larry:

I apologize for not taking the time earlier to tell you what we have been doing with Vita Ferm and how satisfied we are with the results.

As you know, this is about our 10th year on the Vita Ferm System. Dad was in the grocery business and trying to take care of our cow herd while my brother and I were in college and spending time in the service. Dad was feeding 2 lbs. of cottonseed per day which was time consuming and expensive.

Then he heard about the Vita Ferm System and started feeding Vita Ferm at the rate of 2 oz. per head per day free choice and only had to put it out every 14 days, rather than feeding every day. The economics was much better also as it cost 5¢ for Vita Ferm and salt and about 10¢ for the 2 lbs. of cottonseed. Dad felt the cattle wintered just as good as ever and the herd health was excellent. He definitely felt he got more good out of 2 oz. of Vita Ferm than he did the 2 lbs. of cottonseed.

For over a year my Dad marketed our heifers through his grocery store. He took 700# heifers and fed them for 60 days a ration of ground milo, 2 oz. Vita Ferm per head per day and alfalfa hay.

I have been home for two calving seasons and can give you some excellent results.

Our cows have been on the Vita Ferm total nutritional system year around with no other supplementation or additional minerals or vitamins. Our herd health is excellent. In 1973 out of 125 cows and first calf heifers we had one open cow and 2 open heifers. The calves were strong, including the heifers, and the calves got up within a 30 minute average time and got the colostrum milk. The cows gave ample milk and cleaned very well. They bred back easily as is evidenced by our 1974 calf crop. We had 120 of 125 calves leaving 5 open cows and 43 of 47 replacement heifers calved. There were no retained placentas. There was a small percentage of the calves getting pneumonia and scours with no death loss on the cows' calves, but lost 2 calves from heifers. If we count our 9 open cows and heifers and our 2 head death loss, we will wean a 94% calf crop in the fall of 1974. This is excellent when you figure our cost per cow calf unit at \$19.00 per year for the Vita Ferm feeding system. Our cows run on native grass in the summer and fall and run on wheat and milo stubble in the winter.

Larry, we have just concluded one test with Vita Ferm and alfalfa hay in confinement and we are still conducting a test with cattle grazing alfalfa and having access to Vita Ferm.

We put 93 steers weighing an average of 670 lbs. in confinement on a ration of straight alfalfa hay free choice and Vita Ferm and salt mixture free choice for 51 days. On May 13 we weighed the steers and they averaged 735 lbs. for a gain of 1.27 lbs. per day. We killed two steers that dressed out 54% and graded High Good. They were killed at Caviness Packing Company in Dalhart and graded by a grader from Swift Packing Company in Guymon, Oklahoma. The grader said they would just about go Low Choice because of the youthful eye appealing carcass.

We are eating one of the steer carcasses now and it is tender and had a good flavor and my wife likes not having all that fat you find on grain fed cattle. We have even eaten cattle fed on the Vita Ferm System and found a great adventure in eating beef.

We haven't completed our grazing season on alfalfa yet, but we have 140 heifers on 50 acres of alfalfa and the Vita Ferm System and it looks like they are gaining over 2 lbs. per day and are carrying the flesh of grain fed heifers of comparable weight (650#).

Since we have been on this program there have been many cattlemen switch to the Vita Ferm System just by looking at our cattle.

The Vita Ferm M.O. has provided nutrition and Magnesium Oxide for cattle on wheat pasture from which cattle have experienced poisoning in the early spring. Mr. Jimmy Summerour, Manager of Summerour Ranch (one of the biggest in the Texas panhandle) is completely sold on using the M.O. on wheat pasture. Two years ago he lost 5 head on wheat before he started using M.O. He hasn't lost any since.

Come see us.

Yours truly,

(s) Ralph Pater & Sons
Dalhart, Texas

APPENDIX E
Excerpt From A Speech by John Milne,
“Beef Production”
2nd Annual Alaskan Agricultural Symposium

Our cattle operation is basically a cow-calf feedlot operation. We calve them in February or March, put them on the grazing lease during the summer, wean them in October, winter them over, and then in the spring we decide whether we will sell them as feeders, leave them in the feedlot and finish them out or put them back on grass and finish them next year. In the spring we have these options that, depending on market, determine just what we'll do with them from that point on.

Another requirement for these winters is a good supply of straw. I am a firm believer in having a lot of straw. When we start baling in the fall, we bale until the snow flies. We get all the straw we can. It is absolutely essential if you're going to winter calves. It is necessary for bedding. Good barley straw is good for stretching your feed supply, and you can actually get by with it if you run out of hay. You can make do by feeding barley straw and barley grain. It will pull you through short periods quite nicely.

Another point in this cold weather is that you have a reliable system of feeding your cattle. If you haven't, you can really run into trouble. It always seems like you'll run into trouble on days when it's -40F. We get -40F weather too, maybe not as often and long as here in Alaska, but we always get one or two shots every winter. There is nothing worse in the winter when it's -40F, than having a frozen water system or tractor that won't start. We had some experience with small tractors, and this sort of thing, trying to feed large numbers of cattle under these cold conditions in the snow. I think you should try to look ahead a little bit. Ask yourself all kinds of "what if" questions. What if the water freezes? What if the tractor won't start? Try and anticipate some of these problems you can have. When it gets cold and things get out of control, they seem to get really out of control.

We use the big round bales and feed with a 100 horse tractor with a big loader on it. It is a new tractor. You need something like this that you can handle.

We do keep track of the forecast, and if the forecasters are predicting a long cold period (a week of cold weather or something like that), we've got a few extra, small pastures around the place that can be used to ease the feeding chore. We will pile out enough bales in each of these pastures to feed the cows for two or three days, shut them into one pasture, and then we just turn them from one pen to the other. We can actually stock up a little bit and get ahead so that we can keep these cows and the calves and all our

other cattle going for probably a week. You don't have to start up in the cold weather.

These are things that don't sound like much of a problem when you're talking about an hour in the middle of the summer. When you hit the wintertime though, they can become a very big problem.

We have a problem with water, but it is my understanding that this area has good ground water. We have to rely on dugouts which can cause a problem either by freezing up or by going dry. I think that if you have large numbers of livestock, you're going to have to look at automatic electric heating bowls to handle your water situation.

For years in the Peace River area, over 40% of the cattle north of the river did not have water. They wintered on snow. There is no problem wintering cows on snow. In fact, the research people in Alberta in the last couple of years have done some work on wintering cattle on snow and have found that there is no significant difference in the weight of the cow or that of the calf or of the general health of the cow (between cows wintered on snow and wintered on water up until calving). I personally like water but mostly because of tradition. Once they calve, they need a lot of extra water and a lot of extra feed. You can no longer depend on snow alone; water must be available.

In our area, very few cattle are actually housed inside buildings. Your housing requirements can range all the way from a completely controlled environment, right through to spruce brush. If you have a lot of cattle to get into a completely controlled environment, you're looking at a "heck" of a capital investment. That is one that I don't think the cattle operation, particularly the cow-calf operation, can handle. The only alternative, as I see it, is to go to an open housing situation.

We winter all our cattle in the open. There are no sheds for the cows or calves or anything else. They are all out in the open. They have got shelter from the wind, either in bush or windbreak fences. We bed them down and use a lot of straw. They do fine out there. In fact, you'll have less problems with pneumonia if they are out in the cold. They are better off being cold and dry than they are even in open front sheds, where they will crowd and try to take some protection. The moisture accumulates in there and will cause them more problems than having them in the open. We keep them outside.

The other thing that you must have if you are going to run a cattle operation is well designed handling facilities. You will need corrals and shutes to make it easy to take a cow that is a little bit sick, run her into a corral, put her in a shute and give her a needle or do whatever else is needed. If you don't have these facilities and the weather is cold and miserable, you will find yourself saying, "It's too big a problem to wrestle her down. Maybe she'll get better tomorrow." Build yourself a simple set of handling facilities but a good set. It will save you a lot of problems when it comes to handling the cattle in the winter.

I think that you should use corrals. We have big corrals and we use lots of space. Not too many of our corrals are less than an acre in size. That way, over the long feeding period, your build up of straw and manure will be better scattered around. Also, if you don't get those corrals cleaned out in the summertime, you can bed them in one corner for one winter and bed them in the next corner the next winter. At least they are big enough that you have some options. Use lots of room and make your corrals big.

Now I would like to say a word about calving into February and March. We calve in February and March, and we do this for a number of reasons. One is to do all the work that has got to be done. Sometimes, the summers just get away on you. It's sort of like the bumble bee that was flitting around the forest, from flower to flower one day. The sun was shining and the skies were blue. He landed on a daisy and an elk ate it. A bumble bee has got an awful temper. So on the way down to the stomach, he said to himself, "When I get to this stomach I'm going to sting this elk." When he got down to the stomach, it was so nice and warm and comfortable, he thought, "Well, maybe I'll have a little sleep first." When he woke up, the elk was gone. That is what our summers are like. You sleep too much, they're gone. You know where you find yourself.

We calve in the wintertime because that is one job that we can do in the winter. We've got time, and we don't have to mess around calving cows when spring seeding starts in May.

The other thing is that April is a bad month for us. It is cold, windy and damp, and newborn calves end up running around in the muck and the manure and have problems with scours. We don't have much of a problem in February and March with scours since things are still frozen. These little calves can get well started

before the scour season really starts, and they sail right through with no problem.

The other thing about it is the February and March calves are big. When we put them on the lease, they are big enough that they're not baby calves out on that rough lease; they can eat the grass and get their milk. By fall, we've got big, rangy calves. Last fall, our steer calves averaged 596 pounds and our heifers 564 pounds when we weaned them in October. By early calving like this, they're big enough that we can wean them off. They'll go into the next winter with some size on them, and they handle easily. By spring, we've got an 800 pound animal, and the option to sell it, to finish it, put it up on grass, or whatever.

If you're going to calve in the wintertime, there are a couple of things that I think you've got to take a good look at. You've got to be prepared to check these cows regularly. If it is less than -10F, you've got to go out every two hours. When it's -40F their ears are frozen in about 15 minutes, and in a half an hour their feet are frozen. We calve them out in the open, because with a number of cows like this, it's impossible to know completely which cows you should be putting in the barn. We put the cows in the straw piles, check them, and when a calf is born, put it on an old piece of mat or a little sleigh, especially built for that and drag it across the yard to the cabin barn. The cow follows along behind you. We put it in a stall in the cabin barn where it can stay a little warmer and get a chance to dry off. If it's real cold, we put a heat lamp on it. After it's dried out, we make sure that it's sucking the cow and everything is all right. Then we can dump it back out again.

When you turn your calves out, we've found that using calf hutches is a help. We take 4x8 sheets of plywood, put some 2x4s on and around the edges and across the middle, just to stiffen them up a little bit and bolt these things together to make a hutch that is 8 feet wide and 16 feet long and throw a few sheets of plywood up on top to cover it off. We put some bedding in the hutches, and these little calves will go right in. They've got a creep area by themselves, and they can get away from the cows. They stay nice and comfortable in there. If you've got one of those little hutches for about every 20 calves, scattered around in the pens that you've got your cows in, it makes quite a bit of difference.

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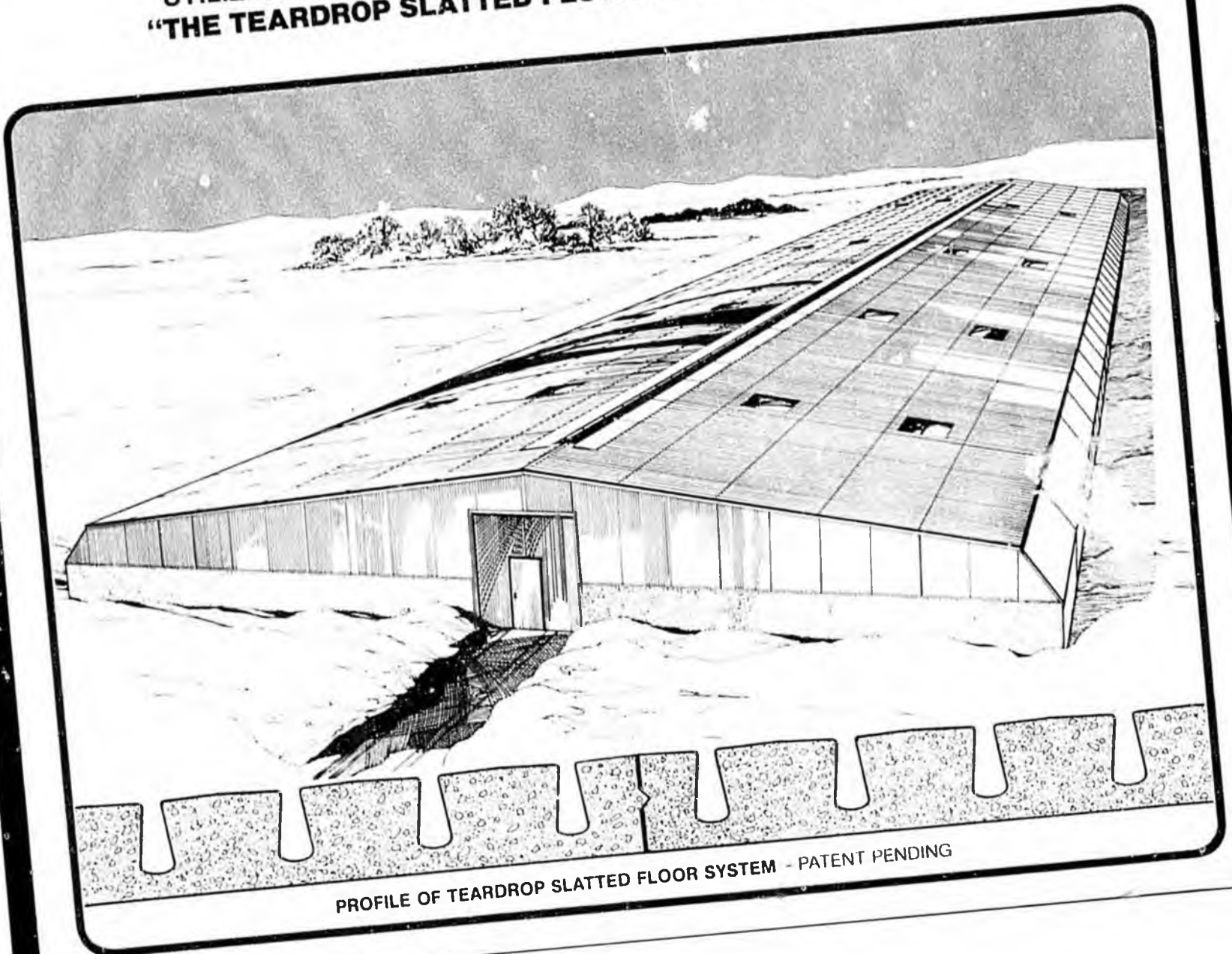
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PROFILE OF TEARDROP SLATTED FLOOR SYSTEM - PATENT PENDING

COLD WEATHER DESIGN

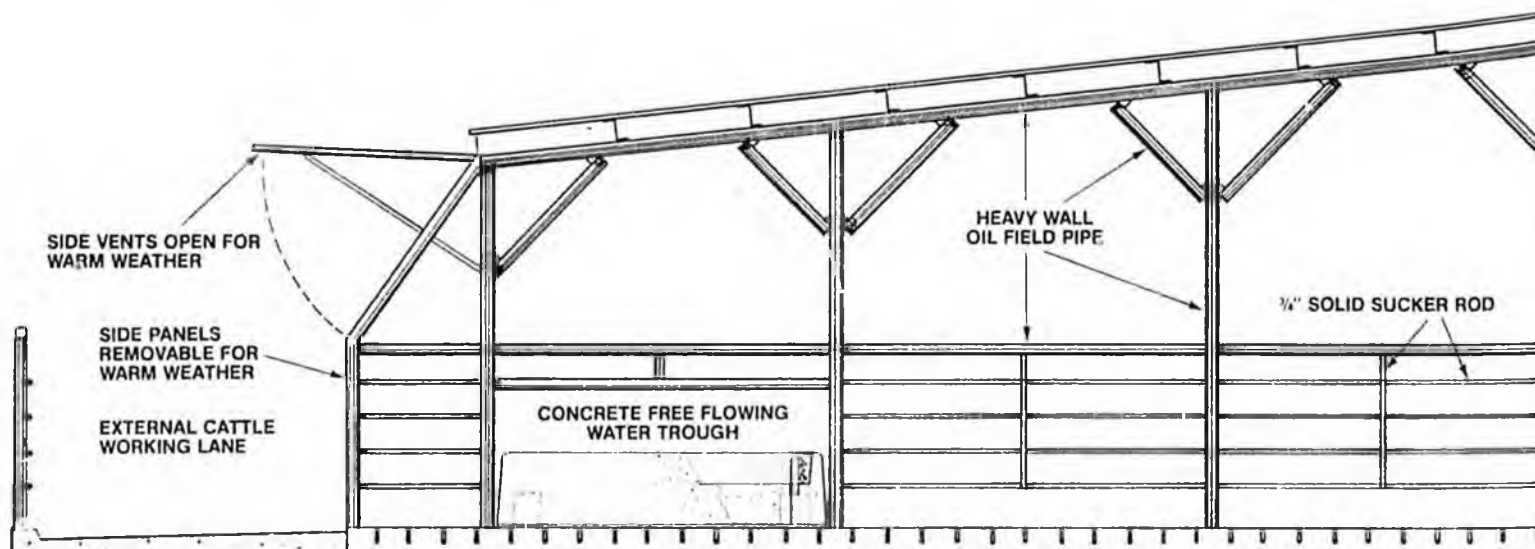
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The cold weather building with the "Laminar Flow" roof design is the product of research conducted in Canada by the world's foremost snow and wind specialists.

This exclusive roof and panel arrangement allows wind to flow smoothly over the roof without turbulence producing projections or shapes, thereby practically eliminating snow drift build-up on the roof.

Ventilation and animal heat containment can be precisely regulated by adjusting the roof vent and side flaps, to suit all seasonal weather changes.

All Corral buildings are custom adapted to the particular area, the type of cattle confined, type of feed used, special budget problems, etc.



SUMMER CONDITIONS

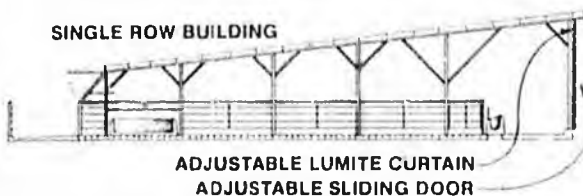
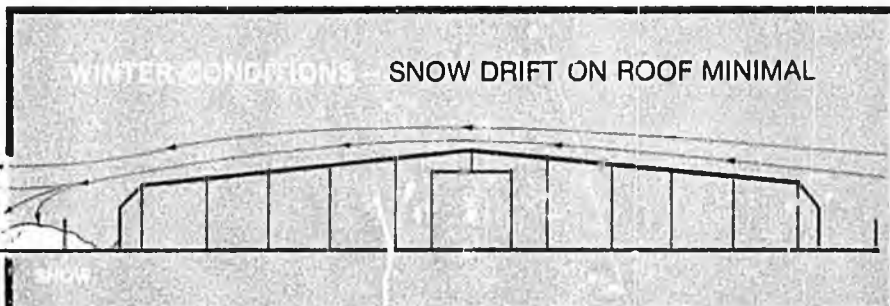
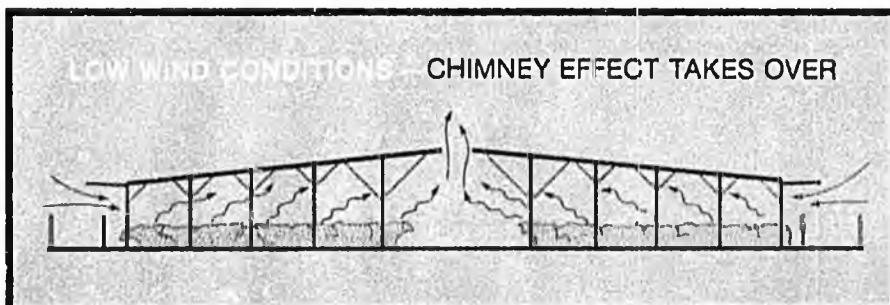
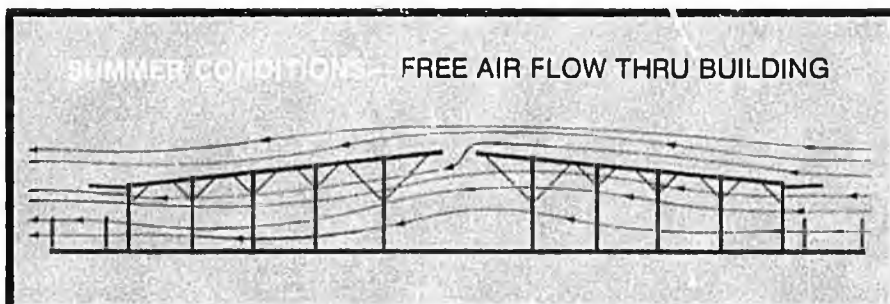
In summer the building becomes a giant sunshade. The roof vent at the center is opened to the maximum. All side vent panels are removed and stored. The side vent flaps are raised to full open position. This allows moving air to flow freely through the building and out through the roof vent. When wind is of low velocity, an area of negative pressure is formed at the roof ridge vent, and air flows down through the vent. This provides for equal air distribution in the down wind building.

LOW WIND CONDITIONS

When the weather is calm and there is very little air movement, the chimney effect takes over. Rising heat from the cattle and the natural draft at the roof vent draws air through the building and out through the roof vent (convection effect).

WINTER CONDITIONS

When cold weather returns, the side panels are reinstalled in the guides along the outer walls, the side vent flaps are closed and the roof vent is closed to its minimum 2' opening. This allows for proper cold weather ventilation, while enclosing the building and providing maximum weather protection for the cattle. To create the most ideal conditions within the building, one or more flaps may be raised or lowered to any degree necessary, and the center roof vent regulated accordingly.



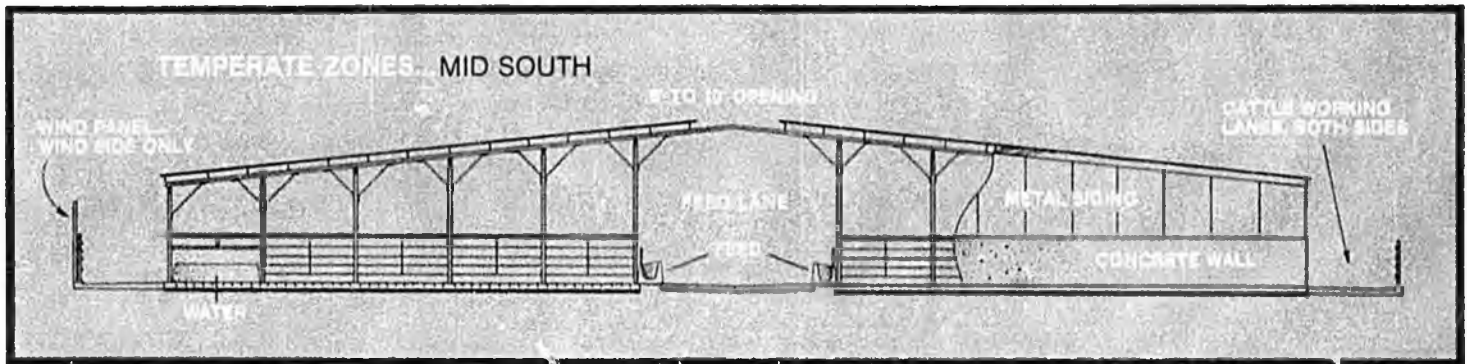
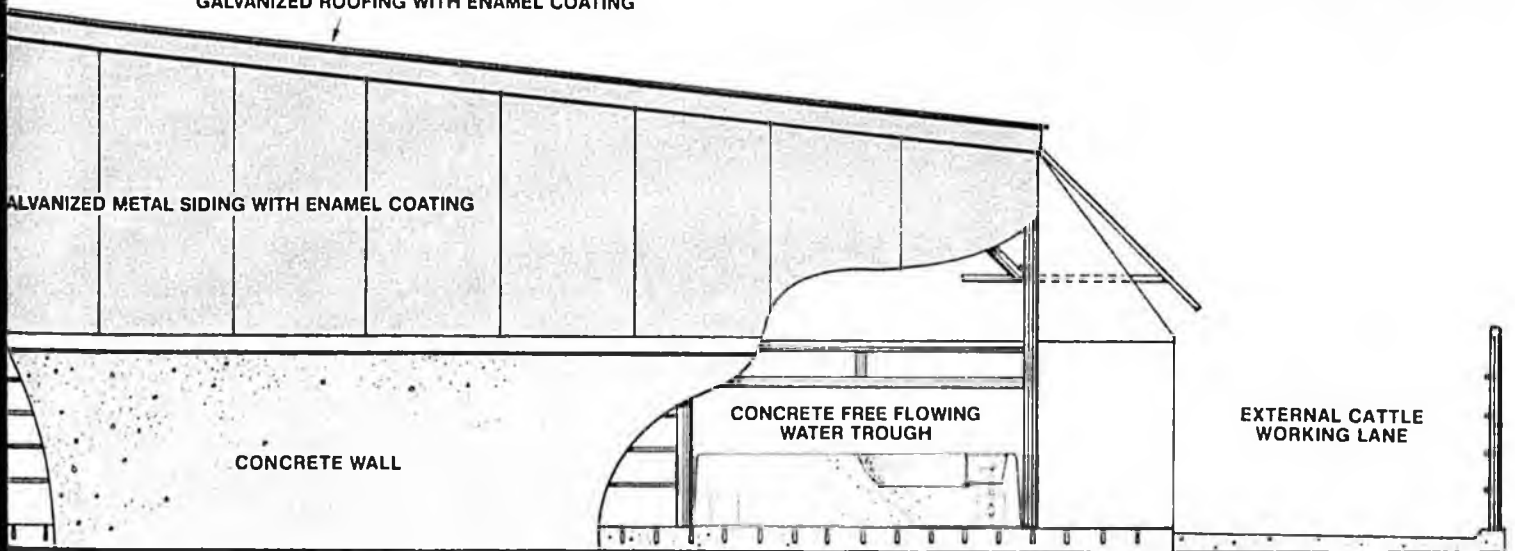
INTERMEDIATE WEATHER DESIGN

For areas of the country where weather extremes are not a problem, Corral has designed a building compatible with these moderate temperature conditions.

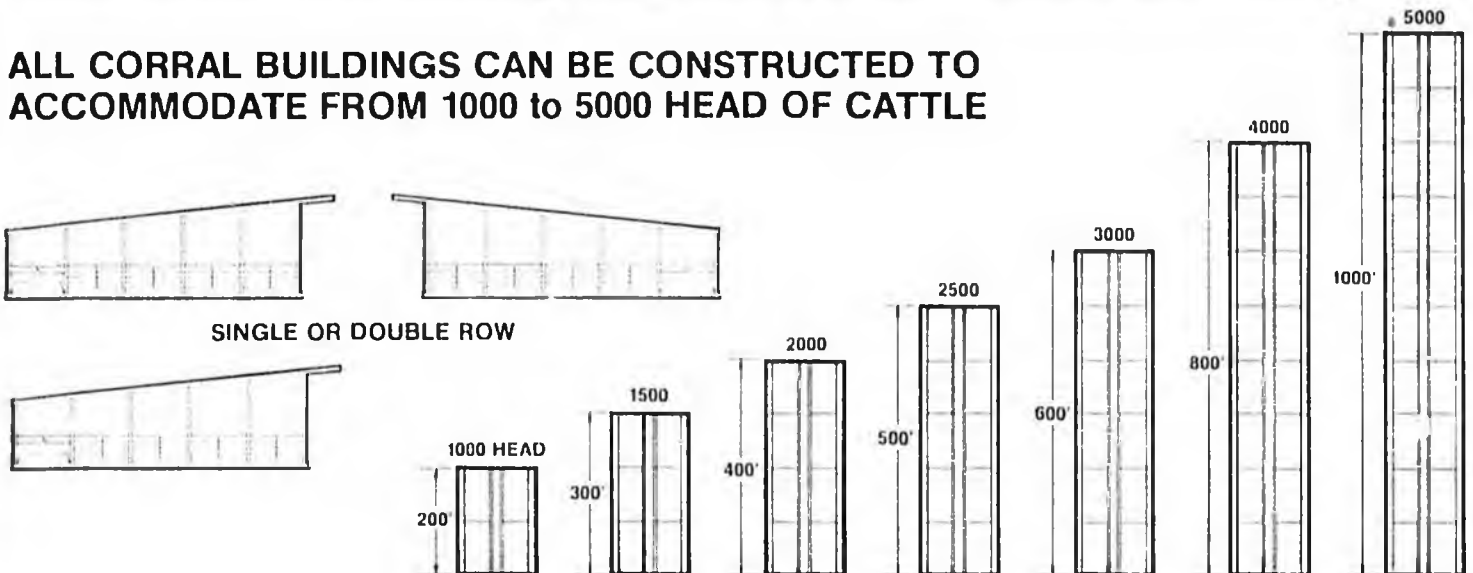
This building is well suited to areas where occasional snow and ice conditions exist, and even to the extent that snow or cold may at times be excessive. For this reason we use the same roof construction as for the cold weather design, but without the vents and wind flaps along the exterior fence line.

For this building, 8' windbreak panels are installed on the cold wind side for added winter protection. This panel causes the wind to be deflected "up and over" the roof of the building and not into the interior.

GALVANIZED ROOFING WITH ENAMEL COATING



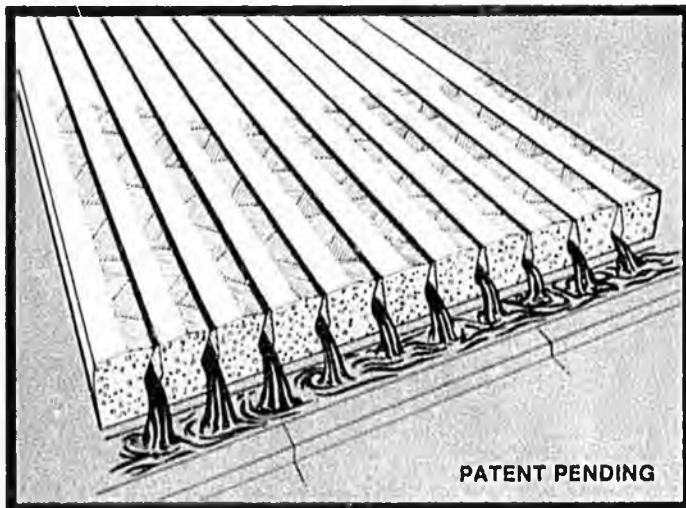
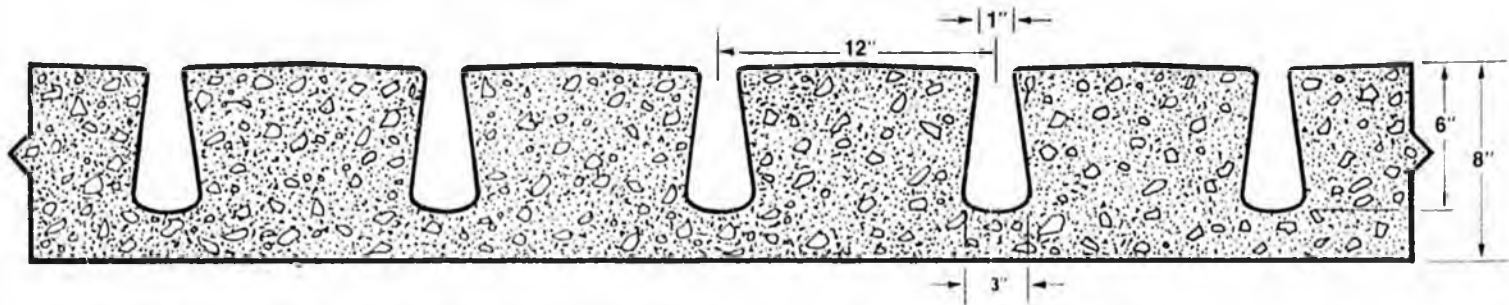
ALL CORRAL BUILDINGS CAN BE CONSTRUCTED TO ACCOMMODATE FROM 1000 to 5000 HEAD OF CATTLE



ALL BUILDING DESIGNS COPYRIGHTED - PATENTS PENDING

THE TEARDROP SLATTED FLOOR SYSTEM

Corral's newly developed slip-form technique for laying concrete greatly reduces original construction costs.



This totally automated procedure allows us to make long continuous runs, building the sub-grade as we go. The equipment is accurately controlled by a laser beam for straight line guidance, lateral alignment, and proper angle or slope for the finished floor.

The **TEARDROP** slatted floor becomes a very effective flush system for animal waste, without the conventional removal pits beneath the floor. Each **TEARDROP** slot serves as its own waste removal conduit. The **TEARDROP** shape provides a narrow opening at the top where the animals walk and widens to form a rounded trough below. Each **TEARDROP** carries from 3 to 5 gallons of water per minute on a gently sloping floor which provides the flushing action. The waste is worked into the slots by animal traffic as it is with all slatted floor designs. The water flow carries the waste the length of the building to the collection ditch and from

there to the holding pond. The liquid fraction is returned to the flush cycle either from the nutrient recovery center or directly from the anaerobic pond.

The liquid is constantly being diluted with fresh water additions from a make-up line. At the beginning of the cycle water enters through the manifold injection system. Each **TEARDROP** has its own flexible manifold valve which is pre-set for proper water flow at all times.

The surface of the **TEARDROP** slatted floor is a special design. The slightly raised centers between slats provide run-off of all liquids to the **TEARDROP** channels. Smoothly rounded, extruded corners at **TEARDROP** openings provide for cleaner run-off and prevent chipping and breaking of these edges. The floor surface is specially textured to retain small fibrous manure particles which build up to a thin carpet-like surface on the concrete. This finish, as well as the fiber pack, eliminates wet or slippery conditions which result in injured or dirty animals. The texture and shape of the surface and animal loading are carefully balanced to minimize any excessive build-up of manure.

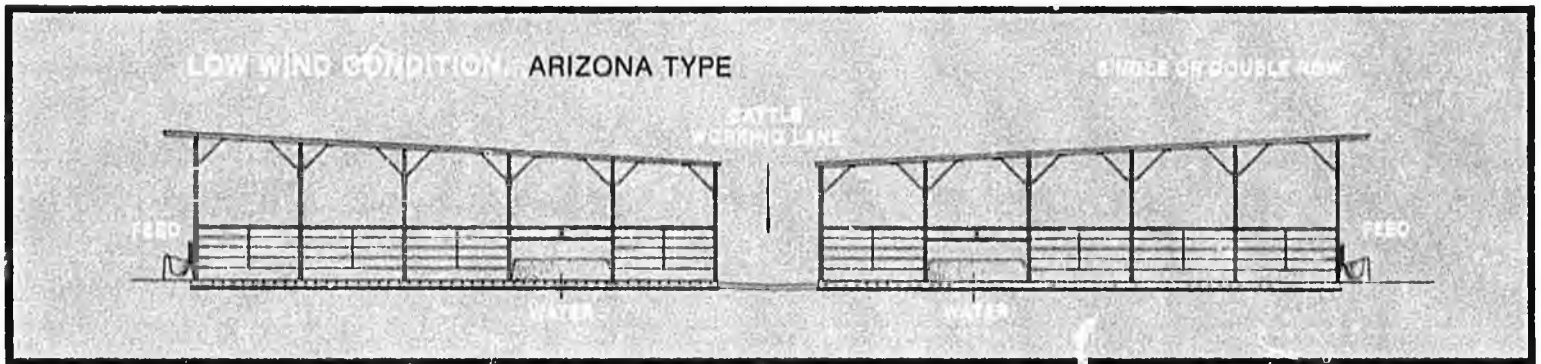
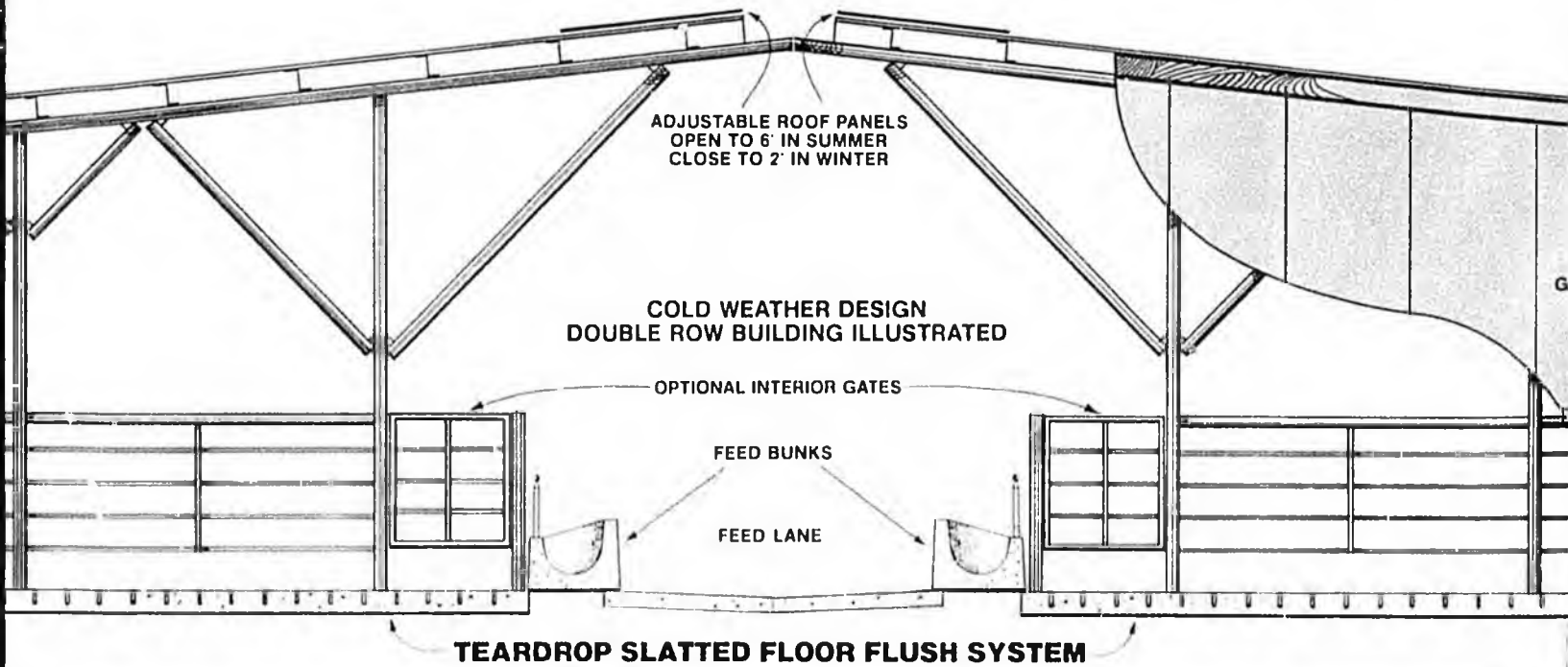
Water flow may be continuous in winter, as running water is difficult to freeze and running water with manure in it acts like "anti-freeze". Also remember that the building flaps in the cold weather design are closed partially or completely in winter to contain animal heat which helps prevent freezing. In summer the flow may be intermittent or as necessary.

The running water through the system will create a mild "aerobic" condition (accumulation of oxygen) that reduces gas and odor release within the building. This condition will aid in the management of any subsequent irrigation or pond systems. Chemicals can be introduced into the main pump line to eliminate ammonia gas release within the buildings.

HOT WEATHER DESIGN

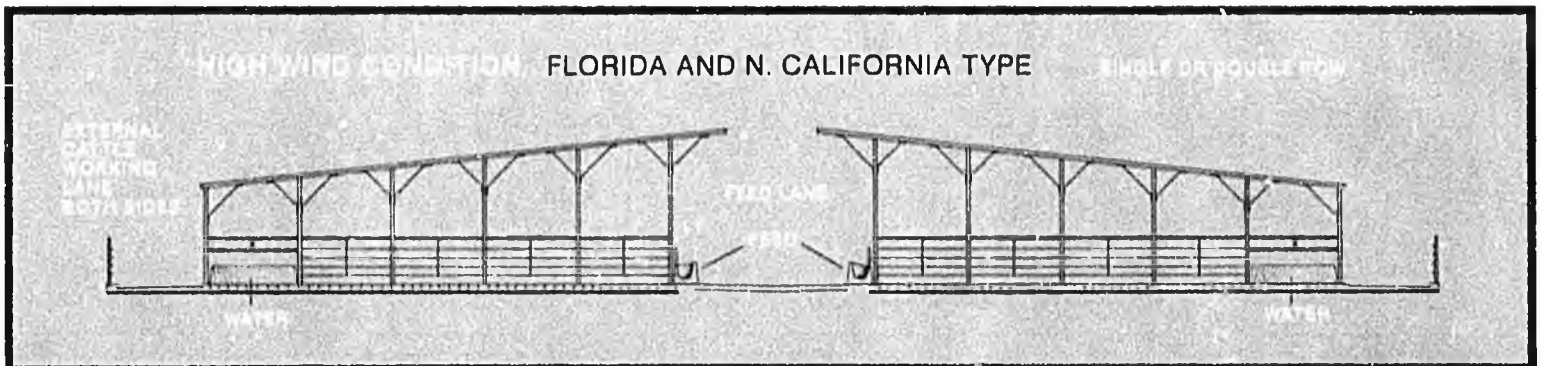
Careful attention to air flow patterns is one of the keys to the success of the hot weather building. These buildings have proven successful in the hot dry desert regions of Arizona and California and also the hot humid areas of central Florida.

Cattle are protected from sun or rain by the large galvanized sunshade roof. This Corral exclusive cable supported wire roof is stressed for no sag and high wind resistance. The pitch and careful spacing of the shades provide for maximum air flow through the building and for proper run-off of rain. Again these buildings are custom adapted to any unusual or special conditions.



In desert climates like Arizona and Southern California where there is very little rainfall and wind conditions are normally very calm, the roof design slopes to the center rather than the

outside. This provides more moving air pick-up at the outer perimeter and some air squeeze for maximum air movement through the building.



In warmer climates where rainfall is greater and winds much stronger, the roof slopes to the outside to facilitate proper run-off and prevent water from entering the building area.

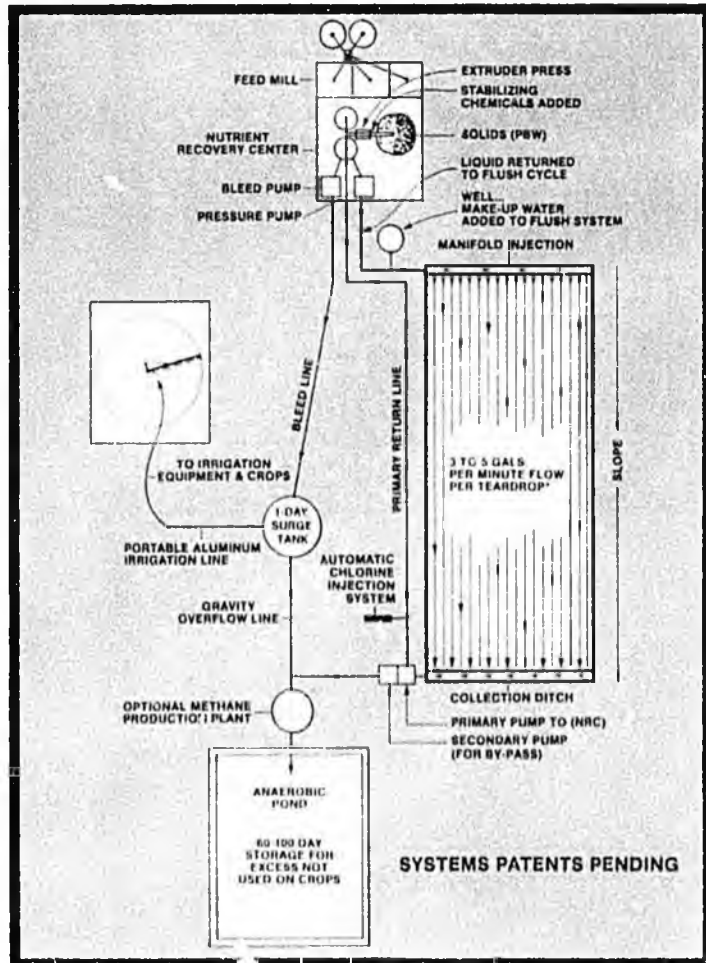
8' wind break panels may be mounted on the outer railings for cold winter wind protection.

WASTE HANDLING

RECOVERY SYSTEM

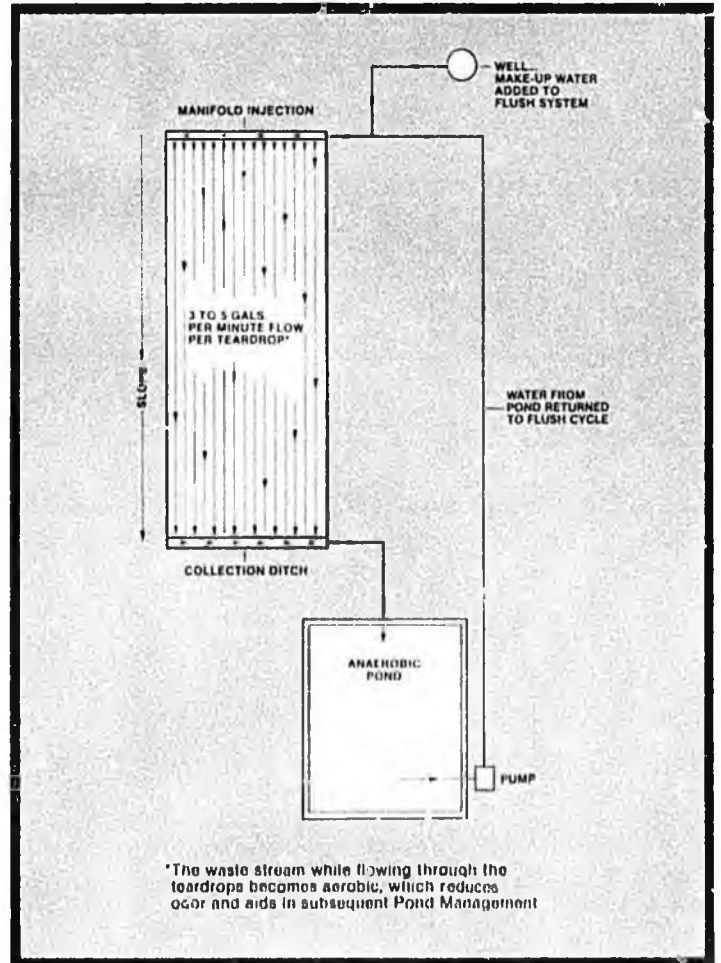
SOLIDS RECYCLING (PBW) PROCESSED BOVINE WASTE
LIQUID FERTILIZER FOR IRRIGATION

RECOMMENDED FOR 2000 HEAD CONFINEMENT FACILITIES AND LARGER



DISPOSAL SYSTEM WITH ANAEROBIC POND

RECOMMENDED FOR SMALLER BUILDINGS, 2000 HEAD OR LESS



SPECIAL NOTE ON CHLORINE INJECTION: This accurately controlled, automatic system is a very fast and inexpensive method of bacteria kill. Though this does not kill all bacteria...growth is greatly suppressed and holds the PH to a slightly acid condition. With bacteria growth at a minimum and the PH at this slightly acid state, we are able to prevent major amounts of ammonia release--which can be detrimental to the general health of cattle.

Corral Industries is the recognized leader in the design and construction of confinement systems for cattle, and conventional feed lots as well. We are also the world's leader in the area of animal waste recycling systems.

For immediate information please write or call: Dick Bunger for construction or John Fuller--waste processing.

Corral can custom design and turnkey build these systems from start to finish, including feed mill. We can start by helping with site selection and land acquisitions. We have considerable information pertaining to in-depth projections and feasibilities as well as detailed interpretations of investment tax credit applications. We also help in the acquisition of EPA and zoning permits. We can develop detailed financial projections and feasibilities that fit your requirements.

We can also custom design an irrigation system to accomplish either "disposal" or maximum "utilization" of the liquid fertilizer.

CORRAL INDUSTRIES INCORPORATED

MULTI-STATE RESEARCH SUMMARY

High moisture grains have superior feeding value

Prof. F.S. Baker, Jr.

Ensiled (fermented) high moisture grain is now widely used in beef, hog, and dairy rations with consistently superior results when the feed is properly handled. The grain may be harvested with a combine as high moisture grain before it dries in the field, or dry grain may be reconstituted to high moisture content by adding water before ensiling.

Best results are obtained with shelled or threshed high moisture grain when stored in whole form in an oxygen-limiting structure. The grain should be ground or rolled when removed from storage for feeding. Ground ear corn can be successfully reconstituted and stored in ground form.

Here is a summary of research from over the country which quickly tells the story of high moisture grain:

Advantages of high moisture grain

1. In cattle finishing rations, ensiled high moisture corn or sorghum grain, processed as described above, has consistently shown better feed conversion than dry grain.

It should be pointed out that the percentage improvement shown is for the total ration. Calculations for the Texas, Florida, and Arizona trials show high moisture grain itself was utilized 19% more efficiently than dry grain.

2. Digestibility of high moisture grains. Several studies indicate that high moisture grain is more digestible than dry grain. In Oklahoma studies, it was shown that the non-protein portion of rolled high moisture milo was more digestible; Texas experiments showed both the protein and non-protein portions more digestible. With corn, the improved feed conversion found with the high moisture grain is also likely due to greater digestibility.

3. Faster gains with high moisture grain have been proven in several experiments. Two examples come from Agriculture Research and Educational Center (AREC) at Quincy, Florida and University of Arizona:

Table 1. Improved feed conversion with high moisture (HM) grain

Location	Number trials	Grain	% Moisture HM grain	Form stored	Form fed	% improvement total ration feed conversion, HM over dry grain
Agri. Res. and Ed. Ctr., Quincy, Fla.	4	Shelled corn	23 to 26	Whole	Rolled	12
Texas A & M Univ.	7	Milo grain	23 to 32	Whole	Ground	11
Univ. of Arizona	2	Milo grain	27	Whole	Rolled	14
Okla. State Univ.	1	Milo grain	30	Whole	Ground	9
Iowa State Univ.	3	Shelled corn	26	Whole	Rolled	8
Purdue Univ.	2	Ear corn	32	Ground	Ground	10
Iowa State Univ.	2	Ear corn	31	Ground	Ground	10

About the author . . .

F. SLOAN BAKER, JR. is professor (beef cattle) Agricultural Research and Education Center (AREC), IFAS, University of Florida, Quincy, Fla. He is a native of Texas, received his B.S. from Texas A&M and M.S. from University of Florida. He has been a member of the faculty at Quincy 20 years. Among his research projects have been active programs with growth and finishing of young cattle and high moisture grain.

Table 2. Increased gain with high moisture (HM) grain

	Average daily gain (lbs.)		Difference	
	Dry grain	HM grain	Lbs.	%
Quincy, Fla. (4 trials)	2.28	2.60	0.41	18
University of Arizona (2 trials)	2.04	2.48	0.44	22

Dry matter feed intake was slightly greater with the high moisture grain at both locations. Carcass weights were not reported in the Arizona trials, but chilled carcass weight was significantly greater for cattle fed high moisture corn in the Florida experiments.

	Chilled Carcass Weight		
	Dry corn	High moisture corn	Difference
Avg. 4 trials, Quincy, Florida	597 lbs.	622 lbs.	25 lbs.

Generally, results of feeding trials indicate little difference in cattle gain with dry and high moisture grain, with improved feed conversion of high moisture grain due to smaller dry matter feed intake than with dry grain. Whether due to greater gain with about the same feed intake, or about the same gain with smaller feed intake, there is a consistent improvement in feed

conversion with high moisture over dry grain (Table 1).
4. Economic advantage of high moisture over dry grain was demonstrated in Florida tests. At AREC in Florida, improved gain and feed conversion resulted in a marked economic advantage. With shelled corn priced at \$89.29 per ton (\$2.50/bu.) on a No. 2 (15% moisture) basis, improvement of 12% in total ration dry matter feed conversion of high moisture over dry corn resulted in feed cost per 100 pounds gain of \$5.70 less with high moisture corn, and an increase in value of the corn of \$19.08 per ton (No. 2 basis), or 53c per bushel. One filling of a 20'x60' oxygen-limiting storage structure with 13,820 bushels of high moisture corn was worth \$7,383 more than feeding the same quantity of corn as dry grain. Table 3 on this page shows feeding value advantage of high moisture corn in an oxygen-limiting structure (not including any cattle grade increase) with No. 2 corn at various prices.

Table 3. Advantage One Filling of Oxygen-Limiting (Harvestore) Structure

Price No. 2 shelled corn		Size and capacity structure		
Bushel	Ton	2027 (6,220 bu)	2060 (13,820 bu)	2565 (23,390 bu)
\$1.26	\$ 45.00	\$1843	\$4094	\$ 6929
1.75	52.50	2713	6029	10204
2.00	71.43	2922	6493	10990
2.25	80.36	3121	6934	11736
2.50	89.29	3323	7383	12496
2.75	98.21	3624	8052	13627
3.00	107.14	3832	8513	14408

What makes high-moisture grain special — and how to use it for best livestock returns

Dr. E.E. Hatfield

There are several factors influencing the producer's decision on time and method of harvesting grains. If the grain is to be stored and fed near the production sites, there appears to be several advantages in early harvesting.

Physiological maturity is a factor to be considered. According to University of Illinois Blight Report of July 27, 1971, corn ear development is generally as follows:

- 12 days from silk stage to blister stage
- 24 days to advance to the dough stage
- 36 days to the beginning of the dent stage (last stage)
- 12 days to complete denting — "At 60 days after silking, corn is generally physiologically mature — at 30 to 35 percent moisture."

Other factors for consideration are field losses and storage losses. An experiment was reported by the University of Illinois in 1959 in which one variety of corn widely used in central Illinois was planted on 120 acres. The field was divided into strips that contained two rows for harvesting each of four moisture contents — 35%, 30%, 25%, and 18%. Table 1 shows the field losses.

Table 1. Field losses of corn harvested at different moisture contents

Moisture content	35%	30%	25%	18%
Loss (bushels per acre)				
Ear loss (machine and detached)	0.8	0.8	2.7	5.4
Shelled loss (snapping rolls and separation)	2.6	1.6	2.3	2.1
Cylinder loss (on cobs)	5.2	2.4	2.4	0.4
TOTAL	8.6	4.8	7.4	7.9

Losses of grain during storage may be divided into the following:

1. Respiration (aerobic) losses in the silo
2. Fermentation (anaerobic) losses
3. Losses due to discarding unacceptable feed (usually minimal under most conditions in most storage units)

The respiration losses will be directly correlated with the availability of oxygen. These losses will continue as long as oxygen is present and until the pH is drastically lowered. These losses are accompanied by a substantial rise in temperature of the stored grain mass. Excluding the oxygen is the practical method of reducing these losses.

Fermentation losses are due to microbial activity under anaerobic conditions. These losses should be predictable from knowledge of biochemical pathways of the micro-organism involved. The net losses due to silo fermentation is less than suggested if one con-

About the author . . .

E. E. HATFIELD is Professor of Animal Science, University of Illinois, Urbana, Illinois. He received his B.S. in Agriculture at the University of Arkansas, his M.S. in Animal Nutrition from Oklahoma State University, and his Ph.D. in Animal Science from the University of Illinois. Special professional appointments include Chairman, Committee on Standard Reference Diets for Ruminants, Animal Nutrition Research Council.

siders that the carbohydrates, organic acids (mainly malic and citric), and amino acids fermented would undergo similar fermentation in the rumen and assuming the main exogenous end-products of silo fermentation — formic, acetic, and lactic acids — will be used in similar manner as rumen produced formic, acetic, and lactic acids.

Losses due to discarding spoiled or damaged surface material are probably the major losses on many farms. Several factors will influence these losses — type of storage facility, frequency of removing material during warm weather, additives, and others.

As shown in Table 2, a considerable amount of variation in feedlot performance from the different stations has been reported. However, as more data becomes available the advantages of high moisture grains over dry grains is more apparent — particularly the advantage in feed efficiency (units of feed per unit of gain). In most of the trials in which the daily gains were higher for the dry grains, the feed efficiencies were essentially equal or favored the high moisture grains.

The 32 trials with high moisture corn reported in Table 2 show an unweighted average of 7.2% improvement in feed efficiency over dry corn; in the 11 trials with reconstituted high moisture corn the unweighted average was 7.7% improvement over dry corn; in the 11 grain sorghum trials the unweighted average was 16.5% improvement over dry grain sorghum.

Voluntary feed intake is often used as a criterion for evaluating feeds. Although many producers have indicated higher acceptability of high moisture grains over comparable dry grains, the reported data does not indicate as much increase in dry matter intake as one might expect. For example, Oklahoma State reported an experiment in which they compared dry milo with reconstituted milo as the main constituent (84%) of the diet for growing heifers. The feed consumption of the reconstituted milo was not increased, but both daily gains and feed efficiency were improved. Feed efficiency was improved 12.9% with milo stored at 30% moisture for only 10 days, and improvement was 15.6% for either 30% or 38% moisture milo stored 20 days.

The increase feed efficiency with equal or less feed intake is likely due, in part, to increased digestibility.

The accumulation of the performance data summarized in Table 2 increases the level of confidence in high moisture grains (harvested or reconstituted).

High Moisture vs. Dry Barley for Feedlot Cattle

by Dr. Harvey F. Windels

Two separate years' trials with groups of yearling steers fed rations with dry or high moisture barley, and housed either in a slatted floor cold confinement or conventional open pole barn, were conducted at Northwest Experiment Station at Crookston, Minnesota.

Results show that the cattle fed high moisture barley in either type of housing gained faster, and on less feed dry matter, than those on dry barley.

A two-year summary of the feeding trials reveals that cattle fed high moisture barley gained an average of 2.52 lbs. per day, compared with 2.32 lbs. per day for dry barley-fed cattle, an advantage of 8.6%. (See Table 1).

Also, the high moisture barley cattle required significantly less feed dry matter per pound of gain than cattle fed dry barley.

Feed required per 100 lbs. of gain with the high moisture barley-fed animals was 805 lbs. total feed, as opposed to the dry barley-fed animals requiring 888 lbs. of total feed. Daily feed consumption, on a dry matter basis, was not significantly different between the groups. Also, there were no important differences in carcass characteristics.

Economic calculations indicated that cattle fed high moisture barley returned more money per head than those fed dry barley.

Considerable bloat problems were encountered in cattle fed dry barley in both types of housing and in both years. All animals affected with bloat received treatment and none were lost. The moderate to severe cases were treated by stomach tube evacuation of air and/or drenched with poloxylene or mineral oil using a 4-oz. dose syringe. Individual access to mixed hay for a couple of hours relieved the bloat on most, but not all, medium to slight bloat cases.

Bloat proved to be of only minor importance in cattle fed high moisture barley.

Feeding procedures used

The high moisture barley was harvested and stored in an oxygen-limited (Harvestore) structure both years. The first year of the trials, moisture content of the barley coming out of the Harvestore was 39.5%; the second year's crop was lower in percent of moisture at 33.5%. Crude protein (dry matter basis) of the high moisture barley the second year was 15.5%, compared with 12.8% the first year.

The high moisture barley was removed from the Harvestore and rolled just prior to feeding. The dry barley was ground. Complete mixed rations were fed once daily.

When on full feed¹, the cattle were fed 3 lbs. of alfalfa haylage dry matter per head per day and either high moisture or dry barley free-choice.

About the author . . .

HARVEY F. WINDELS is Animal Scientist and Associate Professor, University of Minnesota, Northwest Experiment Station, Crookston, Minn. He was raised on a Minnesota livestock and grain farm, earned his B.S. in animal science and M.S. and Ph.D. degrees in nutrition from University of Minnesota. He is involved in nutritional and management research with feedlot cattle and sheep, including the use of barley, beef topilage, haylage, and other crops.

Table 1. Influence of dry and high moisture barley on the performance and carcass characteristics of yearling steers — two year summary.

Item	Dry barley	High moisture barley	Significance
No. of steers	105	108	
Avg. initial wt., lb ¹	777.2	777.8	
Avg. final wt., lb ²	1092.2	1117.6	
Avg. daily gain, lb ²	2.32	2.52	P .01
Avg. daily feed, lb. dry matter			
Barley	14.8	14.5	
Haylage	4.9	4.9	
Supplement	0.9	0.9	
Total	20.6	20.3	NS
Feed/100 lb. gain, lb. dry matter			
Barley	638	575	
Haylage	211	194	
Supplement	39	36	
Total	888	805	P .01
Carcass characteristics ³			
Marbling score ⁴	5.10	5.22	NS
Conformation score ⁵	13.4	13.4	NS
KHP, %	3.14	3.16	NS
Rib eye area, sq. in.	12.0	12.1	NS
Fat depth, in.	0.63	0.69	P .05
Quality grade ⁶	11.6	11.8	NS
Yield grade ⁶	3.44	3.54	NS

¹Shrink weight

²Adjusted to a dressing percentage of 61.2

³All carcass data adjusted to an equal carcass weight of 676.2 pounds

⁴Marbling scores: 4 is slight, 5 is small, 6 is modest

⁵Conformation scores and carcass grades: 9 is low good, 10 is average good, 11 is high good, 12 is low choice, 13 is average choice

⁶Values near 1 indicate a high yield of boned and trimmed retail cuts and values near 5 indicate a low yield

Advantages of High Moisture Barley

1. No artificial drying expense
2. No field losses due to delayed combining
3. Harvest 5-10 days earlier
4. Can harvest with dew or light frost
5. Reduce weather risks — hail, wind, rain
6. Increase yield — less shattering loss
7. Easier to combine — less powdering and maling
8. Reduced lodging losses — increase cutter bar height
9. Green patches not a problem
10. Weeds are better controlled — cut before mature
11. Harvest wild oats before shattering
12. Decreases competition for new seedlings
13. Eliminate swathing — direct combining
14. Combine more hours in a day
15. Increase after harvest time
16. Less dusty
17. Results in high quality feed — higher protein
18. Better feed conversion
19. No bloat problems
20. No nutritional disorders — very palatable

Hog Scalding vs. Skinning Costs

The pork industry is in a period of transition between scalding and skinning, and within 10 years it appears that everybody will be skinning, providing a few problems can be solved.

This is the belief of at least one expert in the field, and *Meat Industry* queried him and other packers and processors around the country to compare the two methods of removing hair from slaughtered hogs.

Here is how the methods compare in cost and product quality:

- On the basis of capital investment, scalding requires an initial capital outlay of \$563,080 for purchase and installation of equipment to process 600 hogs an hour, whereas the capital investment for skinning is \$135,030. The cost per hog is estimated at \$.047 for scalding and \$.011 for skinning.

- In terms of energy costs, scalding uses large amounts of hot water and natural gas, and the estimated cost for utilities for scalding is \$.054 per hog, compared to \$.019 per hog for skinning.

- In skinning, the loss of drop items like feet, tails, jowls, snouts, ears, and skin for gelatin, represents an estimated \$1.94 per hog. That can be more than offset by the sale value of the hide. If it can bring \$5, there can be a net gain of more than \$3.

- Surface contamination doesn't differ between skinned and scalded carcasses, though the distribution of organisms varies and seems to depend on the degree of handling of various carcass areas by workers.

- The shrinkage of skinned carcasses is extremely low, but this is not necessarily an advantage over scalded carcasses because they take up water in the scalding tank which is later lost during the chilling period.

- Scalding carcasses also cool at a slightly faster rate than skinned carcasses, though the cooling of skinned carcasses is not accompanied by increased shrinkage.

WHO USES WHICH METHOD?

For the packer who has already made the capital investment in conventional scalding, it can be a fast and efficient process which requires less kill floor labor than skinning. It also means that the skin is left on, and this is important to fresh pork operations that process skin-on hams themselves or sell them to others for processing.

For packers who make whole hog sausage, having the whole skin removed is an advantage. It's also an advantage for packers who don't need skins left on because they make boneless products, for they can benefit from energy savings and lesser capital in-

vestments. One of their concerns, however, is with the gouging of fat during pulling so that bellies are damaged for use as bacon.

George A. Hormel & Co. scalds because it is efficient for a big plant, such as its one in Ottumwa, Iowa, and because skin-on cuts have greater marketability.

"There isn't an established market for skinless hams," comments Donald Hittner, manager of industrial engineering for the Ottumwa plant. To justify Hormel's switching from scalding to skinning. "There would have to be adjustments made to meet market requirements. When a big packer sells to others, he sells a board of trade ham. That's what most are familiar with."

Sugardale Foods, Inc., in Canton, Ohio, scalds, though it switched to that method from hide pulling several years ago.

"We used to have two hide pullers out on the kill floor, and that didn't work out very well," says kill floor superintendent Tom Stratil. "There was a big loss of yield and added labor."

One Midwest packer says that if he could build a plant from scratch, he would hot skin. "Because the bulk of the carcass is going to be skinned anyway, sooner or later." He says at his Iowa boning plant he buys hams from the outside and has to take the skin off anyway.

"If you get a combo bin filled with hams on Friday and don't skin them until Monday so that they sit in the cooler over the weekend, the skin stiffens up, and it takes a greater length of time to skin it. If you pull that skin off when the hog is hot, it comes off easily.

"If you're a further processor, you save the steps of skinning individual hams when they're cold, and you're saving and getting a better yield. You lose more fat if you skin when cold," he says.

Jimmy Dean Meat Co. makes whole hog sausage and has hide pullers at both its Osceola, Iowa, and Plainsview, Tex., plants.

"The reason we went into hide pulling," says Vinco Bernard, vice president of engineering and production, "is because we don't want the hide on. We want the increased drop rate from the hide, and it's easier to bone without the hide." The company hot bones hogs.

"In large plants, on a commercial fresh pork operation, some cuts still need to be sold with the skin on," says Bernard. "However, today, if you were to build a new plant, I don't know why anyone would scald. It takes additional labor to remove skin after scalding, and you can only get 80 to 90 cents for the skin, compared to \$5 for a hide."

Gibson Packing Co. in Zanesville, Ohio, is an example of a full line processing plant that switched from scalding to hide pulling. One of the reasons is that, like a whole hog sausage maker, Gibson doesn't need skin on its hams. "The market has changed," says Carl Gibson, "and our market is predominantly going to boneless now."

Two other reasons that Gibson turned to hide pulling are contamination to animals during scalding and the desire to reduce energy consumption. Gibson estimates his energy costs have dropped by one-third since the changeover.

Hillshire Farm Co., New London, Wis., which makes boneless hams, went into skinning more than five years ago. The company scalded prior to that, but Max Kennedy, superintendent of pork operations, says that there were problems with inadequate cleaning — hair not being removed.

Hillshire's volume is 800 to 1100 hogs a day — primarily heavyweight and midweight butchers — but the company also buys hams. "We can't produce enough hams off of our cut line," says Kennedy. "We buy commercial hams with skin on and trim to our own specifications."

Kennedy feels that even though scalding and dehairing use a lot of energy, the method is more efficient on a hog per man hour basis for the big packers. But Hillshire does not intend to be a fresh pork operation, he says, and is satisfied with the 110-115 hogs per hour that it processes now comfortably.

An example of a large processor that has changed to skinning is Farmland Foods which has a Jimmy Dean hide pulling system in operation at its Crete, Neb., plant, and one of the reasons for the change is the energy savings resulting from the lower use of hot water and power equipment, says plant manager Jim Jeffers. The other reason is the savings in capital investment.

LABOR

Labor costs are similar in both processes, according to a study, *Hog Skinning vs. Scalding*, conducted at Purdue University by M.D. Judge, C.P. Salm and M.R. Okos. The study, which compares capital investment, energy costs, drop loss and other characteristics of the two systems, was presented this year at the Meat Industry Research Conference at the University of Chicago.

The study reasons that the skinning procedure probably requires more labor for slaughter and less for carcass cutting, as compared to the scalding process.

The way Donald Hittner looks at it is that the costs of capital investment vs. labor costs constitute a trade-off for Hormel.

There is general agreement among the processors we talked to that skinning requires more labor to prepare a hog for hide pulling, so that on the kill floor alone, scalding is more efficient for a large operation on a hog per man hour basis.

Product losses and credits in skinning	
(Based on \$/hog)	
Feet 3 lb @ \$.16	Losses \$ 48
Tails 0.25 lb @ .13	03
Partial jowls 0.5 lb @ .24	12
Snouts 0.5 lb @ .19	10
Ears 0.5 lb @ .21	11
Fat removed with skin 1 lb @ .20	20
Gelatin skin value 8.0 lb @ .10	80
Belly damage (5-10% incidence)	10
Total	\$1 94
Inedible feet, fat, etc. 5.75 lb @ \$.04	Credits \$ 23
Leather skins	5 00
Total	\$5 28
Net Gain	\$3 29

However, there is also general agreement that there is a labor savings in the cutting room when the skin does not have to be removed. One packer also observes that it is more difficult to remove skin from a chilled carcass than from a freshly slaughtered animal.

There are two double hide pullers at Jimmy Dean's Osceola plant. Vince Bernard, vice president of engineering and production, says that the double puller can process 300 hogs an hour with a total work gang of 11 to 12 men. Two operate the puller, one does front legs and transfer, and the rest operate rotary air knives to do skinning.

Preparation involves removing feet, opening the skin on the fore and hind legs and belly. Rotary air knives are used to skin the front, hind legs, belly and shoulder. The head is skinned out with a straight knife. Then workers skin around the shoulders and head and attach the puller, anchoring the jaw, so that the hide is pulled upwards and away from the carcass, then dropped into the basement where it is trimmed.

The ears, snout and head skin go to rendering. The hide is sold to a broker who will flesh it, dehair it, salt it and freeze the hides in bales.

At Hillshire, workers clear the skin of the hog over the shoulder, break it across the hams, and then attach a chain to the hide puller.

Max Kennedy says the company has 11 men in its skinning and dehiding operations and four in the hide room, and he feels that's not as efficient for a big fresh pork operation as a scalding and dehairing system which can operate at 700 an hour with about 13 men, he estimates.

HIDE VALUES

The value of pulled hides, which can be sold to the leather industry is greater, of course, than the value of scalded skins.

But in order to receive a top price, a pulled hide has to have come from a quality 200 lb. or more animal and must have been removed with a minimum amount of damage.

APPENDIX J Continued

Capital Investments for scalding and skinning

Rate is 600 hogs per hour

SCALDING		SKINNING	
Slaughter			
Scald tank	\$ 49,800	Slaughter	
Dunkers	25,000	Dehider knives (8)	\$ 5,600
Platform	22,600	Hock cutters (2)	4,600
Conveyor (pull through)	27,000	Platforms	2,250
Unshakler	1,400	Skin pullers* (4)	42,000
Dehairer	151,000	Washer and pump	15,000
Hair conveyor	2,500	Conveyor	27,000
Platforms	14,300	Subtotal	96,450
Conveyor (gambreling)	18,000	Installation (40%)	38,580
Singer	19,000	Grand total	\$135,030
Polisher	22,000	*Alternative is four vertical drum	
Platforms (shaving)	2,600	skinners: 12c/hog, 2000 hrs./yr ;	
Rail washer	1,500	10 yrs = \$1,440,000 less main-	
Slide and hopper	4,500	tenance	
Cutting			
Skinners			
Bacon	8,750		
Jowl, fat back	9,750		
Butt (2)	12,200		
Ham (2)	10,300		
Subtotal	402,200		
Installation (40%)	160,880		
Grand total	\$563,080		

These tables were compiled by M.D. Judge, C.P. Salm and M.R. Okos, Purdue University, Lafayette, Ind., for their study, *Hot Skinning vs. Scalding*, presented at the Meat Industry Research Conference, University of Chicago, in March.

The first two years after Carl Gibson switched from scalding to hide pulling, he couldn't find a good market for his hides, but then his by-products outlet found a foreign market — both Europe and Taiwan — and he has been able to receive from \$4 to \$5.50 a hide.

The hide market has fluctuated from \$5 to \$8 each for top hides from 200-240 lb. animals, according to Bernard, and he says most of his company's hides are sold for the garment trade.

Jim Jeffers of Farmland has not seen a hide market as good as the one Bernard describes. However, he does agree that in comparing the two systems, loss of the drop items has to be balanced against the value of the hide.

Scalded skins can also be pulled by means of skinning equipment, and the skin can be sold for use as shoe leather, glove leather, shoe lining, and for hat stock.

Scalded skins produce leather that is 10% thinner and has 10% to 23% less tensile strength than leather from unscalded skins, according to the Purdue study.

However, not all scalded skins are suitable for use in shoe leather, and one study shows that more than 50% of them are not. Most of the reduction of value of scalded skins is due to mechanical damage, such as

Processing costs for scalding and skinning

(Capital outlay and operational costs estimated on a \$/hog base)

	SCALDING		SKINNING	
	Utilities	\$	Utilities	\$
Capital Investment*		.047		.01
Operational costs**				
Water, gal.				
Scalding	2.6			
Dehairing	2.7			
Washing	4.0		22.5	
Cleanup	2.3		0.1	
	9.6 gal.	.002	22.6 gal.	.00
Steam, lb.				
Scalding	3.2			
Dehairing	1.8			
Cleanup	0.3		0.1	
	5.3 lb.	.016	0.1 lb.	.00
Electricity, kw. hr.				
Dehairing etc.	0.24			
Polishing	0.03			
Skin pullers			0.02	
Washing			0.06	
Skinners	0.01			
	0.28 kw. hr.	.007	0.08 kw. hr.	.00
Gas, cu. ft.	13.75 cu. ft.	.024		
Sewage, gal.		.005		.01
Total		\$.101	Total	\$.03

*Assumes 10 yr. equipment life, does not include maintenance.

**Utility costs: water, 25c/1000 gal., electricity 2.5c/kw. hr., steam \$3.00/1000 lb., gas, \$1.75/1000 cu. ft., sewage, 50c/1000 gal.

damage to the skin grain layer caused by scraping to remove hairs retained within their follicles.

Scalding temperatures can also damage the grain layer of pigskins, but this damage can be minimized. Scald temperatures of from 132°F to 137°F are considered safe, though these temperatures are too low to effectively scald during some periods of the year.

"We have to watch scalding temperatures so that we don't scorch," says Donald Hittner at Hormel, "and we would not scald for more than five minutes at a temperature higher than 140°F.

Hormel has a Wolverine full side skinner and sells its skins to Wolverine. The full side skinner skins both sides of a scalded hog and removes the skin in one piece, because the back has not been split all the way through on the kill floor. Thus, the two sides have been kept together through the cooler and the hams and shoulders have been cut off, the loin pulled and the ribs lifted out, the remaining part of the carcass going through the fullside plate skinner.

Sugardale also uses a Wolverine full side skinner, and Tom Stratil says the temperature of the company's 4800 gallon scalding tub is kept at 138°F in order to protect the skins.

SCALDING TANK

The scalding tank is considered a potential source of microbial contamination because of the hair, dirt, feces and other materials contributed by the long line of hogs dipped into the tank.

A 1978 study shows that, judging by microbial counts, the total surface contamination does not differ between skinned and scalded carcasses, though the distribution of organisms varies.

For instance, the total plate count on hams was nearly four times as great for scalded hams as for skinned hams. Bellies were almost equal in total plate count, but shoulders reflected four to five times the total plate count for skinned shoulders as for scalded ones.

The amount of surface contamination seemed to depend on the degree of handling of carcass areas by workers.

"We feel ultimately that USDA will outlaw scalding," says Vince Bernard, "because in plants you can't intermingle the hogs until you get to final inspection, but at the same time they let you dip 3000 pre-rigor hogs in the same vat of water. This water can be ingested into the animal's lungs, and if it gets into the lungs, it can reach the internal organs."

GOUGING

One of the problems in hide pulling is in yield loss. As the hide is pulled upwards from the animal, sometimes patches of fat are pulled loose, especially in the flank of the belly.

Even with good preparatory trimming and follow-up as the hide is removed, globs of belly still can be torn off.

There is no problem with gouging, says Bernard, if the animal is properly prepared for hide pulling.

Hillshire acknowledges there is a problem with gouging. "We will have gouges in our bacon production," says Max Kennedy, "and we will have lighter weight bellies. But we trim our bellies severely. We trim to meet the width specifications of our slicing machine.

A recent development in hide pulling is Wolverine's new drum skinner for unscalded hogs. According to John Krause, who helped develop the machine, it skins hogs so closely that anywhere from 10-20 lbs. of fat normally left on the skin is kept on the carcass. The rate is 5-10 lbs. for butcher hogs.

This skinner is being used at three plants in the Southeast. Kentucky Sausage Co., Nashville, Tenn., (see story in this issue) reports that the company is getting no fat on its hides now. They also say that about the same amount of labor is needed to operate

the drum skinner as the hide puller it replaced at the company's plant.

The drummer skinner, which slants at an 8° angle, revolves against a carcass to peel off the hide. There is a ditch that runs the length of the drum, and into it is inserted a seven-inch flap that has been skinned the length of the hog on the belly side.

This long flap is gripped in the ditch by grippers which work on air cylinders that pull. The clamp bar is closed, and the drum rotates past a dull scraper. Behind the scraper is an air bag like a fire hose that maintains pressure on the scraper to move it in close to the drum or away from it depending on the thickness of the skin that is being removed. When the cycle is completed, the skin drops.

It operates similarly to a European skinner used in Poland (see April '78 MI, page 25), but removes the whole hide, not just the croupion.

CUTTING

Butcher methods have also been dictated in scalding by the fact that the skin is left on the cuts.

This, when the skin is removed, cutting procedures need to be adjusted in operations that cut primals.

The pull the loin, for instance, Carl Gibson says he uses four hooks instead of two to compensate for the fact that the skin has been removed and can't be used as a stronger anchor than fat.

One advantage that he sees is that he has been able to take a couple of men from cutting and put them on the kill floor. Because the skin has already been removed — the ham capped, the rind removed from the bacon, no feet to work on — there is labor needed in the cutting room.

Like Gibson, Hillshire is not a fresh pork operation, so it is an advantage to have the skin removed.

Pulling the loin is more difficult now, Max Kennedy agrees, because the skin is not on the fat back to hook onto a conveyor. However, they maintain their pace of 135 hogs per hour by basically pulling the loin the same as before, the weight of the hog holding it down, and the worker using a knife guard and pulling it against the belly guard.

Since Hillshire uses its fresh pork primarily for further processing, the company bones all of its picnics, trims bellies severely and uses the fresh trimmings for sausage. Bacon is trimmed to conform to the company specifications, and the trimmings are recovered. The firm also is a large buyer of trimmings.

THE FUTURE

The industry is in a period of transition between scalding and skinning, according to Charles Wallace, senior technical consultant for ITT Gwaltney, Inc., Smithfield, Va., a company that scalds.

He feels that in 10 years all hogs will be skinned, because of the savings in capital outlay and energy costs, but in the meantime the innovators in fresh pork operations will have to deal with the problem of marketing skinless hams. He also sees yield loss, caused by gouging, especially in the belly, as a problem, because it reduces the value of fat and can damage bellies so that they can't be used for bacon.

What he thinks slows down the big fresh pork operations from switching to skinning from scalding is that even though the boning of hams has increased dramatically so that the need of skin-on hams is

lessening, the big packers still sell their hams to other plants and the established market is for skin-on hams.

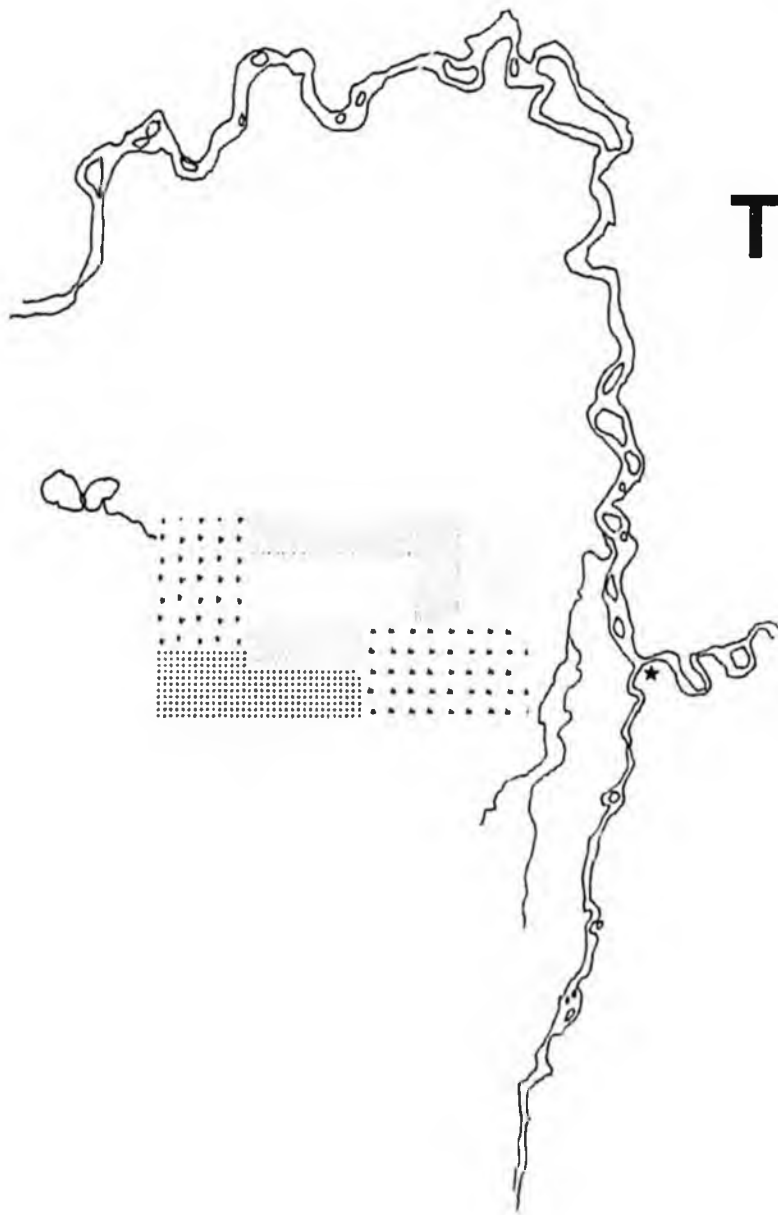
"The pioneer is likely to find himself with a marketing problem to overcome -- the resistance of a buyer who wants to buy a ham to smoke, and he doesn't want to smoke it derind." There's also the price resistance in the market place.

"Skin is worth 10 cents a pound, and the housewife should be very happy to be rid of it, but when she goes to buy a smoked ham, bone-in, she wants that rind on the way it's looked to her for years. Plus the fact that she won't like being told she's got to pay more money for it because the skin is off."

The transition will be aided by the increase in boneless hams and more convenience cuts, he feels.

NENANA

Agricultural Transportation Systems



Project No. AG101

FEBRUARY, 1981

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ATC

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NENANA AGRICULTURAL TRANSPORTATION SYSTEMS

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CHAPTER I
INTRODUCTION

Transportation is an important aspect in rural development. To quote current research:

"If rural development is to proceed in an orderly and efficient manner, adequate performance of the transportation infrastructure and regulatory structure is mandatory. Highway, water, rail, and air transportation investments should be closely coordinated with those state and federal agencies directing the various rural development programs."¹

Efficient and competitive routing of goods to and from a rural center is the key in providing social and economic benefits to that area. A well designed and constructed farm to market road network is essential in any agricultural development as it will be servicing the aggregation of grain, machinery, fertilizer, feed, seed and chemical hauling.

This report provides a proposed roadway network in the Nenana agricultural area starting with an initial phase of two townships expanding to several townships in future phases. Commodity routing systems in the Nenana area were examined to maintain a flexible, multi-modal system in the area. Alternative processing site locations are compared in relation to the City of Nenana, the initial phase of the project, and existing commodity routing systems. Cost analyses were done on alternate access routes to the initial area and the farm to market transport system.

Roadway development and construction includes an examination of soils, land ownership, parcelization and climatic conditions. Alternative roadway section designs are based upon the location of gravel, and wet or permafrost areas. A roadway layout is proposed that takes advantage of section line easements and allows for flexibility in final parcelization. Estimated costs for construction and maintenance of this layout are also presented.

¹Richard K. Hart, Transportation and Rural Development: Some Policy Considerations.

It is our understanding that the project development schedule is for land disposal in 1981 or early 1982 at the latest. In order for the transportation system to be in place, construction must occur in the 1981 construction season. For this to happen, the project planning and design must be fast tracked. Because of this, the consultant team has initiated permit procedure for field work this winter and early spring. This includes bridge-borings, site surveys and borings, plus material site investigations.

Below is a list of total costs for the Nenana Phase I access road. These costs include engineering and construction costs, and are reasonable order-of-magnitude costs for work as of Spring 1981. When more thorough soil testing is complete, costs may be actually lower.

**Three (3) bridges, 23 miles of primary access road (secondary standards) and 14 miles of secondary and tertiary roads connecting farm lots:	\$ 15,319,700.00
**Right-of-way Aquisition:	\$ 30,300.00
**Contingency:	\$ 1,840,000.00
**First Year Maintenance:	\$ <u>115,255.00</u>
T O T A L	\$ 17,305,255.00

CHAPTER II
OVERVIEW OF COMMODITY ROUTING SYSTEMS

There are three potential commodities being considered for the Nenana Agricultural Area. Studies to determine the viability of livestock raising and vegetable production are presently being undertaken. However, with the imminent success of the Delta Barley Project in mind, grain production must be given the major consideration. Thus, of the three (3) alternatives, grain production will be considered in this report as the primary user of any routing system established. This is due in part to the information available concerning grain production in Alaska (Delta Junction); the predominance of Class III soils in the project area, which are well suited to grain production; and the present lack of information regarding vegetable and livestock production.

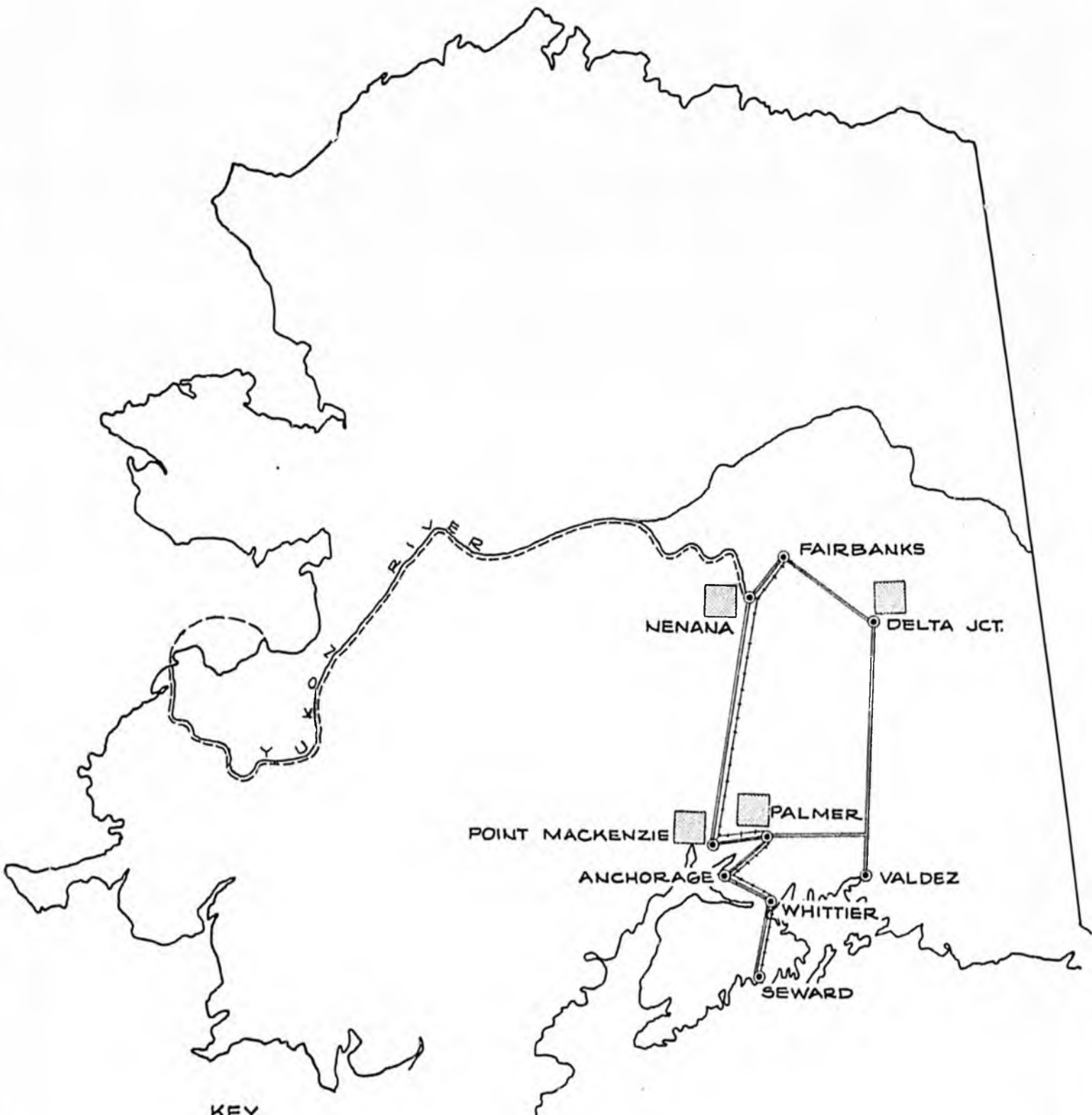
This section will provide an overview of the routing systems that exist in the Nenana area. To remain within the scope of the overall report, no analysis of routing economics will be undertaken here. Rather, the focus will be on how the roadway network and processing area within the project might impact the various routing systems. It should be noted however, that the agricultural industry relies on economically competitive transportation modes. Thus, every effort should be made to maintain maximum flexibility of the routing systems available to various agricultural areas in Alaska. Figure 1 illustrates the commodity routing systems available to various agricultural areas in Alaska. Nenana has a distinct advantage in being on all four modes of routing. This, coupled with its central location within the state, makes it a focal point for the distribution of agricultural goods both within the state and for export.





Though there are four systems available for use (air, truck, rail, and barge), raw agricultural goods generally move using the bulk facilities, low operating costs, and proximity to markets available on truck and rail modes.

1. Truck Routing

Routing agricultural commodities by truck is most efficient over short hauls and when backhaul possibilities are definite. Thus, truck routing

FIGURE 1
COMMODITY ROUTING SYSTEMS



KEY
HIGHWAY 
BARGE 
RAILROAD 
AGRICULTURAL AREA 

would most likely be used in local/intra-state distribution of vegetables grown in Nenana and livestock processed there, having Fairbanks and Anchorage as the two major points of transfer. The hauling of grain by truck, while possible, is not likely due to the large number of trucks needed to haul the grain and the more economical use of rail in hauling such bulk quantities.

Starter herds for livestock would be most effectively transported by truck up the Alaskan highway. Ultimately, red meat for export would be transported by truck to Fairbanks International Airport and flown to foreign markets.

2. Rail Routing

Routing of agricultural commodities by rail is most efficient in bulk handling and long hauls due to its low operating costs and established routes. Currently, problems exist in the availability of equipment to handle grain. As agriculture continues to develop in Alaska basic routing necessities such as these will become economically viable and therefore these are seen as only initial or short term problems.

If fertilizer is to be brought to Nenana from plants on the Kenai, the use of truck routing is most efficient. There is only one transfer required in this mode while there would be three in the rail mode. Rail would be most effective in bringing fertilizer produced in the Lower 48 to Nenana as there is a direct rail link between most ports and Nenana.

Due to high construction costs involved in establishing new rail lines, (\$1.4 million/mile) no additional routes are seen in the immediate future and short spurs into the agricultural area seem unlikely at this time.

3. Barge Routing

Though barge routing has low operating costs and relatively large bulk handling capacities, certain restrictions make the use of this mode unlikely in the routing of grain for export. There is potential local

routing of fresh and processed vegetables, processed red meat, and some grain.

Three restrictions to barge routing of export grain are the short season available to both barge operation and agriculture, which often times are not compatible, the more feasible routing of grain by rail, and the difficulty in establishing a scheduled shipping route into the St. Michaels area.

4. Local Air Routing

At the present time, Nenana Air Service, Inc., is the only scheduled air service based in Nenana. They fly supplies to Tanana, and offer charter services to other communities in the bush. Alaska Central Airways, Inc., uses Nenana as a flag stop on flights to Galena and Tanana. It is possible that air service could provide various bush communities with the agricultural commodities grown and processed in the Nenana area (primarily vegetable and red meat).

5. Port Facilities

Currently, the Alaska Agricultural Action Council has Requests for Proposal out to various ports in Alaska with the intention of establishing a permanent facility for the exploration of Alaskan produced grains. Appendix 1 is a copy of the RFP sent to Anchorage, Palmer, Seward, Valdez, and Whittier. Seward was to be utilized for the 1980 barley crop from Delta Junction, though due to a shortened harvest season, no grain was exported this year.

CHAPTER III
PROCESSING AREA LOCATION

Any project area impacts on the routing systems center on the location of a processing area as this is where the major unloading, loading and any processing and packing would take place. To maintain the flexibility desired, this processing area should be located where all routing systems are readily available, or to somehow allow for efficient routing of commodities. The end three locational concepts were developed for the processing area and presented below. Advantages and disadvantages for each concept are identified and impacts on existing routing systems discussed. These should be addressed in making a decision on the location of the area.

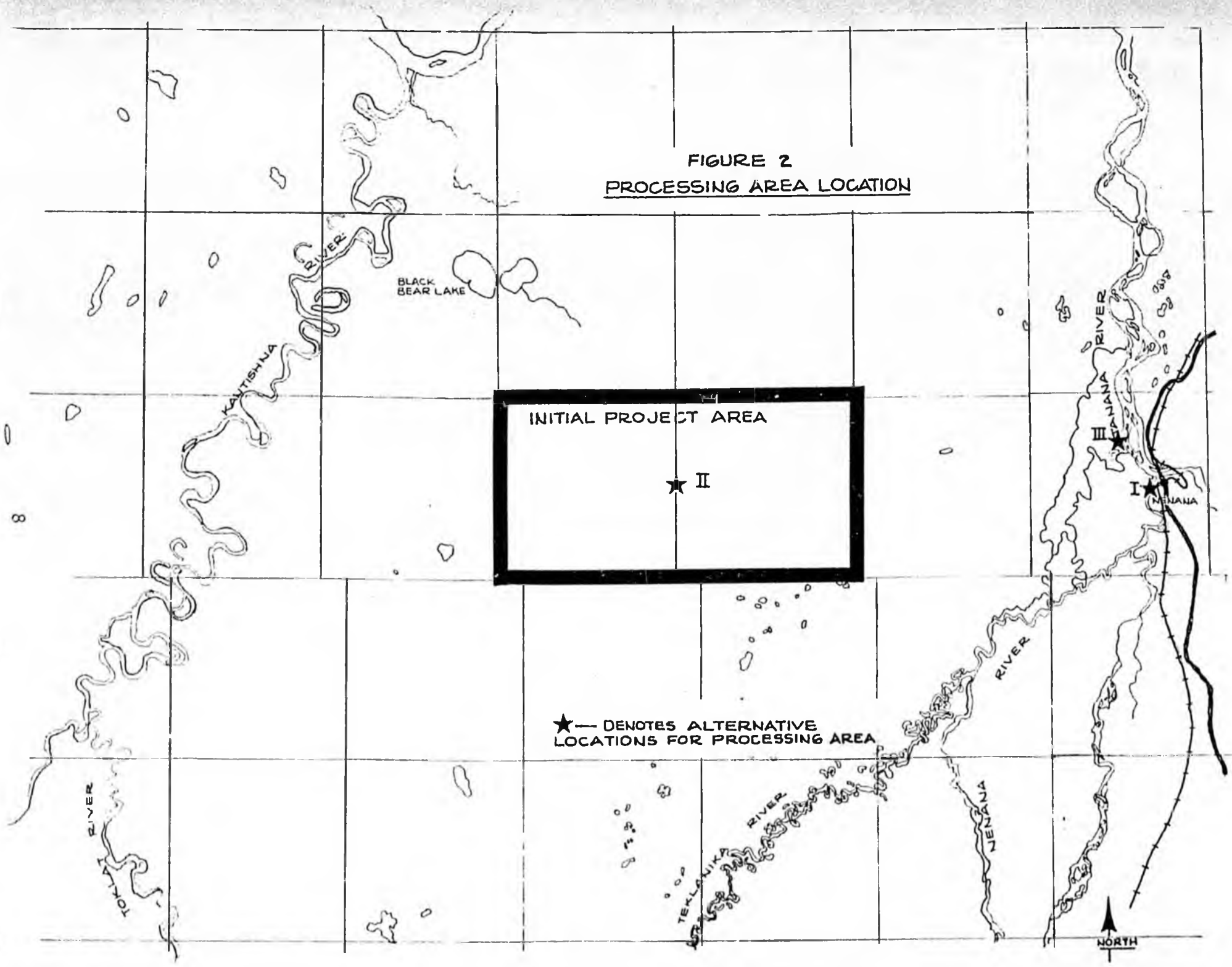
1. Concept I - Processing Area in City

Figure 2 illustrates a possible processing area in, or adjacent to, Nenana. This location is ideal from a transportation standpoint as all modes of routing are available within a corridor, meaning virtually no capital improvements to reach the area, the area is close to the residences of people who would be working in the processing area; and a source of water is close at hand for processing purposes. Impact from possible noise, smell, and air output could pollute the surrounding area and cause ice fog problems for the airport, though wind data indicates that the direction of prevailing winds might mitigate any air pollution problems within the community boundaries. A potential flood hazard exists due to the areas' proximity to the rivers; and soils maps indicate heavy permafrost in some areas.

2. Concept II - Processing Area Centered in Project Area

In this concept, the processing area would be located along a rail spur in the center of the project (Figure 2). This would cut down the distance between the field and the processing area; reduce the area's impact on the community of Nenana; and, if the spur were to connect Nenana and Tanana, it would create another access to the Tanana area and reduce travel time for

FIGURE 2
PROCESSING AREA LOCATION



INITIAL PROJECT AREA

★ II

★ III

★ I

★ — DENOTES ALTERNATIVE
LOCATIONS FOR PROCESSING AREA

NORTH

8

commodities traveling by barge. However, this concept would entail considerable capital expense in terms of a transportation corridor linking the processing area with the existing modes; water would not be as readily available for industrial use; commodities, if shipped by barge to the final destination, would have to be handled twice (load rail/load barge); and locating the area in the center of the project would take up a considerable amount of valuable agricultural land. Workers driving to the area pose potential traffic congestion problems on the bridge and main roads, and the commuting cost is the largest as this location is the furthest from Nenana.

3. Concept III - Processing Area Downstream from Nenana (Figure 2)

In this concept the processing area would be located approximately a mile down the Tanana River from Nenana. Being a distance from the community would alleviate possible incompatibility and pollution problems associated with being near other activities. Locating the area here would allow for only a moderate capital investment in terms of a transportation corridor. All modes of routing could still be available; though, as the major expense in linking the areas with the main rail system would be a railroad bridge across the Nenana River, an expenditure of this magnitude is unwarranted unless the spur continued on to the community of Tanana.

CHAPTER IV
PRELIMINARY ROADWAY NETWORK

Before establishing a roadway network for the project area, several factors were reviewed which affect its layout. Soil in the area was reviewed for its agricultural capability and the location of permafrost and bogs. Land ownership was reviewed to determine location of state-patent lands and boundaries of other ownership which might affect roadway layout, (easements and rights-of-way are discussed in Chapter VII). A parcelization scheme was put together based on agricultural capability of the soil and present land ownership.

Various phases of road development are proposed linking the project area with Nenana and the Parks Highway at Rex. The initial phase would provide access from the project area to a central processing point and loading point in Nenana (as discussed in Chapter III). Other phases would continue expansion into areas adjacent to Phase I and would include the development of a road to Rex. Layout, design and estimated costs of this development are discussed in this section.

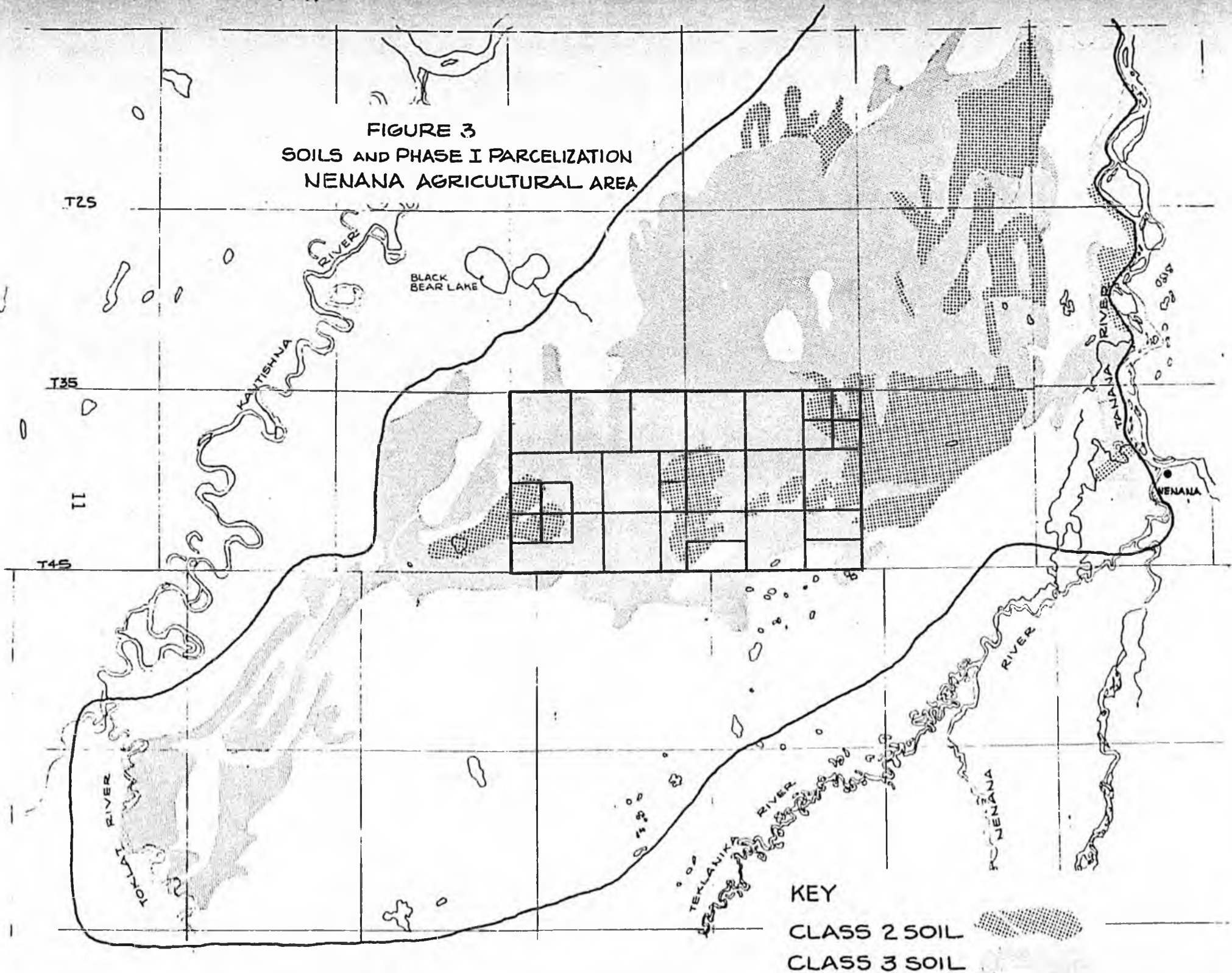
1. Soils and Parcelization

Figure 3 indicates the soil characteristics in the project area. Class II and III soils are highlighted and are the only soils considered adequate for agricultural production. Class IV and below are being considered for grazing purposes. Areas of permafrost and bog are also identified, as these areas must be avoided both in agricultural activities and roadway construction.

It has been recommended that Class II soils be put into parcels of 640 acres and under for purposes of vegetable production and Class III soils into parcels of 2,560 acres and over for purposes of grain production.¹

¹Interview with Bob Pollock, Agricultural Action Council, October 8, 1980.

FIGURE 3
SOILS AND PHASE I PARCELIZATION
NENANA AGRICULTURAL AREA



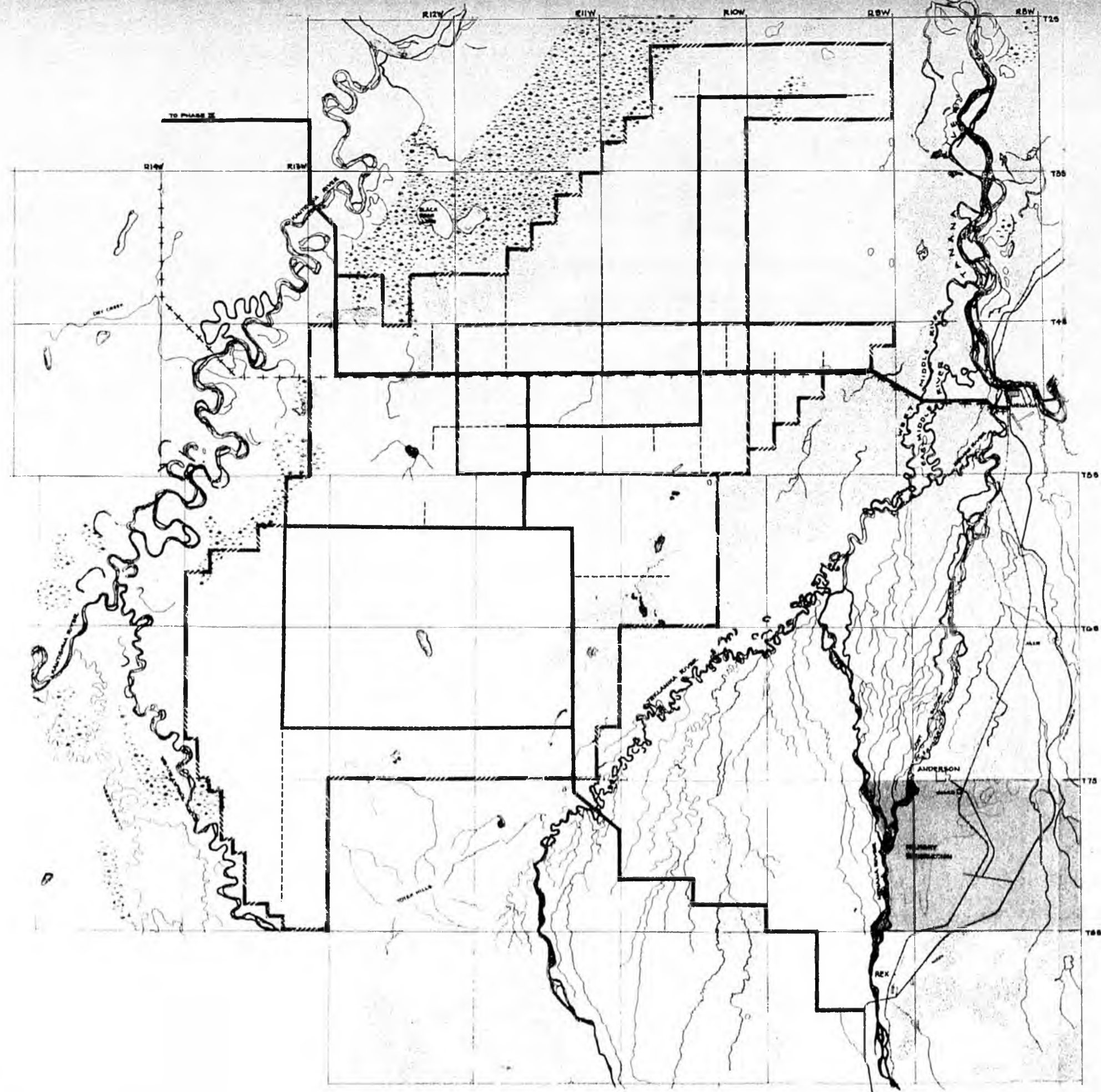
It was also assumed that several small lots (5-10 acres) would be made available to increase the population base and reduce utility costs. Figure 3 illustrates a possible parcelization of the initial project area based on the above information.

2. Layout

Figures 4 and 5 illustrate the proposed roadway network providing access to the initial phase of the project. This network attempted to follow section lines for two reasons: First, to take advantage of section line easements; and second, parcelization will most likely be in aliquot parts. This roadway layout is flexible in that it can be modified fairly easily once the final parcelization is made. This network also lends itself to future branching out from the initial phase in a wheel and spoke manner. Collector and feeder roads were laid out to provide access to parcels and where traffic was estimated to be primarily local.

3. Roadway Design and Estimated Costs

Preliminary soils studies indicate a more economical alternative than the standard pit borrow method of building roads may be utilized for the Nenana Agricultural Project. The combination of minimal overburden with suitable structural material directly beneath lends itself to the roadside borrow concept of construction. This method utilizes the structural material from within the right-of-way to build the road, eliminating the more expensive remote borrow-haul method. The organic overburden is stripped and stockpiled at the edge of the right-of-way for use as backfill to bring the sideslopes and ditches to grade. This method of construction will require rights-of-way in excess of the 100 foot section line easements that may be available. In areas where adequate right-of-way is not available or where pockets of unsuitable structural material exist, the pit borrow method will have to be utilized as an alternate construction method. Tables A and B show estimated 1981 cost comparisons indicating that approximately \$35,000.00 per mile may be saved by utilizing the roadside borrow method of construction. Figure 6 illustrates typical roadway sections for all types of roads in the project using both alternatives



LEGEND

PHASE I - 46,080 ACRES
 PHASE II - 256,000 ACRES

ROADS
 ARTERIAL
 COLLECTOR
 FEEDER
 RAILROAD

AREAS OF LOW RELIEF AS INTERPRETED FROM AERIAL PHOTOGRAPHS - POSSIBLE ICE LENSES.

SWAMPS AS PORTRAYED, INDICATE ONLY THE WETTER AREAS, AS INTERPRETED FROM AERIAL PHOTOGRAPHS - POSSIBLE ICE LENSES.

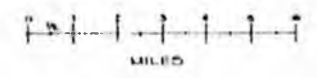


FIGURE NO 4
 FEBRUARY 1981

LAYOUT DRAWING OVERALL PROJECT ROADWAY - NENANA		
SCALE: 1" = 240'	APPROVED BY:	DRAWN BY: WHALLEY
DATE: 2-10-81	REVISION: 2-10-81	
Alaska Transportation Consultants, Inc.		
SHEET NUMBER		SMT 1 B3

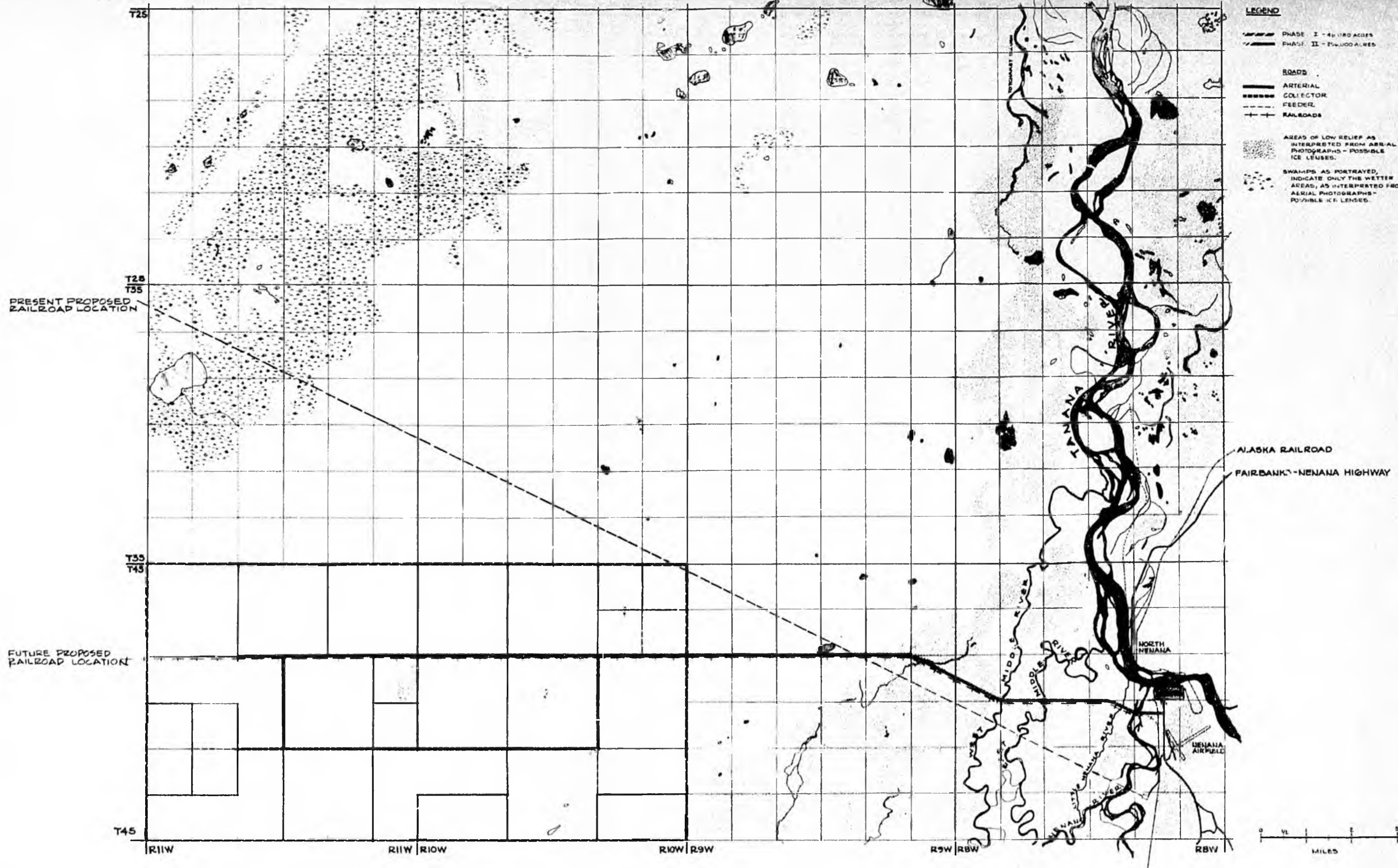
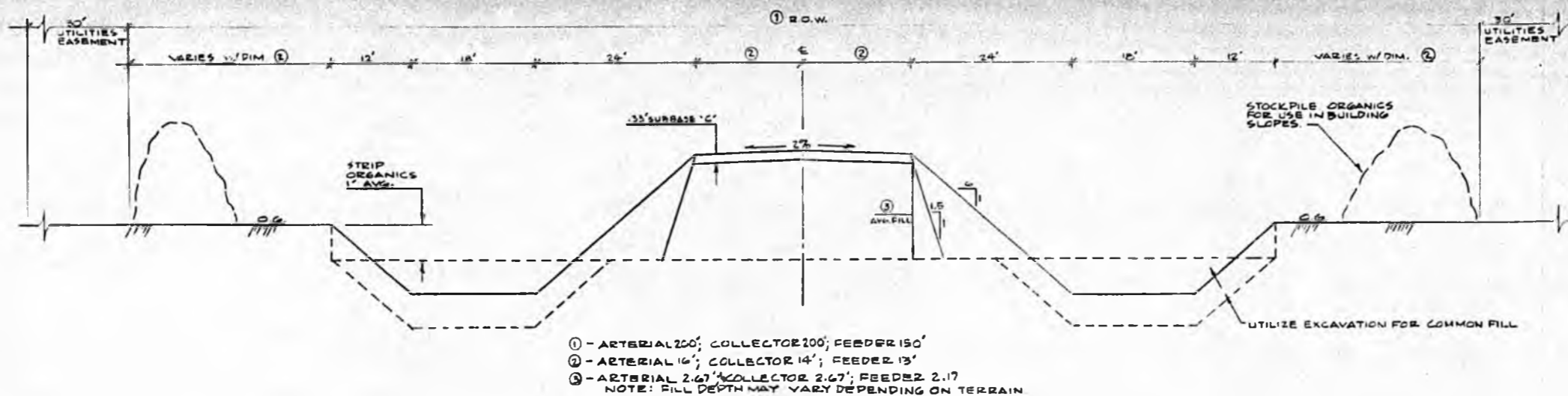


FIGURE N&S

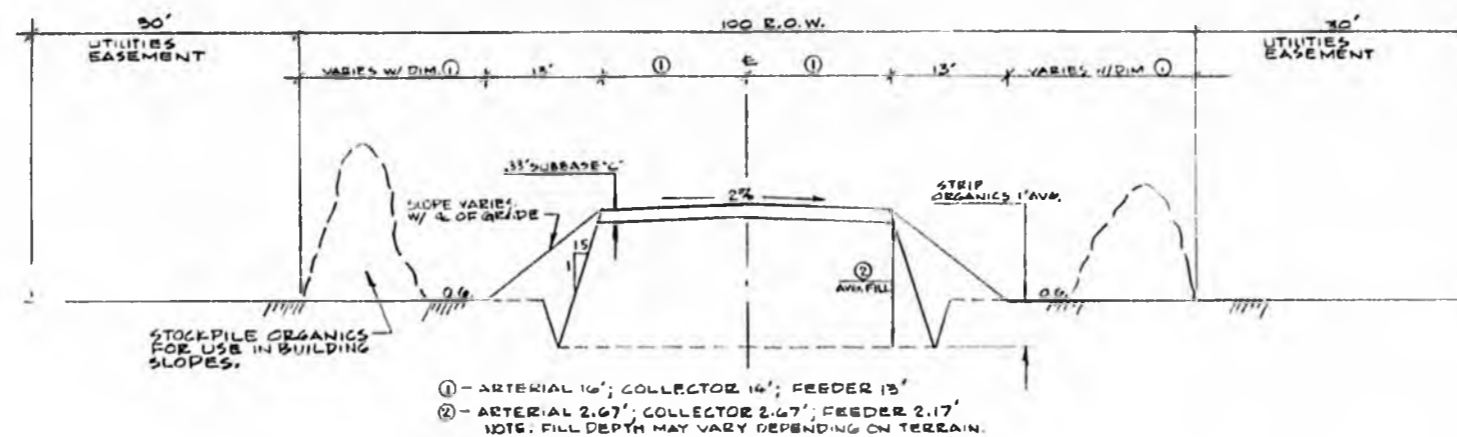
FEBRUARY 1981

LAYOUT DRAWING INITIAL PHASE ROADWAY SYSTEM NENANA		
SCALE: 1" = 1 MILE	APPROVED BY:	DRAWN BY: WHALEY
DATE: 2-10-81		REVISION: 1-10-81
Alaska Transportation Consultants, Inc.		
		DATE: 2-2-81

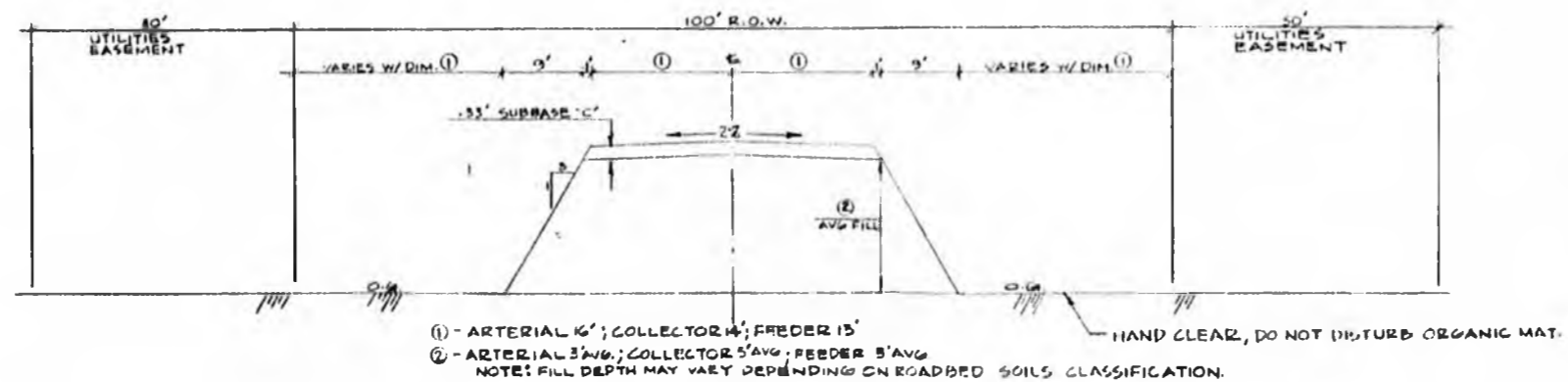
**GENERAL
NOTES**



TYPICAL FARM ROADSIDE BORROW
 SCALE: HORIZ. 1"=10'; VERT. 1"=2'



TYPICAL FARM PIT BORROW
 SCALE: HORIZ. 1"=10'; VERT. 1"=2'



TYPICAL FARM UNSTABLE ROADBED PIT BORROW
 SCALE: HORIZ. 1"=10'; VERT. 1"=2'



FIGURE NO. 6

FEBRUARY 1981

SECTION DRAWING NENANA
 TYPICAL ROADWAYS

DRAWN BY: STATION
 DATE: 2-10-81
 APPROVED BY:
 REVISED: 1-10-81

Alaska Transportation Consultants, Inc.

SHT. 3 OF 3

as well as a typical section for roadway through unstable areas or permafrost. The proposed gravel road system within the Nenana Agricultural Project will be quite similar to the existing gravel roads that service the Delta Barley Project with respect to usage and climatic influences. State Department of Transportation figures indicate that the Fiscal Year of 1979-1980 average maintenance cost per mile per year for 41.36 miles of gravel road near Delta was \$2,490.00. Assuming a 25% inflation factor from 1980 to 1982, surface maintenance and snow removal costs for gravel roads in the Nenana Agricultural Project should average approximately \$3,115.00 per mile for the Fiscal Year of 1982.

TABLE A

TYPICAL CROSS SECTION QUANTITIES - PIT BORROW

		UNIT PRICE	COST/MILE
Cleared Grub	100 LF	\$2,000/acre	\$ 24,242.42
Unclassified Exc.	41.5 sq.ft.	\$2.50/yd.	\$ 20,288.89
Borrow	104.1 sq.ft.	\$3.75/yd.	\$ 76,340.00
Subbase "C"	10.83 sq.ft.	\$19.75/yd.	\$ 1,827.27
Side slopes	35.28 sq.ft.	\$2.50/yd.	\$ 17,248.00
Seeding	68 LF	\$11.75/1,000 sq.ft.	\$ 4,218.72
18" Culverts (82 LF)	1 pr. 2500 ft.	\$35.00/LF	\$ 6,061.44
Culvert markers	2 pr. 2500 ft.	\$50.00/EA	\$ 211.20
Monument cases	4/miles	\$200.00/EA	\$ 800.00
Open borrow pits	1 pr. 2 miles	\$64.60/EA	\$ 3,230.00
Road Signs	10 sq.ft/mile	\$40.00/sq.ft.	\$ 400.00
		<u>Subtotal</u>	\$ 194,868.55
Dust control		\$7.50/1,000 gal.	\$ 550.00
Equal Employment Opportunity		N/A	\$ 100.00
		<u>Subtotal</u>	\$ 194,868.55
Contractor Engineering (5%)			\$ 9,775.93
Contractor Costs		<u>Total</u>	\$ 205,294.48
Consultant Engineering (20%)			\$ 41,058.90
		<u>Total</u>	\$ 246,353.38
Assume 25% inflation 1979-1981			\$ 307,941.72
		<u>Use</u>	\$ 310,000.00

* rounded numbers

TABLE B

TYPICAL CROSS SECTION QUANTITIES - ROADSIDE BORROW

		UNIT PRICE	COST/MILE
Cleared grub	200 LF	\$2,000/acre	\$ 48,484.85
Unclassified exc.	132 sq.ft.	\$2.50/cu.yd.	\$ 64,533.33
Subbase "C"	10.83 sq.ft.	\$19.75/cu.yd.	\$ 41,827.27
Seeding	168 LF	\$11.75/1,000 sq.ft.	\$ 10,422.72
18" Culvert (92 LF)	1 pr. 2500 ft.	\$35.00/LF	\$ 6,800.64
Culvert markers	2 pr. 2500 ft.	\$50.00/EA	\$ 211.20
Monument cases	4/miles	\$200.00/EA	\$ 800.00
Road signs	10 sq.ft./mile	\$40.00/sq.ft.	\$ 400.00
		<u>Subtotal</u>	\$ 173,480.01
Dust control		\$7.50/1,000 gal.	\$ 550.00
Equal Employment Opportunity (EEO)		N/A	\$ 100.00
		<u>Subtotal</u>	\$ 174,130.01
Contractor Engineering (5%)			\$ 8,706.50
Contractor Costs		<u>Total</u>	\$ 182,836.51
Consultant Engineering (20%)			\$ 36,567.30
		<u>Total</u>	\$ 219,403.81
Assume 25% inflation 1979-1981			\$ 274,254.76
		<u>Use</u>	\$ 275,000.00*

* rounded numbers

CHAPTER V
STREAM CROSSINGS

The roadway network which will serve the agricultural development in the Tanana Valley will originate in Nenana. Nenana has rail, highway, and river transportation facilities, and is the logical focal point for this transportation link.

Direct access to Nenana does require a major river crossing structure over the Nenana River, as well as several other smaller structures for the West Middle and East Middle Rivers and for the Little Nenana River. Since Nenana will be the origin and destination for much of the traffic generated in this valley, the optimum cost benefit ratio for users would dictate that the river crossing be placed in close proximity to Nenana.

A reconnaissance of the Nenana River Valley upstream from its junction with the Tanana River was made by air. The general mapping of the region was reviewed and using the air reconnaissance and the mapping, it is possible to determine the general characteristics of the river in this area. For an extended distance upstream from the river junction, the Nenana River flows through a broad, flat flood plain. Generally, the stream is highly braided, with evidence of a shifting stream occurring through the years. There is evidence that the erodable nature of the river valley, coupled with periods of high stream flow, due to the source of the stream in mountainous terrain, results in frequent shifts in the river course and in general instability of the river channel.

Although it is not clear cut, there appears to be some higher degree of stability of the river in the vicinity of its junction with the Tanana River. Because of the general development in this region, some minor bank control has been done in the past. Future development of this area would warrant additional stabilization measures in the vicinity of Nenana, and these measures would not only benefit the community, but could also serve to protect the roadway link to the Tanana Valley.

Limited geological information is available for the area. It is assumed that the river is of sufficient size for a thaw bulb to exit in the

general vicinity of the river. Generally, it is understood that unconsolidated gravels and sands which are an outwash from the mountains prevail through the area. Since these underlying materials are unconsolidated, it is anticipated that piles will be required for the foundation support. In accordance with local practice and also as a general appropriate application, it is anticipated that steel H piles will be used for all foundations. Soil borings will be required at the location of the substructure units along with a geotechnical report to more accurately identify actual insitu conditions.

At the West Middle and East Middle River and at the Little Nenana River, it appears that the stream flow is minimal. Thus, there is a possibility that permafrost does exist in these locations. The presence of permafrost would be determined by future soil borings.

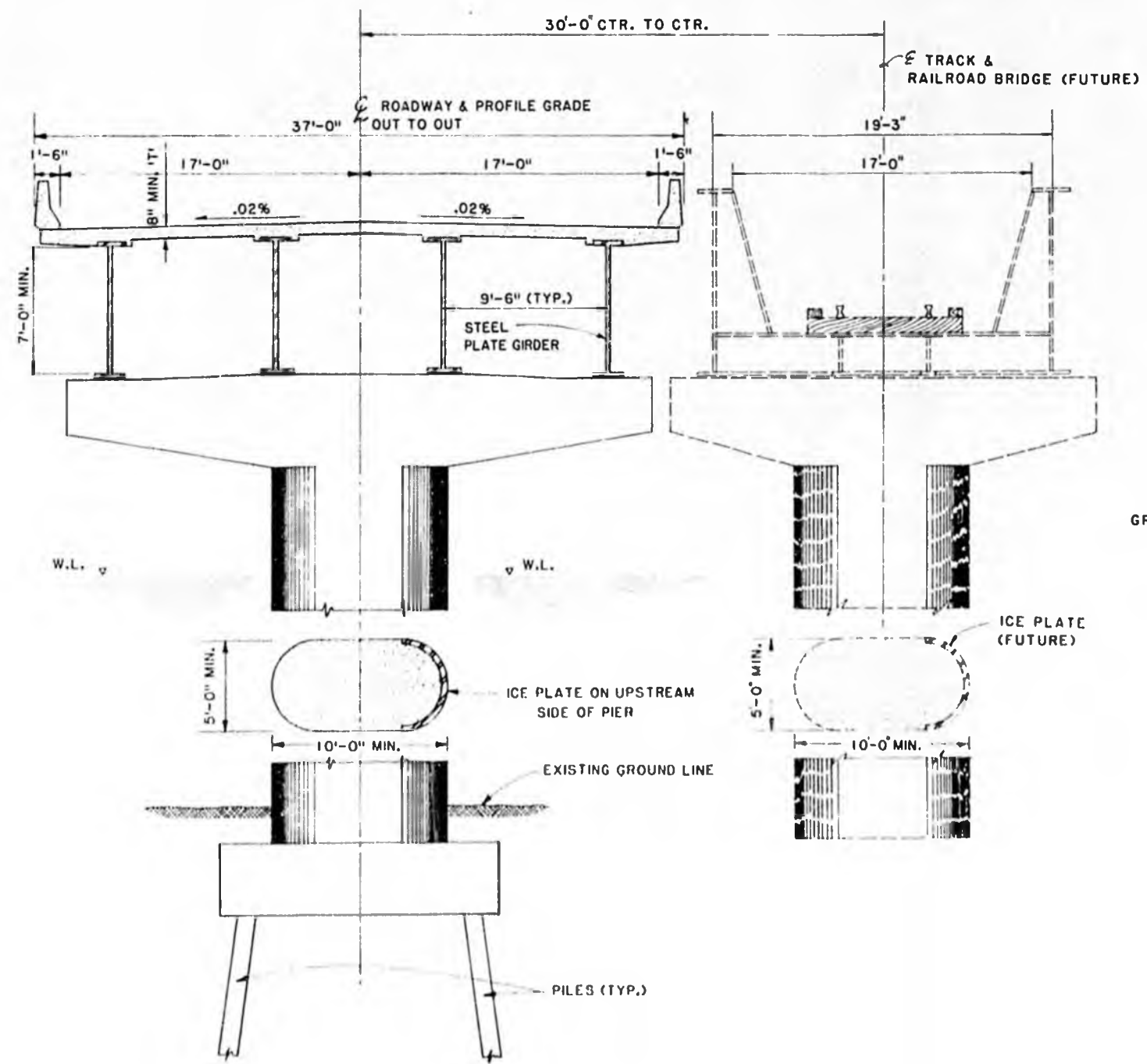
There is not a gaging station in the vicinity of Nenana on the Nenana River and as a result, there is limited hydrological information available. Generally, the approximate ground elevation of Nenana is 351.0 feet. A high water elevation on the Tanana River at the railroad bridge is 358 feet for a 50 year flood. The proximity of the bridge crossing to the railroad bridge justifies the use of this elevation for the high water elevation in the development of the bridge concept plan.

A tentative location for the river crossing has been set at a location approximately 3,000 feet upstream from the Tanana River. This location will permit the roadway to connect with Tenth Street, which has been extended by the City across the railroad. At this location, the river channel is relatively well defined and a crossing can be made without skewing the structure, which will optimize the structural length and result in minimum costs.

The proposed structure is a three span structure with a length of 560 feet having spans of 172'-6". 215'-0". 172'-6". (Figure 7,8) The superstructure consists of four steel girders using composite action with a concrete deck. The concrete deck has a clear roadway width of 34'-0" with concrete barrier curbs.

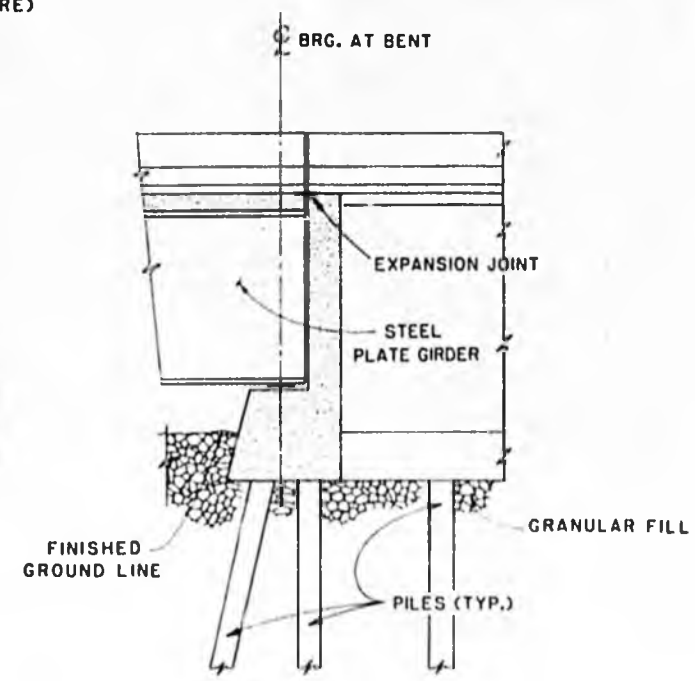
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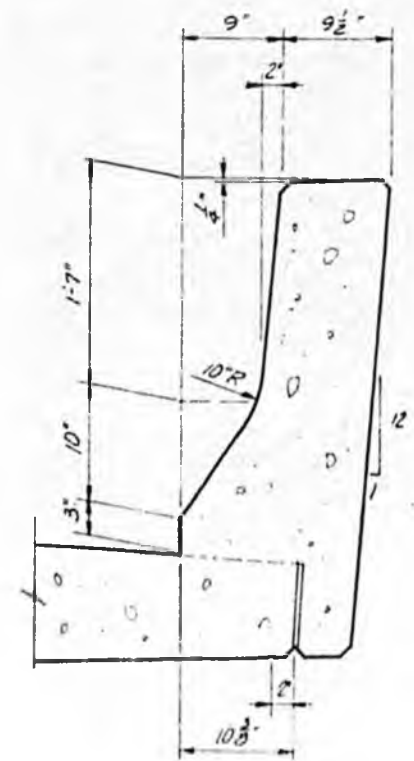
TYPICAL PIER ELEVATION

SCALE: 1/4"=1'-0"



TYPICAL BENT SECTION

SCALE: 1/4"=1'-0"



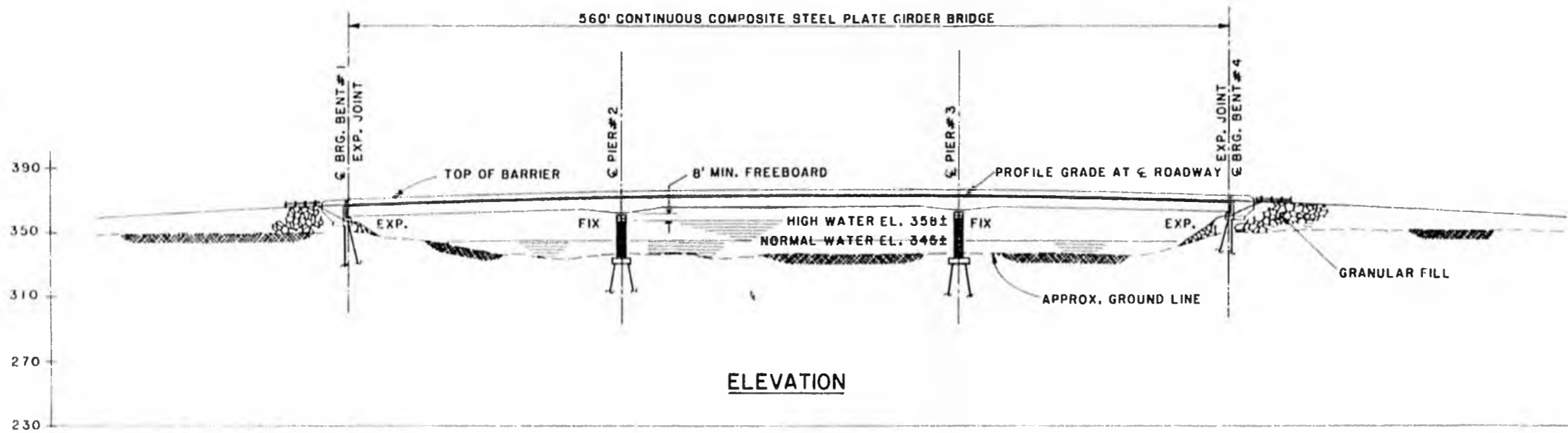
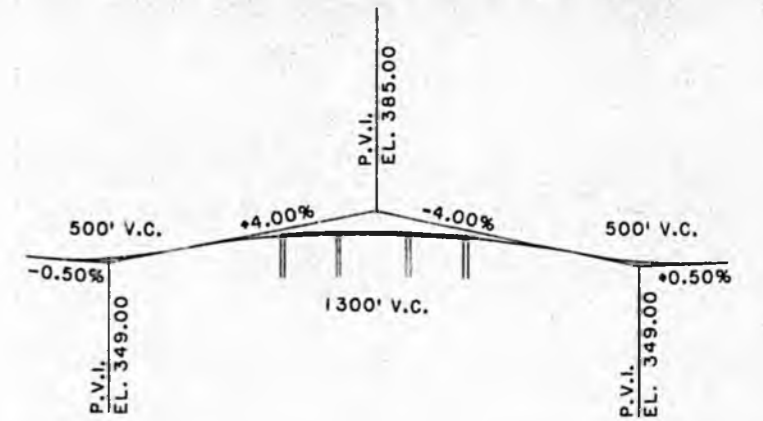
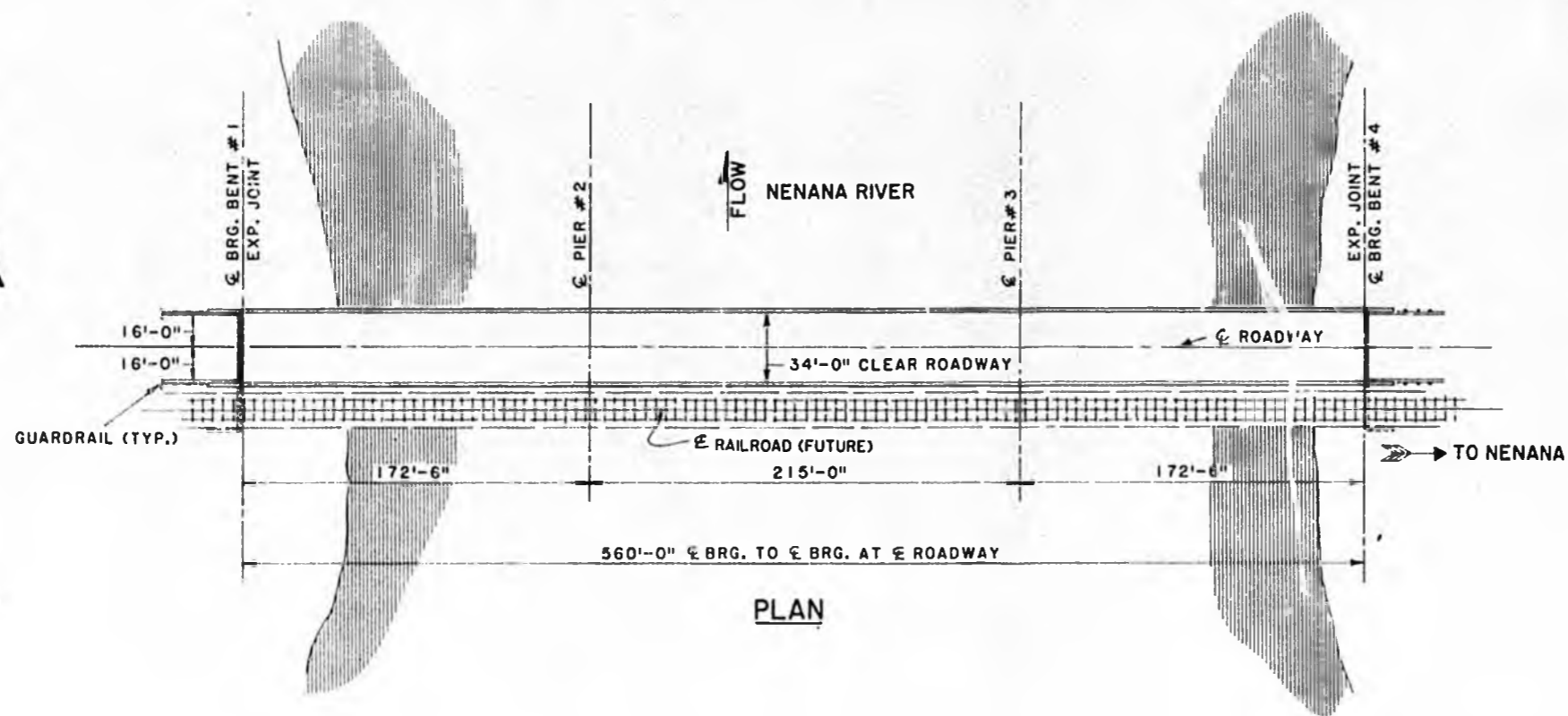
BARRIER DETAIL

SCALE: 1 1/2"=1'-0"

FEBRUARY 1981

NENANA RIVER BRIDGE		
DESIGNED BY	CHECKED BY	DRAWN BY BB/RC
DATE 11/12/80		
HDR		
ALASKA TRANSPORTATION CONSULTANTS, INC.		
DRAWING NUMBER		2 OF 3

REVIEWED	DATE



NOTES:

- HS20-44
- LIVE LOADS: COOPER E80
- DESIGN SPEED: 60 MPH
- STREAM DATA: ASSUMED

FIGURE NO 7

FEBRUARY 1981

NENANA RIVER BRIDGE		
SCALE: 1"=40'-0"	APPROVED BY:	DRAWN BY: BB/RC
DATE: 11/12/80		
HOR		
ALASKA TRANSPORTATION CONSULTANTS, INC.		
		1 OF 3

Using a high water elevation of 358 feet, a minimum clearance of 8'-0" is indicated above high water to low steel, which exceeds the suggested 6'-0" clearance by AASHTO Bridge Specifications. The necessary clearance over high water, and the depth of the superstructure will elevate the roadway above the approach roadways. The roadway elevation will be achieved by using a gradient on the approach roadways from each direction, and with a vertical curve on the structure with its apex near the center of the structure. The vertical curve will be designed for a speed of 60 mph.

A three span bridge will require the placement of two piers in the stream flow. The velocity of the stream, heavy water volumes, and thick ice will require large massive piers. Presently, it is contemplated that these will be single shaft concrete piers with steel ice plates. Footings will be located below the stream bed sufficiently to be below anticipated scour depths, and will be supported on steel H piles.

The abutments would be concrete stub abutments supported on steel H piles. These abutments will be located on embankment and the material for the embankment in the vicinity of these abutments should be non-frost susceptible soils to prevent frost heave.

Without specific information on water volumes, it has not been ascertained that the indicated waterway opening is sufficient to accommodate the flows. However, with low profile approach roadways, the approach roadways would be inundated during periods of flooding with flow crossing over the roadway.

Initially, it was contemplated that rail service to the area was a consideration. There presently does not exist justification for rail service to the study region based on cost-benefit ratios. However, should the ultimate development of the area occur with the addition of agri-processing plants, there may well be the economic need and demand for rail service to the area. This rail link would logically tie to the existing rail line at Nenana. To avoid the establishment of an additional and independent transportation corridor, the future rail line would closely parallel the roadway corridor. As a result, the river crossing of the Nenana would be

parallel and adjacent to the highway crossing.

The railroad bridge would preferably be a through girder steel bridge structure on the upstream side of the highway bridge. The superstructure and substructure would be independent of the highway bridge. Some overall cost savings would be achieved if the substructure for the railroad bridge was constructed with that of the highway bridge, but this would require a substantial investment for a structure which may not be constructed at any time in the near future.

In recognition of the severe lateral forces imposed on the substructure, the railroad would have an identical span arrangement with that of the highway bridge. This is also necessary to avoid impeding the flow of water and ice which would occur if non-aligned piers for the two structures were used. The superstructure would be designed for a Cooper's E-80 loading. It is assumed that the rail line would be a low speed operation and that the structure could be a non-ballasted deck.

The approach grades to the railroad structure would have gradients not exceeding 2% and would be somewhat longer than the roadway approaches.

With some inherent instability of the stream, stabilization of the river banks may be required upstream from the structure. It is not expected to be a major undertaking, but it will be necessary to inspect the upstream banks in the vicinity of the proposed structure to ascertain if any revetments are required.

For purposes of development of a concept, a clear span of 100 feet was assumed for the West Middle and East Middle River. (Figure 9) These structures would consist of concrete bulb T superstructures, supported on concrete stub abutment with steel H piles. For the Little Menana River Bridge, it was assumed that a large culvert could be used to contain the flow in this stream.

No site specific information was available in the form of surveys, geological information, or hydrological data, and these concepts for the

structures were developed using aerial photographs and other undocumented data. As more specific knowledge is gained, the proposed structures may change in concept and size.

Other minor structures will be required to provide flow for drainage areas lying in the path of the proposed roadway. Presently, it is contemplated that round culverts will be adequate for this purpose.

The following is a list of total costs, including soil exploration, engineering, construction inspection, and construction cost for each of the bridges over Nenana River and its tributaries. Costs related to various items such as right-of-way, utilities, bridge embankments and inflation factors are not included in the estimate. Costs presented are to be reasonable order-of-magnitude costs for work as of Spring 1981.

<u>NAME</u>	<u>TOTAL COST</u>
A. Nenana River Bridge	\$ 4,040,400
B. Little Nenana River Bridge	\$ 97,500
C. East Middle River Bridge	\$ 608,400
D. West Middle River Bridge	<u>\$ 608,400</u>
TOTAL	\$ 5,354,700

CHAPTER VI

PERMITS

Permits are required from both state and federal agencies. Use of land and environmental concerns will involve the state in all stages of the project; construction stages will also require federal permits. The application process has been divided into four (4) stages, based on anticipated work progress. A separate application for state permits will be made for each of the four (4) stages, which are:

1. Survey and Boring-Bridges
2. Survey and Boring-Road (Phase I)
3. Bridge Construction
4. Road Construction

For state permits, Master Applications will be used (as detailed below); and, the staged application procedure will more effectively identify required state permits. Federal agencies are easier to identify, as fewer are directly involved; however processing time is six (6) months or longer. The federal government is now in the process of making a wetlands determination, the outcome of which would identify the need for any federal permits.

State Permits

A Master Application has been made to the Alaska Permit Information Center in Fairbanks. The Master Application serves as a notice of intent to the state of a proposed project. The Center notifies state agencies (about 200), and they have fifteen (15) days to respond. All responses including necessary individual department permit applications are returned to the center. The process is outlined in the attached Master Application Information Sheet, (See Appendix 2). The applicant is responsible for completion of all applications and payment of fees.

Key state departments are Fish & Game, and the Department of Environmental Conservation (DEC). State Division of Lands will be concerned about right-of-way. Fish & Game is primarily concerned with stream crossing and will issue a Title 16 Permit; first stage boring work will be

subject to Fish & Game requirements. DEC requires Water Quality Certification under Section 401 of Public Law 92500. The Master Application process will identify all state agencies requiring permits for the individual stages. Agencies not responding to the Master Application within fifteen (15) days, may not later require a permit.¹

With the state agencies, as with federal departments, preliminary review of the application prior to submission will expedite approval.

Federal Permits

Application to the Corps of Engineers is the principle step in the federal process. The Corps assures public notice of a proposed project; other agencies then respond to the Corps. Statutes that apply are:

1. "River and Harbor Act of 1899", Section 10.
2. "Clean Water Act", Section 404, covers use of fill material.
3. Permits required for use of areas defined as Wetlands and Floodplains.

A key agency that should review applications prior to filing is the U.S. Department of Fish & Wildlife Service. The Fairbanks office will work closely with the applicant; recommendations will be made so that proposed project will be within Fish & Wildlife guidelines. An important part of the review will be definition of Wetlands, if any in the project area. Time frame for the review will be 3-4 weeks and is now in progress.

The Environmental Protection Agency (EPA) and National Marine Fisheries Service will be concerned; but, individual contact at present does not appear to be needed prior to Corps application. Their reaction and progress concerning the Corps application, should be monitored however.

The Coast Guard grants permits to cross navigable rivers under Section 9 of the "River and Harbor Act of 1899".²

¹Section 46.35.030, Water, Etc., Conservation (See Appendix 3).

²Interview with Mark Millea, Aids to Navigation Section, U.S. Coast Guard, Juneau, Alaska.

The Nenana River is classified in the Advanced Approval Category and requires no permit. The East and West Middle Rivers were determined to be distributaries of the Nenana River, thus being classified in the Advance Approval category as well, (Appendix 4).

No federal permits are required for preliminary survey and geotechnical work along the proposed roadway routing.

Additionally, a permit is needed to cross Alaska Railroad Terminal Reserve on the east bank of the Nenana River. The process to obtain this permit has been initiated though final results are still pending.

CHAPTER VII
LAND ACQUISITION FOR RIGHTS-OF-WAY

There are various methods available to acquire land for the roadway and utility rights-of-way in this project. The most straightforward of these methods is the use of section line easements granted through both state and federal statutes.¹ For the most part, the proposed roadway network follows section lines to take advantage of this easement. Other methods of acquiring land are included in the power of eminent domain. The use of eminent domain and section line easements, project rights-of-way requirements, and recommendations pursuant to the acquisition of those rights-of-way are detailed below.

1. Eminent Domain

According to Title 9, Article 4, Section 9.55.240, the power of eminent domain is available for use in acquiring land for the building of the roads, telephone lines, and power lines in this project. Proceedings instituted under the power of eminent domain are accompanied by a declaration of taking. This declaration must contain items describing the authority under which the property is taken, the public use for which it is taken, a description of the property, an estimate of just compensation, etc.² It has been stressed that the most important item to be contained in the declaration of taking is "a statement that the property is taken by necessity for a project located in a manner which is most compatible with the greatest public good and the least private injury."³

¹Basis for section line easements: Act of July 26, 1866, (RS 2477), (43 CFR 2822, 43 USC 932); Chapter 19 SLA, April 6, 1923; Chapter 123 SLA, March 26, 1951; Chapter 35 SLA, March 21, 1953; Taken from workbook on Section Line Easements put together by Bill Newman, Fairbanks North Star Borough, Planning Department, 1978.

²A.S. 09.55.430.

³Ibid; Interview with Bill Satterberg, Department of Law, Highways Section, October 28, 1980.

The power of eminent domain could be utilized where section line easements are not already established and in the acquisition of land required beyond that granted in section line easements. This power is granted to both the state and first class cities such as Nenana.¹

2. Section Line Easements

As detailed in Chapter IV, the roadway network has been laid out to take full advantage of section line easements. Following is a brief outline of the federal and state laws concerning section line easements and a method for determining which laws might apply to a certain piece of property.

(A) History²

The Mining Law of 1866 made an offer of free right-of-way over unreserved public land for highway purposes. This offer became effective on April 6, 1923, when the territorial legislature passed Chapter 19. Any lands in Alaska appropriated and patented after April 6, 1923 were subject to an easement along all sections, 4 rods (66 feet) wide.

The section line easements law remained in effect until January 18, 1949. On this date, the legislature accepted the compilation of Alaska law which also repealed all laws not included. The section line easement law was repealed.

On March 26, 1951, the legislature passed an easement law which dedicated a section line easement 100 feet wide along all section lines on land owned by or acquired from the territory. This was modified on March 21, 1953, to include an easement 4 rods wide along all other section lines in the territory.

To have an easement on a section line means that the section line must be surveyed under the normal rectangular system. On large areas such as State or Native selections, only the exterior boundaries are surveyed

¹A.S. 09.55.420 (a).

²Taken from Workbook on Section Line Easements put together by Bill Newman, 1978.

hence, there are no section line easements in these areas (until further subdivisional surveys are carried out).

Since all federal land is reserved in Alaska at this time and since the section line easement will have any applicability on any finalized D-2 land since the land will be reserved at the time of any survey.

Land surveyed by special survey or mineral survey are not affected by section line easements since such surveys are not a part of the rectangular net.

Section line easements relate solely to highway or road use by the public. They cannot be used for powerlines or restricted private access. The date of survey and appropriation of the land must be considered in determining the presence of a section line easement.

(B) Methodology¹

Using the date of entry and the date of survey plat approval, an analysis of section line easements would proceed as follows:

- A. If date of entry predated survey plat approval there is no easement.
- B. If entry predated April 6, 1923 (date of enabling legislation for section line easements) there is no section line easement.
- C. If survey plat approval predated April 6, 1923, but date of entry is after April 6, 1923, but before January 18, 1949, there is a section line easement.
- D. If survey plat approval is during the period of January 18, 1949 and March 21, 1953, and date of entry falls within this period, there is no section line easement.
- E. If survey plat approval is during the period of January 18, 1949 and March 21, 1953, and date of entry falls after March 21, 1953, there is a section line easement.
- F. If the land is in state ownership, there is a section line easement.
- G. If the land was disposed of by the state or territory during the period of January 18, 1949 and March 26, 1951, there is no section line easement.
- H. United States Surveys (U.S.S. and Number) and Mineral Surveys (M.S. and Number) are not a part of the rectangular new of survey. If the rectangular new is later extended, it is established around these surveys. There are no section lines through a U.S.S. or M.S., therefore, no section line easements can exist on such areas.

¹Taken from "Section Line Easement Research Technique" put together by the Fairbanks North Star Borough, Planning Department, 1979.

There may be many other situations which would require evaluation and decision on a case by case basis.

3. Project Right-of-Way Requirements

Figure 4 presents existing land ownership in the project area. Land in the initial phase of the project was chosen because it is state patented. The proposed roadway traverses a township which has been tentatively approved for state patent and a township including both state patent land and private property. The bridge crossing the Nenana River crosses private land along the river's west bank. Property along the east bank is currently classified as railroad terminal reserve. The entire township in which Nenana lies is being claimed for private use under the Alaska Native Claims Act. Thus, rights-of-way will have to be acquired from state, federal, and private ownership.

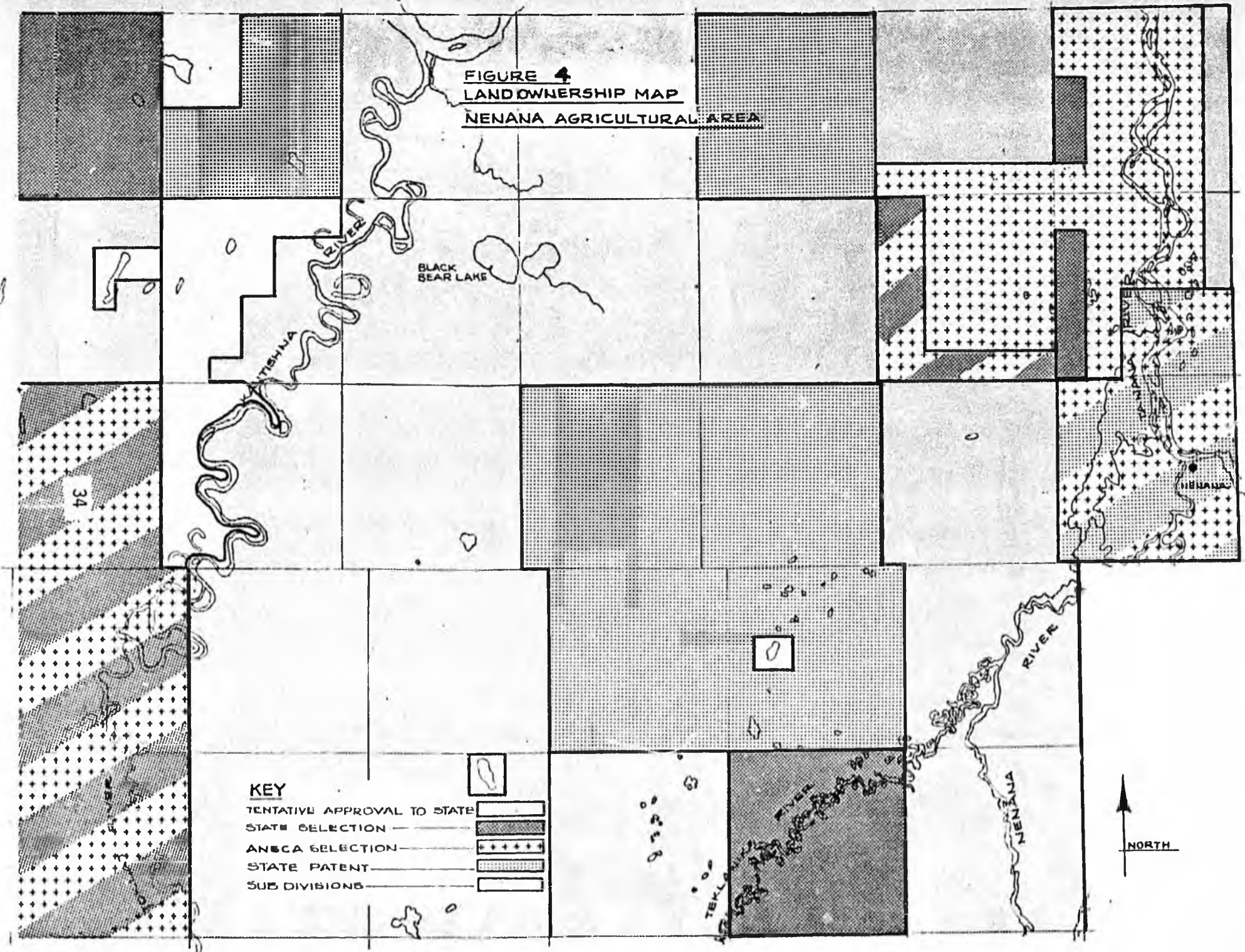
As discussed in Chapter IV, a right-of-way 200 feet wide is required for the main and collector roads in addition to a 30 foot utility easement on either side of the roadway easement. Within the roadway easement are 32' and 28' of traffic lanes for the main and collector roads respectively; 52-54 feet of ditch on either side of the traffic lanes; and 30-34 feet of space for storage of organic to be used in the building of slopes. Feeder roads require 150 feet of roadway easement with a 30 foot utility easement on either side. (See Figure 6).

4. Conclusions and Recommendations






Acquiring rights-of-way can become a complex issue with the potential to slow-up or even stop a project. In the foregoing sections it was found that the proposed roadway would traverse state, federal and private property. It was also found that required rights-of-way were greater than easements available along section lines. It has been recommended that use of "blanket condemnation" for necessary right-of-way might be a way of avoiding many problems.¹

¹Interview with Bill Satterberg, Department of Law, Highways Section, October 28, 1980.

FIGURE 4
LANDOWNERSHIP MAP
NENANA AGRICULTURAL AREA



KEY

- TENTATIVE APPROVAL TO STATE 
- STATE SELECTION 
- ANSCA SELECTION 
- STATE PATENT 
- SUB DIVISIONS 



Though this is an area which definitely requires legal expertise, current Judicial practice is that an Engineers' expertise will not be substituted for Judiciary opinion if it is clear that the Engineer has exercised his or her judgement in roadway layout.¹ This expertise and many other resources could be made available should the road be built under the umbrella of the Local Service Roads and Trails Act (LSR&T).

Development and construction of the roadway network under LSR&T appears to be the most expedient approach to the acquisition of rights-of-way and many other developmental requirements discussed in this section. Under LSR&T the state can use its mechanisms and powers to acquire necessary right-of-way in accordance with AS 19.05.080-.9.05.120.² The current revision of the act would provide funds for purchase of rights-of-way and gravel. However, this revision is yet unsigned by the governor and there remains some controversy in the legislature regarding the specific provisions for the purchase of right-of-way.³ Until the issue is resolved however, funding for the purchase of right-of-way will have to come through some other legislative vehicle.

Construction of the roads under LSR&T would also guarantee maintenance either through the Department of Transportation and Public Facilities or local government by way of revenue sharing.⁴

¹Interview with Bill Satterberg, Department of Law, Highways Section, October 28, 1980.

²AS 19.30.171.

³Interview with Donovan Ronkin, LSR&T Engineer, Department of Transportation and Public Facilities, November 13, 1980.

⁴AS 19.30.211.

CHAPTER VIII

Cost-Benefit Study of Phase I Access Routes

Two options are available for the access road to Phase I of the Nenana Agricultural Project. Option One is a 22.2 mile route from Nenana to the Center of Phase One that requires four bridges to be built. Option Two is a 34.7 mile route from near the Rex siding that requires one bridge across the Teklanika River. A cost analysis, reduced to a per-year basis, indicates that the Nenana route will cost \$1,472,913.12 per year while the Rex route will cost \$1,517,365.48 (Tables C - G). User costs are estimated to be \$3,218,713.50 for the Nenana route and \$9,167,753.50 for the Rex route. These figures indicate that the Nenana route will result in a net savings to the general tax payer of approximately \$44,500.00 per year and a net savings to the user of approximately \$5,949,000.00 per year for a total savings of \$5,993,500.00 per year.

A cursory review indicated that freight costs per metric ton from the center of Phase I to the siding will be \$3.66 per ton (utilizing rail from Nenana) for the Nenana route and \$4.15 per ton for the Rex route resulting in a net savings of \$0.49 per metric ton from the Nenana route.

Table C
Capital Costs Projected to 1981

Estimated project center: 1/4 corner common to sections 13 and 14,
T4S, R11W, F.M.

Planned road life - 20 years, structures - 40 years, Right-of-Way - 60
years

Estimated Right-of-Way Costs - \$5,000/Acre

Estimated Road Costs - \$275,000/mile - Type "RB", \$310,000/mile - Type "PB"

Estimated Maintenance Costs - \$3,115/mile

Estimated Bridge Costs - Nenana Route - \$5,354,700, Rex Route - \$608,400

Estimated Interest Rate - 10%

	<u>Nenana Route</u>	<u>Rex Route</u>	
	22.2 Miles Gravel	34.7 Miles Gravel	
	0 Miles Paved	28.9 Miles Paved	
Right-of-Way Costs	\$1,345,454.55	\$2,254,545.46	0
Capital Recovery Cost	134,989.45	226,198.55	0
Construction Costs	\$6,140,000.00	\$9,542,500.00	0
Capital Recovery Cost	721,204.40	1,120,862.05	0
Bridge Costs	\$5,354,700.00	\$ 608,400.00	0
Capital Recovery Cost	547,566.27	62,214.38	0
Maintenance Cost/Year	\$ 69,153.00	\$ 108,090.50 ¹	
Total Costs/Year	\$1,472,913.12	\$1,517,365.48	0

¹ Traffic from the Nenana Agricultural Project would approximately double the average daily traffic on the paved section of the George Parks Highway from Rex to Nenana. Current maintenance costs are primarily climate-related with negligible traffic-related costs. For this reason it is assumed that project-related traffic would not appreciably affect maintenance costs for this section of highway.

Table D
User Cost: Dollars-Per-Year

	<u>Nenana Route</u> 22.2 Miles Gravel	<u>Rex Route</u> 34.7 Miles Gravel	23.9 Miles Paved
Operating Costs:			
76,405/Yr/Mi Gravel	1,696,191	2,651,253.50	
50,940/Yr/Mi Paved			1,472,166
29,100/Yr-1 Stop	29,100	29,100	
Travel Costs:			
25,385/Ry/Mi	563,547	880,859.50	733,626.50
8,155/Yr-1 Stop	8,155	8,155	
Fuel Consumption:			
27,730/Yr/Mi	615,606	962,231	801,397
9,455/Yr-1 Stop	9,455	9,455	
Comfort and Convenience:			
11,635/Yr/Mi Gravel	258,297	403,734.50	
3,880/Yr/Mi Paved			112,132
Accident Costs:			
1,705/Yr/Mi Gravel	38,367.50	59,163.50	
1,044,480/Yr Paved			1,044,480
Sub Total	\$3,218,713.50	\$5,003,952.00	\$4,163,801.50
Total	3,218,713.50	9,167,753.00	

Table E
Roadway Operating Cost Comparisons

A. Operating Costs: Assume level grade - 55 MPH - 1 Stop

$$\frac{(76.23)(1.723)(850)(365)(1.25)}{1000} = \$50,936.96 \text{ use } \$50,940/\text{Yr}/\text{Mi (Paved)}$$

$$\text{gravel } (1.5)(50,936.96) = 76,405.44$$

$$\text{use } 76,405/\text{Yr}/\text{Mi}$$

$$\frac{(30.75)(1.627)(850)(365)(1.25)}{1000} = \$19,402.36/\text{Yr use } \$19,400/\text{Yr (Paved)}$$

$$\text{gravel } (1.5)(19,402.36) = 29,103.53$$

$$\text{use } \$29,100/\text{Yr}$$

B. Travel Time:

$$\frac{(850)(365)(3.60 \text{ average wage})(1.25/\text{NF})}{55} = \$25,384.09 \text{ use } \$25,385/\text{Yr}/\text{Mi}$$

$$\frac{(5.84)(850)(365)(1)(3.60)(1.25)}{1000} = \$8,153.37 \text{ Use } \$8,155/\text{Yr}$$

C. Fuel Consumption: Assume \$1.30/Gal - \$1.25 Inflation

$$\frac{(55)(850)(365)(1.30)(1.25)}{1000} = \$27,728.59 \text{ use } \$27,730/\text{Yr}/\text{Mi}$$

$$\frac{(18.75)(850)(365)(1.30)(1.25)}{1000} = \$9,452.93 \text{ use } \$9,455/\text{Yr}$$

D. Comfort and Convenience: \$.03/vehicle mile for gravel \$.01 for pavement

$$\text{Gravel } (.03)(850)(365)(1.25) = 11,634.38 \text{ use } \$11,635/\text{Yr}/\text{Mi}$$

$$\text{Paving } (.01)(850)(365)(1.25) = 3,878.13 \text{ use } \$ 3,880/\text{Yr}/\text{Mi}$$

Table F
Traffic Data

Accident Data: (Use 13.2 Mile Delta Clearwater Road for similar comparison)
DOT/PF monetary equivalents: injury - \$9,490; fatality - \$260,000.

Gravel Roads

	Fatalities	Injuries	Property Damage/\$
1977	0	3	7,775
1978	0	0	2,350
1979	<u>0</u>	<u>1</u>	<u>6,150</u>
3 Year Total	0	4	16,275
Total Costs	0	\$37,960	\$16,275

Cost/Yr/Mi $(37,960+16,275)/(3)(13.25) = 1364.4 \times 25\% \text{ Inflation} =$
\$1705.50 use \$1705

George Parks Highway Rex to Nenana

	Fatalities	Injuries	Property Damage/\$
1977	1	16	90,095
1978	1	8	44,250
1979	<u>1</u>	<u>8</u>	<u>35,350</u>
3 Year Total	3	32	169,695
Total Costs	\$780,000	\$303,680	\$169,695

Cost/Yr $(780,000+303,680+169,695)/3 \text{ Year} = \$417,791.67 \times 25\% \text{ Inflation} =$
\$522,239.58 $\times 2$ for approximately doubling traffic =
\$1,044,479.17 use \$1,044,480.00

Note: Design Speed 55 MPH
Volume 850 ADT
Stops 1
Slowdowns
and Idling N/A

Table G
Freight Costs

Projected to 1981: $(.035)^1(1.25\% \text{ Inflation}) = \$0.44/\text{metric ton mile rail}$
 $(.046)^2(2)(1.25\% \text{ Inflation}) = \$.115/\text{metric ton mile}$

Railroad miles Rex to Nenana	25% (approximate)
Road miles Nenana Railroad to Project	22 (approximate)
Road miles Rex to Project	36.1 (approximate)

Nenana Route

Rex Route

RR Road
 1.13 + 2.53 = \$3.66/ton

Road
 \$4.15/ton

¹Rail \$035/metric ton mile (based on Delta Barley Project Costs).

²Commercial Truck \$046/metric ton mile (one-way) (based on Delta Barley Project Costs).

CHAPTER IX

COMMERCIAL VIABILITY OF THE AGRICULTURAL TRANSPORTATION SYSTEM

Commercial viability of a roadway network can be defined as how the system lends itself to an increase in benefits to the primary commercial user. In this case the grain producers will be considered the primary users initially; and it is assumed that, while the other agricultural industries may have different transportation needs, costs and analytical approach would be similar.

As stated in the introduction to this report, transportation is an important aspect in rural development. A commercially viable transport system is a major cog in the success of agricultural development in Alaska. The Final Report of the Rural Transportation Advisory Task Force states that it is vital to assure the efficient movement of agricultural products and farm inputs, "both because of the geographic dispersion of farming, and because of export of agricultural products has become essential to the nation's balance of payments."¹ This statement holds true in Alaska especially when considering the present marketing plans for Alaskan barley and the transportation problems unique to Alaska's emerging agricultural industry.

This section presents an analysis of alternative methods for the transport of grain between the initial project area and Nenana. The purpose of this analysis is to provide a flexible range of options by which the transportation system can be made commercially viable.

A roadway is commercially viable if commercial user costs are low enough to provide for a competitive profit margin. This is accomplished through the design of a system which most effectively reduces costs essential to the transport of a commodity from farm to market.

¹"Agricultural Transportation Services: Needs, Problems, Opportunities",
The Final Report of the Rural Transportation Advisory Task Force, January, 1980., p. 11.

Four transport schemes were evaluated for transportation of grain from farm to market:

- I. Home Storage, farmer hauls to Nenana
- II. Home Storage, transfer point other entity transports to Nenana
- III. No Home Storage, transfer point
- IV. No Home Storage, no transfer point

To analyze the various alternatives for transferring the grain from farm to market, several assumptions of conditions and calculations of costs were made for the initial project area. The following is a brief description of estimated project area activity along with an outline of assumptions used to determine costs of the transportation system.

Project Area Activity

The initial project area is two townships in size, lying 13 miles west of the City of Nenana. There are seventeen (17) grain farms and ten (10) smaller farms within the project under proposed parcelization. Additional 5 acre home sites are being recommended to increase the population base in the area. An estimate of grain production is based on a 1/3 fallow system and 42 bushels/acre, average harvest of barley. There are 39, 680 acres within the 17 grain farms. This would put 26,450 acres into barley at any one time. At 42 bushels/acre there would be approximately 1,111,000 bushels per harvest. This grain would be transferred to the railhead in Nenana and shipped from there to port. Additional transportation would be required by commodities originating on the smaller farms.

Assumptions

Several assumptions were applied to the analysis of the grain transport system. These assumptions, which should be modified to fit individual farm situations, were:

1. Average Farm Size: 2560 acre
2. Combine Capacity: 2,000 bushels/day
3. Combine bin capacity: 65 bushels requiring unloading every twenty (20) minutes
4. Truck capacities: 250 bushels, 700 bushels, 1,050 bushels
5. Average Speed of Trucks: 35 mph

6. Ten (10) hour workday
7. Average Harvest on 2560 acres = 71,680 bushels

Following the conclusion of Chapter VIII, it was also assumed that the proposed roadway between the initial project and Nenana would be the road used by the farmers in the initial project area.

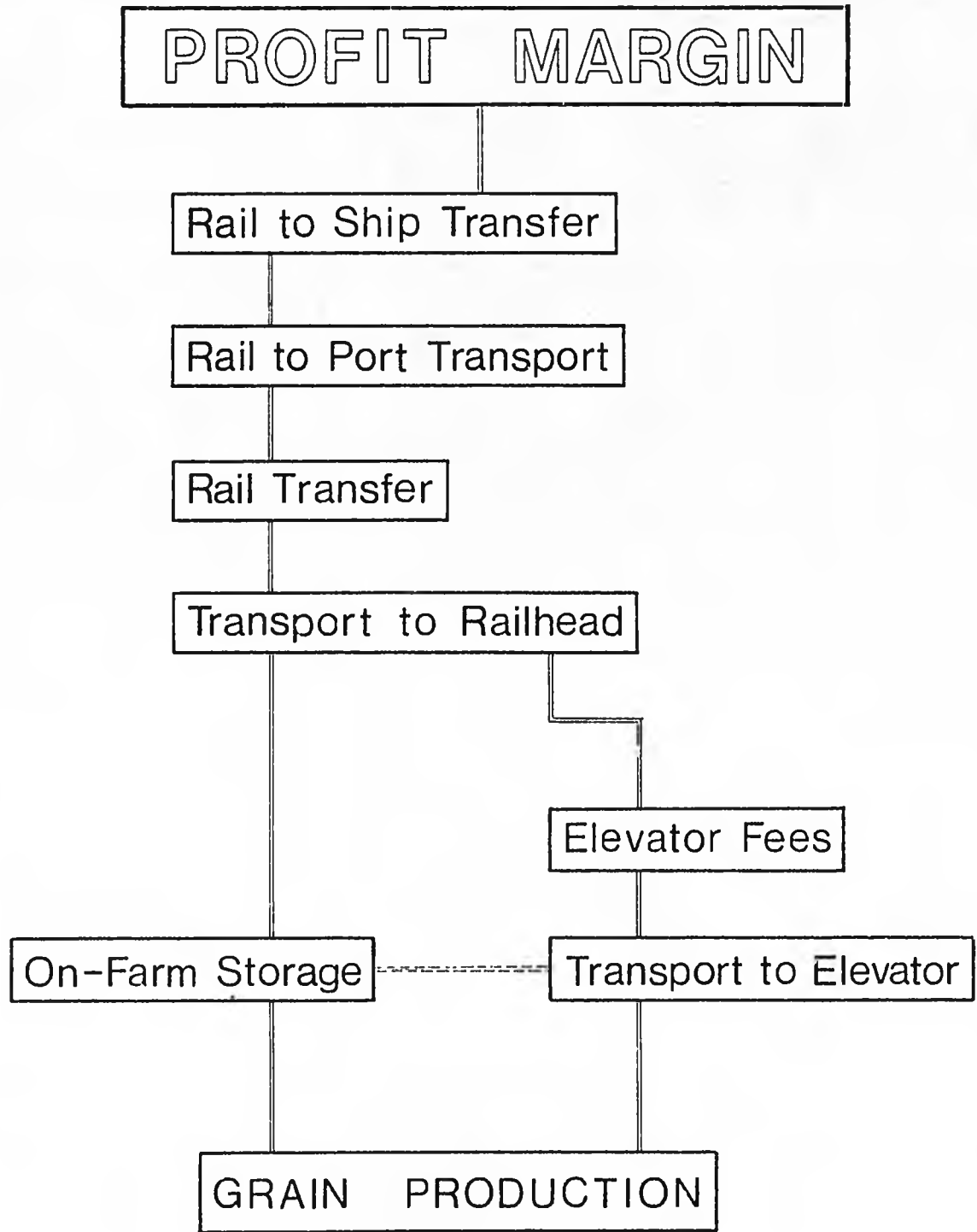
Essential costs for Nenana grain transport were determined to center in the areas outlined in Figure 11. This report focuses on costs involved in transporting grain from on-farm storage to railhead. Roadway quality, location of possible transfer facilities, choice in method of transport are factors which affect essential costs. An examination of the relationship between these factors and essential costs is used in determining a framework for a commercially viable road. These will be discussed following an analysis of the essential cost components.

Essential Cost Components

On-farm storage offers flexibility to the grain producers in a number of ways. First, it allows them to hold their crops until they can sell at the best price. Second, storing the grain on the farm allows the farmer to transfer the grain to the railhead using the mode most economical to him. Third, on-farm storage reduces or eliminates storage costs elsewhere.

It was estimated from experiences in Delta Junction that grain storage in Alaska costs about \$0.25/bushel/year.¹ While agriculture is in its developmental stages in Alaska grain receives certain price supports which nullify the advantages of on-farm storage. As Alaskan grain becomes subject to world market prices the advantages of on-farm storage will increase considerably. As a result, it is assumed that the majority of the farmers in the Nenana area will have on-farm storage for a large portion, if not all of their harvest. Costs involved in on-farm storage are made up in

¹Agricultural Action Council, December 1, 1980.



ESSENTIAL COST COMPONENTS—GRAIN MARKETING

Figure 11

savings resulting from increased flexibility; though the rate of savings depends on distance between farm and elevator, labor costs, elevator fees, etc.

If the farmer does not have on-farm storage, or if the time is right to market the harvest; it is possible that a transfer site could be located between 1 and 7 miles of his farm. One such transfer site would be adequate for the initial project area, though others might be necessary as agriculture expands outward from there. Once the grain is transported to this site it would be loaded onto larger trucks and taken to the railhead in Nenana.

Grain would be transported either from a centralized transfer site or directly from on-farm storage to the railhead in Nenana. Once the grain reached the main elevator there would be additional handling and storage fees.

Evaluation of Alternatives

The alternative transport schemes were analyzed in terms of the costs of their essential components. Thus, Scheme I - home storage of grain, hauled directly to the elevator in Nenana; was evaluated on a cost per bushel basis using the following formula:

$$H + A + E = \text{Scheme I Costs}$$

$$H + B + E = \text{Scheme I Costs}$$

$$H + C + E = \text{Scheme I Costs}$$

where:

H = Home Storage Costs

A = Costs of 300 bushel truck hauling direct to Nenana
(Calculated with and without labor)

B = Costs of 700 bushel truck hauling direct to Nenana
(Calculated with and without labor)

C = Costs of tractor/semi-trailer (Both commercial costs
and with/without labor)

E = Costs of storage and handling at elevator.

Scheme II was evaluated using the following formula:

$$H + A + T + C + E = \text{II}$$

$$H + B + T + C + E = \text{II}$$

Where 'T' equals costs of handling at transfer point. Scheme II also compares 2.5 ton truck and 5 ton truck haul costs to transfer point.

Scheme III was evaluated using the following formula:

$$A + T + C + E = III$$

$$B + T + C + E = III$$

Scheme IV was evaluated using the following formula:

$$A + E = IV$$

$$B + E = IV$$

$$C + E = IV$$

Operating Costs

Costs involved owning and operating the three alternative trucks were obtained from local sources and are presented in Table H. For the 2.5 ton and 5 ton trucks, 25% of the annual fixed costs were assigned to the hauling of grain. As the larger 10 ton truck is not as versatile as the 2 smaller trucks might be, 69% of its fixed costs were assigned to grain hauling. Home storage costs were utilized from a recent study in Washington state.¹ These costs were adjusted for inflation and higher costs in Alaska and were approximated at 13¢/bushel. Elevator handling costs are currently 12¢/bushel in the Delta project the elevator costs and costs at the possible transfer site in the initial project area.

Formulas listed in Figure 12 were utilized in determining the various transport costs of the four alternative schemes. These formulas were obtained from a similar study done in Washington state.²

Findings

It was found that while Scheme IV had the lowest costs of all the alternatives, Scheme I offered the most flexibility at the least costs to the

¹Hately, Rogers, Casavant. "Evaluating Transportation and Storage Alternatives Available to Whitman County Grain Growers". Washington State University, College of Agricultural Resources Center, May, 1976.

²IBID.

Table H

Operating Costs/Mile - Alternative Grain Hauling Vehicles

	A 2.5 Ton (300/Bu)	B Ton (700/Bu)	C 10 Ton Tractor/Semi (1,500/Bu)
<u>Fixed Costs</u>			
Interest on Investment	708	1654	4536
Depreciation	1583	3325	9120
Insurance	600	1050	1350
License and Fees	30	30	240
Total Fixed Costs	2921	6059	15,246
25% assigned to Grain	730.25	1514.75	
65% assigned to Grain---C			9,909.90
<u>Variable Costs</u>			
Gas	0.108	0.185	.29
Repairs	0.131	0.131	.80 (includes tires)
Tires	0.030	0.050	---
Total Variable Costs	0.269	0.366	1.09

●License Costs:
Alaska Motor Vehicles Dept.

●Insurance:
Butch Stein, Alaska 100

●Repairs:
U.S.D.O.T. formula and
local interviews

●Gasoline:
Price/Gal: ± MPG

New Cost

Tires:
6 @ 200.00
± 40,000 mile

New Cost-35,000
Salvage value 1,750

Alaska Sales
in Anchorage

Tires:
10 @ 200.00
± 40,000

New Cost-96,000

Gene Javette, K&W Trucking

Figure 12

Formulas Used to Determine Grain Transport Costs

Fixed Costs/Per Bushel:

$$\frac{\text{Fixed Costs} \times \text{Number of Trucks}}{\text{Total Harvest}}$$

Variable Costs/Per Bushel:

$$\frac{\text{Variable Costs} \times \text{Trip Miles}}{\text{Bushels Per One Trip}}$$

Trips Possible:

$$\text{Hours in Workday} \div \frac{\text{Trip Miles}}{\text{Avg. Speed}} + 20 \text{ Minutes (Loading and Unloading)}$$

Labor Costs/Per Bushel:

$$\frac{12.50 \times \text{Hours in Workday}}{\text{Bushels Hauled/Per Day}}$$

Home storage costs were adjusted for inflation in the following manner:

$$\begin{aligned} \text{Cost in 1976 (Washington State)} &= 8¢/\text{Bu} \\ &\quad \times 1.61 \text{ (rate of inflation 1976 - 1980)} \\ &= 12.88¢/\text{Bu or approximately } 13¢/\text{Bu in 1980} \end{aligned}$$

farmer. It was also determined that use of the 5 ton truck under Scheme I was the most cost effective vehicle, particularly when the farmers' labor replaced hired labor.

Scheme I examined the costs involved in hauling grain direct, farm to elevator. Costs were determined for distances of 14, 18, 22 and 26 miles. Costs of commercial trucking were found to be competitive and were much lower than costs involved in hiring a driver. With the flexibility of home storage and the options of commercial hauling, farmers labor, or hired labor; this scheme offers the most economical and cost effective method in transporting grain from the farm to the market. Table I presents the results of analysis under Scheme I.

Scheme II included a transfer point in the middle of the project. In this instance, costs were determined for the 2.5 and 5 ton trucks for distances of 1, 3, 5 and 7 miles from the transfer point. From that point, the grain would have to be transported 19 miles to the railhead in Nenana. It was determined that, at least initially, commercial trucking would be more cost effective for the 19 mile haul. If, in the future, cooperatively owned trucks could be utilized for activities other than grain hauling; fixed costs assigned to that purpose could be significantly reduced. Overall, Scheme II had drawbacks causing its higher costs. The transfer point offers no real advantage to a farmer with home storage as transportation costs direct to Nenana are still less after paying the additional transport costs and main elevator handling fees. Table J presents the results of analysis under Scheme II.

Scheme III was basically the same as Scheme II but in this instance, there was no home storage. Without home storage several constraints are placed on the farmer. Assuming a combine operating 10 hours per day, 4,000 bushels of grain could be made available for transport. This grain would have to be transported to either the transfer site or the main elevator in Nenana. The farmer would not be able to take advantage of any price fluctuations and would most likely have to hire labor. The results of analysis under Scheme III are presented in Table K.

Scheme IV assumed no home storage and no transfer site. Under these conditions two 2.5 ton trucks would be required to handle the daily harvest.