WILDLANDS WORKERS' HANDBOOK
REVISED THIRD EDITION

James R. Brunner

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Wildlands Workers' Handbook

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Wildlands Workers' Handbook - Revised Third Edition

Introduction

This volume describes how to live and work in the Wildlands. It was conceived and written because none of the newer employees had any training in this art. This being the third edition, more livestock handling has been added to help ranchers to raise bigger calves or lambs and to improve the grazing plants as they do so. The cow and/or sheep are a wonderful management tools to help improve ranges.

This handbook is also important to working ranchers, who find a need for some of the improvements. The chapters on grazing systems may prove valuable.

Most new employees of a land management agency are expected to work in the field, not in an office. It is a new experience for most people that involves new skills and knowledge. Unfortunately, almost all the colleges that train natural resource managers have eliminated practical courses in field surveying, etc. The traditional methods of passing the information from experienced workers to new employees is slow and labor intensive.

This volume will provide an advantage for field workers just learning practical improvement skills. It will acquaint them with the common improvement practices used as tools for maintaining environmental balance or improvement. We recognize that change is the only constant force in Nature, so the worker will work ***with*** Nature to effect some particular goal. Some may define the work as Conservation, which is wise ***use*** of the land.

The charts, graphs, and tables reproduced in this manual are the accumulation of thirty years. The origins of most are lost in the mists of antiquity, even though the columns are verity.

Fieldwork produces a sense of accomplishment. This volume will enhance your knowledge and confidence so fieldwork will be enjoyable to you.

Some professional range people are very sensitive about the proven truth. Some of the items noted or advice given has not been verified by doctorate degree studies. These items are pretty much confined to Section Three. This is mostly 'Empirical data', meaning it is partly or mostly true most of the time. The wide variety of ranches makes it impossible to correctly verify each statement; so think about the item, see if it pertains to your ranch, and if not, can you change the idea so it does?

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Chapter 1

Basic Information

Driving in the Wildlands

The chapter could be titled "Going to the Country and Getting Back". When driving in the Wildlands, you drop back about a century as far as roads are concerned. A properly equipped vehicle is essential and the driver must develop the skill of driving a vehicle under Wildland conditions. Make no mistake, an inexperienced or careless driver can end up in serious trouble. Many work areas are 2 to 4 days walk from civilization and a vehicle breakdown can mean discomfort or even death.

Living and playing in the Wildlands, your awareness is at a peak. You see everything, or try to, at least. You note the soil profile in the arroyo, the kinds of vegetation, and its condition. In the arid Southwest the geology of the mountain is laid out for you to read. In wetter climes, use a geology map to help read the land. There is much to see, to interpret, and to understand. (See Figures 1 to 5)

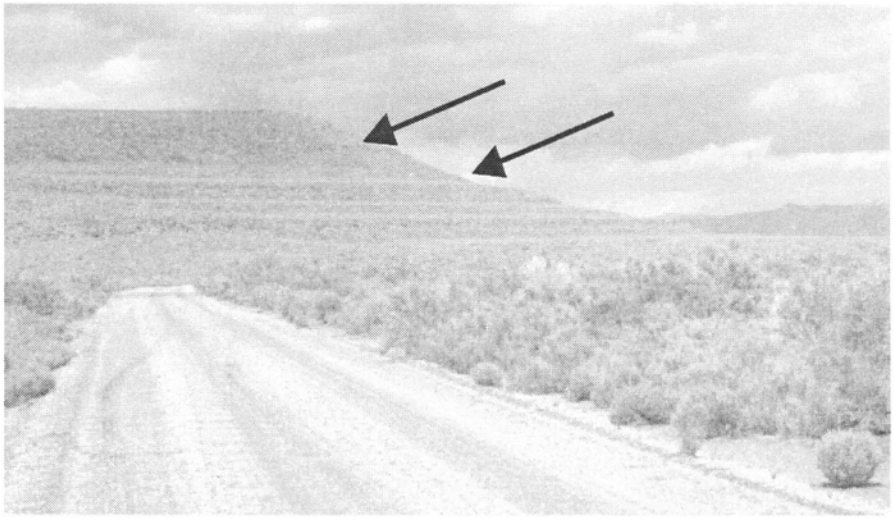


Figure 1-1

Note: Second Lake Lahonton terraces on the ridge. About half way from top to first terrace are faint signs of the First Lake Lahonton. The first lake dried about 30,000 years ago and the second lake dried about 10,000 years ago.

Figure 1-2.

Look for old Spanish trail signs. This one has two little men in peaked hats sitting on each end of a bar, with a curved arrow between them pointing up and to the right to a silver mine. Done about 400 years ago—so it is getting dimmer.

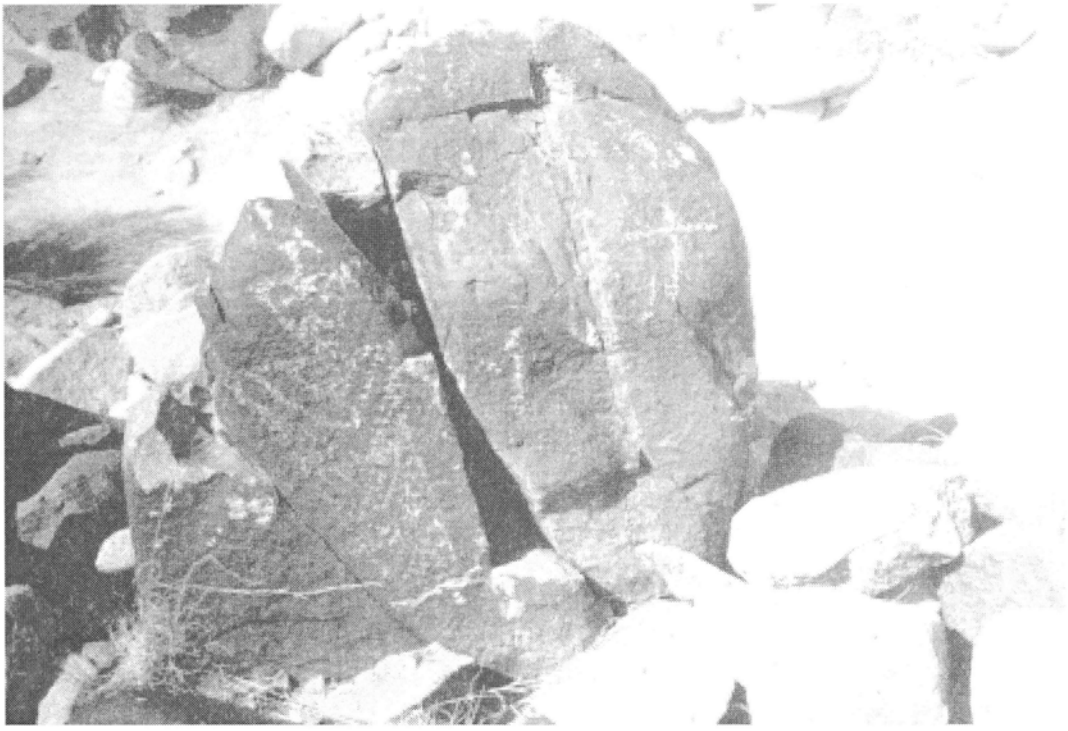


Figure 1-3.

Look for these Spanish trail signs. This one has a portrait and a + for church-financed group. Some hundreds of groups traveled the West between about 1520 and 1850.

Figure 1-4.

Another Spanish trail sign. KH is the group symbol, and the suns rays equals days travel to a mine. A bar under the sand points to magnetic north. Cut with good Toledo steel.

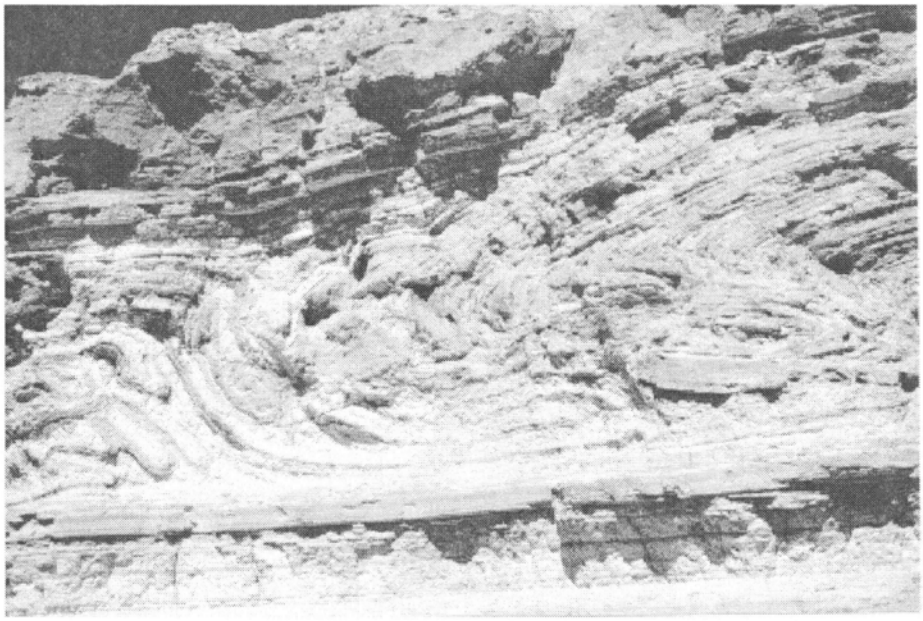


Figure 1-5.

An unusual and interesting rock formation discovered while hiking in the Wildlands.

The Field Vehicle

The vehicle should have a minimum of inherent design problems. A well-designed vehicle for Wildland use should have the following:

1. Four-Wheel drive with a high and low range transfer box. These features are needed for mobility. The low range is often essential, not for power, but to allow moving slowly over rough country without excessive bouncing and lugging the engine. A full-time four-wheel drive has all wheels driven at the same speed. For Wildlands travel, it is best to have front wheel locks that can be turned in when needed.

A four or five speed gearshift is better than fluid drive because the braking power of the engine is needed on steep downgrades. However, fluid drive is best when driving over rock piles.

2. A short wheelbase is preferred over a long one to provide a short turning radius and better maneuverability to dodge rocks and ditches. The long wheelbase trucks also have a longer rear bumper overhang, which is a primary cause of getting stuck. The carryall type of body has a high center of gravity, which is objectionable in a vehicle that must occasionally traverse a side-hill.

3. A standard size (6-ft. long) pickup bed is sufficient to carry the tools of the trade. A sheet of ½ inch (or thicker) steel plate, cut to fit in the bed, and bolted down, will protect the bed and give weight essential to hold the rear wheels down on a steep slope. Adding large rocks is an emergency measure and is sure to scar the pickup bed.

4. A large six-cylinder gasoline engine is ideal for off-road travel a speeds from ½ to 1-mile per hour since the 'big 6' will lug (maintain pulling power at low revolutions per minute). Some V-6 and V-8 engines will lug without damage to the engine. A high performance engine, if consistently lugged, will require new spark plugs and points weekly.

5. Bumpers are required; they should be mounted level with the frame and close to the body of the truck. A bumper must be strong enough to support one-half of the truck's weight when the vehicle is lifted with a bumper jack. The front bumper also serves as a brush-guard. It may be necessary to turn the vehicle around in its own length and this a done by jacking up the front or rear half of the truck and pushing it off the jack in a selected direction.

6. Coolant. There must be an overflow bottle to store radiator fluid when the vehicle is hot; otherwise, the vehicle can lose a gallon of fluid a day. Most modern vehicles have bottles, but if your vehicle is without one, it takes only minutes to install one. This will be discussed under personalizing your vehicle.

When the vehicle is in 4-wheel drive, low range and the wind is from the rear of the vehicle, cooling may be a problem. To keep a radiator from boiling it is helpful to install a 140-degree thermostat for summer use and change back to a 180-degree thermostat for winter. Some engines are designed to run hot, therefore this modification should be considered only after talking with an authorized company representative.

7. An oil-bath air cleaner limits the dust an engine ingests and reduces piston ring and valve wear. In summer, dust can be 6 to 10 inches deep and flows like water in road ruts. Under such conditions, the air cleaner should be serviced daily. Under normal conditions, service weekly. If the oil bath air cleaner is overfilled, it will spill oil onto the engine when traversing steep grades.

8. The ideal Wildlands vehicle will have neither power brakes nor power steering. This may be difficult to understand, but take the vehicle to a large EMPTY parking lot and speed up to 5-mph, then cut the ignition and use the foot brake to stop the vehicle. Then start the engine, regain speed, cut the engine and attempt to turn the vehicle in a circle.

Now imagine the truck is a 2-day walk from the nearest paved highway and the power steering belts flip off or the power brake cylinder fails. Can you imagine driving a dim jeep trail or cat track without power steering or brakes? Though, some persons feel it is worth the risk. Moreover, it may not be your decision.

Some full-power vehicles lose steering and braking when the engine dies. Avoid such vehicles.

9. Roll Bars. Because steel cabs have limited internal support, it may be wise to install a roll-over bar behind the cab. A better choice is to limit driving to areas where turnovers are unlikely.

10. Tires. Conventional highway-tread tires are best for Wildlands driving. Tires with tractor-type lugs dig into dry soil or mud. Purchase 6-ply tires with a thick tread to resist thorny bushes and in winter use mud-and-snow tires with as flat a tread as possible. Tire chains are a must in mud or snow.

Tubes are almost obsolete except on large truck tires, but give much more flexibility if you have them inside your 6- ply tires. You can reduce pressure to about 15 pounds to let you skim over sand dunes.

Wide tread tires were designed to support heavy loads and are a substitute for dual wheels. Such tires provide needed flotation on dry sand but provide too much floatation on mud, ice, and wet pavement, hence give little or no traction.

At least one spare tire, mounted on a wheel, should be carried. In thorny brush country (the Southwest) carry at least 2 spares.

11. Emergency brake should be on a drum that is mounted on the drive-shaft. Some vehicles have a series of steel cables which activate the rear wheel brakes during an emergency. Brush damages these cables; therefore check these cables frequently so the emergency brake is available when needed.

12. Gasoline is an essential ingredient for sustained travel. A large 6-cylinder engine in low range will average about 10-miles per gallon. A V-10 gets maybe five. It is best and safest to order the vehicle with dual gas tanks.

Use only inside-the-frame mounted tanks. If the tank is where the rear bumper should be, although inside the frame, wrap a piece of sheet steel around the front and underside and up the back of the tank.

It is unsafe to carry extra gasoline in barrels or cans in the bed of the truck. If necessary to transport extra fuel to a camp, this fuel should be unloaded near, but not in camp before going to work.

13. Grease fittings. The friction points on steering drive assemblies, and springs should have zerk grease fittings and be serviced weekly. The nylon bushings are functional but should be frequently checked since they were designed for dust-free highway driving. When the nylon ones wear out, replace with zerks.

Some vehicles have tiny lubrication holes on the drive shaft. Replace these with zerks because a grease gun can apply 5,000 pounds per square inch to force out the old dust-filled grease.

Should a high-pitched squeal develop when the vehicle moves, quickly replace the U-joints on the rear wheel drive shaft. If the U-joint breaks while driving, the vehicle will move only with front wheel drive.

14. Be sure the axles of the vehicle are of equal length and the rear wheels run in the tracks of the front wheels. In mud, snow, or soft ground, the front wheels make tracks, and in effect, the vehicle is on a grade equal to the track depth. If the axles are different lengths, the rear wheels must make their own tracks and the grade is doubled; this limits vehicle mobility.

15. Critical components should be mounted up out of harm's way. I define a critical item as something without which the vehicle cannot operate. The oil filter should not hang down below the engine, the oil pan should be above axle height, and the tie rods should be behind the front axle. The front brake lines should be in flexible steel conduit and the rear brake lines should be behind the rear axle.

16. Air conditioner and heater are needed for health and safety. With these devices the truck cab can be pressurized so dust within the cab will not limit vision.

17. Springs should be matched with the expected work-load. Overload springs engage only with heavy loads and the vehicle should ride comfortably without excessively jarring the driver. Undersized or weak shock absorbers will result in breaking the top leaf of the rear springs.

Personalizing Your Vehicle

If an agency furnished the vehicle, your ability to improve it may be limited. However, do check it over and make any changes possible. The Safety Officer may help in getting gas tanks protected.

The first measure is to tighten vehicle nuts, bolts and screws. Next, determine if the rear hydraulic brake lines are behind the axle. If not, move the lines behind the axle and secure them with bailing wire. Failure to tie the lines in several places so there is no slack can result in brush breaking the line, leaving the vehicle without brakes. The front brake lines arrive from the frame channel and drop to the front wheels. If needed, have a mechanic change the copper tubing for steel flex lines.

Once the brake lines are secured, memorize Brunner's First Law of Wilderness Driving: *NEVER BACK UP!* The reason for this law is because you can avoid only what you can see.

If the oil filter or oil pan is below the frame, place a steel plate under the engine. The vehicle frame will flex during Wildland travel so weld the plate only on one side, usually at the front end. Leaves and twigs accumulate on the plate and should be cleaned frequently since a spark on the dry leaves may start a fire.

Some vehicles have the fan belts exposed from below. When driving in brush, the branches can and will flip-up in the space and flip-off the fan belt. The immediate result is a rapid increase in engine temperature. The solution is a short steel plate welded under the main pulley; again, weld only one side.

An extended rear bumper may cause hanging up when crossing ditches and draws. If such a bumper is needed for a trailer hitch, box it in on the bottom to eliminate the sharp corners. A better solution is a removable hitch that won't limit movement when traveling primitive roads or cross-country. An overhanging rear bumper will get you stuck more frequently than any other item.

Brush leaves that fall when disturbed by the passage of the truck are sucked into the radiator by the fan. A piece of window screen wire fitted across the front of the radiator will keep leaves and twigs out of the cooling coils. Tie the screen just at the top so it's easy to remove and shake clean several times a day.

Exhaust systems are not a critical item, but can become a problem if mounted too low. If the exhaust stack is knocked off on a rock, have it rerouted when it is replaced. Be aware that catalytic converters are hot and when parked on dry grass or brush, may ignite a fire. Find an open spot to park.

Insure gasoline line protection. Generally these are flexible lines that can be moved up into the frame and wired. If copper tubing is present, (generally when extra fuel tanks are added) there should be a short length of flexible line at one end to prevent the copper tubing from breaking from fatigue. If rubber tubing is present, replace it with gasoline flex line. Rubber tubing erodes pellets that clog the fuel system.

If steel cables activate the emergency brake, investigate rerouting the cables to reduce risk of damage. Pulleys can be used to lift the cables up above the frame; this may require lengthening the cables.

Most modern vehicles have the wires that run to the rear of the vehicle safely encased up in the frame channels. If needed to protect this wiring, split a length of 1½ to 2 inch plastic water pipe, fit it over the wires and tie the pipe into the frame with bailing wire. Wires running to the tail lights and rear license plate can be placed inside short lengths of plastic pipe and wired to bumper supports. Check for dangling wires in the engine compartment, also.

A radiator overflow bottle is easily made from a one-gallon bleach bottle. Cut a small hole in the bottle shoulder, disconnect the lower end of the overflow hose and thread the hose into the hole in the bleach bottle. The hose should fit snugly. Extra hose length can be cut off to match the bottom of the bottle or it can be coiled in the bottle. Wire the bleach bottle securely to the forward corner of the engine compartment and fill the bottle ¼ full of antifreeze solution. Drill a small hole in the lid of the bleach bottle to allow easy circulation.

Drain holes in the bottom of the pickup cab can be plugged with rags, duct tape or fiberglass insulation. This allows the cab to be pressurized with heater or air conditioner to limit dust entering the cab.

Equipment

Necessary items for Wildland travel include a spare tire, mounted on a wheel, and with sufficient air enclosed and a large lug wrench to remove lug nuts/bolts put on with an impact wrench with 120 lbs. of torque. I find the L-shaped wrench desirable because with a 3 to 4 ft. long steel pipe slipped over the handle, it will loosen any bolt. The spare tire should be mounted in the pickup bed because it is not always possible to crawl under the truck and undo the spare tire. Checking the air pressure is almost impossible when a spare tire is mounted under the truck.

Another essential item is a jack that can raise half of the pickup wheels well above the ground. When rear wheels are mired to the axle, it is convenient to lift both with one lift of a jack. The jack should be a bumper type since the bumper is bolted to the frame. In addition, several 2 x 6-inch boards will be needed under the jack to prevent the jack from sinking out of sight in the mud.

Screwdrivers and wrenches are needed for minor mechanical repairs. One or two shovels and an axe are also required equipment.

If there is a winch on the truck, never plan on using it to get your truck unstuck. A winch should be used for pulling other vehicles out. With a persistence and thought, a way can be found to free a stuck vehicle.

A tire pump (a spark plug pump or compressor that works off the lighter) can be of great value. Little sealant cans used to repair car tires are inadequate for a truck tire repair and a pump will supplement the pressurized air in the can. When driving in sand, reduce tire air pressure to about 15 lbs. to provide flotation, if using tube-type tires. With tubeless tires, reduce air pressure to about 20 lbs. and don't spin the wheels. When returning to pavement, remember to reinflate the tires.

Tire chains are needed infrequently, but they are an essential item. Four-wheel drive trucks with locking hubs have front wheels that turn slightly faster than the rear wheels. Therefore, in snow the chains go on the front wheels and in mud chains go on the rear wheels.

Carry all equipment in a box securely bolted to the pickup bed. If the box is slightly narrower than the bed, this provides a place to carry fence posts, survey rods and other long items.

It may be desirable to carry a few spare parts such as a fan belt, an extra spark plug and some plastic tape to mend a blown water hose.

Driving

Driving in Wildlands on a dim trail or cross-country is an acquired art and is only a means of transporting equipment. Driving across rocks and brush is hard work and safe travel speeds average about ½ mph. Should you just want to look at the country, it is faster and easier to walk.

Driving in Wildlands is not an off-road race where drivers have specially built, heavily reinforced vehicles with three or more shock absorbers on each wheel; and where crews of mechanics are present with truckloads of spare parts. It is my belief that showing a four-wheel drive vehicle with all four wheels off the ground is ridiculous and presents an unrealistic expectation in novice Wildlands drivers.

In real life, travel speeds are ¼ to ½ mph and up to maybe 5 mph for a few yards of smooth going. It could be deleterious to your health to break down with help 50-miles away, so drive slowly and carefully.

Remember to hold the steering wheel firmly with both hands at about 9 o'clock and 3 o'clock. Do not wrap your thumbs around the steering wheel. Remember Brunner's Second Law: *THUMBS UP!* The steering wheel kicks back when the front wheels hit a rock and can sprain or break a thumb. With power steering this kickback is not as violent, but still adequate to injure. Some off-road vehicles have a shock absorber in the steering linkage to minimize kickback injury.

Manually engage the front wheel locking hubs when leaving the main road, even if the immediate foreground looks smooth and easy. Some vehicles have automatic front wheel hubs that should cut in when needed. Sometimes these automatic hubs work and sometimes they don't, and never when in reverse gear.

Often, hurrying will get the truck through a bad spot and minimize the chances of getting stuck. However, trying to ease through or stopping midway will usually get you stuck. Do this 'hurrying' with due consideration. If the accelerator is floor-boarded, this may produce more broken trucks than your supervisor can tolerate. Apply pressure to the accelerator as gently as a violinist plays his instrument.

Brunner's Third Law of Wilderness driving is: *KNOW WHERE THE WHEELS ARE!* That is, know exactly where the four wheels will track. Find a smooth area and scatter some small rocks around, then

drive over the area trying to hit a certain rock with the right or left front tire. If you don't feel a bump, get out and see how far you missed. Practice with the rear wheels, too, particularly with the right rear wheel. Turn sharply to learn where the rear wheels will track on a turn.

Locate the banjo (bell housing) on the front axle; is it to the right or left of center? The rear banjo is almost always in the center of the axle. Practice estimating the height of rocks. Will the axles clear if you can miss the rock with the front banjo? Drive slowly up to a large rock, then stop and get out, look to see if the axle will clear. Soon you'll have an idea of what sized rock you can skim over and what size you must avoid. Remember that each make of vehicle is different and practice will be needed when making a vehicle change.

When driving in the Wildlands continually visualize where each of the four tires is located. Poor judgment in wheel placement can result in a broken truck or an accident.

A problem in Wildlands driving is limited visibility. Brunner's Fourth Law is: IF YOU CAN'T SEE, DON'T GO! Night time driving is a nightmare; it should be avoided if at all possible. Shadows hide rocks and deep gullies look flat, tiny gullies look deep. If night driving is necessary, have someone walking ahead of the vehicle.

When there isn't room to avoid a large rock put a wheel on the rock and drive over it. Comfort is of little consideration, drive to protect the vehicle for a safe return to town or to camp.

If a hidden rock bends a tie-rod, have it straightened when in town and have an angle iron welded the length of the tie-rod. If you neglect this step, the tire-rod will bend again and again and eventually break.

As previously mentioned, the most common cause of getting stuck is the rear bumper. When driving into a draw, cross it at an oblique angle, never at a right angle. Then, just before a rear wheel touches, tap the accelerator and the vehicle will generally carry on through. The vehicle crosses although the rear bumper hits and one rear wheel is momentarily off the ground. If the accelerator is not tapped, the rear bumper corner hangs up and holds the rear wheel off the ground and the other rear wheel digs in. Then the truck is stuck.

Learn that once the truck stops moving, you are stuck. Gunning the engine at that point merely sticks you deeper. Immediately get out and look to see what is holding the truck. Then use the shovel and possibly the jack to free the vehicle. It may require only a few minutes or it may take several hours. Don't forget to memorize the situation and avoid a similar problem in the future.

Some makes of trucks have pinned rear axles and some have free-floating axles. If a pinned rear axle is broken, shift into front wheel drive and continue. If a free-floating axle breaks, a wrecker will be required to retrieve the pickup. When a free-floating axle breaks, replace the axle housing. If the housing is not replaced, the new axle will break the next trip out.

With today's computerized vehicles, it may not be possible to repair a vehicle in the field. This brings us to Brunner's Fifth Law: TAKE WATER, FOOD, and A BED! Pack a few cans of stew, some matches, water and a sleeping bag. A pickup can lose coolant so take a gallon or two for the truck and one for yourself.

Some people must look a person in the eye when talking, even if the person addressed is in the back seat. This is a bad habit when driving in the Wildlands. Keep your eyes and your mind on the area ahead at all times. If your attention is distracted by a wasp that has flown in the window, or if you must read the odometer, stop the pickup.

Take pride in getting to the job, doing it, and coming back unassisted. Good Luck!

Chapter 2

Camping Out

Camping in the Wildlands is different than using a developed campground. You have thousands of acres from which to choose the site and there will be neither potable water nor rest rooms provided. If a tent will be used, before leaving town, set up the tent to insure all the ropes, poles, and stakes are present. After this check, immediately load the tent and required tools.

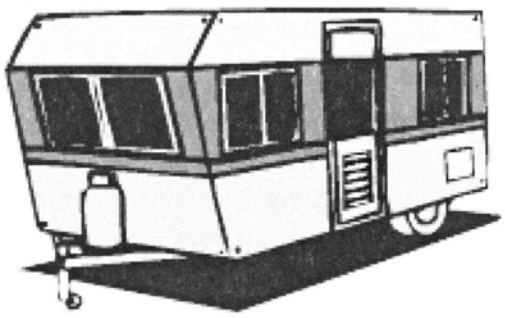
Have your field vehicle timed and tuned, sensors checked before heading out in the spring. Remember, do not use a propane heater in any enclosed sleeping area, even a tent.

A group called *Leave No Trace* espouses the following rules: 1) Plan ahead and prepare. 2) Travel and camp on durable surfaces. 3) Dispose of waste properly. 4) Leave what you find. 5) Minimize campfire impacts. 6) Respect wildlife. 7) Be considerate of other visitors.

Living comfortably in the Wildlands is a developed skill. Often it is convenient or necessary to camp out for several days or weeks to save travel time or to study a natural process.

One or two persons should buy the food for the trip. Make an attempt to learn of each person's likes and dislikes in food before buying. This may be done at a meeting where sample menus are proposed. Collect from each person for the food.

Traveling to the campsite with a trailer requires a different set of skills. Before leaving town make sure the appliances are in working order and that water and propane tanks are full. An experienced driver should drive the truck pulling the trailer. The tow truck should be fitted with trailer brake controls.



When passed by an 18-wheeler, a trailer will sway and bob in the windblast created by the truck's passage. Your truck and trailer will be pulled toward the centerline of the road. To limit this problem, (1) Drive with the truck and trailer right side wheels on the fog line of the road. (2) Keep a steady speed and (3) touch the trailer brake lever gently to control the trailer after the truck has passed.

Setting up a trailer is accomplished by parking it on a level place, digging with a shovel to level the wheels if needed. Level the trailer (else the refrigerator won't work) and open the propane valve on the tank. Light the refrigerator. If there is no toilet in the trailer, dig a slit trench. Dig a fire-pit for evening use. Gather firewood before dark, when snakes hunt.

The Camp Site

Choose a protected and safe flat spot. Wind protection is important in fall and winter. To alleviate the windchill factor and to make cooking easier, choose a shielded location where ground contour or vegetation protects the campsite from strong winds. In spring/summer, when gnats and mosquitoes are epidemic, choose a windy ridge. A check of animal trails may reveal bear scats or moose tracks; these signs would argue against camping here.

Large dead trees or single tall trees may shed limbs in a storm or attract lightning. When camping below a cliff, check for signs of rock falls; these may occur when the morning sun warms and expands the rocks clinging to the cliff and makes such a site dangerous. Never camp in an arroyo, watercourse or in a narrow steep canyon; a rain miles upstream can funnel floodwaters into camp. Low or flooded areas will produce more stinging insects than are comfortable.

In summer, seek shade and in the winter seek open sunny sites. A warm-season campsite should catch the early morning sun but be shaded in the afternoon. In the fall-winter, the coldest time of day is at sunrise, therefore arise early and finish breakfast before sunrise.

Camp well away from and upwind of regularly traveled roads and limit vehicle access into the campsite. Winds are normally from the southwest in the 11-western states. Use this fact when selecting a camp.

If the site is near a spring or stream, the camper will have easy access to washing water, but this will prevent wildlife from drinking. Always bring drinking and cooking water from town; the spring maybe bacteria-free but charged with Epsom or other salts.

A well-grazed dry meadow bordered by tall brush or trees is usually a good campsite. Firewood is handy and a meadow is not a favorite spot for rattlesnakes. Take time to scout the area and locate a good site. If a better site is located later, it is easy to move to a more comfortable site.

Setting up Camp

After the campsite is selected, all campers should help set up camp.

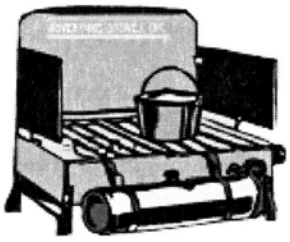
Clear rocks and brush from under the tent location to prepare a clean smooth surface. Level the tent site by digging on the high side and filling the low side and lay a sheet of plastic on the ground under the tent to prevent moisture from collecting in the tent. Set up the tent as if severe weather is expected. Bank dirt around the edges of the floor to prevent water from running into or under the tent and ditch to lead water away from the tent. Use the full complement of stakes and pull ropes tight. It is undesirable to have to secure a tent in a downpour.

Camp Manners

Camping is like a holiday for most persons, but don't let lack of personal grooming and crude behavior spoil the trip. Usually, liquor is not carried to camp, because there is always at least one person who will drink too much and be unable to work intelligently the next day. There is considerable relaxing. People see you as you really are, and firm friendships are made.

Camp Cookery

Hire a cook if a large group is to be fed. If only a few persons, someone who has experience may cook for the group. Decide whether to cook on a campfire or on gas/propane stoves, then bring the proper supplies. Experienced campers will use a stove to cook on and use the campfire for warmth and companionship. Consider cooking over a campfire, such as Dutch oven meals left in the coals to cook during work/play absences. Use due regard for fire danger.



Always be very clean in the 'kitchen'. Wash hands religiously, mop up spills immediately, have table space to place foods before and after cooking. Dishes are washed in one soapy pan, then rinsed in another pan with hot water, then dried with a clean towel. Clean up immediately after a meal and place all food in rodent proof containers. Rats shuffling through a pile of paper-sacked food will keep you awake all night.

Bring foods that require a minimum of preparation and cook quickly. The freeze-dried foods are useful and provide variety of diets. Healthy appetites require more volume and calories than usual for sedentary activities. Coolers for drinks, milk, and perishables use block ice and are shaded from afternoon sun. Plan on using fresh meats and vegetables early in the outing for safety.

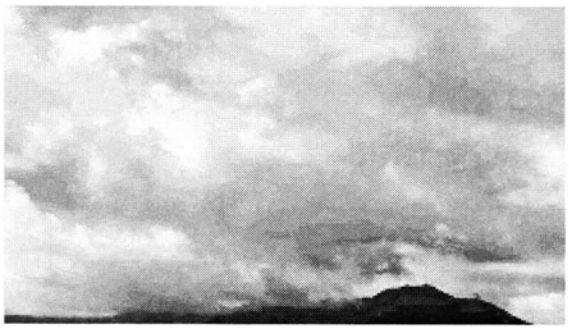
Camp Sanitation

The old standby for a bathroom is a slit trench dug 6" wide and 18" deep that can be straddled. It is downwind and out of sight of camp. Place a sack of quicklime nearby with a cup for spreading lime over the remains. The roll of toilet paper is placed on a forked stick.. If location requires, screen the latrine with brush or a tarp tied to steel posts. The last act on closing camp is to fill the trench. Portable toilets may carried together with water for flushing and the necessary chemicals. Also bring steel posts and a tarp to erect as a screen, especially if there are ladies in the crew.

Reading the Weather

Follow the weather forecasts before going on a camp-out. Realize that this forecast will be accurate about 65% of the time, at best. At least it should help determine if you need winter coats or down sleeping bags. If you work or live in the Wildlands you will learn to read the weather from the clouds and the winds. Remember the circular motion of a front. A cold front will have counterclockwise winds so you can tell where the center of the front is by the wind direction. Learn mares'-tail clouds from a mackerel sky clouds and ask a local weatherperson to interpret them for you.

Once you are attuned to the weather, you will feel unease when a storm approaches. Deer will come off a mountain about 12 hours in advance of a storm, so when you see this, you can decide whether to tough it out or to run for town. Birds tend to flock and feed before a storm. Most summer storms are small in area, so it may rain in town and be clear and bright at your camp site. Winter storms tend to be larger in size, move more slowly. If you have a protected camp site, plenty of food and gasoline, and are not too far from maintained roads, it may be wise to sit the storm out, then go back to work. Factors to consider are how far the job is along, how much time it will take to go to town and then come back out, if personnel will still be available to return, and many other items.



Signs of approaching storms.

Weather

Learn how to calculate 'degree days' to be able to predict proper turn-out time for livestock grazing. Click on www.ipm.ucdavis.edu/WEATHER/ddconcepts.html>. Basically, read the high and low temperatures for yesterday, add them together, divide by 2. Subtract 50 from the remainder. The result is the degree days for yesterday. If a negative, there are no degree days. Every plant and animal and insect needs a certain number of degree days to break dormancy, to hatch an egg, etc. So you can keep up with when the grass will be ready to graze, when the grasshoppers will hatch, etc.(Capital Press, Nov. 23, 2007).

Chapter 3

Horse Sense

The Wildlands visitor often uses a horse for transportation into and out of the Wildlands. For a generation, the tough scrambling 4-wheel drive vehicles supplanted the horse in most Wildlands areas. But with Environmental Concerns, there are places where vehicle travel is possible, but the fragility of the area forbids. Examples are erosion pavement, sandy soil, wildlife areas where the noise of a vehicle could unduly disturb wildlife (particularly when with young), or where vegetation would be damaged.

The art of getting on a horse and staying there all day is best learned with a horse at hand. Rental stables and licensed guides can give a taste of horseback riding and offer riding tips. This chapter will offer hints on what to do and not to do.

First, choose a well-broken horse, but not an old plug that has to be kicked each step he takes. Some horses are 'spoiled' (have bad habits such as trying to run back to the corral, biting, kicking). Let the horse's owner choose your first mount. If you inflate your riding ability, the horse owner may give you a green-broke horse (one that is only partly tamed and still bucks).

Walk calmly and confidently to the horse's left shoulder. Talk to him. He'll usually turn and amble away; he doesn't want to work if he can get out of it. Walk him into a corner or until he stops and be ready to put a rope or halter around his neck. If you run at him, he'll run away. A few oats in a can may hold his interest long enough to capture him. Don't try to rope a gentle horse; that rope is hard and it stings when it hits.

When you get up to him, place the halter lead rope around his neck and hold the loop. He knows he's caught then and stands while the halter is slipped up on his nose and hooked behind the ears. Lead him to the saddle and tie the halter rope to something solid, like a corral post. A horse had a brain about the size of an English walnut so don't expect a dazzling intelligence. Most of a horse's actions are hard-wired genetics.

Curry or brush the horse's back and his belly up front to clean all the dust, straw and trash off him. Always stay at the horse's side and front shoulder because it is a safe place. He can't kick you and if he turns to bite, you have time to slap him away or jump back. Watch his ears- if they point and he looks, there is something to see. If he flops and rolls his ears, he's listening. When he's mildly annoyed, his ears are halfback. When his ears lay clear back against the neck, he's mad, so stop whatever you're doing that is annoying him, unless you're disciplining him.

The left side of the horse is the 'near' side and the right side is the 'off'. Everyone but Indians saddle and mount from the near side.

Once the horse's back is cleaned, call the owner's attention to any sores or wounds on the horse. He may want to doctor it or he may want to let the horse rest. Then fold the saddle blanket or pad so it will fit under the saddle with a few inches hanging out. Generally a full-sized blanket will be folded in half long ways, then in thirds to make a proper sized pad. Put the blanket on the horse with the front end of the pad on the high point of the back. Just below and behind the shoulders is a hollow on each side, the withers. The saddle tree, that is the part just below the horn, fits into the withers and holds the saddle from turning.

When you pick up the saddle, pull the straps and stirrup for the far side over the seat of the saddle. Some horses object to being whapped with that heavy stirrup when the saddle is tossed on his back. Once the saddle is on, straighten the straps, strings, etc. from under the saddle on your side. Then go under the horse's neck and straighten out the off-side straps. Go back under the horse's neck and reach under the horse to get the front cinch. There is a long leather strap on your side of the saddle and this goes through the loop on the cinch and either ties or is buckled. Get someone to show you how to tie it. Some saddles have only

one cinch, the front one and is a 'center-fire' rig. If there are two cinches, on in front and one in the rear, it is called 'full-rigged'. Leave plenty of slack in the rear cinch, you tighten it only when roping big steers or you want the horse to buck.

As you work around the horse, talk to him. It reassures him and he knows where you are. Mature horses sleep on their feet, and if suddenly awakened, may kick reflexively. When passing behind him, put one hand on his rump and pass close to him. Then if he kicks, he'll shove you instead of striking you, which ouches a lot less.

A quarter-horse has no withers, so you need a saddle made to fit and stay on his back. A quarter-horse saddle will not stay on a horse with withers. Decide which type of horse you will ride most before buying a saddle. Seldom will you ride quarter-horses except when working cattle.

In the Southwest, riders place a gunny sack under the saddle blanket to allow better air circulation and keep the horse's back cooler.

If the horse is a bit spooky or a high wind is blowing put on the blanket and saddle at the same time, using both hands. If the pony fidgets, pick up the saddle by the hole under the horn and arrange the blanket under the saddle. Hold an edge of the blanket with the thumb of right hand holding the saddle and with the left hand grab the headstall of the bridle or halter. Pull his head around a bit and toss saddle and blanket on. Grab the cinch first and tighten it, then worry about straightening straps and strings.

Once the saddle is tied down, check the length of the stirrups. Put the bottom of the stirrup in your armpit and stretch your arm toward the saddle. Your fingers should brush the saddle with an inch or two to spare. Stirrup straps are long straps running up into the tree and back down again to form a loop. The strap fastens with either a buckle or a rawhide thong. Too-long stirrups are uncomfortable, so adjust them to fit. Start with them long enough that you just clear the saddle by an inch when standing in the stirrups. Be sure both stirrups are the same lengths; count the holes from one end of the strap.

The bridle goes on over the halter for most riding, as you'll be getting off the horse to work and you'll want to tie the halter rope to something solid. Reins are too fragile to tie with. Some horses are trained to 'ground-tie', to stand when the reins are dropped on the ground. Never assume the horse will stand, tie him down.

Few horses will take the bit readily, so hold the bit by the long side-bar and push the bit up to his mouth and between his lips, sometimes several tries are needed to get him to open up and take the bit. He may lift his head out of reach. A slight bang of bit against teeth may help him decide to open his mouth. If the bit has no side-bars, gently guide the bit while lifting on the headstall (the leather strap that holds the bit and goes up over his ears). Keep the hand flat, palm up, so if he opens up suddenly, the hand won't go in between those big teeth. The cross bar of the bit fits into a toothless slot on the lower jaw between the front teeth and the molars. Adjust the headstall so the bit comes just to the corner of his mouth. The curb strap (or chain) fits under the chin. When the reins are pulled, this strap tightens and ouches him enough to stop him. If this strap is too loose, he won't stop; if too tight, it will hurt him constantly and make him nervous. Two fingers worth of slack is about right for the curb strap. The throat latch is the long thin strap that buckles under his neck to hold the bridle on. Again, two fingers slack.

Then check the saddle girth again. Some horses will swell up when the cinch is first tightened then when you try to mount, the cinch is loose and the saddle turns. In flat country, the cinch needn't be very tight, but in steep areas it must be tight.

You are ready to mount. Stand next to the horse's near shoulder, gather any slack out of the reins (so he can't get his head down to buck or turn his head to bite you). Face the rear, turn the stirrup with your right hand so it is open to your foot. Put the left foot in the stirrup, grab the horn with the right hand and swing aboard. Immediately kick your right foot into the stirrup. Some horses are trained to turn left as soon as you gather the reins and get a foot in the stirrup; these are easy to mount. Some will turn away from you while you mount, and this can cause you to sit in the dust. Choke the reins or grab the headstall and pull his head toward you to forestall this.

Riding in soft boots or sneakers requires putting weight on the ball of the foot, which after several hours equals agony. Wear a boot with a steel instep, enough heel that the foot can't slide through a stirrup and has a pointed toe so the foot goes into the stirrup smoothly.

Western horses are ridden with slack reins. Turn a horse to the right by laying the reins on the left side of his neck; this is called 'neck-reining'. Don't try to guide the horse by pulling on the rein toward the direction you want to go. That's how movie cowboys make a horse fall in front of the camera.

Most gentle horses are ridden without spurs or quirt. Lift the slack reins and gently kick a heel into his ribs to get him to go. As experience is gained, you'll find most range horses perform better if they know you're wearing spurs. Spur gently once in the morning and maybe once in the afternoon and that is enough.

Spurs are not worn when riding in trees. If throwing a leg over the horn to clear a tight spot or if a small tree drags a leg back, the horse will receive an unnecessary jab. Use a quirt or bat in trees. A quirt is a short whip with a stiff handle. A bat is a 2 to 3 foot long piece of doubled leather, 3 inches wide, with a handle. The bat pops when he is hit with the flat side and it scares him more than it hurts him.

Don't spur or quirt a horse in front of the shoulders. That is a sensitive area. It belongs to the horse, the cowboy's say.

On flat country find the horse's most comfortable traveling gait that is faster than a walk. By shaking him with reins and heels, get him to change from a walk to a trot. He may have a natural running walk, fox trot, or pace-trot. Any of these gaits is smooth and easy to ride. A fast trot is murder after a few minutes. A quarter horse has only two comfortable gaits, a walk and a rocking-horse gallop. A regular horse usually travels at a gentle trot. Sit deep in the saddle, turn your toes out and relax. The English invented posting, which is rising slightly in the stirrups each time the horse's right front foot hits the ground at a trot. While OK for short rides, it isn't for a 12 to 16 hour ride. Most ranchers travel at a trot on a standardbred horse or at a lope if on a quarter-horse.

Never run a horse for fun. Do not let a horse run back to the corral or barn. This is a bad habit. If he tries to run and just pulling on the reins won't stop him, slide the right hand up the reins until they are tight on his neck, then turn your hand over. This extra leverage will either stop him or break his jaw.

A mistake the novice makes is letting the horse grab a bite to eat as he goes along. Jerk his head up and sock him with your heels the first few times and he'll stop trying. If you don't, he'll soon stop traveling and just graze.

Measure distance by counting the horse's steps. Count each time his right front foot hits the ground; determine the length of his pace by comparing it with your own.

When through riding for the day and have unsaddled, wipe the horse's sweaty back where the saddle has been. In the southwest, find a gallon can by the water trough, wash the back down, then dry it with a gunny sack. Don't let a horse fill up with cold water when he is hot. If you walk him the last half-mile to the

corral, it will help him cool down. Recognize a horse will literally eat itself to death if given access to a bushel of oats; feed it hay, one flake.

Horses that are working hard day after day need shoes in most areas and particularly in igneous rock. A competent farrier (professional horseshoer) should be able to watch the horse walk and trot for awhile and devise a shoe that will fit, improve his gait and be comfortable. Some horse owners prefer that their horses go barefoot and this is fine as long as it isn't worked hard, (more than 2 hours a day, 5 days a week). Trimming hoofs (a hoof is a toenail) every 6 to 8 weeks should be left to a farrier.

Despite the mystique of the horse, which as bitten me as badly as anyone, look on a horse as a means of transportation, not a faithful loving animal. Treat every horse, now matter how tame, as if he were a green-broke bronc, it will avoid trouble. Remember the size of a horse's brain and don't expect him to think. It is the dog that is man's best friend.

Chapter 4

Ranching Customs and Philosophy

A rancher has an intimate knowledge of his ranchland and his livestock. Most ranchers today are college graduates. Economic studies have considered why a person would invest in a low-return on capital investments such as ranching (3%) when other ventures would yield much more. The answer was that the life style, the freedom of decision, the sense of being 'king of all I survey', and the prestige of being a rancher (cream of Western society) overbalances the higher return.

Distinguish between three types of ranch people. There are cowboys, cowmen, and men in the cattle business. A cowboy knows about horses and cattle and ranch machinery. A cowman knows about cattle, horses, vegetation, finances, machinery repair and the multitude of other skills (like politics) needed to operate a ranch for a profit. The man in the cattle business is concerned with finance and isn't interested in the livestock or the vegetation.

Work with all three types. From the cowboy, learn his intimate knowledge of 'cowpography' (how a cow thinks and what it does). Also, gently teach him about vegetation; the names of plants, which are ice-cream plants that will put more than two pounds of weight a day on a steer, and which plants are poison. Ranching is a lonesome proposition and the cowboy or sheepherder is normally glad to see you and to talk. When visiting an isolated ranch, take a copy of today's newspaper for them. They'll appreciate it. The cowboy may be a cowman someday.

A cowman is a busy person. Therefore, make a date with him if a tour of the ranch or other business will take more than a few minutes. Avoid dropping by at noon, you'll be expected to eat with them and there may not be enough to go around. It is an insult to refuse and eat your own lunch. Many ranchers in the Southwest take a siesta after lunch. They ride from about 4 a.m. until noon, then eat and take a siesta, then saddle a fresh horse and ride from about 4 p.m. until dark. The cowman will be interested in learning about the vegetation and range improvements. Teach him about vegetation and ecology; pure ecology; the study of a plant or animal in relation to its environment. If you're an environmentalist, realize that the rancher is a better one because he's doing what you only dream. If a preservationist, you have no place working with ranchers or other outdoor landowners; you are the '*Enemy*'.

The man in the cattle business will not go out on the ground to see what is going on and why, unless there is a clear financial gain. Work with him when possible, he may develop into a cowman someday.

Listen to the rancher. Suggest a few pieces of information he needs for his decision and never argue. In your specialty, where your training is firm, advise, explain, teach. You are dealing with a man's bread and butter, so do not propose uneconomical practices. Some people feel that preservation of a resource is holy and making a profit is crass; keep this type of person away from a cowman.

The average rancher has been on the ranch most of his life and knows the land better than you ever can and how his livestock use the vegetation. He can almost instantly decide if a proposal has merit or not. **Ask** him if a certain practice is feasible. If not, what change can be made to achieve the goal and make it practical for this rancher. Be goal oriented, leave the nuts-and-bolts up to the rancher.

Almost all ranchers today understand plant physiology or ecology. The few that don't, feel that when it rains a depleted range will restore itself. And a deluge that occurs once in about 30 years appears to do so. There is some truth to his assertions. The land will cover itself with vegetation in a wet year; even the desert around Las Vegas, Nevada, which normally carries only a sparse growth of creosote bush.

I have clipped over 2-tons per acre off that normally barren land after a wet growing season. A rancher unable to distinguish between 'ice-cream' plants and weed grasses feels the range has renewed itself. If he permits heavy use, the livestock will be forced to eat unpalatable forage, so the palatability difference is not apparent.

The desert rancher has been pretty much eliminated through federal regulations; therefore, the ordinary rancher you will work ***with,*** is a very intelligent person with a college degree. Though, his degree stressed livestock while yours stressed plants, together, you can work wonders in maximizing products of rangeland.

Some environmentalists are really just persons opposed to any resource extraction from the Wildlands, be it a cow or a hiker or an oil well. Those whose god is the Earth, are an illogical bunch, willing to live in a house made of trees, but unwilling to let anyone else do so. The 'Deep Ecologists' fall into this category. One can make a six-figure salary frightening persons that the '*End is Near*' and that baby seals and all Nature must be protected from the '*Enemy*', which is Mankind. Hundreds of people make a living foisting false 'science' on the public. They are recognized by their adjectives.

Using the United Nations, they have been successful in selling several hoaxes such as the Ozone Layer, Acid Rain, and now, Global Warming. On the home front, the worshipers of *Gaia* (the earth) have been united in using such hoaxes as the endangered salmon, the marbled murlet, and the spotted owl to wreck various industries to the vast detriment of the ecosystems. I hold that man is a steward of the Earth.

Chapter 5

Range Livestock

Range livestock differ from farm livestock only in the amount of care needed. A good range animal is able to find its food and walk several miles to water, to mother its young without Man's help, and to survive in rough terrain in all kinds of weather.

Kinds of Livestock

Range livestock can be broadly classified into cattle, sheep, goats, and horses. Wildlife ranching, where imported or native wildlife is raised, will not be discussed here. Within each broad class are purebred and mixed breeds. A herd that is nearly purebred is called a 'grade' herd.

Cattle

Breeds of cattle for range use are usually one of the beef breeds such as Hereford or Angus or one of the draft breeds such as Charolais or Limousin. Crossbreeding is used to achieve a certain goal such as better milk production by the cow or a larger calf at weaning through heterogeneity.

Angus bulls may be used to breed Hereford heifers because the resulting calf has a smaller head, making first calving easier. These calves will normally have a white face, but otherwise black. Angus may be black or (seldom) red. The English-European breeds do not have the ability to sweat and this hurts weigh gain in hot climates. The Brahman and related Indian-Asian breeds do have sweat glands and are used to cross with a beef animal to produce a fast-gaining heavy calf.

Each rancher breeds toward a certain goal, whether he runs purebreds or ridge-runners. Basically, he is balancing the terrain and the forage with the maximum output of beef.

Most cattleman turn the bulls in with the cows in the fall for about a month so all the calves will drop within about thirty days the next spring, usually April or May. Gestation period for a cow is nine months. The uniform calf crop makes selling easier and for higher prices. Supermarkets want the same size and cut of meat in their markets yearlong and this determines in large part the entire cycle of growing and feeding cattle. Buyers want the calves to be as alike as peas in a pod.

A few cattlemen still breed yearlong. The bulls run with the cows permanently. Most of the calves will be dropped 9-months after the cows come into heat which is influenced by enough good feed to put the cow in good physical condition. A cow won't start a family if she's in poor condition. Thus, the herd may calve at any month of the year and if in the dead of winter, this can be costly. The total number of calves will be about the same, but some will be early or late calves that are difficult to market with the bulk of the calves. These odd-aged calves may be sold at local auction or eaten. On open range, bulls will stake out a territory on one of the trails to water.

Bulls will breed up to 20 to 25 cows each on open range. In pasture situations one bull will cover about 40 cows. When breeding begins, the bulls are fertile, but as days pass, they become exhausted and infertile. Some ranchers turn in 2/3rds of the bulls initially, and after three weeks remove the worn out bulls and put in fresh bulls to complete the breeding. Bulls are expensive and can be used only a few years. Since most ranchers raise replacement heifers, some inbreeding may occur to the detriment of the breeding program if bulls are retained long enough to breed their daughters. A 'bulldog' face on the calf often indicates inbreeding.

The more progressive ranches now use artificial insemination and/or pregnancy testing. Economic conditions forbid running a barren cow for a year, or even nine months. The cost of bulls, their mortality rates, and cost of food and water for them make artificial insemination attractive.

The rancher is more certain that the cow will 'catch', and if she doesn't, it is a sign she ought to 'go to town' (be sold). Pregnancy testing helps assure a 90% or better calf crop. Most small operators (100 to 200 head) breed and calve 'inside' (in a small pasture), and can achieve a 95% calf crop. An ordinary open range (no interior pastures) breed-yearlong cow outfit will average 35% to 55% calf crop. A rule of thumb says it takes at least a 55% calf crop to break even on expenses. The ranchers who have been able to stay in business with a small calf crop percentages have the benefit of cheap grazing fees on federal lands and by spending as little as possible for labor, capital improvements, or maintenance. "One cowboy per 1,000 head of cows.", said John Jay Casey. Many of these are hobby ranches where the family income is received from outside sources.

Ideally, the calves should weigh about 500 lbs. at 6 months of age (weaning time). During a drought some ranchers creep-feed calves to increase their weight. A creep is a feed-trough fenced to exclude grown cattle. Usually a pole fence is placed at a height to permit the calves to walk under. It may not be economical to creep-feed, but is done to maintain the rancher's reputation with cattle buyers for big calves.

After pregnancy testing, a cow should not be penned or run through a chute. If a government agency wishes the cattle to be ear-tagged before being turned out on federal range, this may be done while the cows are in the chute for systemic lice spray, etc. If cows are handled after pregnancy is advanced, it may well cost the rancher a number of aborted calves. Range cows are not tame animals.

Brahmans and their crosses have their ears hooked on below and behind the horns (or where the horns should be) making recognition easy. The Brahmans' ears are usually lax. Brahmans are more pugnacious than English breeds.

Cattle prefer to eat their fill several times a day. They often graze at night. After eating, they go to water, then to salt, then out to graze again. Cattle on good range grasses should gain about one-pound per day. On a crested wheatgrass seeding in the spring, they may gain 2½ lbs. per day. Steers in a feedlot should gain from 2½ to 3½ lbs. per day. Steers gain faster than heifer calves. The rate of gain seems to be an inherited characteristic so a bull's progeny are tested to select for this characteristic.

Cattle have multiple stomachs, the first being storage for hastily gathered vegetation. Cattle have no upper teeth, so the forage is torn off with the aid of the tongue. When the first stomach is filled, the cow lies down to rest. She regurgitates food from the first stomach, chews it into finer pieces and then swallows it into the second stomach. In the second and third stomachs, bacterial action breaks down the forage, releasing sugars and starches which are absorbed into the cow's blood stream for use in building and repairing tissue. If the cow has been on dry range grass, she will have mostly a certain kind of bacteria. If she is moved onto a green grass pasture, she will lose weight for 10 days to 2 weeks until the proper bacteria to digest the green feed have developed in sufficient quantity. It is possible to take a cud from a cow that has been on a certain feed for several weeks and give it to a newly introduced cow (or calf) to help get the proper bacteria culture well started. A calf gets bacteria from the mother cow as she licks the calf's nose.

Sheep

Range sheep are white-faced, indicating Suffolk backgrounds. Most range sheep are termed 'natives', indicating a crossbred status. Unlike the white-faced sheep, the black-faced Hampshire has no herding instinct. The ewes tend to walk around the pasture daily. If the pasture is large, the ewe may take a couple of days to complete her circuit and get back to her lamb, so it may be dead by then. In a small farm pasture situation, the black-face is a good choice.

The average range ewe is a crossbred, weighing 100 to 125 lbs., with medium grade wool (11/16ths.). She is bred in the fall to lamb April 1; 5 months later. The lambing band numbers about 500 ewes with two

to five herders. The band is drifted very slowly thorough an area with good feed and water. As a ewe's time comes, she slips away from the band and has her offspring, very often twins. The herders try to keep predators away from the newborn lambs and assist the ewes as needed. If a ewe dies or refuses to mother the lamb, the herder tries to get another ewe to accept the lamb. If this fails, the lamb becomes a 'bum' and is bottle-fed if possible. A tramp sheep outfit (one without a home ranch) will knock the bum or the weaker of the twins in the head. As soon as the lambs can walk well (2 to 3 days) the band is gathered again for safety against predators.

A normal summer band will have about 1,000 ewes with their lambs and a winter band of ewes will comprise some 1,500 sheep.

Sheep have been described as 'an animal looking for a place to die' and are frustrating to care for, but they are money-makers. The lamb crop will make as much money as would a calf-crop and the ewe's wool is extra profit. Sheep raising is labor intensive, requiring constant attendance when herded. Open herding, where sheep are run unattended in small (600 to 1,000 acre) pastures is a high-capital enterprise because of the cost of fencing. The increases in predator populations (mostly coyotes), since preservationists have outlawed effective poison controls, have terminated open herded sheep ranching in West Texas and other parts of the West.

Sheep's wool is a valuable commodity and is classed according to length of fiber. The longest fibers are the most valuable. Native sheep have wool that is medium length and sturdy enough to withstand being pulled out by brush. Range sheep are sheared once a year in the spring about a month after lambing, but in the northern areas ewes need their wool for warmth so before lambing herders 'tag and shear eyes'. The area around the udder is sheared so the lamb won't try to suckle a strand of wool (a tag), and the face is sheared so the ewe can see properly. In the north, the ewes are sheared about a month after lambing. In the southern U.S., sheep are often sheared twice a year since they get too hot with a full coat of wool. In any area a cold rain on newly sheared sheep can be disastrous. An itinerant crew of experts who can shear a sheep in 3 to 5 minutes usually does shearing. They use mechanical shears, powered by a gasoline engine.

Sheepmen are looked down upon by cattlemen, as they have been since the 1800's.

There is no truth to the story that sheep ruin a range. Properly managed sheep are easier on most ranges than are cattle. Sheep are lighter, so there is less soil compaction in wet weather. Properly herded, a band of sheep can graze through an area and the impact is noticeable only to a trained observer.

Goats

Goats for range use are of two types—hair goats and meat goats.

The hair goats are Angora breed or crossbred. The hair is long and silky; thus it breaks or pulls out fairly easily. The Angora cannot be grazed in stiff thorny brush. The major product of the angora is the hair, which is clipped annually or semiannually. The hair goat herd may consist entirely of wethers (castrated males) with a small separate band of females to provide replacements. Kids are not necessarily good meat animals and are sold quite young to avoid overstocking the range.

Mature hair goats are very tough animals and will run off a dog or coyote that enters their domain. Goats can be used to consume brushy plants while the dry grasses are not eaten, thus improving the watershed value of the land. They are most frequently used in oak-brush country where they consume the sprouts.

The meat goat is usually a varicolored shorthaired goat. This type of goat is also used for milk production, but only on goat dairy farms. The goat is the bane of anyone who is trying to improve the range. Everywhere in the world that goats run, from the Mediterranean area to the Navajo Reservation, ranges

have been severely depleted by mismanaged goats herding. This is due mostly to the competition by goat owners for limited forage and in part to the omnivorous appetite of the goat which will eat almost any plant.

A well-managed meat-goat ranch, which is usually on rangeland that is too rough, steep or brushy for other livestock, can give lie to the tale that goats are naturally destructive grazers.

A few ranchers run cattle to eat the grass, sheep to eat the forbs and goats to eat the brush. This can be conservatively done and improve the range. Too frequently, though, you end up with polished rocks.

Horses

Large horse raising operations are a thing of the past. Today it is rare to find a ranch with more than a dozen brood mares. The market for horses is largely for animals for suburbanites. Most ranchers feel it is cheaper to buy horses from a small breeder. Horse raising is a labor-intensive business. The long gestation period (11 months) plus the long adolescence (2 to 4 years) plus the need to break and train the young horse all adds up to 4 to 5 years of feeding and care before realizing a cash sale or a useful animal. With cattle the care period is about 15 months and with sheep it is only 11 months.

Moreover, horses have but one stomach and tend to eat finer forage, which is rare on the range and require from 2 to 3 times as much forage as a cow for maintenance. Horses have a full set of teeth and tend to nip of grasses at the crown of the plant. Not managed, they are very destructive grazers. Horses are curious and like to play with desert tortoises, which cures any overpopulation problems for the tortoise.

Although some ranches raise and train their riding stock, generally this is found where there are oil wells on the ranch, labor is cheap or where it is traditional for that ranch.

The small horse breeder will raise a certain breed of horses. Morgan and Thoroughbreds are popular in the mountain West. These are big horses, weighing over a 1,000 lbs., and are long-coupled (a long span between the ribs and the hip) thus are good walkers and smooth at a trot. If born and raised in mountain country they are strong and sure-footed.

For working cattle, the quarter horse has no peer. It is short-coupled and able to turn quickly. It may have an inherited 'cow sense' that aids immeasurably in cutting out or driving cattle. The quarter horse has a bone-jarring trot and can be ridden comfortably at either a walk or a rocking-horse gallop, gaits suitable for short rides of 5 to 10 miles.

A few breeders raise ponies or miniature horses, which are sold for children's mounts. The miniature horses can travel right with a big horse. Shetland ponies seem fairly common.

Mules, a cross between a horse and a donkey, are used for riding on ranches where the terrain is too rough for horses. Mules are more sure-footed and will not overeat and die (founder) when confronted by a full sack of oats as will a horse. Many early frontiersmen rode mules since a mule will give warning of a stranger's approach. A mare-jackass cross is a mule, while a donkey-stallion cross is a hinny. A jenny is a female mule. All are sterile. A male mule, a jack, has all the inclinations if not the abilities of a stallion thus can be used to reduce the numbers of feral horses on a range.

General Information

In the harsher environments of the West, the rancher runs native cattle that know the vegetation, the location of the water-holes and springs, and know where and when to go to cover and when to move out to graze. In these areas only native cattle can survive so one maintains them or looks for a town job.

A new herd of cattle on a ranch is usually inspired by income tax advantages or a new grazing system to which the native cattle refuse to adapt. The first year there is a smaller calf crop of lighter calves since the

cattle are constantly on the move getting located. After the first year the cattle that survive have adapted and become natives. Some ranchers spend years developing and improving a herd of adapted cattle for their rangeland. In desert area this will probably be long-legged cattle that can 'rustle' (go find the feed) and utilize it to make pounds of calf.

The installation of a rest-rotation grazing system may mean that the herd the rancher has worked for years to develop may not accept the new fences and will have to be sold to make the system work. Be sure he knows and realizes this facet of the problem beforehand.

Handling Livestock

Range animals are semi-wild and not to be trusted. Although the dairy bull holds the record for man-killing, a Brahman bull or a heifer with a new calf can also be dangerous. A stud on the range with his mares can be very dangerous. Always be alert, even around 'gentle' horses or cattle.

Most federal agencies take to horseback to supervise the movement of livestock. BLM and USFS occasionally help gather the animals to count them. A horse and saddle may be rented for the occasion. Ask a fellow employee to assist with the first saddling and during the first drive. The roundup boss will assign various riders to different areas, usually beginning on a boundary, to drive the cattle to a central area. Cattle are usually easy to drive, once bunched, and only a few will decide to quit the herd and these must be recovered. The horse may know a lot about cattle driving; when he shows he does, follow his lead. If the horse is an old plug that wants to chase a steer at a trot, wake the horse up with your spurs or quirt. Once he finds he's there on business, he'll cooperate.

Livestock is always moved at a walk. If they have recently filled up on water, handle these animals gently. Sheep are moved at a walk for a horse, which is nearly a trot for a sheep. The animals are kept on the move, not allowed to graze on the way.

Brahman or Brahman-cross animals must be handled more gently than the English beef-breeds. Brahmans have a tendency to 'come back up the rope' (charge the horse or cowboy who ropes the animal). They will bunch fairly well, being polled (no horns) but if crowded they will scatter like a flock of blackbirds. They can be drifted by staying a hundred feet behind and walking the horse back and forth. The best ways to move a herd of Brahmans is to teach them to eat cottonseed cake, then get in the back of a pickup with a sack of cake and have the driver move off slowly while you trickle a bit of cake on the ground. The cattle will follow to eat the cake. Pour out only a few pieces every 10-feet. After a time or two practicing, when time to move the herd, get in the back of the pickup, wave an empty cake sack and drive off. The Brahmans will trot after you to wherever you want to go, to the next pasture or into the corral.

See Chapter 2 (Horses) for more tips on handling horses. On the range a band of horses are normally driven at a gallop. If you are riding alone, be wary of a stallion with his mares. He may want to put the mare you're riding in with his band, or if you ride a gelding, he may decide to kill it. This behavior is not normal for tame horses, but on feral horse ranges, be aware.

Range Livestock Diseases

Be aware that livestock parasites lurk in forage on pastures and open rangeland. A regular treatment program will help keep losses to a minimum. Treatment usually consists of drenching the animal (putting a bottle in its mouth and making it swallow the medicine). The treatment may be tied to unusually hot or cold weather, when it is more difficult for the worm to survive. Breaking manure piles may help eliminate a harbor for pests. Changing species of livestock may break the cycle. Know which parasite the livestock have and work with a parasitologist to try to break the pest's life cycle and slow it down.

One Texas rancher confided he'd found a way to eliminate worms in his sheep, he'd leased a piece of ground out near Ft. Stockton. "You know worm eggs come out with the droppings. They hatch and become a worm and crawl up on a leaf of grass and are eaten by a sheep which re-infects the sheep. But out there, a worm crawls itself to death looking for something to crawl up on. Result-no worms in my sheep".

Beneficial Livestock Use

At one time some 48,000 cattle grazed the coastal watersheds in northern California. These were sent packing by Super Greens, who object to anything not 'natural' on the land. Then, after a nearly 20 year hiatus, cattle were reintroduced because the lack of forbs seemed to threaten the bay checker-spot butterfly; too much grass. The exotic grasses were getting the upper hand over native grasses without cattle grazing. Now, in Alameda, Contra Costa, San Mateo, and Santa Clara Counties, cattle are back to suppress exotic grasses, reduce fire danger, maintain a healthier environment, and prevent encroachment of forests.

Animals benefiting from the cattle use include toads, salamanders, ground squirrels, bob cats, coyotes, hawks, plus listed species such as the red legged frog, San Francisco garter snake, and the San Mateo wooly sunflower (Capitol Press, 12/28/06, Don Curlee).

Be aware that an outline for Sustainable Rangelands is available on the internet at: http:// sustainablerangelands.cnr.colostate.edu.

Greens will fight it because they are against any extraction of any resource because it violates *Gaia* (the Goddess of Earth), who they worship. The question is purely one of religion.

Range Livestock Distribution

Using low-moisture block supplements may help get cattle off the bottom lands and onto the grassy hills. Cattle must be taken to the supplement at first, so they know where it is. If taken late in the day, the cattle tend to stay in the area to graze overnight and until time to go to water the next day.

By analyzing fecal matter and grass nutrition levels, a rancher can maximize production. Often the calves weigh 100 lb. more than before the adjustment in management foretold by the analysis. (Cattleman's Magazine)

Grazing Systems

Commonly used grazing systems are Hormay's Three pasture system, or one from Texas which utilizes different types of livestock and small pastures, or the Holistic system, One that is truly a winner is the Twice-Over system.

The twice-Over grazing system is not a new system, it has been proven over a thirty year period in the Northern Great plains. It promises better plant diversity, better forage, improved wildlife habitat and soil tilth (condition) improvement. The only drawback is that one must have fairly reliable summer rains. It would probably not work well in the Pacific Northwest where all reliable precipitation falls before the grazing season begins.

Graze the top out of the grass in spring, then move the cattle to another pasture. Pasture size should limit this first period to about 15 days. Grass will tiller and when cattle come back in one or two months, much more forage is available.

This system showed as best when raising ducks. The number of nests and success rate were compared for this grazing system with light continuous and season long use. Sharp tail grouse also did better under this land treatment.

Soil health was better after 30 years of this treatment with deep roots, good soil structure and much water stored. Light continuous grazing shows little root mat, good structure down to 15-plus inches, plant diversity was high. Intensive continuous grazing produces root-bound wads 2 to 3-inch depth, as there is little infiltration. Moderate continuous grazing equals average soil health, but with root mat 1½ to 2½-inches down, no deep roots.

Heavy early season grazing produces dense root mats 1½ to 2½-inches down, poor soil structure below, no water stored (just like your lawn).

Idle-(CRP) results in root mat in topsoil, no roots past 6-inches. Acted as shallow soil with much runoff (obviously had plow-sole). (Llewellyn Manake, Range Sci. North Dakota State University, Dickinson Research Extn. Ctr., 1089 State Ave., Dickinson, ND, 58601, (701) 483-2076.)

Livestock- Range improvement.

Stone Lakes National Wildlife Refuge outlawed cattle about 1989, but brought them back in 1999 to graze the grass and to suppress weeds so wildlife have their required food. Cattle reduced the grass height so Canada geese can graze on the nutritious short grass left. Before, the grass was so thick and tall they couldn't even land. Officials are using sheep on Jepson Prairie Preserve in Solano Co. Calif. to control rip-gut brome and medusa head.

With star thistle, don't graze early as it reduces competition so star thistle can grow better as a flat rosette. Graze in early summer when neighboring plants have dried and star thistle is growing rapidly but not yet set spines. The plant is very nutritious. (Range Magazine, Summer, 1999, Scripps-Howard News Service)

Ranching Customs, Rule of Thumb

Nothing should be set in concrete on a ranch. If it doesn't make a profit, it goes. Outsourcing hay may be profitable in decreasing labor and capital costs. A moderate sized cow may give more profit than the largest size due to decreased feed costs, better mobility, and general health. Move cattle when grass is ready, not according to a calendar. Weaning weights may not be a worthwhile measure of success. ((Range Magazine, Spring, 1999, p.7-8)

Ranchers should advertise their allegiance to environmental health. Perhaps a group could hire a publicity expert to issue periodic press releases of goals and results. Or a free lance writer could do an article in Range Magazine? Websites reach more people. Hard-core environmentalists try to stop any resource extraction, be it bird watching, hiking, or livestock.

Natural Resource Conservation Service is switching from Range Sites and Condition Classes to Ecological sites, a natural next step in understanding the landscape. Find a tame NRCS range person for details.

Invent holes in a Styrofoam ice chest to hold vaccination tools that are out of the sun, and keep cool and clean. Disinfect syringes only with boiling water, ***never*** with soap or chemicals which kill live and chemically altered products. Do not enter a bottle with a used needle. Avoid using a disposable syringe to give multiple doses, some animals get to much, some not enough. Use vaccine to lubricate syringe. ***Do not*** use a petroleum product or silicone to lubricate; they kill the active ingredients in the vaccine. (Progressive Farmer, Janurary, 2004)

Livestock - The speed with which a calf leaves the squeeze chute is an indication of the 'wildness' of the animal. You do not want wild cattle, so breed for tameness.

Chapter 6

Rangeland Terminology

We earlier suggested that you need a different vocabulary to talk with ranching people. Some common terms and their definitions are as follows:

Barren - A cow that can't conceive.

Bat - A 3-foot long doubled flat strap with handle, used to scare horses.

Black Baldies - Angus-Hereford crosses.

Bosal - A hackamore used to constrain horses while training.

Breachy - A cow that will jump fences.

Broken-winded - A horse disorder, damaged lung.

Bulling - A cow in heat.

Chaps or chaparejos - Leather protection for a riders' legs. If straight-legged they are 'shotguns'. If open-legged, held together with snaps, they are 'batwings'. Movie cowboys used to favor Angora chaps.

Cienega - An open meadow in mountain country. Also, called a 'park'.

Cold-backed horse - One that bucks first thing in the morning.

Cow - A female bovine, generally with a calf.

Crossbred - Any cross of different bloodlines.

Dally or dale vuelta - To take a turn around the saddle horn to hold one end of the rope.

Dry cow - One without a calf.

Fenders - Riveted to stirrup leathers to protect the inside of a rider's legs.

Fore-foot - To rope a steer's front feet and jerk them out from under him. Knocks two weeks gain off the animal.

Founder - A horse gets sick or dies from eating too much oats or other concentrated food.

Flushing - Feeding cows nutritious feed before breeding or calving.

Gather - To round up and bunch cattle or horses running on the range.

Gelding - A male castrated horse.

Greenhorn - Inexperienced ranch hand.

Gunsel - A smart-aleck person who thinks he knows everything.

Hackamore - A bridle without a bit. Also a Bosal. Pressure on the horse's nose halts him when the reins are pulled.

Halter - Soft rope or strap headstall used to lead or tie a horse.

Halter broke - Trained to lead when haltered.

Hard and fast - To tie one end of a roping rope to the saddle horn.

Heaves - A lung disorder in horses.

Heifer - Female calf, up to 3 years old, hasn't had a calf.

Hobbles - Soft leather or rope cuffs, held together with a short chain, which are buckled around a horse's front ankles to restrict his movements and keep him within 5 miles of camp.

Leppie or doggie - A motherless calf. Pronounced 'dough-ie'.

Locoed or weedy - A cow or horse that has a nervous disorder from eating loco weed (Astragalus).

Mossy horn - An old cow or bull, generally wild.

Mothering-up - The calf finding its mother or vice versa. On a drive the two will become separated.

Okies, corrientes, or Mexican steers - Common cattle, nonuniform in size and color.

Open cow - One that is not pregnant.

Picket - Tying a haltered horse to a long rope fastened to a tree or large stake driven deep into the ground. The horse can graze a limited area.

Polled cattle - Breeds without horns.

Proud cut - A gelding horse with stallion characteristics, usually because castrated when fairly mature.

Quirt - A short whip used to influence horses.

Reata - A rope made of thin strips of braided cowhide. For expert ropers only.

Remuda or cavvy - Group of saddle horses, used as spares. Tended by a wrangler.

Rigging or rig - Saddle, blankets, bridle, etc.

Rope - A hemp or manila hard twist rope, 5/8ths inch diameter. Has eye in one end (a hondo). Used to catch stock. (See Reata). In winter, use a nylon rope of same size, it handles easier.

Schelly cows - Old cow in poor condition. Also called 'on the lift'.

Shipping fever - A general term for sickness caused by stress or infection while being hauled by truck or train.

Shrink - Weight loss during shipping. Usually 3 to 5 percent.

Slick - Unbranded stock.

Slick ear - Unmarked calf or lamb.

Smooth mouth - A horse with worn-out teeth, generally over 10 years old.

Sound - A horse with no leg or breathing problems.

Springing heifer - A heifer close to calving.

Staggy - A steer with bull characteristics.

Spurs - Worn on heels of boots, used to persuade horses to behave.

Steer - A castrated bull.

Stingy - A cow on the fight. Also called 'on the prod'.

Stockers - Light cattle, usually yearlings.

Stockings - White ankles on a horse. Avoid in Arabian horses. "If a horse with one white foot, give him to a friend, if the horse has two white feet, sell him next month. If three white feet, sell him tomorrow. But if a horse has four white feet, keep him not a day." Old Arabian verses.

Taps or tapaderos - Leather stirrup covers to protect rider's feet.

Tip horns - To cut ends from cattle horns to lessen injury to neighbors.

Wet cow - One giving milk.

Wild cattle - Animals that haven't been worked and are not used to riders. Some are as wild as deer. They used to rope these and yoke them to a gentle ox and let the ox bring the outlaw to the haystack. Nowadays they are generally shot and dressed out on the spot.

Some terms apply to groups of things.

Horses - Cutting horses are quarter-horses trained to separate one calf or cow from the herd.

Roping horses are trained to help in roping a calf or cow. Calf roping horses must sprint to catch the calf, then the cowboy throws his lasso, resulting in a loop about the calves neck, then said horse stops and

backs up to keep the rope tight while the rider runs to throw and tie the legs of the captured calf. Steer roping horses (jerk-down) are trained to catch up to the steer, and then turn as the animal is caught to sideline the animal with the rope and flip it on its back. The rider can then tie the stunned animal.

Team-roping horses are trained so one holds and tows the steer that has been roped around the horns and the other horse, after the steer's rear legs are caught, backs away to stretch the steer out on the ground. Steer then can be doctored.

Cow horses are trained to drive cattle, do some cutting, and maybe some roping.

Calves working - When working calves it means they are individually caught and thrown, branded with a hot iron that kills the hair and makes a permanent mark. Some ranchers dehorn calves by sawing off small horns or removing the horn buds. The male calves are castrated so they will grow faster and fight less. Older methods involve physically removing the testicles from the scrotum and severing the cord, usually by mashing with pliers or scraping the cord. Many ranchers now use elastic rings that are fitted over the scrotum with a special tool, then released to constrict; after a week or so the scrotum drops off, since it has been deprived of blood supply. Usually calves are inoculated for disease and ticks. Systemic medicines are more in use now, so the tick is killed when it first takes a drink of the animal's blood. Some ranches use acid to make a brand rather than a hot iron. It smells less, I guess. Modern ranches run calves through a corral to cut them from the mothers and then through a chute where a mechanical squeeze holds the calf while being worked.

Sheep Working - Lambs are small and easy to handle. At about 2 to 3 weeks the lamb's tails are docked. The females are docked short, the wethers docked to about 6 inches long to aid in distinguishing the sexes from a distance. Many ranchers now use elastic bands that are slipped over the tail and released. The blood supply to the end is constricted and thus drops off in a few days. Normally, castrating and ear marking are carried out at the same time.

Animal colors: Horses

Appaloosa - Grey with black spots on the rump. A man-made breed.

Bay - Rich brown color, usually black mane and tail.

Black - Black color.

Chestnut - A rich tan color.

Dun - Tan hide with black mane and tail. Also called grulla (groo-ya).

Grey - Light colored or white horse.

Roan - Solid color with white hairs intermixed.

Pinto or Paint - White with patches of another color.

Sorrel - Reddish color.

Facial markings: Horses

Blaze - Large white spot on forehead.

Snip - White splash on the nose.

Strip - Narrow white strip on face.

Earmarks and Brands: Horses, Cattle, Sheep, Goats.

Top bit or Over bit - A V-cut on top of ear.

Under bit - A V-cut on underside of ear.

End bit - Removing point of ear.

Swallow fork - Slit ear from point in for an inch or so.

Overslope - Larger cut than a top bit to change shape of ear.

Underslope - Larger cut than an under bit, changes shape of ear.

Wattles - Used on cattle. A strip of hide cut partly free and letting the end hang makes a wattle. It helps identify ownership even when winter hair hides the brand. Wattles may be made almost anywhere on the animal, such as on the brisket, nose, neck, cheek, shoulders or rear leg.

Brands - Used to permanently mark an animal's ownership. Brands must be registered with the state and are published in the state Brand Book.

Horses - Usually branded with a small iron and on the hip, shoulder, or stifle (lower front leg). Seldom are they branded on the cheek. Always branded on the near (left) side.

Cattle - Usually branded on the ribs, but sometimes on the hip or shoulder. Branded on either side, but consistent with a ranch.

Reading brands takes practice. Look first in the obvious places, i.e. ribs. Some brands are simple, such as the 'Hip O' brand. Some are involved. A smooth curving letter is called 'running'. A boxy letter is a 'block'. If the latter is lying on its back, it is 'lazy'. If the letter is normal, it is called 'up'. Thus, an 'F' may be running or block, lazy or up. Many times there will be two or more letters or figures combined.

A window shade is a square burned area, beloved of western writers, believed to be have been developed by rustlers to hide the original brand; truly fictional.

Sheep and goats are paint branded. This wears off and must be renewed at least annually. The earmark is permanent.

Saddles and Parts

The Western saddle is designed to help the rider stay with the horse when riding rough country. It has a 'horn' sticking up in front whose purpose is to wrap or tie a rope to it when roping. Use it as a handhold when about to fall off. Below the horn are the swells, which are bumps, sticking out to each side and your knees will hit these as they rise too far and keep you from going further. Swells are needed, so choose a saddle with at least modified swells. If it is a 'slick-fork' tree (the tree being the wooden part of the saddle that is the foundation on which leather is glued, sewn or screwed) then there are no swells. An Association rig is a bucking horse saddle used by rodeo cowboys so everyone has the same amount of swells. A bronco-snapping rig has large swells and a very high cantle (the upturned piece behind where you sit) and is made form fitting. This makes it difficult to quit a horse when it is falling down.

If the saddle has one cinch, it is a center-fire rig. If it has two cinches, it is full or double rigged. The front cinch holds the saddle on the horse. The rear cinch is tightened only when roping big steers or when you want the horse to buck.

A quarter-horse saddle is built to stay on a quarter-horse or a mule and it will not stay on a standard bred horse. A standard bred saddle will not fit properly on a quarter-horse. Quarter-horses have very low withers, as do mules.

The saddle is placed so it just overlaps the horse's withers (the dished out place on top of the shoulders and just behind the mane). The front of the saddle fits into these dished out places.

Horse Gaits

A gaited horse is one that has a pace, fox trot, running-walk, or some other easy riding gait. When traveling horseback, the trot is the normal speed.

Seldom gallop (lope) a horse unless he is a quarter-horse and then hit a rocking-horse gallop. The quarter-horse is short-coupled and it is like sitting on a pile driver when he trots.

A horse can trot all day long and cover many miles; he can run for only maybe five to ten miles, then you need a fresh horse.

A horse that paces, moves both right feet then both left feet at a trot. A running walk has the horse trotting with the front feet and walking with the rear feet. A fox trot is a short easy trot. These gaits are good riding gaits and easy on both horse and rider. Shake a horse around with spurs and reins to find a comfortable gait. A fast trot just short of breaking into a gallop is murder to try to ride on any horse. Westerners sit a trot, they do not post. Posting is an English invention whereby one rises in the stirrups each time the horse's right front foot hits the ground.

Chapter 7

Photography

Photographs are used to record things seen or done in the Wildlands. There is need to photograph each section corner found, especially those marked with chipped rocks. A close-up of the section corner should be followed by a photo of the general area, to help some future seeker find the corner. White chalk on the chips helps the camera see them.

Record before and after shots of a project. If asked to give a talk to an organization on your role in the Wildlands, good slides are a must. There may be things of national importance to photograph. Try to include wildlife in various photos to enliven the talk.

With portrait lens to stack on a normal 50mm lens, photos of even the tiniest belly flower are possible. Photograph an entire herbarium to include all the plants found in the area. Use a book of various colored poster papers as background to emphasize the plant. Photograph small bugs such as sage moth or pine bark beetles to help identify them. Using a 2x, 3x, and a 6x portrait lens can be combined to gain 36x if needed. A zoom telescopic lens is also helpful for distant wildlife or area shots.

Cameras

The most popular camera is the 35mm single lens reflex. Look through the lens to focus and view the subject and also to see the light meter. A double lens reflex has one lens to view the subject and a second lens to photograph through. The single lens is easier to use, especially on close-ups. Other generally used cameras include the plate camera, and the digital camera.

The plate camera is used by professional photographers and may be beyond the price range and expertise of the average worker. It is always used on a tripod, always carried in a large dust proof box, and the plates must be loaded before going to the country and stored in a tight lightproof box. The higher quality photos produced may not be worth the extra bother.

The 35mm camera is small with features such as shutter speed settings from Time (bulb) up to about 1,000th of a second. This allows a wide variety of light settings and film speeds to be used. Many cameras have light meters incorporated in the camera and the meter is viewed through the camera. Some cameras have automatic focus, which may not be useful.

Digital Cameras

These cameras are small, light and within reason, easy to use. A problem is the limited photos that can be taken on one chip. It is suggested you use only 1-gig or larger chips. The telephoto feature is a must, and the flash is seldom used in the field. A 10x telephoto is recommended to take distant photos or to exclude unwanted clutter in the full screen. Be certain a manual is included with the camera, it has useful features that you'll need, if you know how to access them. One will usually delete unwanted or useless frames from the camera at the end of each series. This increases the available space on the chip. These cameras as with all cameras should be carried in a dust-proof bag.

Camera Lens

The 'normal' lens furnished with a 35mm camera is the 50mm lens. This is excellent for most photography and has f-stops from 2.0 to 20 or higher.

A 28mm lens, called a wide-angle lens, is used to take a wider view of a subject with less distortion. This lens is popular for plot photography.

The longer lens (the number given is the distance from the lens to the film) are termed telephoto lens.

These may be fixed or variable. A variable lens is more useful as the field of view can be varied to include only the subject of interest.

A lens will fit only one make and model of camera. Adapters are rare. When buying a replacement camera, keep this in mind. An agency buying cameras should purchase one make and model to insure interchangeability of lens.

Exposure and Film Speeds

F-stop settings measure the lens opening; the lower the number, the more light is admitted. For best depth of field, (to avoid fuzzy backgrounds), use an f-stop of 16 or higher, but not at the expense of a clear photo.

A light meter is essential. Normally on a sunny day in the West, the meter will read about 250 foot-candles. Couple this reading with film speed, which varies from ASA 25 to about 400. The slower speeds (lower numbers) are excellent for still photos, such as flowers. The highest speeds require less light, are best for dawn or dusk, or heavily clouded days. If possible, settle on one film speed, say ASA 100, and use it exclusively. Learn the settings and the light meter is needed only for the first reading that day. When switching from distance shots to close-ups, more light is needed and a light meter is needed to insure good photos.

A dust proof box to carry the camera, lenses, and extra film may be made of an ammunition box lined with foam insulation. A good camera is expensive to buy and costly to have repaired or cleaned. The gentler the instrument is treated, the better results and longer life it will have.

Film Types

The types are color (slide or print), black and white, and infrared.

Color film gives best contrast for normal viewing in that shades of colors are discernible. It helps see a bird or animals more clearly, contrasted with foliage. Present day film colors seem to remain constant even when very old, provided the film is fresh when used. Consider slides to be for normal use and prints only for specialized uses. Slides are much cheaper than prints and once the good photos are winnowed from the stack, they can be reproduced as slides or prints as needed. It may be difficult to find local places to develop slide film; consider using a mail-order photo film company which specializes in slides, even to furnishing its own brand of film.

Black and white film can result in lovely pictures, but requires an expert developer. Many photographers who use black-and-white develop and enlarge at home. Occasionally it will be more useful to use black-and-white film. Publishing photos cost $15 per page with black-and-white versus $80 per page for color, up to $5,000 per page for certain color photos.

Infrared film helps determine if plants are growing or if disease is present. A healthy growing plant will appear red on the film. If an outbreak of spruce budworm is suspected, this film can be used to almost instantly detect the extent of the infestation. When there is a contract to spray sagebrush, use infrared film. If the plants are dormant, they will show up gray; if they are suffering from drought, they will be pink and the contract should be cancelled. Spray sagebrush only when it is growing vigorously.

Optical Physics

Cameras are used to photograph small (one meter) plots to record the state of the vegetation. The photograph will not provide an accurate representation of the vegetation; the photo cannot be planimetered and a density determined, unless all the vegetation is very short.

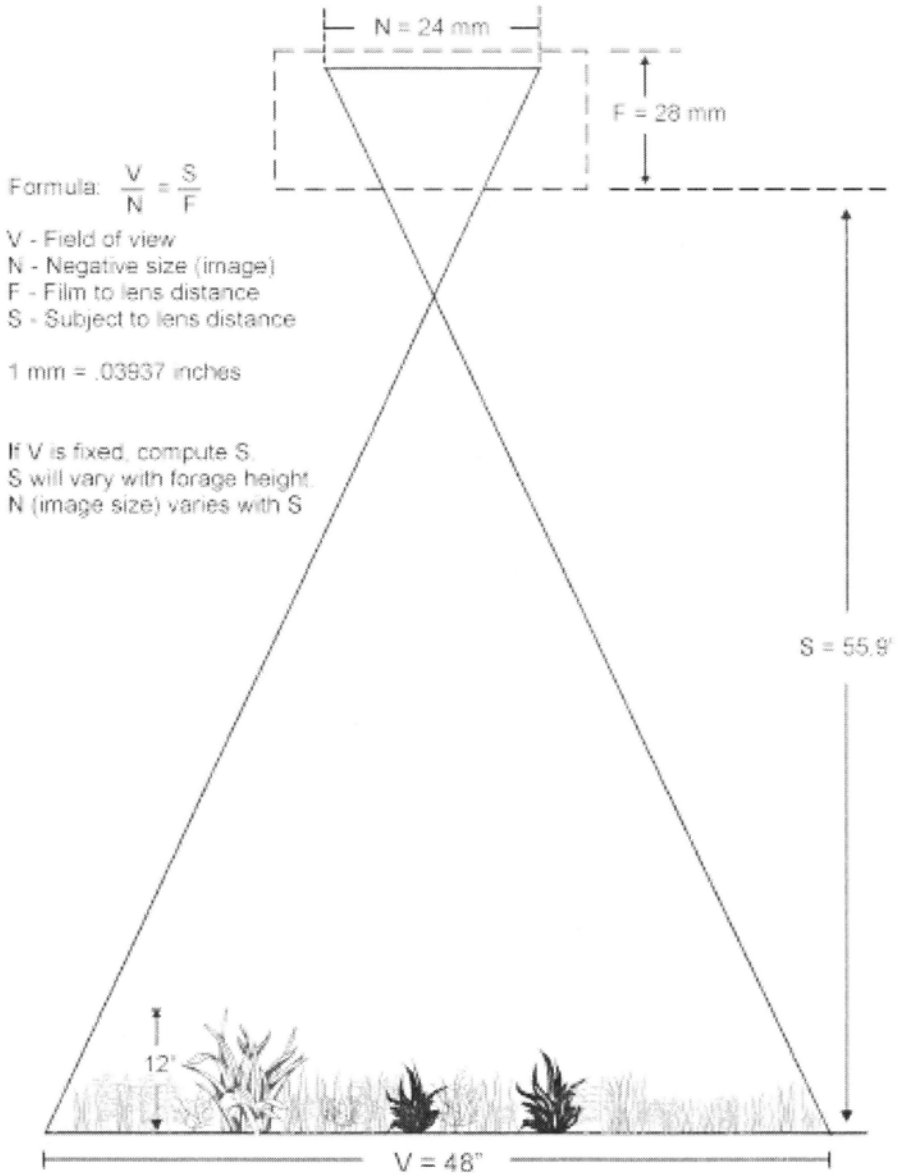
Chapter 8, Map Reading, discusses distortion in aerial photos. When photographing small plots, this same distortion is present and can be determined mathematically.

The formula is V over N equals S over F. See Figure 7-1 for details.

The upshot of the example given is that the brush plant image will be overestimated on the film by 150 percent, because it is closer to the lens and thus will appear larger. This is if a 28mm lens is used and is 55.9 inches from the ground.

Interestingly enough, the error is dropped to 109 percent if an 85mm lens is used, but the lens must be elevated to 14.1 feet above the plot if this longer lens is used.

Figure 7-1



Chapter 8

Map Reading

Map reading is an essential skill for the Wildlands worker. It helps find a certain spot such as a trailhead, or a corral. If a new spring is found, it may be recorded accurately on a map.

A map is a drawing showing land features, as they would look from directly above the land (as in a helicopter). Since it is a drawing, symbols are used to identify various landforms and man-made objects. The commonly used symbols are found in Figure 8-1. Memorize these.

The top of the map is always North, which can be determined by the printing orientation. On the map margin, usually at the bottom is the Legend. This tells who made the map and what year, and includes at least two important pieces of information: map scale and the contour interval. These two items are needed for perspective.

The map scale is usually written as 1 inch equals so many feet or so many miles. It is also written as proportional numbers such as 1:20,000 and is called a representative fraction (RF). This means one unit on the map equals the second number of units on the ground. Thus one unit (inches, centimeters, etc.) on the map equals 20,000 of the same unit on the ground. A common scale, 1:62,500 is translated by multiplying 12 inches in a foot times 5,280 feet in a mile which equals 63,360 units. So the 1:62,500 scale is about 1-inch equal 1-mile scale.

A good field map should have contour lines, which are lines on a map drawn at certain elevation above sea level. They are level lines; all points along a given line are at the same elevation. The legend may state that the contour interval is 20 feet. This means for every 20 ft. in elevation rise, another contour line is drawn. Where contour lines are well and evenly spaced a gentle slope is indicated. Where contour lines are very close together, it means a steep slope or even a cliff. Contour lines 'V' up a small draw, giving additional information of how the land lies.

A very old map may use hachures instead of contours to depict steeper topography. Hatchers are small straight lines, rather like shading, and distance between marks and line width indicates slope angle. It is a lost art.

Because of changes on the land, maps, like telephone directories, become obsolete in a few years. Obtain the best and latest maps available.

The symbols on the map will be out of scale. A paved road symbol on a 1:500,000-scale map may measure a mile wide on the map and a windmill symbol may measure thousands of feet high. The cartographer cannot draw these features to scale; the figures would be too small to see. The dot in the center of the circle for a windmill is the exact location of the windmill on the map. The USGS maps are by far the best maps for fieldwork if they are available.

Frequently the need will arise to go to a specific point on the ground, perhaps to a windmill and corral to check on their state of health. See Figure 8-2. Before leaving headquarters, find the necessary field map or maps that depict this particular improvement. If it is a hundred or so miles to the improvement, find the windmill on a base map and determine which highway to take out of town. The field maps should show a portion of the highway to determine where to turn off to get to the well.

Examine the field map (Figure 8-2). What detail is found in the vicinity of the turnoff to help find the proper road? Are there houses nearby? Is the highway fenced? On which side is the highway fenced? Is there a cattle-guard on the road to your goal? How far does the turnoff measure (converted to miles) from a big draw, a crossroad, or a house?

MAP SYMBOLS

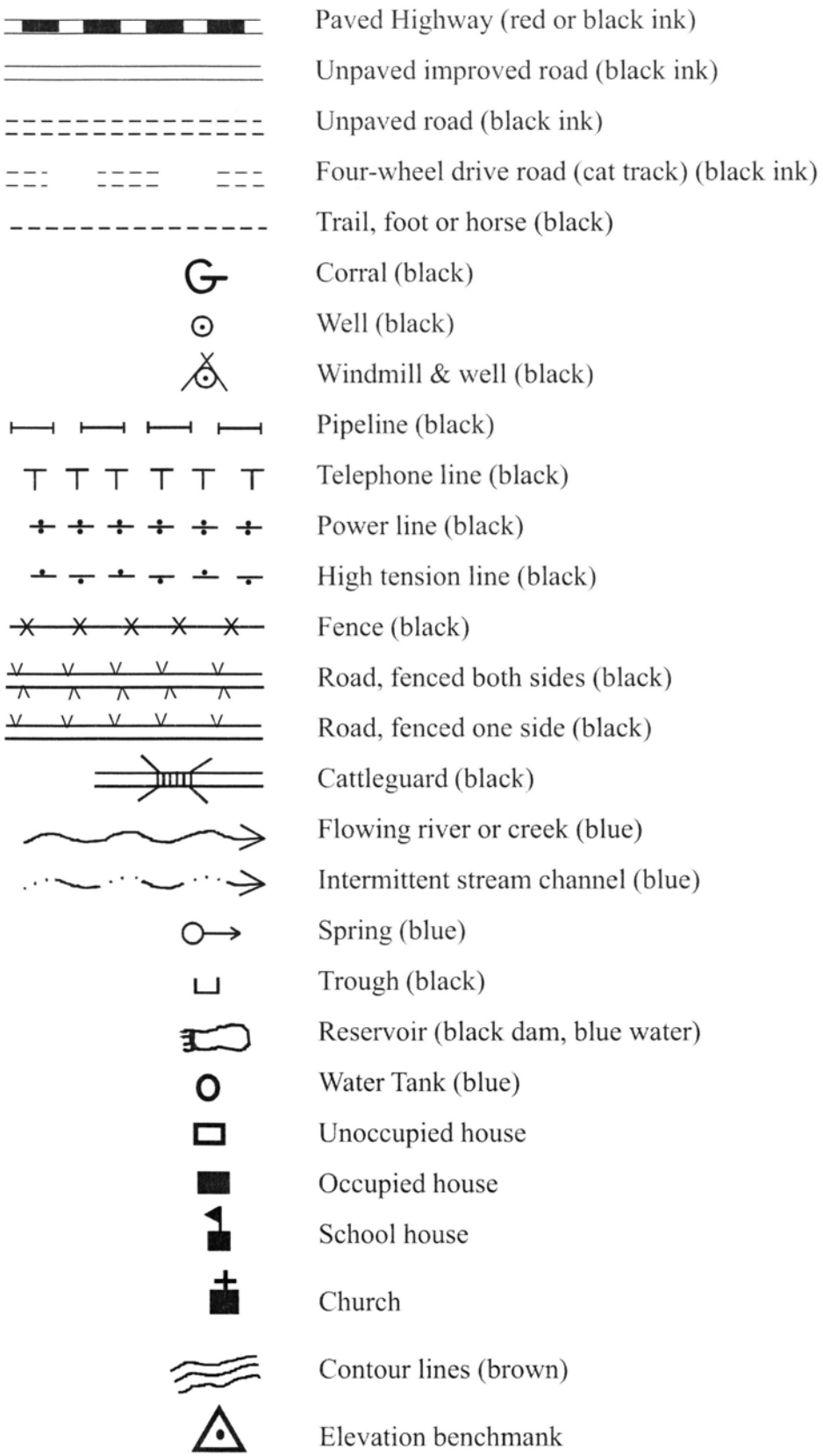


Figure 8-1

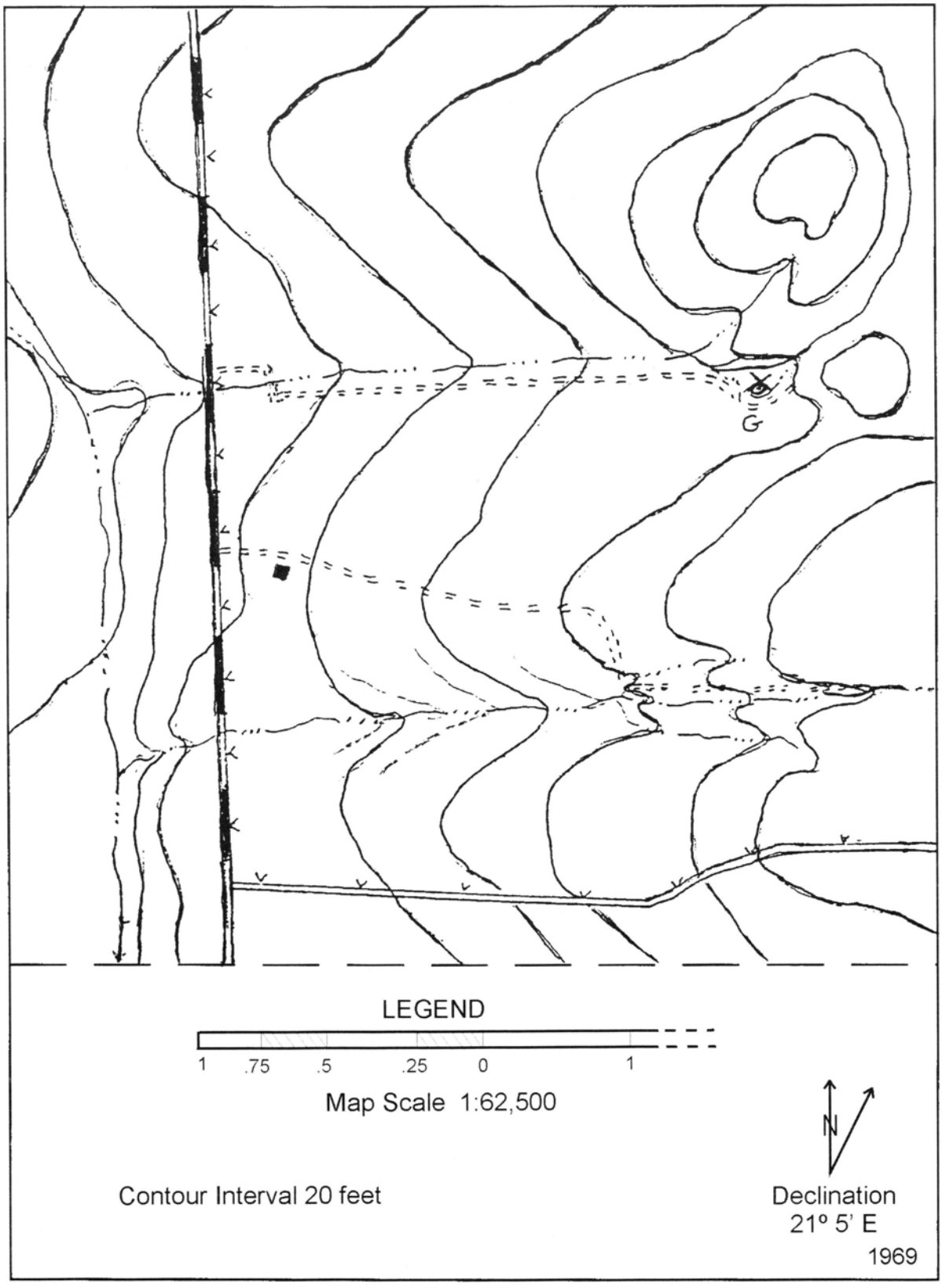

G
LEGEND
1 .75 .5 .25 0 1
Map Scale 1:62,500
N
Contour Interval 20 feet
Declination
21° 5' E
1969

Figure 8-2

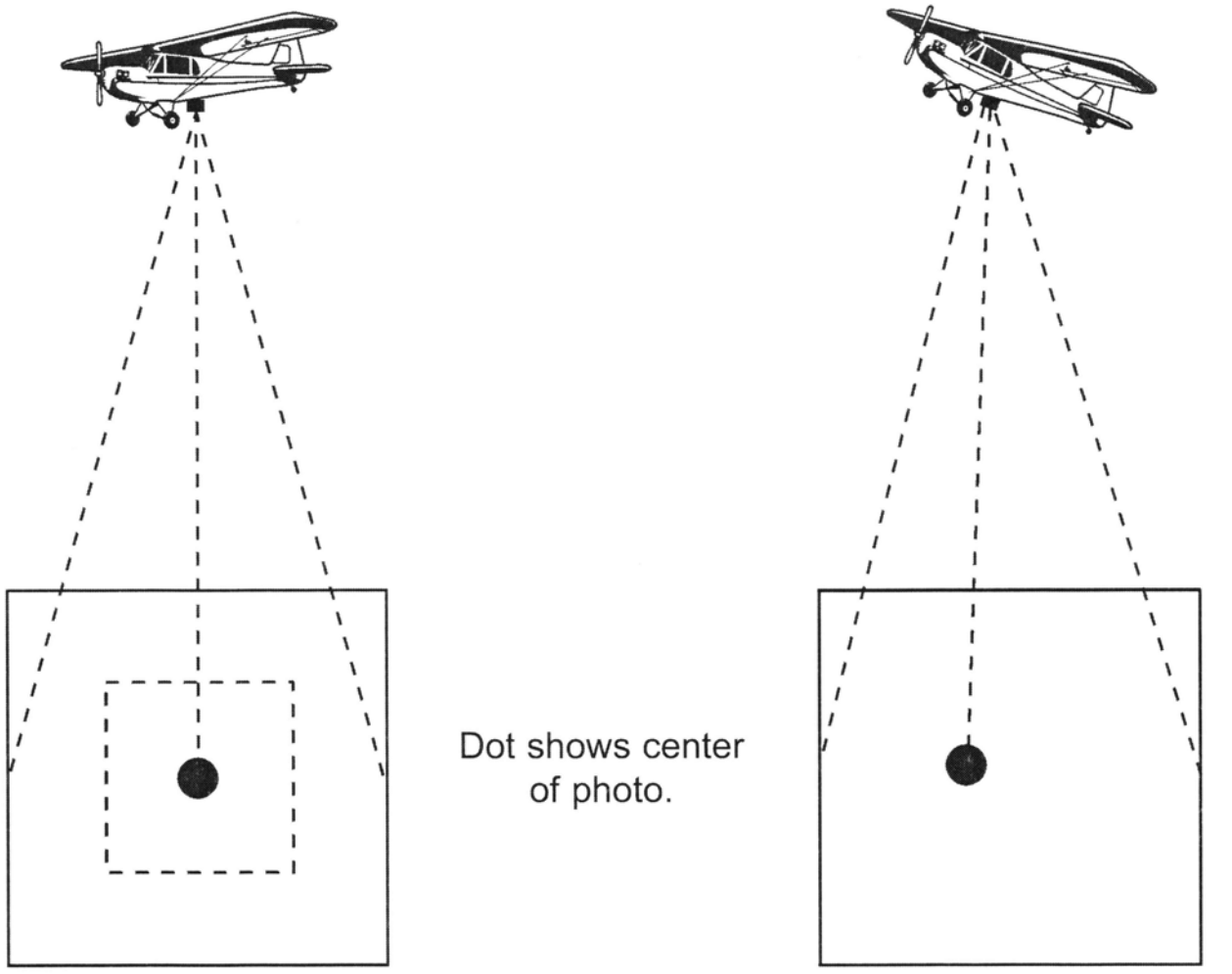

Dot shows center of photo.
Proper attitude photo will have a determinable scale within the dashed lines.
Inclined attitude produces an oblique photo—scale cannot be determined.

Figure 8-3

Determine the map detail, and then match the details on the ground as you drive. Use the odometer for distance, corrected to true mileage. Clock a ten-mile stretch of highway, using highway mileposts to check the odometer's accuracy. If the original tires have been replaced with oversized tires, the odometer may read 8/10ths of a mile when the actual distance is a mile.

A six-inch pocket scale (ruler) divided into inches and tenths is best for measuring map distances. If a map has an odd scale, copy the bar scale from the map legend onto the back of a scale or to note-paper.

There are two other map aids, a photo-mosaic and the aerial photograph. The photo-mosaic is a series of aerial photos matched and joined together to form a picture of an area. Man-made structures are identified by symbols. If the quality of the photos was good and the individual photographs have been carefully matched a reasonable map results. Frequently, the scale will change where two photos were joined.

Aerial photos are taken from an airplane, a satellite, or even a space ship. These vary in quality from excellent to worthless. Good sharp aerial photos taken from an airplane show great detail and when viewed under a stereoscope (in pairs) shows ground features in all their multiplicity.

Determining scale is always a problem when using aerial photos. Since the camera is farther away from the land at the edge of the photo than it is from the center of the photo when the shutter clicks, the scale will be different in the center of the photo from the edges. If there are winds aloft blowing across the flight line, the plane must drop a wing to maintain the flight line and then it photographs at an oblique angle, not vertically. See Figure 8-3. Attempting to determine scale on an oblique photo is quite futile. In mountainous areas, the effect is much like a close-up of a person's face, where the nose appears inordinately large. The mountain top, when near the center of the photo, may appear to be twice its true scale. A straight line on the ground will not appear to be a straight line on the photo because of this distortion.

Aerial photos are an invaluable tool in deriving soil, geologic and vegetation information, which is transferred to a field map, in the field. It cannot be done in the office because of the distortion.

Determine the scale of an aerial photo by measuring between two features on the ground that can be pinpointed on the aerial photograph, working within the center portion of the photo.

Locating Ground Features on a Map

When a spring, a fence, or a new road is found that is not on the map, this important feature must be drawn in on the map. Backtrack to the nearest identifiable point on the ground that is shown on the map, then measure from that point to the new feature. Assure yourself that the road or trail is the one shown on the map. Some people spend their entire lives on heavy equipment improving and changing road locations.

The feature's location may be found by orienting the map and using the compass to triangulate. Move away from the metal of the truck and lay the map on flat ground or a small plane-table. Align the edge of the compass with the edge of the map and free the compass needle. Move the map until the compass needle points north. This is called orienting the map. Find features on the ground that can be identified on the map; these must be points, not areas. Examples are definite hilltops, houses, windmills, road junctions, and fence corners. Set up the compass on its jake-staff and read the compass bearing to at least two features. Draw rays from the feature on the map, using a protractor, using the angles read from the compass. Where two rays intersect will be your location. Usually three rays will form a small triangle where they all intersect. The center of the triangle is your location.

Compass Reading

The compass should be a staff compass with a 4 to 6 inch dial that can be set for declination. Declination is the number of degrees between true North and magnetic North. The compass needle points to a large ore

body in northeastern Canada. The declination is found in the legend of the field map. Be aware that magnetic North moves easterly a few minutes (there are 60 minutes to a degree) each year and if the map is 20 years old, there may be a several degree difference. Since one degree subtends an arc of 92 ft. at one-mile distance, the error can be substantial. Set the proper declination using a brass screw found on the perimeter of the compass. If the proper declination cannot be otherwise determined, set up at night and align the compass sight on the North Star and then move the declination screw until the North zero on the compass is under the needle. Use a match for light; a flashlight can pull the compass needle. Once true north is determined, place 2 stakes in line on true North for use when daylight comes.

There are a number of small compasses, some with tripod. It is difficult to read these small dials accurately and the error so introduced can be substantial.

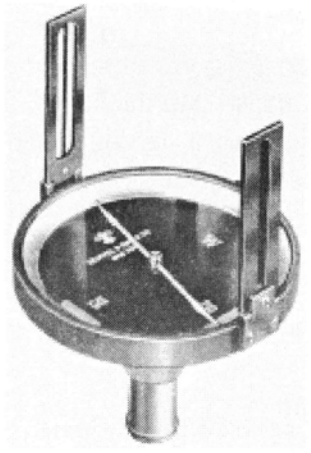
To set up, move away from the pickup at least 50 ft. and stick the jake-staff in the ground. A jake staff is a 5 ft. long wooden pole with a steel point on the bottom end. There is usually enough dirt beside the taproot of a bush to hold the jake-staff. If it is windy, pile rocks around the jake-staff to hold it solidly. Gently place the compass on the jake-staff. If the compass socket does not fit the jake-staff snugly, whittle the end of the jake-staff to fit.

Unleash the compass needle by loosening the small vertical knob on the edge of the dial. If the needle swings widely, damped the swing by tightening the compass needle knob momentarily, but be sure the needle is completely free when beginning to read. The small level bubble in the compass helps to set up level so the needle will not bind and give a false reading. A gun, a wristwatch, or metal framed sunglasses can also cause false reading. Leave the unnecessary iron in the truck and check the necessary items by moving them around the edge of the compass. If the item pulls the needle, lay it several feet away when reading the compass.

When it is windy, the compass needle will not settle, but will continue to swing. If the needle swings the same amount on each side of the desired direction, the compass is right on.

The compass dial has an apparent error in that East and West are reversed. This is only an apparent error. When sighting northeast the needle will be within the northeast quadrant of the compass. The compass needle head end or North end usually has a small arrow scribed in the needle. The tail end or south end has wrapping of fine wire. Read the head end to avoid errors. If a compass needle has been magnetized in reverse, send it for repair, it will unnecessarily complicate working.

The compass dial reads from 0 at North to 90 degrees at East and West, and then the numbers decrease to South. If the compass needle head points to N47E, the tail end of the needle will be on S47W. This is the same angle; it merely depends upon the point of reference. If shooting a bearing from an unknown point (a spring) to a known point (a crossroads), then the ray drawn on the map with a protractor will be in the quadrant read from the tail end of the needle. When on a known point, the ray drawn will be in the quadrant shown on the head end of the needle.

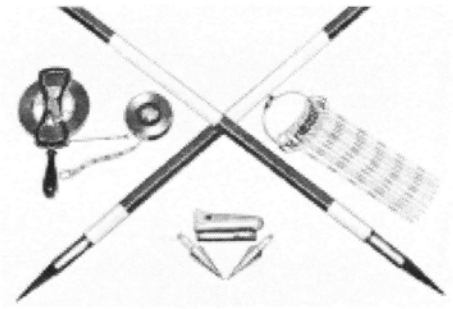

Surveyor's Staff Compass

Don't hurry a compass reading. Read the needle, write down the reading. Then look back at the compass to be sure of the right quadrant and the proper numbers, read from the head end of the needle.

Determining Distance

There are a variety of methods to determine distance and each has its place. Using a pickup odometer may be proper in some instances although a

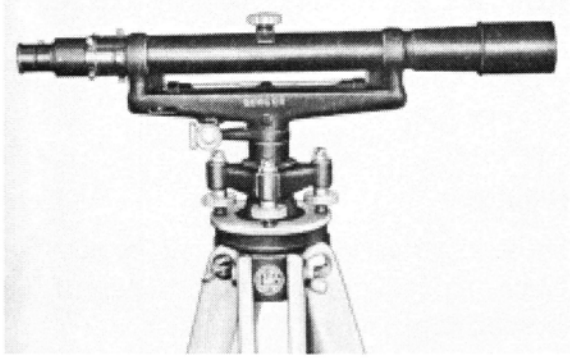
survey odometer is much preferred since it can be read to 50 feet and interpolated to 5 feet. A survey odometer mounts inside the cab and is driven by the same gear as the factory odometer-speedometer. Normally an adapter is used with which drives both factory and survey odometers. Where long distances are involved and steel fence posts are carried for staking a line, the pickup must be driven on line and the survey odometer is used for determining distance. The staff compass determines direction. For shorter distances, pacing is an excellent tool. With practice, pacing should be as accurate as reading stadia. Count each time the right foot touches the ground. Use a tally-whacker to record paces.



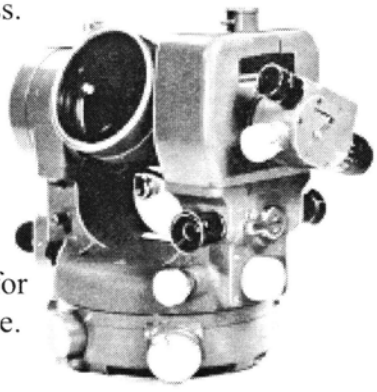
Equipment used for taping

Stadia is a distance measuring method involving a transit with stadia hairs and a rod clearly marked with 1/10th ft. and 1 ft. intervals. Read the distance by looking thorough the transit and seeing how many feet on the rod it is from the top stadia hair to the bottom stadia hair. There is one hair above center and one below. Some persons always read ½ stadia, by placing the center hair on a foot mark on the rod and then reading the top hair, then multiplying by two. Some prefer to read full stadia on distance shots and ½ stadia on close-ups. It is strongly suggested that a worker always uses one or the other never mix them up.

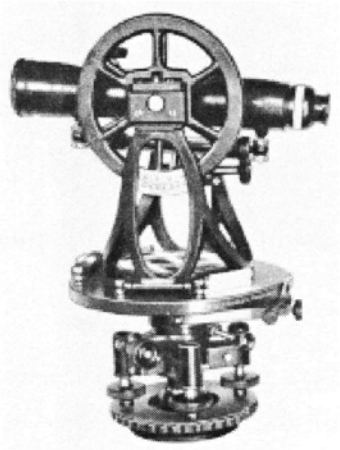
Chaining is a more intensive method; used only where distance must be accurately determined. A steel tape is used rather than the old fashioned chain. The chain has links 6.6 inches long and 100 to the chain, giving 66 ft. per chain; still used to describe cadastral survey distances. Healthy young people can chain a ½ mile in about 15 minutes in flat country, so this needn't be a slow process.



Dumpy level is used for leveling

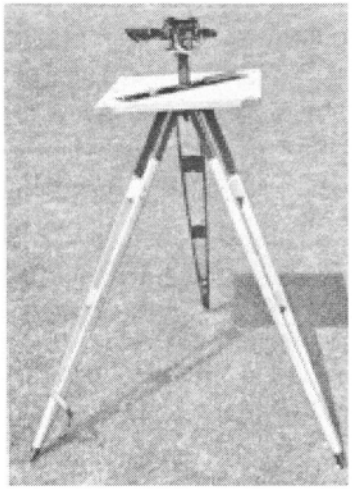


Theodolite is used for direction & distance.



Enginner's transit

(A few of the surveyor's basic tools.)



Plane table and alidade mounted on a rotating Johnson head, which sits upon a tripod. Used for compilation of maps.

Chapter 9

Fences

Fences are man-made barriers to livestock, vehicles and sometimes to big game animals. A natural barrier may be a cliff, deep arroyo or other topographical feature difficult to cross. Fences and natural barriers limit the movement of animals and man. No fence can be 100% impassable; occasionally it will allow a cow, elk or calf to pass.

Exterior fences are usually built on property lines since, in most states, after 'x' years of peaceful adverse possession, the property line moves to the fence line. Government land is always subject to sale or exchange, so consider fencing on section lines as one option. Normal fence life is about 30 years, but civilization may encroach sooner.

Most western states have 'fence-out' laws: to keep the neighbor's cows off your property, you must fence them out. To support a charge of trespassing on private land, each state specifies a required fence height, number of wires, and post spacing. However, on federal lands, a fence is not required to bring a trespass charge and a fence builder need not worry about state specifications.

When planning, decide if the fence should be built of smooth, barbed, or net wire, or using poles or planks. Normally, barbed wire is used to confine livestock. Decide whether 2, 3, or more wires are needed; this depends upon what animals to confine within or to allow through the fence.

Wildlife Considerations

For deer passage, the top wire should be 40 to 42 inches off the ground so deer can jump it. There should be space of a least 10 inches between the top and second wire to help avoid deer being caught in the fence while going over. Antelope tend to go under a fence, so the bottom wire should be 16 inches above the ground. Recent trials indicate the use of smooth wire for the lowest wire is helpful in passage of antelope, plus deer and elk fawns who all go under the fence. Also bird dogs. Leaving gates open when pastures are not in use may help elk to pass without wrecking the fence.

Livestock Considerations

For good neighbor relations, the fence must hold your livestock securely and keep out the neighbors. His or hers operation and kind of livestock must be considered when building the exterior fence. If sheep are on one side of the fence and cattle on the other, the fence must be net wire.

Interior fences need not be as stout as exterior fences. A 2 or 3 wire fence with a 36" high top wire will hold gentle cattle, but long legged Brahman cattle or horses, will walk over this type of fence. In rough places, such as on mountain slopes where there is little livestock pressure, posts 30 to 50 ft. apart (or even 100 ft. apart in some cases) will adequately hold livestock. It is cheaper in labor and materials to build this fence, called a suspension fence, compared to the standard fence with 4 wires and posts one rod (16½ ft.) apart. Conversely, where there is heavy pressure, such a when a fence splits a water trough, 6 wires and posts 10-ft. apart may be needed.

Once the fence is located and plotted on a map, the next job is to stake the location on the ground. Most ranchers and agencies stake the fence themselves and contract fence construction.

Staking the Fence Line

If livestock are using the area, stake the line with steel fence posts. Lath is light and cheap, but hard to see in tall brush. Also, livestock will knock over the lath, requiring re-staking the line. Use regular 5-ft.long

line posts of the type used in the fence. Deduct the number of posts used in staking the line from those issued to the contractor at the warehouse. In very tall brush, use 6½ ft. steel posts to stake the fence line and retrieve them after a cooperative contractor builds the fence. Plan to use 5 to 8 posts per mile in staking.

Steel posts are highly visible when flagged. Use a 2-ft. square of white cloth for flags. Many people are slightly colorblind; therefore an orange or red flag simply disappears to a colorblind person at over 200 yards. In winter a dark red flag shows up black against snow and is highly visible.

Flags must be inter-visible; that is, from any flag you must be able to see the next on-line flag. If this is neglected, the contractor can receive additional time and money to fill in flags.

Almost all staking requires the use of a transit. The transitperson will keep a fence line straight by advising on a hand-held radio. Drive the pickup along the foresight line, since steel posts and a driver must be transported. Place each stake on line so it can be seen from the last stake. Sometimes a minor depression will necessitate wiring a lath on top of the steel post for visibility. Make no effort to measure distance; the important job here is keeping on line.

Fence corners, gates and water-crossings are separate contract bid items in the contract, so to reduce costs, stake a fence with a minimum of road crossings (which require gates) and water crossings. Reroute a road that crosses the fence several times in a mile. However, reroute the fence if it runs down a draw and crosses a watercourse several times. A water crossing is built where a fence crosses a depression that carries enough water to wash out the fence. Place a gate at each road crossing and at least one per mile on a roadless stretch.

If fencing on section lines, find the section corners and quarter corners first, then fill in between with inter-visible stakes and flags. Many cadastral surveys will have a few minutes-of-angle bend at each section corner, so this is a good place for a gate.

If working alone, stake a straight line by back sighting. First establish two stakes exactly on line and at least 50 yards apart. Be sure the stakes are set vertically and firmly. Once the first two stakes are on line, go down the line to where another stake will be needed. Using field glasses (7x), stand soldier-straight, close the left eye, and line up exactly with the two flags. Mark the ground with the right heel and place a stake in the center of the mark. With practice you will be able to run a half-mile and be within 6-in. of line. Since a wooden post is usually about 6 inches in diameter at the base, this is the margin of error. This method saves time and personnel, but never hesitate to go back and realign stakes that are off line.

After the fence is staked, it is tied to the cadastral grid and plotted on the field map. The exact length of the fence can be measured at ground level, the bottom wire distance, or the top wire distance and all will be different figures. To avoid this, use the cadastral survey plat distance, which is unsalability accurate, and place a paragraph in the contract advising that the distance stated is horizontal distance and the contractor is expected to determine if additional labor and materials are required due to slope. This puts the burden on the contractor. In one instance a contract was awarded to fence on a section line where there was a 20-chain hiatus in the survey. This information was placed in the contract, but the successful bidder ignored it. He dropped plans for a law suit after this was pointed out.

Clearing the Fence Line

Don't automatically bulldoze the fence line, this leaves a scar that will last for years. The completed fence will be invisible from 50 yards away if it is built with dark green or dark red posts. Don't use white-topped steel posts, since they cause visual pollution. If the contractor is to clear the line, specify acceptable methods. In low brush or grasslands, the line need not be cleared at all. Tall brush must be removed to

install fence posts on line and to allow the barbed wire to be stretched. A short railroad rail pulled behind a small tractor may be used to knock down taller brush without disturbing grass and low vegetation. In oak brush or chaparral a bulldozer may be needed to clear the brush on-line. In a forested area, some of the trees or at least the limbs must be removed. Wire can be stapled to live trees. The bark will grow over the wire, but this is less damaging to the tree than being cut down.

Consider access for fence maintenance when clearing the line. If time and personnel are not available to maintain the fence afoot or on horseback, then vehicle access must be provided. Locate the access road downhill from the fence, otherwise, in wet and muddy conditions, the truck will slide downhill and damage the fence and truck.

In some areas, fence wires are detached from the posts during the fall so winter snows will not break the wires. These 'lay-down' fences may also be used to permit feral horses and burros to be 'free-roaming' as required by Congress. It is desirable to be able to drive a pickup along a lay-down fence since it must be worked twice a year.

Stretch Panels and Braces

The heart of the fence is the stretch panel, often called a 'double-H'. Stretch panels hold the wires taut, braces and line posts maintain wire spacing. The wires are the barrier.

The posts of the double-H should be sound railroad ties or similar sized wooden posts, set 2 to 3 ft. in the ground. The upright posts are notched to receive the cross bar of the H. The H is wrapped with a loop of wire (usually barbed wire), from the top of one post to the bottom of the adjacent post. Then the wire is twisted taut with a Spanish windlass. Usually two wraps are made, forming an 'X' between the posts. See Figure 9-1 on page 53.

Railroad ties (used ones) have been treated to resist rot. Juniper (called cedar in the West), need not be treated except for alligator juniper. Split Port Orford cedar posts must be treated against rot. To treat posts, set them upright in a barrel of creosote (or other preservative) for 2 to 3 weeks. Treat to 6 inches above the hole depth called for in the contract.

Holes for the double-H posts should be a little oversize and depth is measured, never estimated. Tamp the dirt back around the posts a little at a time. Holes may be dug with a tractor-powered auger or with a shovel. Avoid digging with a bulldozer or a backhoe because the dirt can't be tamped firmly. In actuality, holes are usually dug with a 22-pound iron bar and a tin cup (to dip the rock chips and dirt from the hole).

After the double-H is completed, trim the posts to an even height for a neater looking fence. Some contractors set posts one foot deep, then saw off the tops to give the illusion of a proper job.

Sometimes rock is encountered, either boulders or sheet rock at or near the ground surface. Avoid blasting since it loosens the ground around the hole, making it difficult to set the post solidly. Rock-jacks, which are wooden boxes nailed to the post and filled with rocks, are widely used in some areas. The best way to make a stretch panel in rock substrate is with an air compressor and drill to make a hole big enough in diameter for a 2 to 3 inch heavy wall steel pipe. Drill the hole 1 to 2 ft. deep, slip the steel pipe in the hole and pour concrete around the pipe. Often a metal single-H-brace is welded together beforehand and installed as a unit. A pipe H-brace installed in solid rock may be used for a stretch panel.

Most fence builders install all the corners and H-braces first. Stretch panels are normally placed at ¼ mile intervals because a roll of barbed wire contains that length of wire. A corner is two double H-braces with a common center post. Each wing of a corner is a stretch panel. A gate is simply a double-H on each side of the road, with a separate panel of wires strung in between.

A brace is a single-H placed where an abrupt change of topography occurs (Fig.1-2). If a brace is omitted at the bottom of a steep hill, the steel posts will be pulled out of the ground when the wire contracts during a cold spell. On top of a hill, a steel post will bury itself in cold wet weather. Wood braces are used to avoid these problems.

Gates

Gates are a problem since they are often left open when they should be closed and vice-versa. There should be gates at every road crossing or a maximum of one mile on a roadless stretch. Flag the wires of a gate so it is visible to drivers.

If the fence crosses a well traveled road, plan on a cattle-guard (Chapter 2). Install a gate on one side of a cattle-guard to permit passage of livestock and wide, heavy trucks. Hinge the gatepost closest to the cattleguard, so the open gate can be spread across the guard to prevent livestock from walking into the guard when driven through the gate.

To make a gate, make two loops of wire around the road-end post of each double-H (see Figure 1-3). Slip a short light post into each pair of loops. String 4 or 5 strands of barbed wire across the road in between the light posts. The hinge end of the gate should have the wires used as hinges below the top wire and above the bottom wire. Pull the gate wires hand-tight, do not use machinery or the gate will be too tight to open. When closing the gate, the top latch is slipped over the top of the post after the bottom of the post is slid into the bottom loop. There are many kinds of gate closure latches as people building them. The loops that hold the gate should be smooth wire, #10-gauge.

As the fence settles, it seems to tighten the gates. Make allowance by leaving some extra length on the gate wires and latch wires so they can be lengthened.

Gates cross a road at right angles or nearly so, which may require additional corners to be built.

If a gate requires effort to latch, it will remain open. A lasso or a come-along may be helpful to latch a tight gate. To close a gate using a lasso, put a loop over the light post of the gate, run it behind the back side of the set gate post, put a foot on the gate post and lean back on the rope. Position the loop wire before pulling the rope. Use wire pliers to lengthen the latch loop if too short. A few feet of 10-gauge smooth wire in the truck comes in handy.

Water Crossings

Water crossings are fences placed across streams or arroyos (Fig.1-4). At the high water mark, the fence ends in a double-H. Look for trash or debris to locate the high water mark. A foot or so downstream of the double H and slightly overlapping the fence, build a single-H on each bank. Drive steel posts and string wire across the watercourse. Flood water will take out the posts and wire in the arroyo, but won't damage the main fence. Water crossings are maintained as needed and may be rebuilt several times a year. Some ranchers stash a roll of barbed wire and a few fence posts near a water crossing so materials will be handy if a rider finds a water crossing needing repair.

Wire

Barbed wire is not the only material used for fencing. For small areas or special purposes, other materials such as wooden poles, boards, smooth wire or net wire may be used.

High tensile smooth wire is an import from New Zealand and can be electrified to hold livestock. If not electrified, some barbed wire strands must be added to prevent cattle from going through the fence. Because of low cost, it is growing in popularity. High tensile wire cannot be bent and tied as is done with soft wire.

Use clips to form a loop at a stretch panel and then a spring attachment with a ratchet is installed. The wire is fed through a hole in the center of the ratchet and then the ratchet is turned with an end-wrench until proper tension is achieved. Usually, tighten to the third notch on the bar inside the spring on the ratchet side of the contraption. (See Fig. 9-5).

Barbed wire comes in various diameters, called gauges. The smallest usually found is 14-gauge high-tensile wire. The normal gauge is 12½, which can be either high tensile or soft. High tensile wire is hard and breaks easily at a kink, and will not stretch. Soft wire cuts easily, is malleable, and has considerable stretch.

Metals expand and contract with temperature changes. This change is only a fraction of an inch per foot of wire per degree of temperature change. However, when dealing with 1,320 feet of wire and an annual temperature change of 100-degrees, the expansion and contraction can be several feet.

Before deciding what kind of wire to install, consider what to confine or exclude. When a stud drives his mares into a fence, soft wire will snap and let the animals through with few cuts. High tensile wire will bounce the horses back (although the impact may jar a few posts out of the ground) with considerably more cuts. Soft wire will hold gentle livestock and is the usual choice since soft wire is easier to lay and maintain.

Unrolling spools of wire is best done with a series of 3 or 4 reels mounted in the back of a pickup, so all wires can be laid on one pass. Any other method is backbreaking. The end of the wire is tied to the far end post of a double-H brace, or the center post of a fence corner. It is 'tied' by wrapping the wire around itself a few times. The tighter and closer the wraps, the stronger the tie will be. Then the wire unrolls as the truck is driven along the line. Watch for kinks, since the wire will break at a kink when it is pulled taut. If a kink occurs, stop and try to straighten the wire, if you can't, cut the wire and splice it back together. Make a loop, and wrap the wire end back on itself as was done at the start. Thread the other wire through the loop, bend it back on itself and wrap 3 or 4 tight wraps. At ¼ mile the spool is empty and the end of the wire is tied loosely to the far end of the double-H. High tensile barbed wire, 14-gauge, has ½ mile per spool so the wire is cut and tied, then re-tied to a post and continue driving. Do not tie to a single-H unless it is set in rock.

Most contractors lay several miles of wire before setting the line posts. The bottom wire is the first wire to be pulled tight enough to be exactly on line between two double-H's, which are now functioning as stretch panels. This wire establishes the line to set the line posts.

Normally, steel line posts will be used. It is too expensive to hand-dig holes for wood posts, although in good deep soils posts may be driven with a tractor-mounted pile driver. A steel post can be driven with a few blows from a 30 to 50 pound sleeve-type driver made of heavy wall steel pipe 3 or 4 inches in diameter and 3-feet long. One end of the driver is welded shut and weighted. The open end of the driver is slid over the top of the steel post and operated like a pile driver. A tractor-mounted hydraulic press may be used in soil free of rocks or hardpan. In rocky soil the press will bend posts, which then must be discarded.

The line posts are tossed from the truck while the wire is strung. Each post is turned so the flange is parallel to line. It is polite to put the wire on an exterior fence on your side of the post, as if to say to your neighbor, "I am keeping my stock from bothering you." There are knobs on the flat side of steel posts, which is the side to attach wires. All posts should face in the same direction. Post spacing is critical. A light, sturdy chain with a hook on one end is used as a measuring device. Rope will stretch and give uneven distances.

The stretched bottom wire will establish line, but normally the post is lined up visually with those already driven as a check. Some people want the posts exactly on line. The author prefers that they be staggered within about 2 inches of exact line. Such staggering helps absorb some of the strain when wire contracts from cold. The point where the post should be may be underlain by a rock, so the post is moved a bit, but not over 2 inches off line, nor 6 inches up or down the line.

In sheet rock areas, use the air compressor and drill. Drill a hole 8 to 12 inches deep, slightly smaller in diameter that the diameter of the steel post. Knock off the flange and drive the post in the hole. It can be removed only with a cutting torch. Check the wire again for kinks while walking and driving posts.

After the line posts are set, the other fence wires are pulled taut. One can use a patented winch-with-ratchet tool (called a 'come-along'), or a block and tackle, or pull with a pickup. In the old days, they used a wagon wheel to manually tighten the wire on the wheel's hub. Pull the top wire first; if there is any slack in the H-braces, it will be out before the other wires are pulled. Pull from one stretch panel to the next. It is safest to be in the pickup cab while pulling; if the wire breaks, the whip action of barbed wire can sever a man's head.

How tight is 'tight'? If you slap a loose piece of wire with wire pliers, it will yield a dull 'thunk'. As the strand is tightened, the tone will go up just like a fiddle string. If fences are built during the summer with no slack, the wire may contract enough to break in winter. The wire shouldn't droop between posts, that's too loose. Think back over the ¼ mile stretch just covered. Are there draws where the wire must be pulled down to the post and hills where the wire must be lifted to be tied? If yes, leave more slack. When completed and tied, the fence wires should yield a medium tone when slapped with wire pliers. When the wires have the correct tension, staple each to the end post of the double-H and to the center post of the panel. The staple should barely touch the wire; if it crimps, the wire will break next winter. Slack off the pull and let the wire slip to the first barb, where it will hold. Then wrap the wire around the post and tie it back on itself.

If a wire breaks while being pulled, slack off and go find the break and splice it as earlier explained. An extremely strong person can bend a hook in each end of the break and using two pairs of pliers, pull the hooks together. Use this only on a completed fence when a broken wire is found, since it is a temporary repair.

The wire is attached to the steel post with a patented clip. Hook one end of the clip over the wire, then insert a #16-nail in the clip and rotate the nail so the clip wraps around the barbed wire. Tie wire, 14-gauge, works well, but is slower to install. Use tie wire to hold barbed wire to a wooden line post or use staples. Again, the staple should almost touch the twisted wire. Partly drive a staple and place a spare staple through the staple and beside the wire. Stop pounding when the wire touches the extra staple. Remove the extra staple. This will provide the necessary spacing.

When installing wire on a line post, each wire is placed at proper height using a marked lath or stick as a guide.

Stays are light thin wood posts (1-inch diameter), or may be a patented twisted wire or fiberglass rods. Stays are placed in between line posts to maintain wire spacing. Some cowmen have stated that if a cow can get her head through a fence, she'll go on through. It is cheaper to put in stays rather than more line posts. The twisted wire stays are screwed on from the top using wire pliers, picking up each wire to incorporate it into the stay as it screws down. The fiberglass rods are useful where a fence is to be electrified, they are attached with a patented spring-wire clip and require a tool to install. The tool is a flat piece of steel 1" x 6" with a 1/8th" hole drilled in one corner.

Where a fence crosses a small depression, the wire is pulled down and tied to an auxiliary post or to a large rock placed in the depression. This prevents the line posts from being pulled out of the ground when the ground is wet and the fence wires contract. If a deep narrow depression is encountered, build the fence right across as if it wasn't there. Then build an auxiliary fence under the main fence in the bottom of the draw. These depressions are not active watercourses, just low places.

Electrified Fences

Electric fence is a cheap method of holding livestock in a given area. Used mostly on farms in mesic climes, it is not suitable for use in arid or semidesert lands unless equipped with a ground wire or return wire. It is used as temporary fencing, such as when rotating pastures in a field where you wish to have only one day's grazing enclosed, or to limit and concentrate use in a certain area, such as using sheep or goats to treat an infestation of exotic weeds. Tame livestock is a necessity with electric fences. Feral horses cannot be held by such a fence, if the stud wants to go, he drives his mares into the fence to break it. Elk either jump or break the fence. But it should always be a consideration except in the case of a boundary fence. You will need to get information from one of the local electric fence suppliers to find out what you must and must not do in installing the fence. The supplier can help tailor the fence to your particular situation.

Net Wire

Net wire is used to confine sheep or goats and/or to add strength to a fence where livestock pressure is heavy. Double-H stretch panels are installed as previously described but at intervals of 330 feet, the length of wire in a roll. Either steel or wood line posts may be used to support the wire.

Unrolling net wire is best done by running a steel pipe through the center of the coil of wire and mounting the pipe across the bed of a pickup truck. The free end of the wire is secured to a stretch panel and the truck is driven to unroll the wire.

To pull net wire taut, make a holder for the wire. Place two 2 x 4" boards about 4 ft. long on top of one another and drill 3 holes through both boards (top, middle, bottom). Put one board on each side of the net wire near the end of the roll and bolt the boards together. Large washers on each side will prevent the bolts from cutting too deeply into the wood. Tie the ends of a rope around the top and bottom of the wooden pull frame, drop the slack of the rope over the trailer hitch, and pull with the pickup to tighten the fence. A normal truck will stall before the wire is too tight. Staple or tie the net wire to the far-end post of the stretch panel, then slack off the pull. Wrap each wire around the post and then back on itself. Usually, a net wire fence is completed from one stretch panel to another before the next roll is unrolled.

Tie the net wire to the line posts in 3 or 4 places using 14-gauge tie wire or clips. The common height of net wire is 32 inches so usually one or more strands of barbed wire are added on top of the net so the fence will hold cattle and horses. If antelope inhabit the area, antelope passes should be installed where net wire is used since antelope always go under a fence, never over it (Chapter 10).

Maintenance

The toughest time on a fence is the first year. People and animals don't know it is there and run through it or over it. Any deficiencies in construction will show up.

When cleaning up after construction, any short lengths of wire are coiled and hung on a post for patching material. Inspect the fence carefully before payment is made to be sure the contract was properly completed. Schedule inspection for the first spring and make any necessary repairs. Check water gaps after each rain.

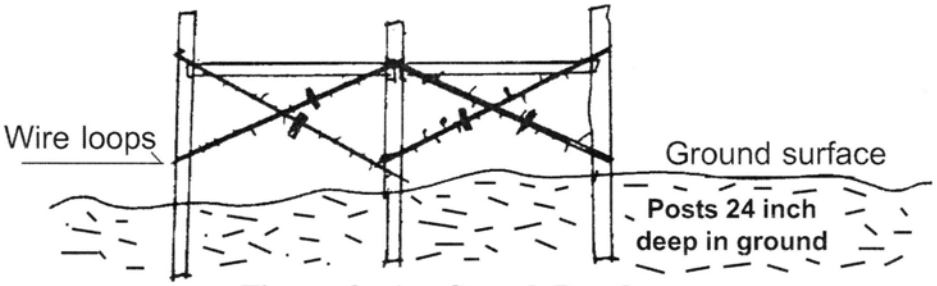


Figure 9 - 1: Stretch Panel

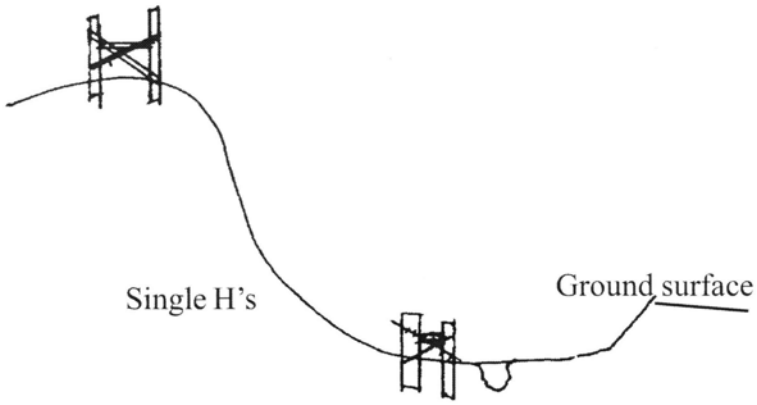


Figure 9 - 2: Single H's used at elevational chanages.

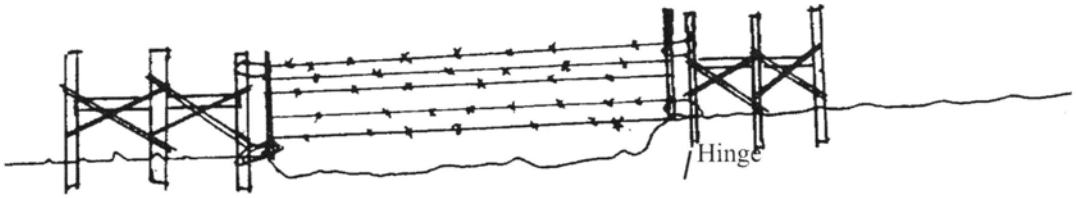


Figure 9 - 3: A wire gate.

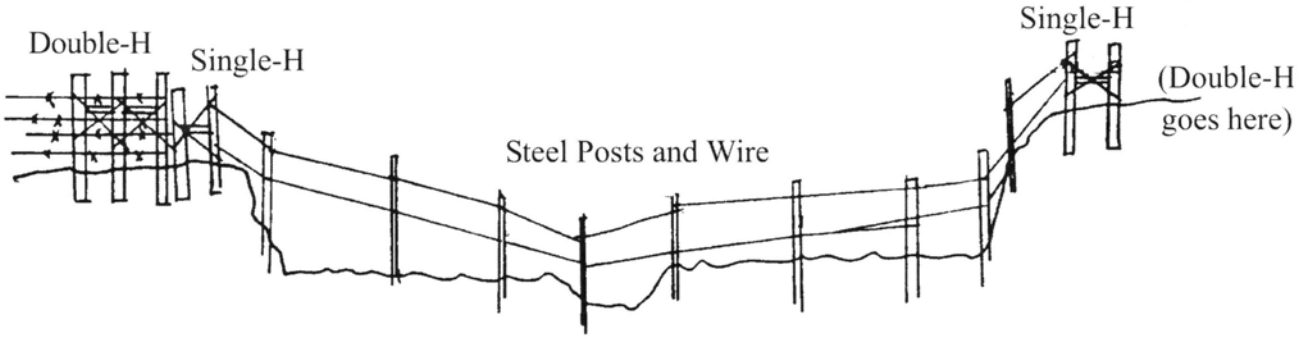


Figure 9 - 4: Water Gap Construction

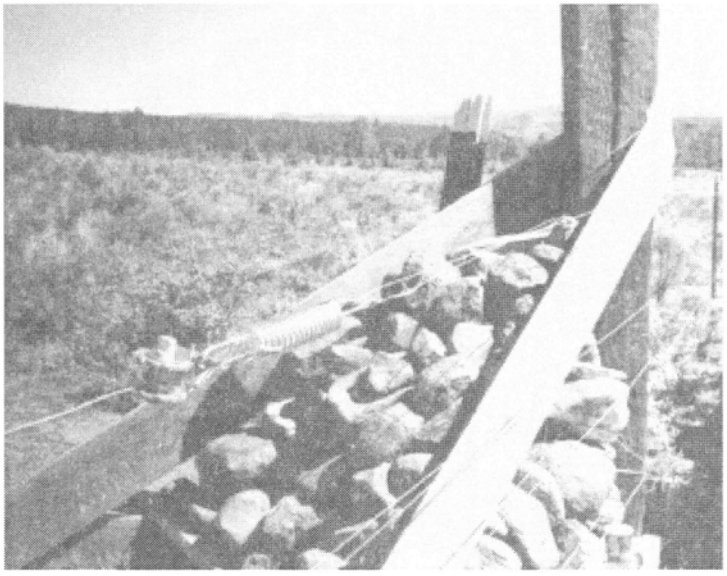


Figure 9 - 5: A close-up photo showing tie, springs and ratchet come-a-long used in installing high tensile smooth wire. This wire is increasingly popular as it is easily electrified when used with polyglass stays. Note the rock-jack 'H'.

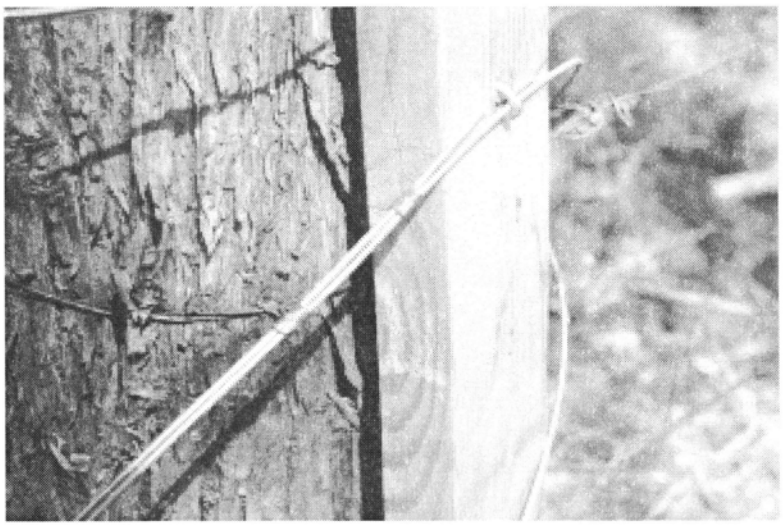


Figure 9 - 6: Photo shows splices in high tensile wire fence. Use a long handled tool to install the clips.

Figure 9- 7: Spooling wire from a home made platform.

Figure 9 - 8: This photo shows the tightening of the rachet with a wrench, until the 3rd groove shows on the bar on left of spring.

Photos courtesy of Dixie Meadows Company.

Chapter 10

Cattleguards

Cattleguards are horizontal fences placed across roads to restrict the movement of livestock while permitting passage of wheeled vehicles. A cattleguard consists of a pit in the road, covered with a platform of rails that run at right angles to the road. The rails are spaced far enough apart that the hoof of an animal will fall through, but close enough that a vehicle wheel will not (Fig.10-1). Cattleguard platforms may be built of small logs, railroad rails, or may be purchased ready-made.

Unsatisfactory substitutes for cattleguards include painted black and white stripes across a paved road and rubber bands cut from old truck inner tubes then stretched across the road.

Measure the width of the road and then build or buy a cattleguard platform that is long enough to span the roadway plus one foot on each side; this platform sits on walls built into the pit. Walls may be railroad ties, or bridge timbers, but concrete walls are preferable.

Usually concrete walls are poured in town. The walls should be 8 inches thick and reinforced with ½" reinforcing bar (rebar). It is best if the cattleguard platform sits into a lip on the long walls (Fig. 10-3). The downhill end-wall should have a generous drain hole at the bottom. If the cattleguard will be bolted down, the bolts are placed in the wet concrete. Leave some rebar loops sticking out of the walls so the cured wall can be picked up mechanically and placed on a trailer or truck for transporting to the site.

Once at the job site, place flagpersons or signs to warn motorists of the construction, and build a detour. Stake the outline of the cattleguard on the road. With a backhoe excavate a pit of the proper size and depth. Pile the dirt off the road. The pit is usually 24" deep. Measure to confirm the hole is the same depth and width as the concrete walls. Each wall is then picked up with the backhoe and placed in the hole. Level each wall before detaching the lifting chain. Place the short walls to hold the long walls in place. Lift the cattleguard platform and set it into the lips of the concrete walls. Bolt the wings to the end posts of the fence double-H and the job is done. Usually, this is a two-hour job.

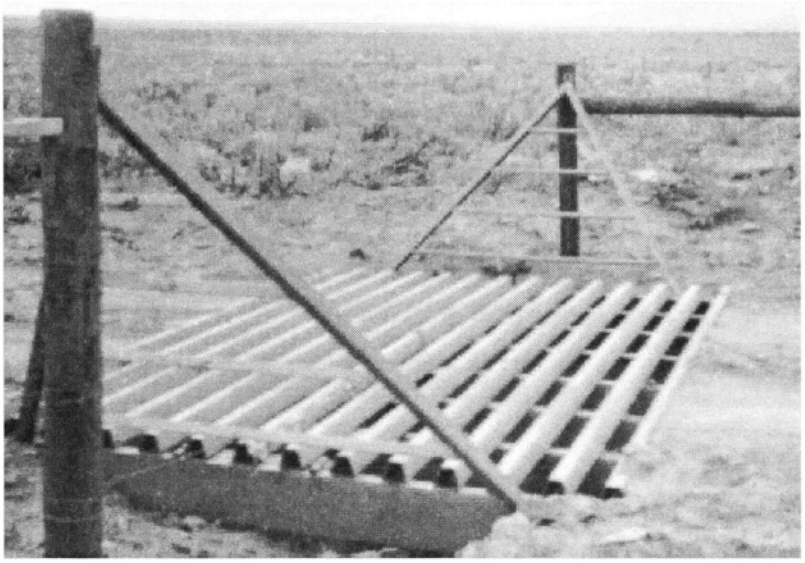


Photo of a Cattle guard

Figure 10 - 1

If the concrete walls are poured in place, a good detour is essential, since the hole will be open for about a week. The additional cost of transporting persons, equipment and materials to the site several times plus the expense of building forms justifies pouring the walls in town. The cattleguard should conform to the road slope.

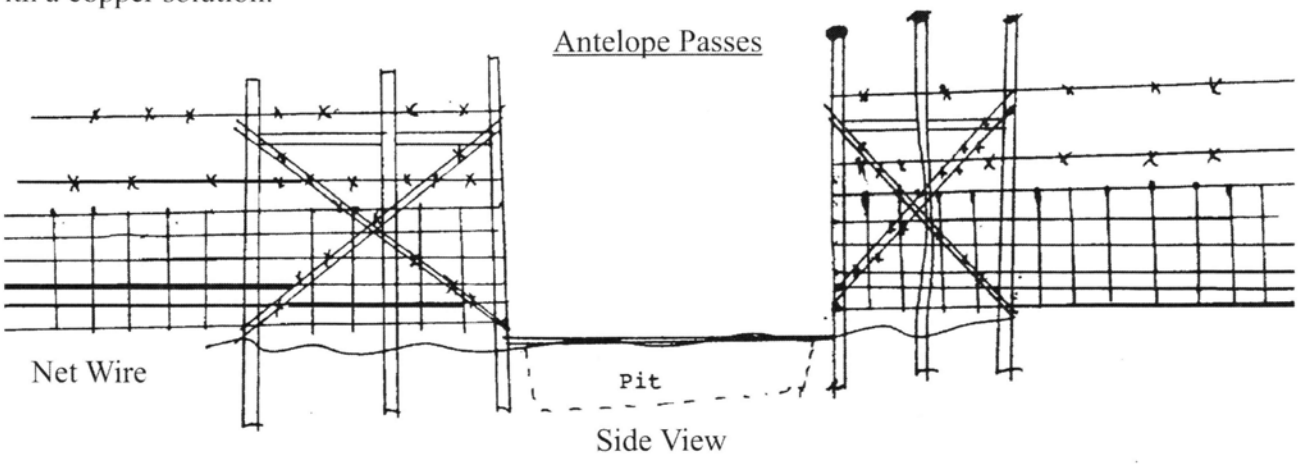
Clever cattle will learn to walk across the cattleguard, usually on the end walls. Feed sacks or old cowhides are used on the wings to hide the edges. When a cow is stuck in the cattleguard, roll her over on her side, tuck up her legs, tie onto her and tug her off with a pickup. Expect to find her stuck again on the way back home that evening.

Antelope Passes

Antelope passes are similar to cattleguards, except they are narrower and not as strong. The purpose is the same, to hold cattle. If antelope inhabit the area, and net wire is used, passes are a must, to be installed at or near each fence corner.

To build an antelope pass, dig a 1 to 2 ft. deep pit about 3 to 4 feet wide and about 4 ft. long. Use sturdy 2" x 6" boards on the ends and nail 2" x 4" boards on edge crossways. The pass is not designed for vehicles and is deliberately built too narrow for a truck. Signs may be needed to warn ATV's not to cross. There is no need for wings.

Treated boards are used throughout, making them slower to rot, since they have been impregnated with a copper solution.



Top View Across Pit

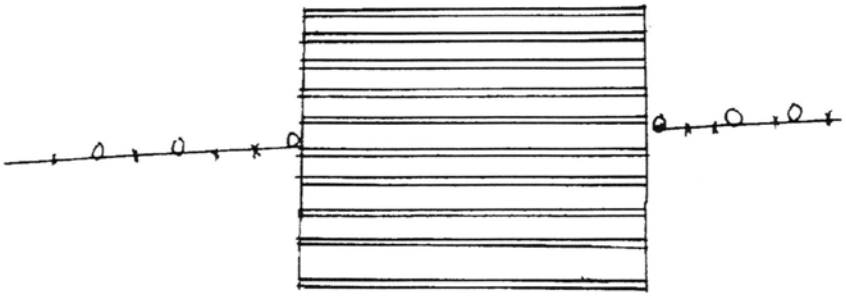


Figure 10 - 2

Maintenance

Considerable amounts of muddy water will flow down the road and into the cattleguard pit, eventually filling it up with silt. If possible, put the guard on a rise. Building a bump or water bar (called a 'thank you, ma'am') is not a good solution to keeping water out of the cattleguard, since it can cause a wreck. The downhill short concrete wall in the pit will have a drainage hole.

To clean silt from a cattleguard pit, first set out flagpersons or warning signs, then lift the platform off the walls and set it to one side, backhoe the accumulated sediments from the pit and reset the platform. Maintenance is easier with lipped walls since rusted bolts with frozen nuts are impossible to remove except with an acetylene torch. Some platforms are built with a trap door opening to enter and shovel out the debris. The backhoe is preferred.

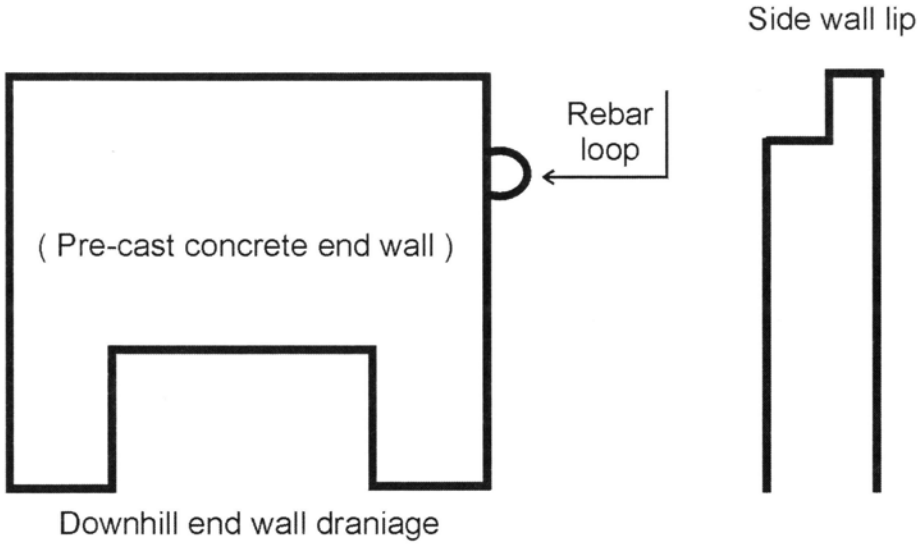


Figure 10 - 3

Chapter 11

Corrals

Corrals are strong tall fences intended to be an absolute barrier to livestock. Enclosing a few hundred to a few thousand square feet, corrals usually have several cross-fences inside to form compartments. A corral with compartments is called a 'set of pens' (Figures 11-1 & 11- 2).

The corral should hold any of the ranch livestock, no matter how recalcitrant the animal. If an animal can escape from a corral it has learned a bad habit. If the animal learns it cannot escape, it will settle down and cause fewer problems. On one ranch where I worked there were four Texas Longhorns in addition to the Herefords. When penned, the longhorns jumped the 5-ft. corral walls easily. It was funny, until they were sold, then they had to be shot.

A rancher is judged by his corrals when neighbors come help work the livestock (branding, vaccinating, etc.). A poor corral is a dangerous place to work.

A corral should be located for easy access, have a good water supply and where soils are deep and relatively rock free. The area should be nearly level. The cattle should come to the corral wing on the level or slightly downhill. Cattle tend to bunch when driven downhill and to split when driven uphill. Since today's cowboy drifts a sick or injured animal to the corral for treatment, the corral should be centrally located in a pasture. A water supply permits holding an injured animal for several days and also facilitates trapping wild livestock.

Large wooden posts are used, preferably 12-ft. railroad ties; thus the soil should be deep enough for a 4-foot hole. The livestock will be crowded in the pens so a rock-free surface is desirable to reduce hoof and leg injuries. When sprinting to escape an angry animal, a person can run faster on a rock-free surface.

If a corral is built on a steep slope, the livestock standing in the upper part can see over the wall at the lower end and get delusions of escape. An animal can get up considerable speed running downhill and may kill or injure itself when it hits the fence.

Design

Design the corral on paper before beginning construction. Decide the direction the animals will be coming from and put the entrance on that side. A wing will help funnel the animals in the gate. Decide how many compartments are needed, where the loading and squeeze chutes will be and which way the gates will swing; in a corral they open in only one direction. A scale for weighing livestock should be near the loading chute. Selling animals where the weights are determined at the destination means the rancher must absorb a 'shrink' of usually 3%. If animals are weighted at the ranch, any losses accrue to the buyer.

Begin the corral design by drawing the entrance gate. This gate is wide and has posts 5 to 6 ft. above the corral for easy identification. A 'waiting room' just inside the gate should be big enough to hold all the animals in the pasture. Plan the gates to the next pen (gates are always in a corner of a pen). One gate should lead to a funnel and a narrow chute (one animal wide). At the end of this chute is a mechanical squeeze where animals can be immobilized for treatment. From the mechanical squeeze there are usually provisions for moving the animals into one of two pens and/or into the loading chute. When the mechanical squeeze is open, the animals can pass freely to the loading chute. The loading chute is an inclined plane, ending at the height of a livestock truck's bed. There is a good gate at the bottom, of course.

When the design is on paper, mentally move livestock through the pens for a specific operation such as applying systemic lice medicine, branding, artificial insemination, shearing sheep, etc.. Refine the wall locations to fit each operation. Consider also the treatment of a lone animal.

Finalize the plan to scale on graph paper, making a blueprint for building. Then stake on the ground where each post will go. Use large posts, 12 to 16 ft. long for horse and cattle corrals, set 4 ft. in the ground. As with fence posts, use only rot-proofed materials. A corral has no H-braces. Set the posts exactly on line using a taut string for line and check plumb with a carpenter's level.

The hole may be backfilled around the post with tamped dirt or with concrete. If concrete is used, fill to within 4 to 6" of ground level and top off with dirt to lessen chances of injury. Posts are set and allowed to settle before the walls are built.

Walls may be heavy planks, chain link fence, V-mesh fence, steel cable, tubing (thin-walled pipe), or whatever is at hand and is economical. Always allow an escape route for a man. If planks are used, nail them to form a ladder and place the bottom board about a foot from the ground. Raise the bottom of a wire fence so a man can slip under and reinforce the top of the opening with a plank.

In hot desert areas, corrals may be walled with ocotillo stems, set upright and wired close together. This type of corral is mostly used for sheep or goats and is protection from coyotes and bobcats.

If handling horses, it is convenient to have one round pen. Horses will circle in a round pen, giving a chance to rope one. In a square pen, they will jam up in a corner.

Trap Corrals

In some places, as in the brush country of West Texas, cattle get a wild as deer. On public lands in the West there are increasing numbers of feral horses and burros. Wildlife agencies often trap part of a population of deer, elk, moose, etc. to be moved to a new area. Trap corrals may be used to catch these animals.

The animals must enter the corral on their own, since they are usually too wild to be driven. The corral is baited with salt or water. When the animals enter, the gate is closed, usually by a trip rope operated by a man hiding downwind. The gate must close quickly and firmly since the stock will try to backtrack in a hurry.

Animals may be trapped using a small V-gate, with spring on one side of the V (Figure 11-3). The animals may push in easily, but can't get back out. The V-gate can be rigged and left wide open at first, then the fingers closed after the animals get used to using the gate. Plans are Figure11-5 & 6, courtesy of British Columbia Dept. of Transportation.

It is impossible to drive wild cattle or wildlife, and some feral horses and burros) into a corral they know it is there. Prefabricated portable corrals can be set up on a trail, in a mountain pass, or around water to do onetime trapping. Then the corral is moved to another location.

Feral horses are now moved to a corral by helicopter. After being gathered a time or two, the horses accept this readily, looking forward to a good meal of hay.

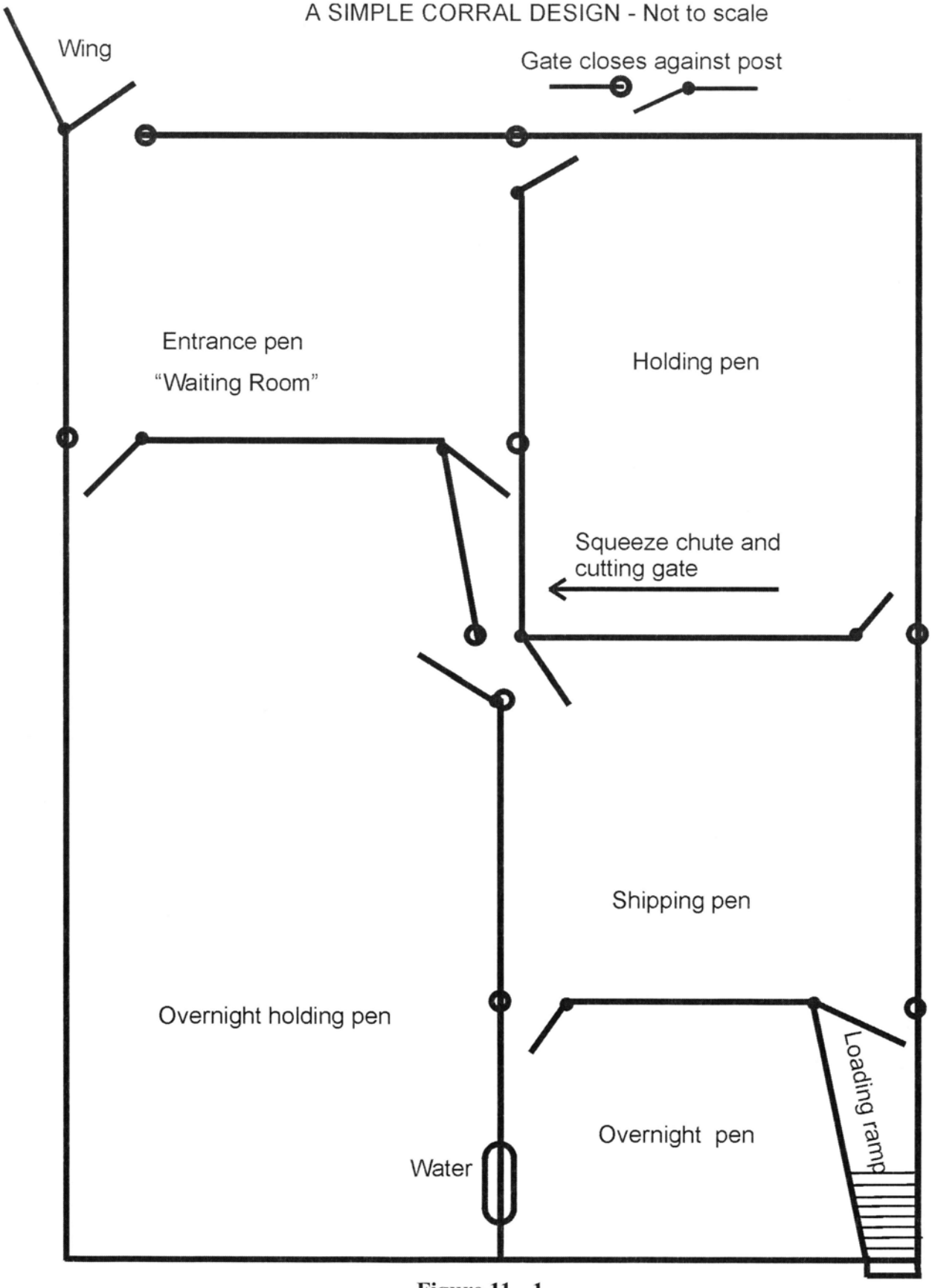

A SIMPLE CORRAL DESIGN - Not to scale
Wing
Gate closes against post
Entrance pen
"Waiting Room"
Holding pen
Squeeze chute and
cutting gate
Shipping pen
Overnight holding pen
Loading ramp
Overnight pen
Water

Figure 11 - 1

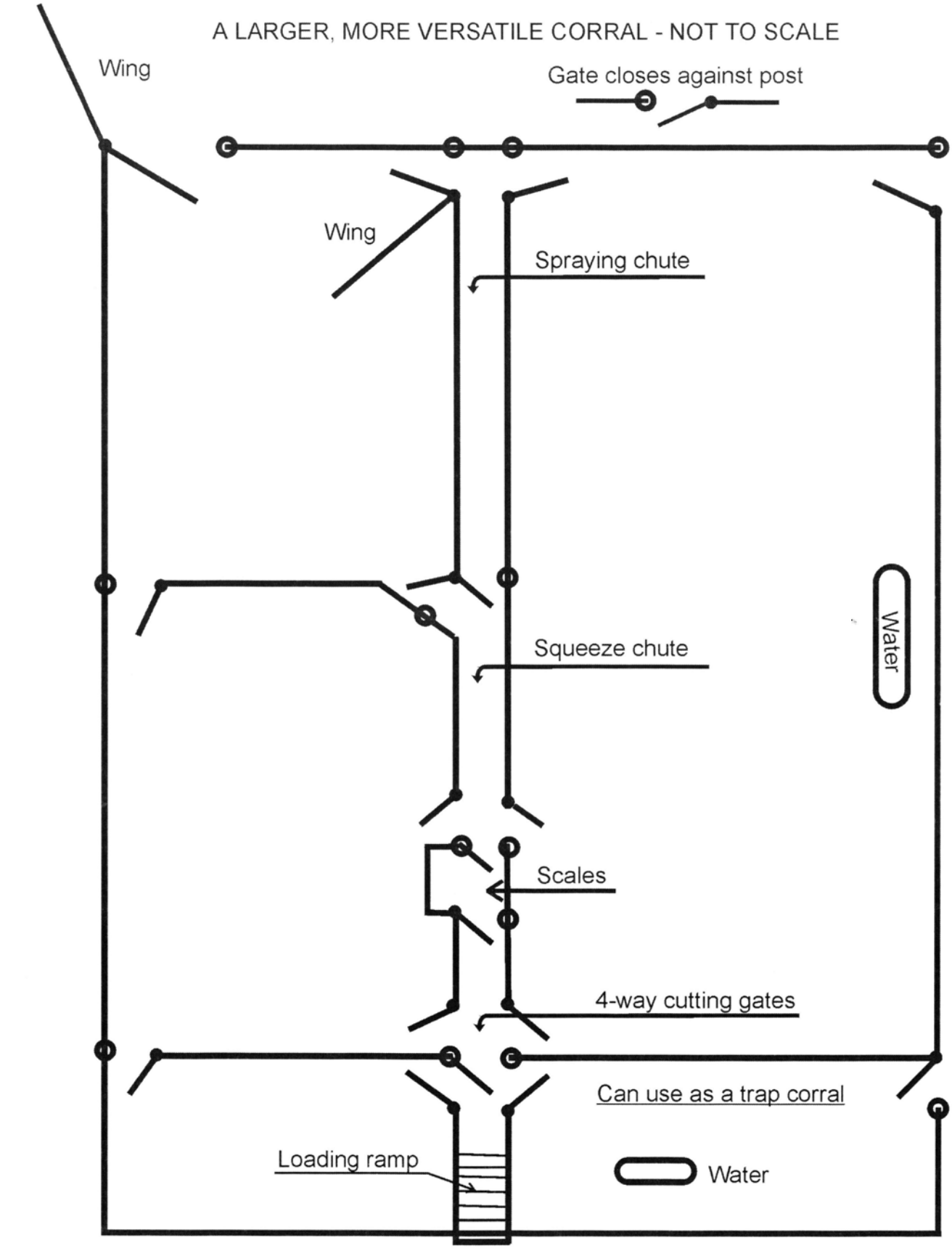

A LARGER, MORE VERSATILE CORRAL - NOT TO SCALE
Wing
Gate closes against post
Wing
Spraying chute
Squeeze chute
Water
Scales
4-way cutting gates
Can use as a trap corral
Loading ramp
Water

Figure 11 - 2

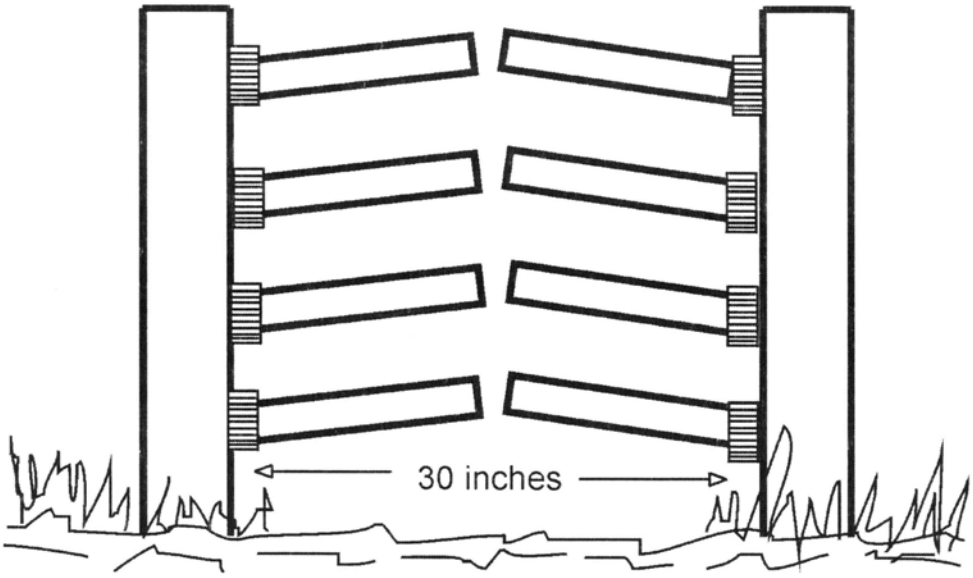


Figure 11 - 3

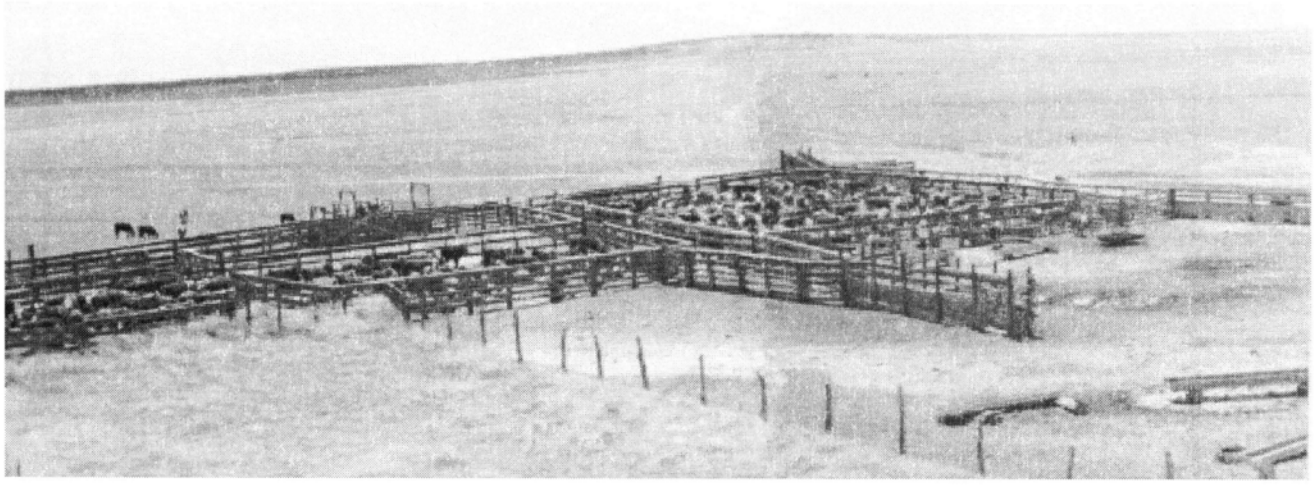
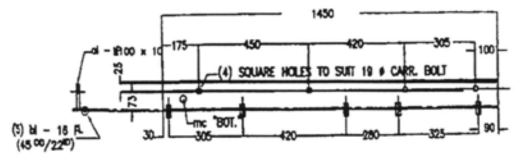


Photo of a Corral on Range Land

Figure 11 - 4



ONE REQUIRED – MOUNTING ℞ – mc. "A1^R" (SHOWN)
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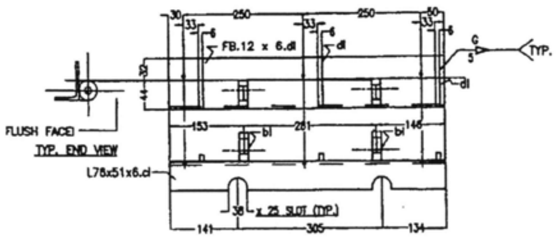

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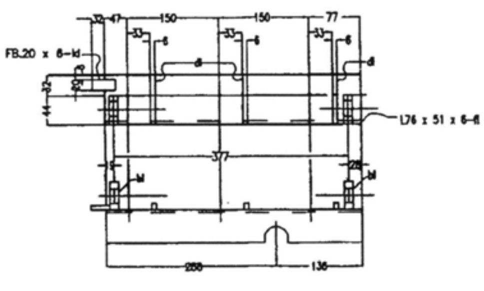
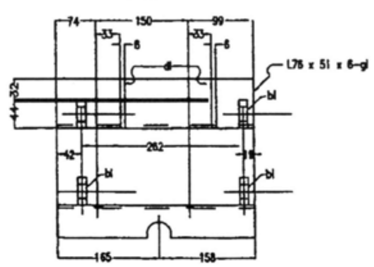
NOT TO SCALE



ONE REQUIRED ANGLE – mc "C1^R" (SHOWN)
ONE REQUIRED ANGLE – mc "C1^L" (OPP.HD.)
NOT TO SCALE



ONE – ANGLE – "D1^R" (SHOWN)
ONE – ANGLE – "D1^L" (OPP. HD.)
NOT TO SCALE

MARK NO.	NO REQUIRED	DESCRIPTION	LENGTH	REMARKS	WEIGHT
	ONE	– PLATE – MC	"A1^R"		
	ONE	– PLATE – MC	"A1^L"		
a1	2	FB, 100x10	1450		
b1	10	℞16th.x45°°/22^LD.			
	ONE	– ANGLE – MC	"B1^R"		
	ONE	– ANGLE – MC	"B1^L"		
c1^R_L	2	L76 x 51 x 6	580		
d1	6	FB, 12 x 6	76		
b1	4	℞16th.x45°°/22^LD.			
	ONE	– ANGLE – MC	"C1^R"		
	ONE	– ANGLE – MC	"C1^L"		
f1^R_L	2	L76 x 51 x 6	424		
b1	4	℞16th.x45°°/22^LD.			
d1	6	FB, 12 x 6	76		
k1	2	FB, 20 x 6	50		
	ONE	– ANGLE – MC	"D1^R"		
	ONE	– ANGLE – MC	"D1^L"		
g1^R_L	2	L76 x 51 x 6	323		
b1	4	℞16th.x45°°/22^LD.			
d1	4	FB, 12 x 6	76		
	8	– TINE – MC	"E1^R"		
	8	– TINE – MC	"E1^L"		
~	16	H.T. ROD 12.5 ø	980±	(ROLLED)	
h1	16	FB, 38 x 8	76		
"G1"	2	PIN 16 ø (HEADED)	1355		
"H1"	22	NYLON BUSHINGS WITH	3mm WASHER CAST	INTO SAME	
"K1"	10	S.S. COIL SPRINGS	(1.25°° – 5mm)	x 4 LG.±	
~	16	BOLTS 12 ø	38		
~	8	GALV'D 19 ø CAR. BOLTS x 267	LG.		

Rev	Date	Description	Init
		ISSUED FOR TENDER	

ISSUE RECORD

SCALE AS SHOWN — DESIGNED ___ DATE ___ CHECKED ___ DATE ___ DRAWN KPW DATE 03/01

Rev	Date	Description	Init

REVISIONS

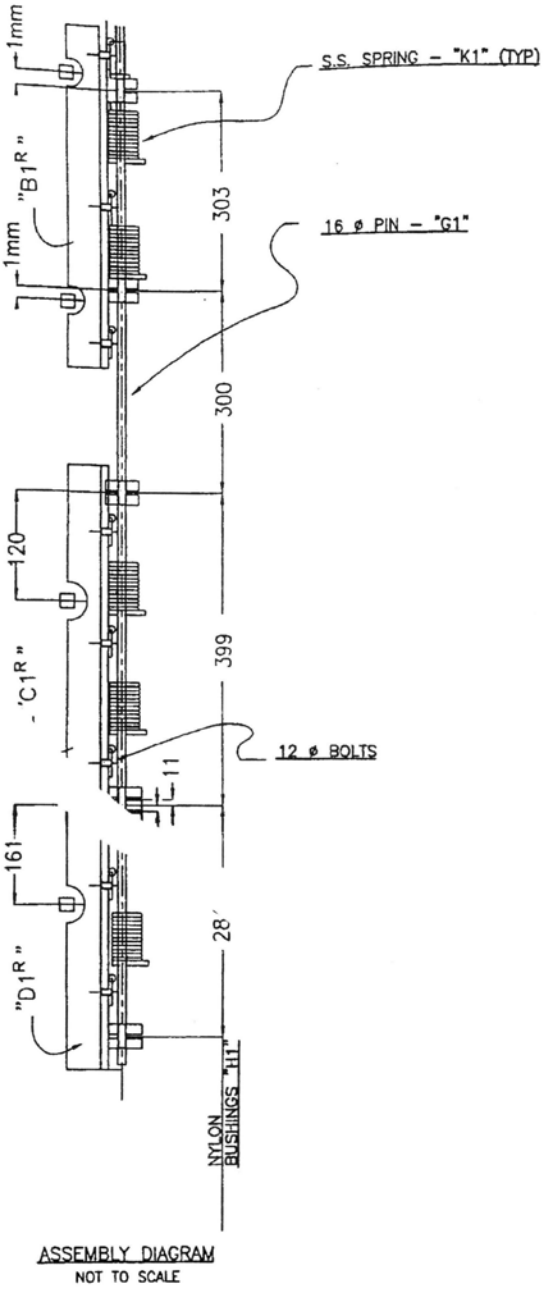
Province of British Columbia
MINISTRY OF TRANSPORTATION AND HIGHWAYS
VANCOUVER ISLAND HIGHWAY PROJECT

SHOP DETAILS – WILDLIFE ONE WAY GATE ASSEMBLY
Inland Island Highway
WILDLIFE FENCING–MAPLE LAKE PIT TO HEADQURTERS CREEK

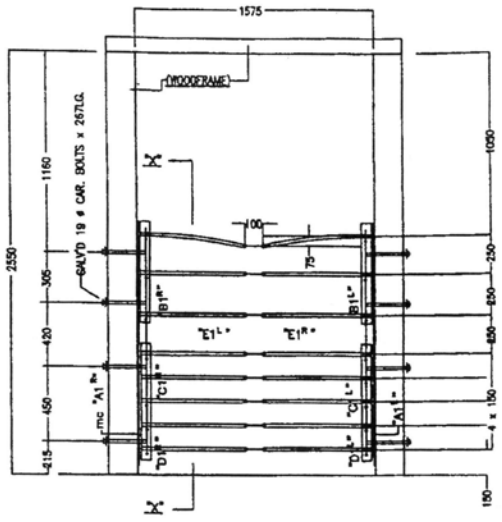
Project Manager: Vancouver Island Highway Project Management Team, 200 – 546 Yates Street, VICTORIA, B.C. V8W 1K8
Design By
PREPARED UNDER THE DIRECTION OF
CONSULTANT
DATE

FILE No.	PROJECT No.	CONTRACT No.	REGION	DRAWING No.
L6-19-442	70600	082MJ6244	6	R6-V442-F204

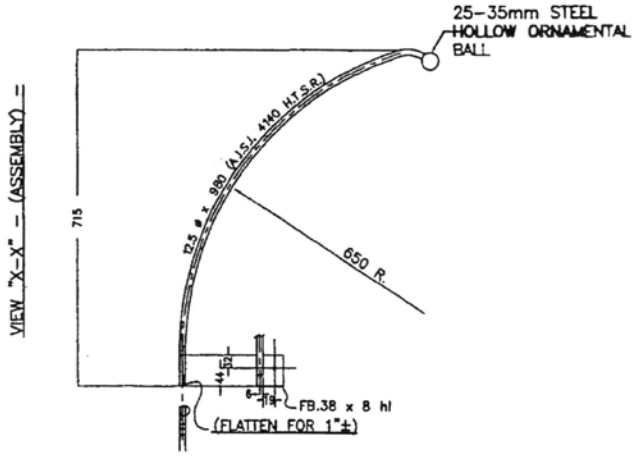
Figure 11 - 5



ASSEMBLY DIAGRAM
NOT TO SCALE



GENERAL ARRANGEMENT
NOT TO SCALE



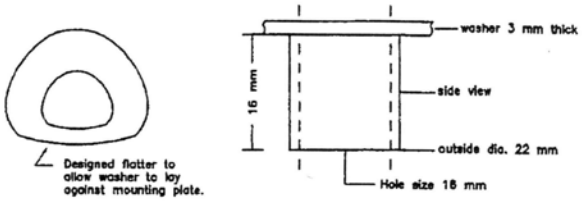
8 REQUIRED – TINE – "E1R" (SHOWN)

8 REQUIRED – TINE – "E1L" (OPP.HD.)

NOT TO SCALE

NOTE:

1) THE TINES SHALL BE MOUNTED ON THE FRONT (HIGHWAY SIDE) OF THE STEEL ANGLES (B1, C1, D1) TO AVOID BINDING ON THE SPRINGS.
2) NYLON, OR OTHER SUITABLE PLASTIC, WASHERS SHALL BE INSTALLED ON THE GATE HINGES, TO LAY AGAINST THE MOUNTING PLATE.
3) 38mm X 50mm PATCHES OF 3mm NEOPRENE RUBBER SHALL BE PERMANENTLY ATTACHED TO EACH SWINGING SECTION, USING A SILICON ADHESIVE, SO THAT THE GATE CAN BE SLAMMED SHUT WITHOUT NOISE.
4) ALL METAL IN THE GATE ASSEMBLY SHALL BE GALVANIZED.
5) THE GATE TINES ONLY SHALL BE HEAT TREATED TO SPECIFICATION RC3235.
6) ACID BATH TREATMENT OF THE TINES PRIOR TO GALVINIZING SHALL BE CONTROLLED TO MINIMIZE POTENTIAL WEAKENING OF WELDS.
7) GATES SHALL BE CAREFULLY FABRICATED AND WELDED TO AVOID BINDING, AND COMPLETED GATES SHALL BE ADJUSTED AND LUBRICATED TO SWING FREELY AND QUIETLY SHUT FROM ANY POSITION.
8) GALVANIZING SHALL BE IN ACCORDANCE WITH SECTION 316 OF THE STANDARD SPECIFICATIONS (AN AVERAGE COATING OF 550g/m² , WITH A MINIMUM COATING OF 490g/m²).



Item "H1": NYLON BUSHINGS
NOT TO SCALE

Figure 11 -6

Chapter 12

Spring Development

Springs are natural seeps or flows of water from underground. Precipitation infiltrates the soil, follows clay or rock ledges to a point where it emerges. Springs in draw bottoms are often underground stream flow that is blocked by a dike (a natural rock dam).

Springs are developed to provide a larger supply of clean water. The underground flow is conveyed to a trough where it can be stored and used.

Water flow may fluctuate annually according to precipitation. During a prolonged drought, most springs decrease in flow. Other springs flow from precipitation that fell tens of thousands of years ago.

No two springs are exactly alike; therefore, development of each is unique. The basic method is to dig a hole where the water emerges, using a shovel or a backhoe. Don't use a bulldozer, the blade is too big, and do not use dynamite; it will disrupt the layer of clay or rock that is the bed for the flow. Dig the hole several feet in diameter and several feet deep.

The water is flowing on an impervious layer; which might be a lens of clay or a layer of precipitate such as calcium. If this layer is destroyed, the water will sink and be lost. Dig one shovel full at a time and watch for water flow. Bail out the muddy water or trench it away from the hole so the place of entrance can be seen. If from the bottom of the hole, dig deeper until the supporting layer is found. Then dig above the layer in the direction of flow.

There is no established rule as to how far to dig upstream. There might be a rock ledge from which the water is emerging and further digging is impossible. Usually, more water is found farther up the trench. It is not uncommon to trench 200 to 300 feet. At other times the initial hole is sufficient for the needed amount of water. Sometimes there is not enough water to develop.

Old timers built a box of wood over the spring to keep it clean and to form a collection pool. Today, plastic domes or steel or aluminum culvert is used for a collection box, but it is still called a spring box. The culvert should be large enough in diameter that a man can enter and clean out silt and dead animals. Culverts are 20 feet long and must be cut to fit the depth of the dug hole. Steel culvert is cut and perforated with a cutting torch and aluminum culvert is cut with an old axe and perforated with a pick.

Perforations (1-inch) are necessary to let the water into the culvert in the lower two feet of the culvert. Cut the culvert about a foot longer than the hole is deep and place it vertically. Wire the end of a roll of plastic pipe into a lower perforation to transport the water to a trough.

Place the culvert in the hole on some rocks for support. Make a filter around the culvert by placing small rocks about two feet deep all around the culvert to cover the perforations. Lay a plastic sheet over the rocks so the backfill won't clog the filter. Trench out on grade and lay the plastic pipe in the trench as far as the trough location. Backfill around the spring box to the original ground level.

The culvert top should be above ground level so muddy rainwater can't flow into it. Always put a tight lid on the spring box. Rabbits and other small mammals have an amazing proclivity for jumping in the box and drowning, which pollutes the water. Tourists love to toss rocks into the spring box; a hasp and lock on

the cover may be needed. Put the lock in a cowbell shaped cover of sheet steel to prevent its being shot off. A recent innovation is a bell-shaped plastic collection box that is completely buried in the hole.

The trough must be out of flood danger and is usually placed on a nearby bench. See Chapter 14, Pipelines, for details of laying plastic pipe. See Chapter 15, Water Troughs, for tips on trough installation.

Wildlife Water

The trough should be near the original spring source so wildlife and livestock can find the water. If it is necessary to take the water more than 100 yards, or out of sight of the source, plan to put wildlife water near the spring. Tee off the main pipeline at a convenient place and run a length of plastic pipe to a wash-basin-sized trough for birds. If the water is to serve big game, refer to Chapters 15,Water Troughs and Chapter 16 Catchments. To make a bird trough, excavate a few inches deep and place a plastic pan or mix concrete to line the trough. It must be shallow so birds can bathe. Put some rocks in the basin to prevent livestock from drinking. The water should just drip into the basin; choke down the flow with a valve or end the pipe with copper tubing squeezed almost shut. Place this water in a small clearing so coyotes can't ambush the birds while they drink.

Horizontal Wells

Modified well drilling equipment, a small light rotary drill, is used to develop springs and seeps. The drill can be transported with a 4-wheel drive pickup. The method may offer a means of developing water with minimal ground disturbance, digging, and road building and thus be more acceptable environmentally than the backhoe. Since the equipment can drill through a rock dike to tap trapped water, it may offer the only practical means of development.

Horizontal well drilling involves the use of a rotary drill bit on 1¼-inch drill stem (See Chapter 13, Wells), a small gasoline engine powers it. The drill makes hole horizontally or slightly inclined so water will flow by gravity from the hole. Water is used to circulate cuttings of the bit from the hole.

When the drill bit first encounters water bearing strata, the drill stem is pulled and a 2-inch casing is placed and cemented in the hole. Then, drilling inside the 2-inch casing, drill further into the water bearing strata as far as necessary to produce sufficient water. The drill stem is then removed and 1¼-inch perforated steel pipe is inserted into the water bearing strata and cemented, to lead the water into the 2-inch casing.

Plumbing fixtures and valves are then connected to the outside end of the 2-inch casing. The water can be taken by pipeline to a trough.

Geologic inference may be used to determine where to explore for water using horizontal well drilling equipment (see Chapter 13, Wells). The presence of rabbitbrush or willows may signal underground water. Water trapped behind a rock dike may have no surface indications other than the presence of the dike on an adjacent south-facing slope.

A spring-box.

Only part of the water is being piped to a trough, leaving the small wet meadow.

Figure 12 - 1

A developed spring

Springbox is at left, trough and overflow pool to right. A "Bird Lifesaver" board is in place.

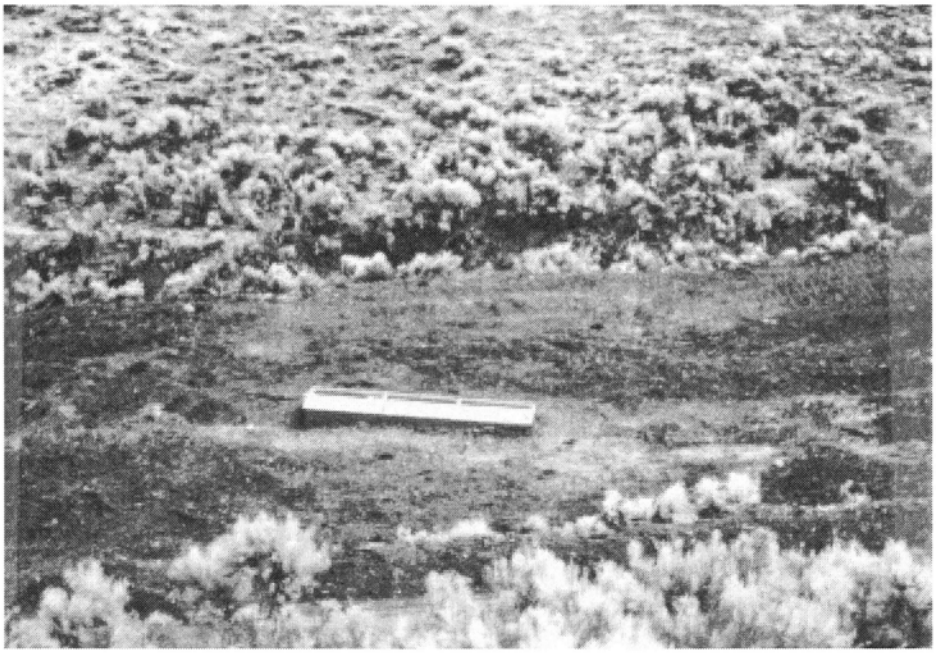


Figure 12 - 2

Chapter 13

Wells

A well is a hole drilled or dug into the earth, usually vertically, to tap an underground source of drinking water. The British call it a 'bore'.

Where to Drill

A well is dug to provide water for a specific purpose; therefore an approximate location is known. Convert this location to a cadastral survey description, e.g., T2N,R53E, MD Base and Meridian.(See Chapter 25.Cadastral Surveying) If possible, refine the description to a section of land. Ask the State (Water) Engineers' Office for a list of wells that have been drilled in that Township and Range, or in an adjacent T&R. A well-log is a record of well drilling and contains a list of the strata encountered while drilling, depth to water, approximate amounts of water, and possibly a reference to water quality.

Almost every state requires this information from a driller. This information will help determine the proper well drilling method. Also listed are dry holes; this information can warn where not to drill.

Plot the well locations and dry hole locations on a map with contour lines such as an U.S. Geological Survey map, so elevations of the various wells can be determined. There may be indications of sheet flow, where all wells have water at about the same depth (Fig.13-1). Or, there may be indications of a pool, where water level is constant (Fig.13-2). When existing wells are plotted on the map, a cross section can be drawn to help determine the type of flow.

In some parts of the West, the U.S. Geological Survey and the State Water Engineer have made elaborate water table studies, even delineating the fresh water from brine areas. Some of the valleys in California and Nevada have huge pools of brine, with lenses of fresh water floating on top. With carefully controlled pumping amounts, fresh water can be used without pumping the brine

The State Water Engineer or a hydrologist with a government agency (Bureau of Land Management, Forest Service, or a University) can inform if a water study is available. During a visit to the State Water Engineer, find out if a permit is needed to drill a well. If the well will be drilled on public land, a permit may not be required, but always notify the State of intent to drill and file a well-log when drilling is completed as a matter of comity.

Check water quality in existing wells while examining the well logs. Each State Health department has water quality standards and can furnish a list of common harmful salts and tolerable amount. Nitrate, arsenic, fluoride, and boron are poisonous in concentrations of only a few parts per million. .If other wells in the area show high concentrations of a poison, do not drill, at least into these strata. Sometimes a top stratum of water is deficient in quality, while a deeper stratum is good quality. The top water must be sealed off so it will not flow down and contaminate the deeper pure water.

A much more likely source of water than sheet or pool flow may become evident as the map is examined. This is underground watercourse flow. After the well-log information is plotted on the map, go to the area and look at the topography. Sit and look at the hills and valleys, the slopes and swales. See where the exposed rock formations protrude. Then project the topography underground and try to figure where the underground watercourse may be (Fig.13-5). In most areas, the mountain developed first and the valleys filled in from erosion until just the tops of the mountains now stick out of the fill. The Ivanpaugh Valley in California reputedly has about 22,000 feet of fill and has a present valley floor elevation of about 2,000 feet

above sea level. One could not afford to drill to bedrock there. This situation is not unique, water in Delamar Valley in Nevada is too deep to drill for because of the cost of drilling, equipping and pumping a deep well.

The underground projection of topography is not a scientific determination and there is no guarantee that the actual underground topography will resemble Fig.13-3, it may duplicate Fig.13-4).

A professional hydrologist may be hired to assist with location of the drilling site. Most government agencies have a geologist on the payroll to provide this expertise.

Some people exploit the idea of 'juvenile' or 'magmatic' water. The thesis is that water is formed underground by chemical combination of hydrogen and oxygen released from rocks. Experienced hydrologists tend to sigh deeply when magmatic water is mentioned. Officially and scientifically there is no such thing as magmatic water.

A rather large group espouses 'water witching' or dowsing to find underground water. This ancient art, through which the presence of water reveals itself to a practitioner holding a rod or forked stick in hand, is probably a true art. In one case, a water witch was able to locate a well in a sandstone crack that was only about 1-foot wide. In another case, the location indicated by a witch resulted in a dry hole. Not all water witches are equally gifted.

A recent invention is that of a small portable seismographic method, invented in England. A small computer, carried in a pickup seat, is wired to a small plate placed on the ground and to a large rubber mallet. When the plate is struck by the mallet, the computer will determine how deep it is to water, what kind of fill lies on top of the water and if the water is fresh or salty. This seems to have enormous promise (Check www.waterfinder.com).

By some method, scientific or inspirational, or maybe with a mixture of both, a site is chosen and a stake placed to indicate where to drill.

Well Drilling Methods

There are several methods of making a hole down to the water- bearing strata (aquifer). If the water is fairly shallow, dig with a pick and shovel. Some hand-dug wells are over 100 feet deep. The hole must be several feet wide and preferably square since shoring (strong walls of wood placed to prevent cave-ins) is more easily placed. Provide a supply of fresh air as the hole deepens. A windlass, rope and bucket are used to lift the dirt from a hole too deep to throw out with a shovel.

Jet or Hydraulic Digging

An alternative method, if the water table is shallow, is to use a jet, which is like using a garden hose with a 3-ft. long piece of 1/2-inch diameter steel pipe on the end. Point the pipe at the ground and turn on the water. As the soil is loosened, it is washed up and out of the hole. Using a high-pressure pump and accouterments to match, shallow wells, (10-30 ft. deep) can be drilled quite easily. Slip in short pieces of 2 or 3 inch casing as the hole deepens, screwing each section on in turn, to avoid cave-ins if a bed of sand is found. If rocks are encountered, drilling stops there.

Well Point

Another shallow well method if the soil is not rocky is to drive a well-point. A well-point is a piece of heavy wall pipe, pointed on the nose end and with perforations and sand screen built in just above the point.

In driving a well-point, screw a driving flange on the threaded end and drive the point into the ground using as big a sledgehammer as possible. After driving the point section, unscrew the driving flange, add another section of pipe, replace the driving flange on top and drive some more. Keep adding pipe sections until water is reached or rock is encountered.

There are other methods of driving the pipe such as using the hydraulic system of a tractor or building a pile driver consisting of a tripod with a pulley at top through which a rope runs to a heavy weight that can be raised and dropped onto the driving flange.

Drilling Rigs

Most Wildlands water well drilling involves fairly deep holes and requires the use of a drilling rig. These come in two basic formats: one is a cable tool and the other is a rotary.

A cable tool rig has a mast over which a large diameter (1-2") steel cable is draped. One end of the cable is wound on a drum for storage and the other end is hooked onto a drill bit. A motor driven eccentric arm alternately shortens and releases the cable, lifting and dropping the drill bit at the rate of once every few seconds. The weight of the drill bit mashes the soil and rock into powder. The drill bit is welded onto a 4 to 8 foot long piece of iron which may be round or fluted and is the proper diameter and weight for the size of hole desired. The bit is sharpened and hard-faced with a welding outfit carried on the rig.

Every so often, detach and park the drill bit; hook onto a bailer, pour water in the hole and dip out the slurry of rock powder, dirt, and water. The bailer is a 6-ft. long piece of pipe with a one-way valve at the bottom. that opens as the bailer hits bottom allowing flow into the bailer. The valve closes when the bailer is lifted. Cable tool rigs drill well in dirt or valley fill but are helpless on basalt or other hard igneous rock. By feeling the cable, the experienced drilling operator can tell if he is 'making hole'.

Surface casing is placed as soon as possible to prevent collapse of the hole. This is usually a 12-inch casing, and only long enough to protect the soft surface strata. This casing is salvaged once the hole is completed. If the drill encounters loose formations, such as a sand bed, place well casing (normally 8") through these formations, from the top down. In general, the entire hole drilled by a cable-tool rig should be cased until the drill hits hard formations.

Add this cost in the estimate of the well drilling contract and have the casing on hand to be used as needed. When completed, a 4-inch casing may be inserted in the larger casing and the larger casing salvaged.

Cable tool outfits drill most water wells in the West since they are less expensive to buy and maintain and can be run by one or two men. This method can find even a light flow of water whereas the rotary may skip right through such a strata. Cable tool rigs are mounted on an old truck or a large trailer.

Rotary Drilling Rigs

These rigs drill with a rotary motion, like an electric drill or a brace-and-bit. The rotary bit actually cuts rock. The cuttings are removed from the hole by: (a) mud slurry, (b) water, or (c) air. In hard rock, the cuttings are removed as a core and are examined by geologists for indications of minerals such as oil or gold.

The rotary rig is usually truck mounted, with a derrick that folds down for travel hence the name 'jack-knife'. A large engine on the rig turns a horizontal plate on the floor of the rig. The drill pipe (called drill stem) is heavy wall pipe and is clamped into the center of the plate. Although the drill bit looks like a bunch of old gears welded together into a cluster, they are carefully engineered and placed to cut. Each type of bit is designed for use on a certain kind of formation, be it sandstone, limestone, boulder fill of granite rocks, etc.

Drilling with Mud and/or Water

As the bit turns and chews up dirt and rock, a constant flow of water or mud flows down inside the drill stem, through the bit and up out of the hole, removing the debris. The bit is drilling on fresh material all the time. A rotary rig makes hole much faster than a cable tool.

Surface casing is always used with a rotary rig. By using the proper consistency of mud, the sides of a rotary hole are sealed as drilling progresses to prevent caving of the hole below the surface casing. This saves using more casing. If the drill goes past a boulder, which then loosens and rolls against the drill stem, the bit cannot be removed from the hole since the bit is of larger diameter than the drill stem and cuts going down, not coming up. Tool-pushers (a man in charge of a drilling rig) have a tendency to build a mud wall that will hold.

When the bit gets dull or if a different formation requires a different bit, the crew 'comes out of the hole' with all the drill stem, which is unscrewed as each joint or pair of joints comes out and is stacked inside the derrick. A new bit is screwed on, and the process is reversed as the crew 'goes back in the hole'. Stay off the rig during this operation, it is dangerous when they throw a diamond-edged chain around the drill stem to break loose a joint of pipe.

Sometimes the bit hits something and jams and the drill stem twists off. Then the crew 'goes fishing' for the equipment still in the hole. Sometimes they fish for days. Tension is very high so stay away from the rig unless you are a collector of colloquialisms. No one can drill through a loose drill bit in the hole, so sometimes the hole must be abandoned and a new one started.

Drilling with mud is a two-edged sword. If an upper strata of salty or contaminated water is found, it may be sealed off with mud. On the other hand, it may drill right through one or more good light water-bearing strata and never know it. Generally, use mud only in the loose surface fill and then drill with only water at depths where water is expected. The tool-pusher is not enthusiastic about this since he is paid by the foot of hole, not by the hour. Drilling in the wildlands is a wildcatting operation, so try to develop all the water found.

The Air Rotary

Some rotaries use air rather than water or mud to circulate the cuttings out of the hole. This rig has a specialized use in hard igneous rock. Usually a cable tool or mud rotary is used down to hard rock, then the air rotary finishes the hole. A cable tool is helpless in very hard rock and a mud rotary is very slow because the mud lubricates. An air rotary will make lots of hole fast in the hardest rock. In northern Nevada and adjacent states are vast lava flows inter-layered with tuff (volcanic ash). The water is normally found in the tuff, so the drill must pass through a layer or two of basalt to get to the water bearing strata, which is called an aquifer.

The Contract

After the site is determined and an inspection of well logs indicates which type of rig to use to drill, work up a contract for bid. A written contract is essential to avoid major problems of the multistep process of drilling, developing, and/or abandonment of a dry hole. The first measure before the 'show me' tour is to provide access to the site. The contractor must get his rig in and out and must make several trips a day with the water truck. If there is just a trail through brush, rocks, and gulches, this lack of access will show up in the bid price.

The contract will specify the size of hole and the size of the casing. A larger diameter hole will permit pumping larger volumes of water but will cost more per foot of depth, both drilling and casing. Most livestock wells use 4 or 6 inch casing. Determine how much water is needed from the well, and then refer to Table 13-1 to help decide casing size. If only a light flow of water can be expected, judging from the well-logs of other wells in the vicinity, or if the need is for only a couple of gallons per minute, then choose smaller casing. For trouble-free pumping, the hole should be cased all the way.

Specify perforation type and size. Seldom can enough water rise through the open bottom of the casing, so the lower walls of the casing are perforated. If several aquifers are encountered in drilling, there should be perforations in each aquifer. Often, a gadget with steel cutting edges is used to perforate the casing after the hole is drilled and the casing is in place. When dropped in the hole at the end of a cable, the tool opens on command and slices slits in the casing as it is pulled upward.

The other common method of perforating is to cut holes or slits in the casing with a welding torch before the casing is installed. Examine the material from the aquifer or from other well-logs to determine perforation size. In many areas a sand screen of the proper size to exclude the local sand is required. Sand is destructive to any pump. When writing the contract, consult with a trustworthy person to arrive at a satisfactory sand-exclusion method for the well.

The contract should deal with the problem of a dry hole. Will the casing be left in the hole? If the plan is to return and drill deeper in a few years, the surface casing must have a cover welded over it. Tourists have an uncontrollable urge to toss rocks down a casing. Over a period of years many feet of depth can be subtracted from a hole.

Plan on a wet hole. The cable tool operator will bail the hole and estimate how much water is present. They usually overestimate by about 100%. The only way to test a well is to pump it, but not with your brand new equipment. Specify in the contract that the driller will test the well with his old worn-out equipment. All wells will pump some rock and sand at first. A test pump should have a capacity sufficient to exceed the amount of water flowing into the hole. In testing the well, 'surge' the hole; pump for awhile, then shut off the pump and let the water in the pump pipe cascade back into the hole. The water sloshes around and gets most of the cuttings and sand into suspension so they can be pumped out. Check the water being pumped from time to time for sediments; continue pumping until these are minimal. Usually one pumps for at least 10 hours and sometimes for 24 hours.

In one case the driller pointed to visible water standing in the hole, collected and left town. When pumped, it was found that the hole actually was twenty feet deep with ten feet of water standing that the driller had carefully poured in.

The contract should consider what to do about contaminated or salty water strata that may be encountered. These must be cased off; they will eventually leak through a mud seal. In some areas, authorities require a concrete seal; drill down through the strata, pour concrete, let it dry, then drill through the concrete.

Pay for drilling is based on per foot drilled. Casing is a separate figure, at so much a foot. Test pumping is a separate figure, at so much an hour.

Set reasonable time limits. Allow some time for fishing for lost tools, water truck breakdowns, etc.

Specify a vertical hole. It is not uncommon, especially with cable tool rigs, to end up with a bend in the hole where it went around a boulder. Although the pump column can be jammed in the hole, frequent pump

replacement will be necessary due to excessive wear. The driller will be more careful if he realizes a bent or slanted hole is not acceptable.

Pumping Equipment

There are many ways to get the water out of a well. If the aquifer is shallow and land slopes from the well site, consider a siphon arrangement. One may need to choke down the siphon pipe with a valve so the outflow about equals the inflow into the well. A siphon may work in remote areas.

Most drilled wills will require a pump. From the test pumping the size and capacity is known. There are three basic kinds of pumps: the centrifugal, the rotary and the cylinder.

The centrifugal pump will lift water about 25 feet at sea level and to lesser heights at higher elevations. But it will push water 150 to 250 feet uphill. Most submersible pumps work on this principle.

The rotary pump is used on wells too deep or with too much volume of water for the centrifugal pump. There are 'stages' in a rotary pump column, generally one every 20-ft. of column; these are booster pumps. Most irrigation wells use this type of pump.

Cylinder pumps, used with windmills and pump-jacks, are yet a different kind of pump. Instead of impellers, which spin to move the water, these pumps use a sucking up and down stroke with check valves to push the water up. Table 13-3, shows sizes and capacities of pump cylinders. Another type of pump is the hydraulic ram, which is found in Chapter 17 on page 105.

The type of power available will determine the type of pump. Electric power is the most dependable and efficient and may be the least-cost alternative. Electrical lines can be buried, if needed for aesthetics. An electric motor operates at 80% efficiency, whereas the internal combustion engine operates at 27% efficiency. Initial cost, maintenance, and upkeep for an electric motor are much less than for a comparably powered internal combustion engine.

A gasoline-powered generator may be used to run an electric pump. Many persons use a gasoline engine to power a pump-jack; they fill the gas tank, start the engine and go their way. When the engine runs out of gasoline, the storage may be full.

Pumps vary in their reliability. The electrical submersible appears to be the most reliable. The next best is the pump-jack equipped with an electric motor or a gasoline/diesel engine. The next best is the windmill. Windmills operate on wind power, so power cost is zero.

Windmills have been used for centuries for power to pump water, saw wood, grind grain and many other tasks. Large windmills with a sail span of 50-feet were used to pump water from depths to 400-feet. The common type of windmill has a tail or vane that keeps the sail blades turned into the wind.

There is a safety clutch that turns the windmill off in high or gusty winds. The tail or vane can be set at an angle to the sail and this turns the sail edgewise to the wind when it becomes too strong. There is also a brake, which can be set by pulling down on a handle located inside a tower leg within reach of the ground. This handle will pull the vane (tail) around to set the sail parallel to the wind and stop the sail from turning. One allied type of windmill has a vane at right angles to the sail. This type will have a small vane behind the sail to guide the sail into the wind.

Another type of windmill has no tail, just a counterweight. This type has a brake to stop the sail. It is designed to pump constantly. It is unique in that the sail is made up of 6 to 8 sections and frequently was made of wood for easy repair. Springs, operated by centrifugal force, open sections of the blades of the sail

as the wind blows. If the wind gets too strong, the individual blades are automatically pulled parallel to the wind and the mill slows its pumping. Called a hurricane-proof windmill, it will pump at about the same rate regardless of the strength of the wind. These windmills were popular on the Great Plains. See Figure 13-1 on page 81 for illustrations of these windmills (Information courtesy of John Cox, Jr.).

Windmills require consistent maintenance and are subject to high-wind damage. Since they do not pump when there is no wind, a larger storage tank is needed. Windmill cylinders contain gaskets (called leathers) which keep the cylinder tight in its sleeve so it can pump water. The leathers must be replaced periodically. The gearbox on the windmill head must be kept full of clean oil. There is an automatic clutch which turns the windmill head parallel to the wind when the wind is high or gusty and this must be kept repaired. Many people mount a pump-jack under the windmill tower so two sources of power are available to the well. The windmill may well be the best alternative for pumping water, if proper maintenance is provided.

Measuring Water

Although once common, artesian wells are rare today. An artesian well flows from underground pressure. Table 13-1 is included to help compute flows for a well where flow is directed vertically.

The flow from a pumped well is usually from a horizontal or slightly inclined pipe. Table 13-2 includes directions on how to measure these flows.

Table 13-3 deals with windmills. Windmills come in various sizes with fans from 6 to 16 feet in diameter. Larger sizes can be ordered. For wells less than 100 feet deep, smaller sizes are used. A double action cylinder on a windmill will lift the water out of the well and then push it up to a storage tank or into a pipeline. If a double action cylinder is used, a larger fan may be needed.

Compute water horsepower needed to pump a well using this formula: WH = lbs. of water in the pump column x gpm x total lift divided by 33,000.

1 gallon of water weighs 8.33 pounds.

1 gallon of water = 231 cubic inches.

1 cubic foot of water = 7.48 gallons.

Water horsepower is pure or brake horsepower and the efficiency of the engine must be factored in to determine what horsepower engine to buy.

Lift is calculated in feet, not just to static water level where the water stands when not being pumped, but to pumped level. As water is pumped out of the hole, the water level decreases to the point where inflow equals outflow. The difference is 'drawdown'. The pump is set just below drawdown level. Thus, figure the lift from the bottom of the pump column. To find the depth to water while being pumped, insert a ¼-inch copper or stiff plastic tube down inside the casing between the casing and the pump column. The tube is marked at one-foot intervals before pushing it into the well. Put a pressure gauge at the top and pump air into the tube (a bicycle pump will do). Slowly push the tubing down while the well is being pumped and watch the gauge; the gauge will rise suddenly as the lower end of the tube enters the water.

Use the formula for computing water horsepower by first figuring the number of cubic inches in the pump column. Use Pi x R squared x d, then convert to gallons, times pounds per gallon. This gives the weight of the water in pounds in the column.

Problem: A well is 90 feet deep, pump set at bottom, 2-inch pump column, estimated flow 15 gpm. What size engine do you need?

Compute 3.1416 x 1 x 1080" x 8.33 lbs/gal divided by 231 cu.in. per gal. Equals 122.35 pounds of water in pipe.

Then place the figures derived into the Water Horsepower formula.

122.35 x 15 x 90 divided by 33,000 equals 5 water horsepower needed.

An electric motor at 80 % efficiency equals 6 rated hp. required.

An internal combustion engine rated at 27% efficiency equals 19 rated hp needed.. With ethyl gasoline add 20%

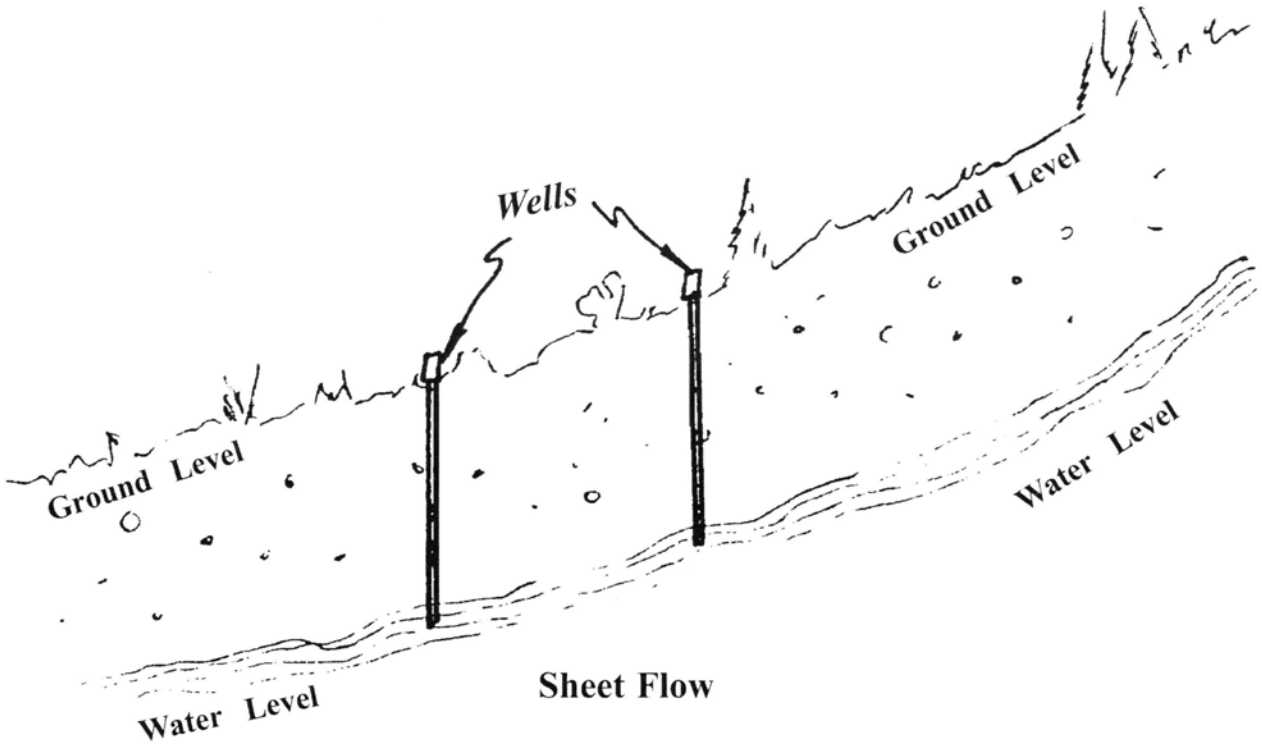


Figure 13 - 1

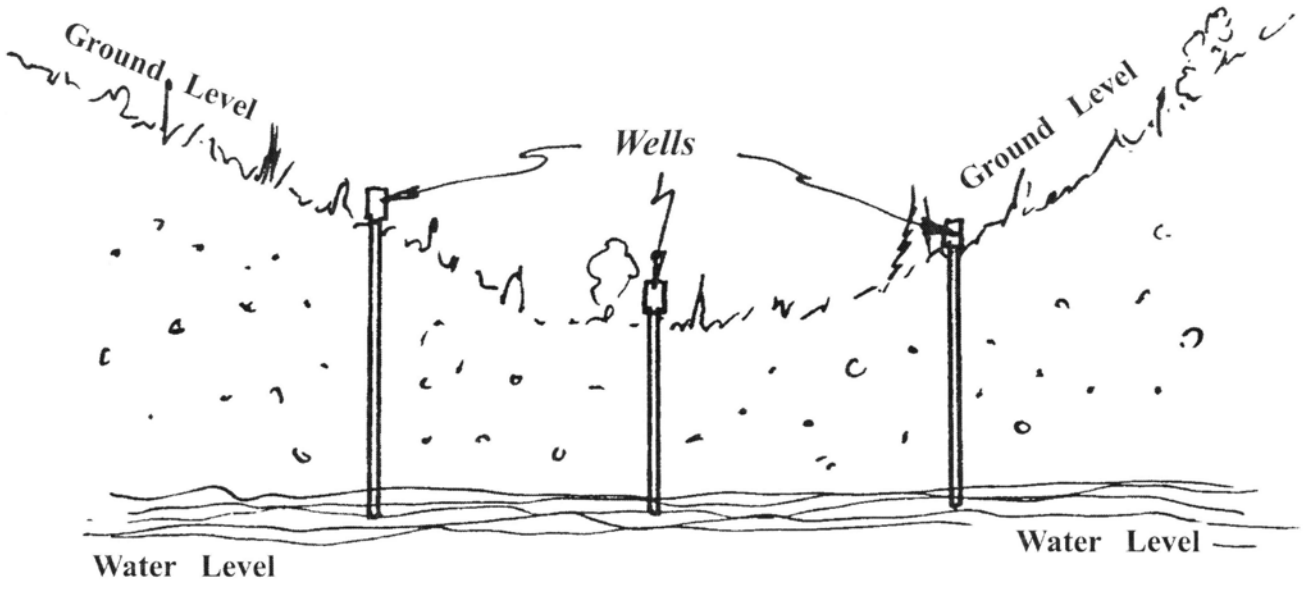


Figure 13 - 2

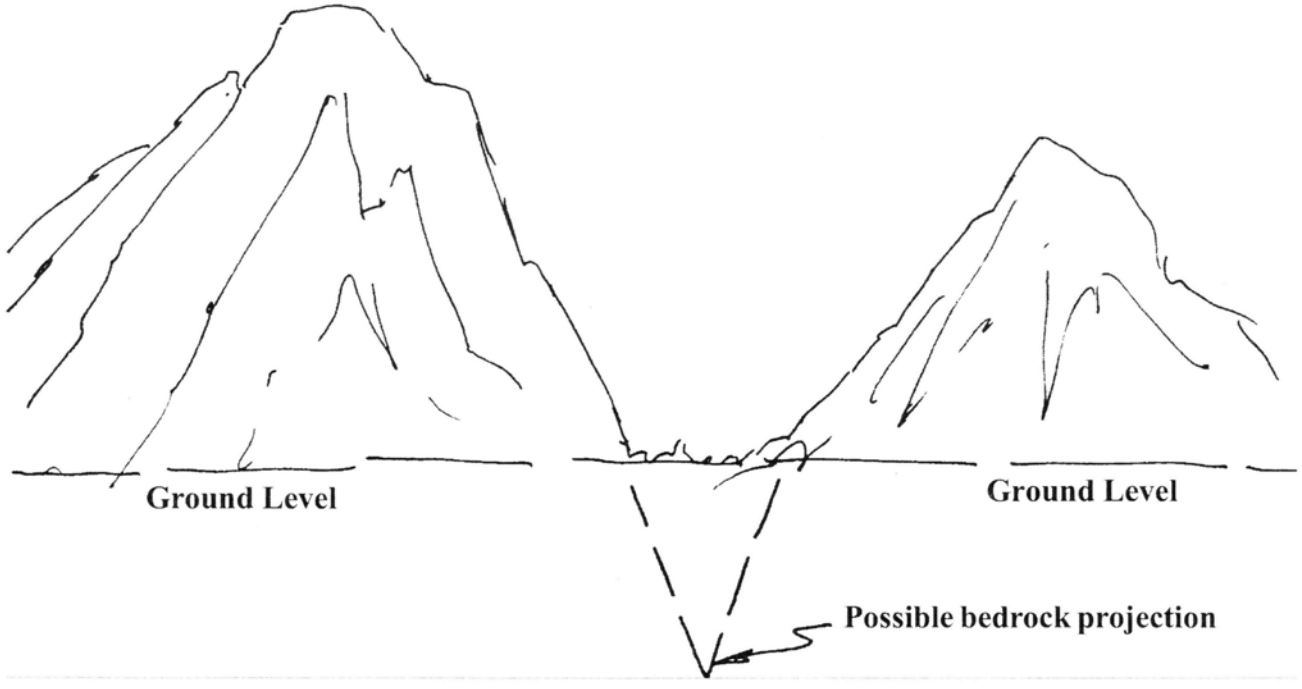


Figure 13 - 3

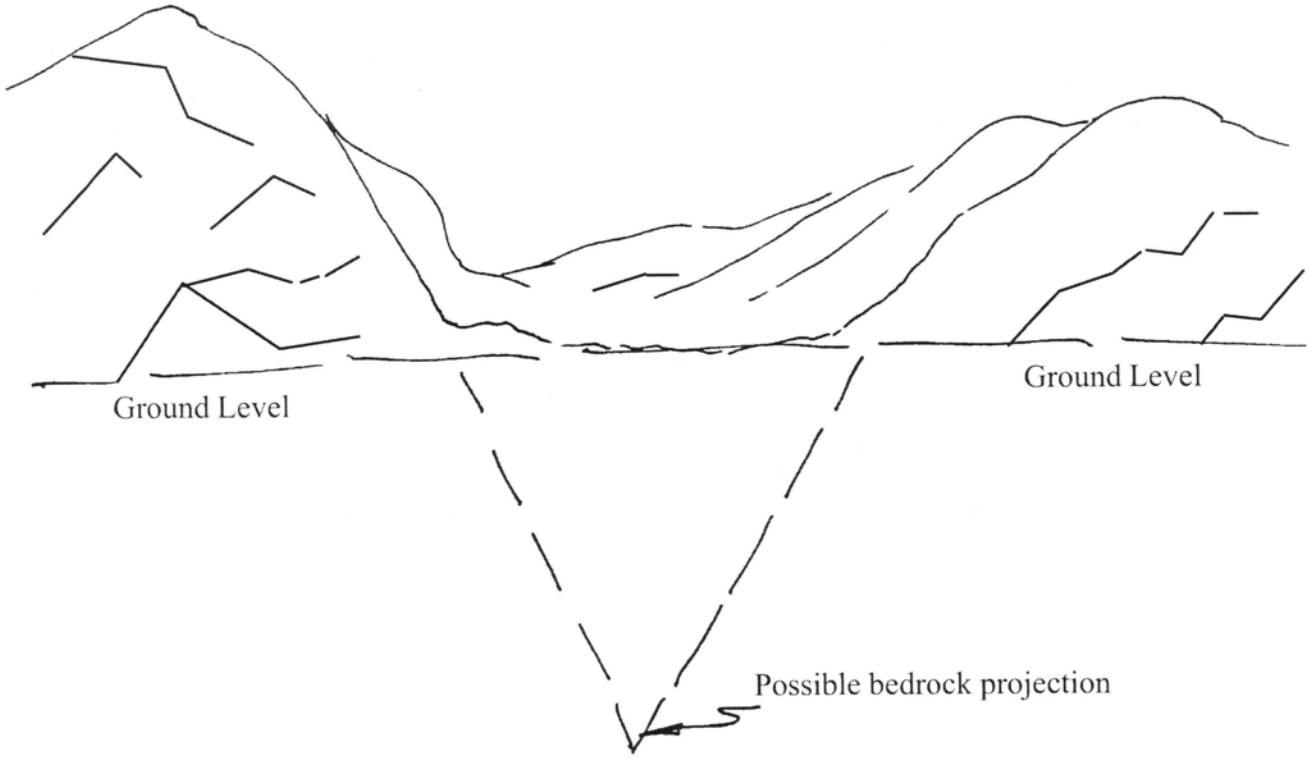


Figure 13 - 4

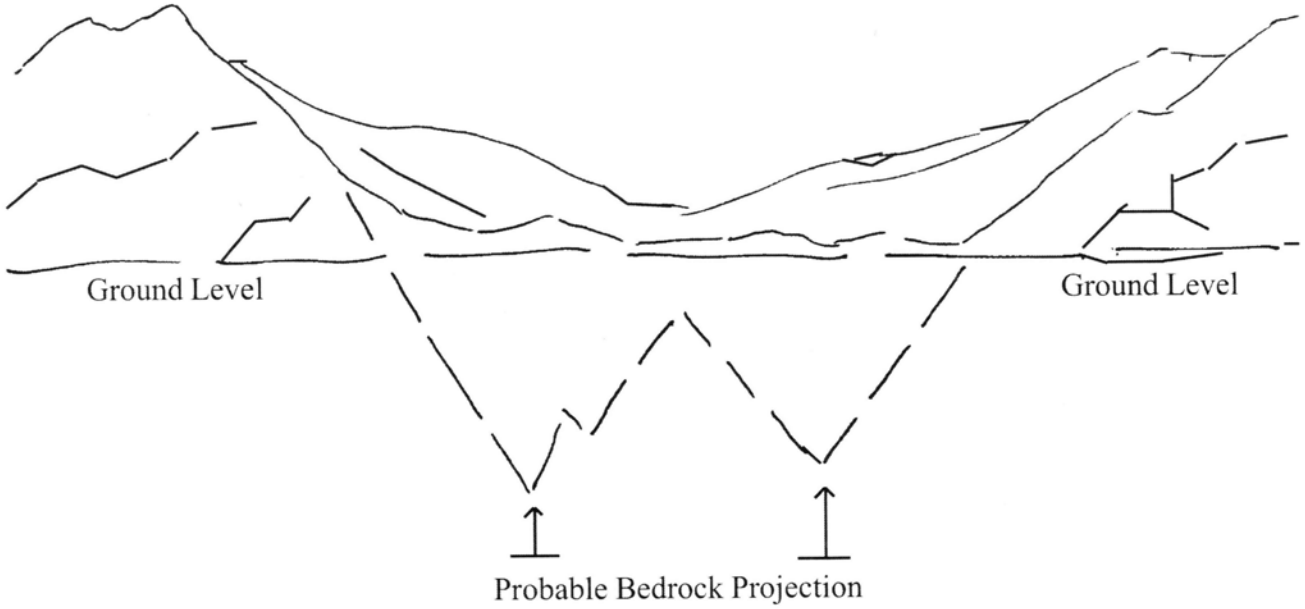
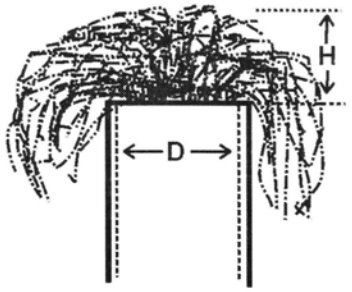


Figure 13 - 5



Estimating Flow from Vertical Pipes or Casings

The approximate flow from vertical pipes or casings can be determined by measuring the maximum height (H) in inches to which the water jet rises above the pipe, and the inside diameter of the pipe (D) in inches.

The flow in gallons per minute is given in the following table for different sizes of standard pipe and for different heights of the water jet.

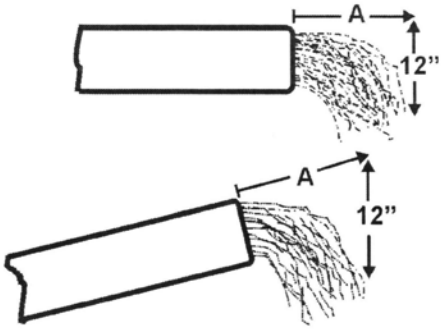
Estimating Flow in Gallons Per Minute

Height (H) in inches	Nominal Diameter of Standard Pipe (inches)							
	2	3	4	5	6	7	8	10
3	35	77	135	217	311	425	569	950
3½	38	85	149	238	341	465	626	1055
4	41	92	161	252	369	503	687	1115
4½	44	98	172	270	396	540	733	1200
5	47	104	182	286	420	575	779	1280
5½	49	109	192	301	444	606	825	1350
6	52	115	202	316	469	638	872	1415
6½	54	121	211	331	490	667	913	1475
7	57	126	219	345	509	700	949	1530
8	61	135	236	370	548	751	1025	1640
9	65	144	251	396	585	802	1095	1740
10	69	153	265	418	621	850	1155	1840
12	76	169	294	463	685	933	1275	2010
14	83	184	319	502	740	1020	1380	2170
16	89	197	342	540	796	1090	1480	2320
18	95	209	364	575	845	1160	1560	2460
20	101	221	386	607	890	1225	1645	2600
25	113	249	433	680	998	1375	1840	2900
30	124	273	476	746	1095	1505	2010	3180
35	135	298	516	810	1175	1630	2160	3420
40	145	318	551	865	1270	1745	2320	3680

For other pipe sizes and heights of jet, use the formula: $GPM = 5.68 \times C \times D^2 \times \sqrt{H}$
Where GPM = gallons per minute; D = inside diameter of pipe in inches; H = height of jet in inches; and C = a constant varying from 0.87 to 0.97 for pipes of 2 to 6 inches in diameter and heights of from 6 to 24 inches. Use C = .92 if uncertain.

Table 13 - 1

Estimating Flow from Horizontal or Inclined Pipes

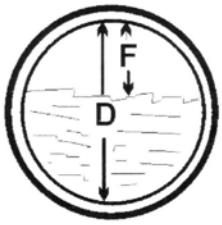


Full Pipes

A fairly close determination of the flow from full open pipes may be made by measuring the distance the stream of water travels parallel to the pipe in falling 12 inches vertically.
Measure the inside diameter of the pipe accurately (in inches) and the distance (A) the stream travels in inches parallel to the pipe for a 12 inch vertical drop (see diagrams).
The flow, in gallons per minute, equals the distance (A) in inches multiplied by a constant "K" obtained from the following tables:

I. D. Pipe	K	I.D. Pipe	K	I.D. Pipe	K	I.D. Pipe	K	I.D. Pipe	K	I.D. Pipe	K
2	3.3	4	13.1	6	29.4	8	52.3	10	81.7	12	118
2¼	4.1	4¼	14.7	6¼	31.9	8¼	55.6	10¼	85.9	12½	128
2½	5.1	4½	16.5	6½	34.5	8½	59.0	10½	90.1	13	138
2¾	6.2	4¾	18.4	6¾	37.2	8¾	62.5	10¾	94.4	13½	149
3	7.3	5	20.4	7	40.0	9	66.2	11	98.9	14	160
3¼	8.6	5¼	22.5	7¼	42.9	9¼	69.9	11¼	103	14½	172
3½	10.0	5½	24.7	7½	45.9	9½	78.7	11½	108	15	184
3¾	11.5	5¾	27.0	7¾	49.8	9¾	77.7	11¾	113	16	209

Table 13-2

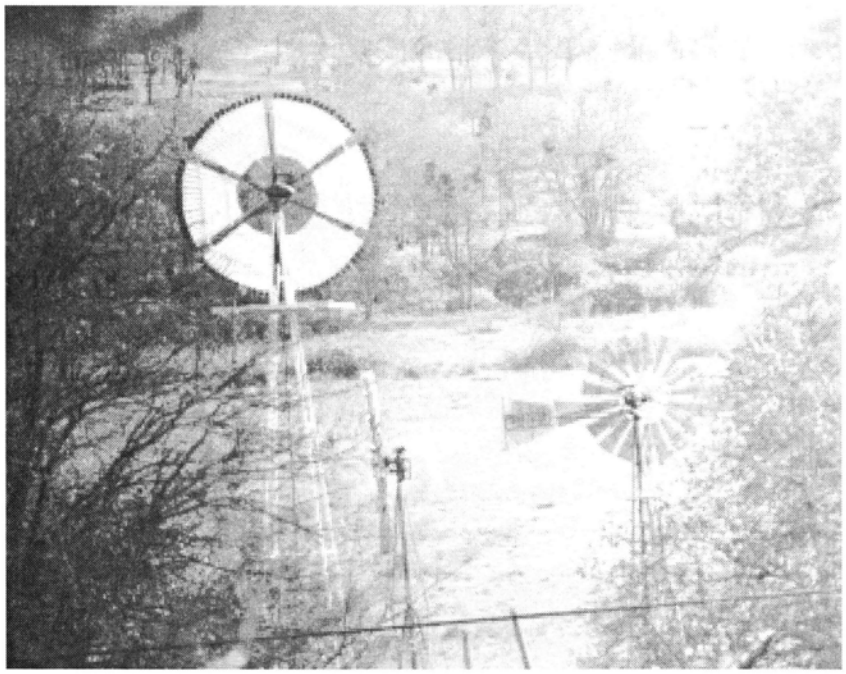


Partially Filled Pipes

For partially filled pipes, measure the freeboard (F) and the inside diameter (D) of the pipe and calculate the ratio of F/D in percent. Measure the stream as explained above for full pipes and calculate the discharge. The actual discharge will be approximately the value for a full pipe of the same diameter multiplied by the correction factor from the following table:

F/D Percent	Factor	F/D Percent	Factor	F/D Percent	Factor	F/D Percent	Factor
5	**0.981**	**30**	**0.747**	**55**	**0.436**	**80**	**0.142**
10	**0.949**	**35**	**0.688**	**60**	**0.375**	**85**	**0.095**
15	**0.905**	**40**	**0.627**	**65**	**0.312**	**90**	**0.052**
20	**0.858**	**45**	**0.564**	**70**	**0.253**	**95**	**0.019**
25	**0.805**	**50**	**0.500**	**75**	**0.195**	**100**	**0.000**

Table 13 - 3



Windmill at left is a 'hurricane-proof' model. At right is a standard Aermotor.

Figure 13 - 1

Pumping Capacities of Windmills (Aermotors)

Size of Cylinder	Capacity per hour in Gallons		Elevations in feet to which water can be raised					
Inches	6 - ft	8 to 16 ft	6 - ft	8 - ft	10 - ft	12 - ft	14 - ft	16 - ft
1¾	105	150	130	185	280	420	600	1000
1 7/8	125	180	120	175	260	390	560	920
2	130	190	95	140	215	320	460	750
2¼	180	260	77	112	170	250	360	590
2½	225	325	65	94	140	210	300	490
2¾	265	385	56	80	120	180	260	425
3	320	370	47	68	100	155	220	360
3¼	----	550	---	---	88	130	185	305
3½	440	640	35	50	76	115	160	265
3¾	----	730	---	---	65	98	143	230
4	570	830	27	39	58	86	125	200

Table 13 - 4