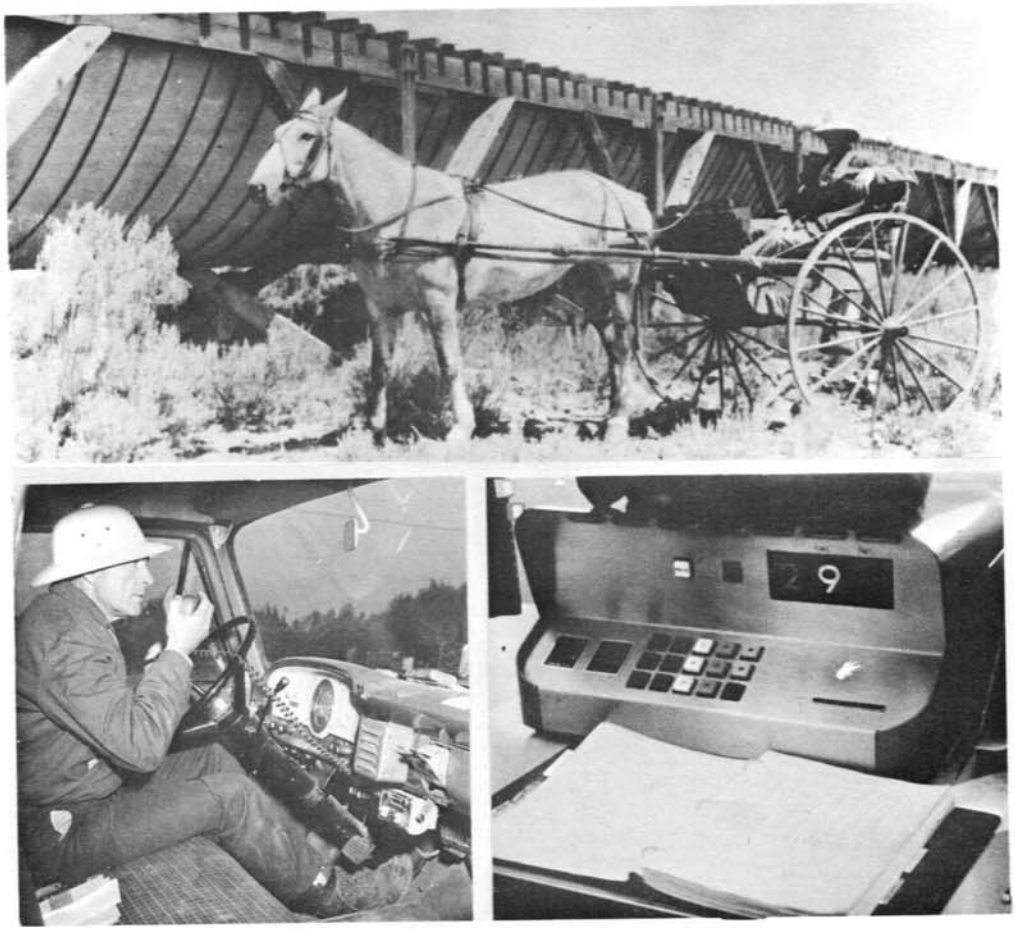
Department of the Interior, Bureau of Reclamation

IRRIGATION OPERATION AND MAINTENANCE

BULLETIN NO. 50

October, November, December, 1964



In This Issue:

Ditchrider Trainee Program

The Irrigation Operation and Maintenance bulletin is published quarterly, for the benefit of irrigation project people. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. It is hoped that the reports herein concerning labor-saving devices and less costly equipment and procedures, developed by resourceful project people, will result in improved efficiency and reduced costs on the systems of those operators adapting these ideas to their needs.

To assure proper recognition of those individuals whose suggestions are published in the bulletins, the suggestion number as well as the person's name is given. All Bureau offices are reminded to notify their Suggestions Award Committee when a suggestion is adopted.

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Division of Irrigation Operations
Office of Chief Engineer
Denver, Colorado

The cover depicts the history of the work of ditchriders. The horse-drawn cart was used in 1916 on the Twin Falls North Side Project, Idaho. PX-D-45751. The second panel shows modern ditchriders communicating with headquarters from a radio-equipped vehicle. PX-D-45750. The third panel shows the console of a remote control system which raises and lowers the gates, and reports elevations of the gates and water surface at the headworks of a canal on the Salt River Project, Arizona. CTP25-D-36931-D.

IRRIGATION SAFETY OPERATIONS PROCEDURES FOR PUMPING PLANTS

With the approach of another irrigation season, it again becomes necessary to emphasize safe operations practice in regard to all pumping plants and relift stations. This applies to plant mechanics, helpers, ditchriders, electricians, and any others who may undertake to operate these plants.

The plant mechanics have been issued danger tags which are to be attached to the operating switchgear prior to irrigation season. When one of these tags is displayed, all personnel are required to secure clearance from the plant mechanic in charge or be accompanied by him before attempting to start any unit. These tags shall be dated and signed by the plant mechanic when attached and when removed, and shall be recorded. The smaller plants may be tagged "OK", signed and dated by the plant mechanic where time will not permit him to be there personally.

The procedures listed below will be followed:

1. Operating instructions for all major pumping plants will be prepared or updated. These will stress safety cautions and procedures and will be mounted in permanent form in a prominent place on the control panels.

2. Instructions and training on safe operating procedures will be reviewed with plant mechanics by their supervisor.

3. The plant mechanic will inspect, clean and adjust all control operating mechanisms each year prior to the start of the irrigation season. Should an unsafe condition be noted during the operating season, arrangements for its correction shall be made between personnel of the field branch and the Technical Services Branch.

4. At least once each year the operating ditchrider and his watermaster will review operating procedures with the plant mechanic at each plant. When a different ditchrider is assigned a ditchride during the operating season, he shall be instructed as to the proper operating procedures for each pumping plant by the plant mechanic and watermaster prior to assuming responsibility for the ditchride.

5. If something goes wrong or is not working properly, the ditchrider is to notify the plant mechanic or watermaster immediately, giving complete information concerning the malfunction.

6. An operator shall report any mistakes which he may have made.

7. Do not block contactors in place with a piece of wood.

8. Shut off motors with pushbutton switches.

9. When burning weeds and rubbish, exercise caution not to burn the galvanizing off fences, rubber cover on flexible conduit canvas motor covers and any other combustible property around the plants.

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March 19, 1964

To: Irrigation Managers - 440, 450, 460, 470

From: Acting Irrigation Supervisor - 400

Subject: Flooded measuring devices - revised procedures for operating irrigation system

During the past winter, letters were sent to many water users asking that deficiencies to measuring devices be rectified where the trouble originated in his system.

Response to the recent reminder sent to the same water users indicates that the majority have either taken care of the trouble or are making arrangements to do so. Some have not responded, either by action or card.

The following instructions apply for handling the delivery of water:

1. Ditchriders shall not permit the flooding of any measuring device unless they have written approval regardless of whether the water user received a letter about his flooding measuring device or not.

2. Those who received letters and still have their problem but intend to take care of it may receive their full water delivery order after the irrigation manager has cleared such action and after the water user's irrigation district director has concurred in a limited extension of time for the rectification work to be done.

3. Those water users who received letters and have not responded by action or mail shall have their water limited to the extent stated in the original letter until such time as they have made arrangements to take care of the deficiency. If

the water user did not receive a letter as to his deficiency he must correct the problem or have the flooding of the measuring device cleared by the watermaster.

It is expected that in handling items 2 and 3, there may be modifications to the system at the water users expense and in some cases concessions on the part of the project. All such actions, however, will be controlled by and be at the discretion of the irrigation manager and in some cases with the collaboration of the irrigation district director or directors.

J D Humes

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Ditchrider Mileage Allowance

During 1964 you will be paid $0.10 a mile for actual speedometer mileage for the use of your privately-owned vehicle on your ditchride from the beginning of the irrigation season through April 25. From April 25 through August 29 you will be paid a beat allowance covering only the regular scheduled ditchride beat. If you are called out or have to go out, outside your regular working hours, to remove weeds, restart pumps, etc., you will be paid actual speedometer mileage.

From August 29 through the end of the irrigation season you will be paid actual speedometer mileage.

Mileage other than the regular beat ride must be reported on Form 115A (Statement of Travel-Mileage Claim).

Be sure that you and your watermaster sign the Form 115A. In filling out the Form 115A, it is not necessary to fill in the arrival and departure time columns.

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GPO 844-644

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Our Fiftieth Issue

This is Issue No. 50 of a publication intended solely to provide a means of exchanging operation and maintenance ideas between irrigation project personnel and to serve as an outlet for general information that is deemed of value to project operators. In the past our publication was known as Operation and Maintenance Equipment and Procedures. For some reason it became known and was usually referred to as a "bulletin." Therefore, beginning with this, our "Golden" issue, we are officially calling the publication a "bulletin," and at the same time changing the name for brevity to Irrigation Operation and Maintenance.

In a large sense, we are only the editors of the "bulletin," publishing material prepared by people in the field who encounter an operation or maintenance problem and solve it through their own initiative and practical approach. It is surprising to find how many problems encountered on a project are common to other projects, and how often the means of solving the problems of one project can be adapted to local conditions on another project. We also have been pleasantly surprised to have so many of you share your ideas. We have never lacked material for the "bulletin," since we began publication in 1952. We wish to express our appreciation to all who have contributed to the success and usefulness of the "bulletin" which started with the first issue of 300 copies distributed primarily to Bureau of Reclamation constructed projects in the western portion of the United States. Requests for the "bulletin," worldwide now, require that we print 800 copies. Our readers are apparently interested in your means of solving irrigation problems, and we will continue to publish them in our renamed, but otherwise, unchanged publication.

Copies of all releases of the Operation and Maintenance Equipment and Procedures series except Releases No. 1, 3, 8 and 16 are available in the office of Chief Engineer, Attention: Code D-400, Building 53, Denver Federal Center, Denver, Colorado 80225. Release No. 1 is out of print and will not be reprinted; Releases No. 3, 8 and 16 were incorporated into Release No. 37 which was devoted to the subject of "Equipment for the Prevention, Control and Disposal of Weeds on Irrigation Projects."

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IRRIGATION OPERATION AND MAINTENANCE
Bulletin No. 50

OCTOBER, NOVEMBER, AND DECEMBER 1964

Ditchriders and zanjeros, the latter a Spanish term used in the Southwest, designate the men who control the water deliveries and patrol waterways on irrigation projects in the United States. They are important to the successful operation of an irrigation project, and, undoubtedly have been since the practice of irrigation began. In addition to distributing the projects' water, and seeing that conveyance systems for handling this principal project commodity are in satisfactory condition, the ditchrider is an important public relations man, and a well-qualified responsible ditchrider or zanjero is an asset, in fact a necessity, in the satisfactory operation and administration of an irrigation project. It is fitting, then, that this our fiftieth issue of the bulletin be devoted to these men and their training.

As depicted on the front cover, time changes most everything. The first ditchriders must have made their rounds on foot, gradually utilizing other means of locomotion as it became available. In the United States the record shows that saddle horses; horse-drawn carts, buggies, and wagons; motorcycles; and other motor-driven vehicles have been used in making the project "rides," that the ditchrider must make in covering his "beat." The modern radio-equipped automobile is in contrast to the horse-drawn cart shown on the cover. If the past is an indication of the future, additional changes will occur, such as the automatic and remote control equipment depicted also on the cover that is now in use on the Salt River Project in Arizona. Such automation provides for greater efficiency, more rapid changes in distribution of water, and increased safety in project operation during emergencies. Nevertheless, the services of competent and well-trained men to maintain vigil in project operation and maintenance and in the maintenance of personal relationships between administrators and water users will continue to be necessary. It is suspected that these men will be "ditchriders."

A good competent ditchrider becomes such only after experience and training. Where large numbers are needed to staff new projects, this becomes a problem. On such projects, time generally does not permit inexperienced personnel to become sufficiently trained through practical field experience to assume the necessary responsibilities, therefore, supplementary training has become important in several instances. This supplementary training is the subject of this issue of the bulletin dedicated to the conscientious men who control the day-by-day distribution of irrigation water so vital to the economic life of a project.

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DITCHRIDER TRAINEE PROGRAM

Introduction

One of the more difficult but recurring jobs on any irrigation project, particularly on the larger ones, is the proper training of ditchriders prior to their assuming full responsibility for their respective rides. Through a period of several years, the Columbia Basin Project, in central Washington State, with the approval of the Civil Service Commission, has developed a good system of training through which they put their new ditchriders each year, including a training school, just prior to the beginning of the irrigation season. The principles comprising the Columbia Basin training system and school are set forth in some detail herein with the thought that operators of other projects may wish to adapt some of these ideas to fit the needs of their own training programs.

The training program developed is designed to halve the time required to qualify a person to perform the work required. The training period is 26 weeks and the Watermaster is directly responsible for all trainees assigned to his section. This includes the classroom training, individual coaching, on-the-job training, and evaluation of the individual periodically during and at the end of the training period. For this latter purpose, a special form prepared for use on the Columbia Basin Project "Report of Ditchrider Trainee" will be found at the end of this article. Also, at the end of the narrative statement is an outline of the Columbia Basin training program which presents an idea as to how it is organized. It will be noted that 3 days are devoted annually to the intensive field demonstrations and special instruction. The "training school" curriculum includes 1 day of instruction and discussion of water measurement and measuring devices, with the morning of the first day spent in the field demonstrations. The second day is devoted to a discussion of ditchrider responsibilities and water records and the third day to relations with irrigation districts and farmers, preventive maintenance work in connection with daily water regulation and a field demonstration of preventative maintenance activities. This schedule may be revised or altered each year.

Water Regulation

The morning session devoted to field demonstrations, during which the trainees actually make dry-run regulations of water, covers the use of such regulating and measuring devices as checks, weirs, constant head orifices (CHO), meter gates and Parshall flumes. Making liberal use of the Bureau's Water Measurement Manual during the demonstrations and in the afternoon session of water measurement and measuring devices, the principles of measurement methods are discussed. Also discussed is lateral regulation as it affects deliveries, downstream conditions and other lateral systems.

Ditchrider Responsibilities

The duties of ditchriders are discussed in relation to progressive responsibility and reduced supervision as trainees receive additional training and experience. It is pointed out that the more experience and knowledge an employee has and the sooner it is applied, the better prepared he will be to meet the qualifications for a promotion. Working conditions, such as tour of duty, period of employment and working hours are explained and in some instances, actual public relation problems are cited. During the training sessions the ditchrider handbook is thoroughly covered. Much of the material presented to the trainees during their training period is summarized in brief form in the "Ditchrider Handbook." Supplements and corrections to this booklet are issued as necessary as conditions warrant or are deemed desirable. One present supplement is concerned with weed control; another with safety in equipment operation, another with safety in operating pumping plants, etc. The handbook is reprinted as an attachment to this issue of the bulletin.

Employment, Leave and General Duties

On the Columbia Basin Project, ditchriders are generally hired on a 12-month-duty basis. They must be generally available 24 hours a day during the irrigation season to meet operational emergencies, to perform emergency services and to assure efficient operation and adequate protection of the irrigation system. During the nonirrigation season, the ditchriders are utilized as canal maintenance men, equipment operators, truck drivers, etc., in the maintenance of the system facilities.

The ditchrider is, of course, responsible for the safety and proper operation of channels and structures in his area and prior arrangements are required for any absence from the regular beat during the irrigation season. Accordingly, leave of any type, annual or sick, must be arranged for in advance as early as possible, since scheduling for relief or substitute ditchriders can often be a complicated problem. Whenever possible, particularly if the regular ditchrider is to be absent for several days, it is better to allow the substitute rider to spend several days with the regular ditchrider and become gradually acquainted with the ditchrider beat prior to taking over his beat.

Hours of Work

The regular workweek for ditchriders on the Columbia Basin Project is Monday through Friday from 7:30 a.m. to 4:00 p.m. each day with a half-hour lunch period. A tour of duty of 8 hours on Saturday or Sunday of overtime is required during the irrigation season each week.

Water User Relations

The general relations with water users and the importance of treating all alike is stressed in the training school. Further, the employee is instructed to be very careful about giving advice to water users concerning their farm operation. Information on farming operations is available from the Soil Conservation Service and County Agents, and farmers should be courteously referred to these agencies when farming questions arise. The acceptance of gifts of any type by employees is called to the attention of new personnel, explaining that the practice must be avoided since it can jeopardize a ditchrider's position and result in questions concerning his ability to perform his duties impartially.

On the Columbia Basin Project the law requires that water be paid for in advance of deliveries. The ditchrider is instructed to deliver water only to those farm units which his watermaster or branch office has informed him are eligible. When a water user has used up the amount of water he has paid for, it is his duty to shut off the water until notified by the watermaster or branch office that he has purchased additional water. Good public relations require that the water user be given advance notice before shutting the water off.

Agreements made between the farmers and the Government which constitute general operating policy may be revised or changed from time to time by mutual consent. The prospective ditchrider is informed concerning these agreements and also informed that it is his responsibility to understand these agreements and try to explain them to the farmer. In this way, better understanding is imparted to the ditchrider of project work and responsibilities and, consequently, a better working relationship is created between the ditchrider and his supervisor. In this same area of discussion, the project supervisors want the ditchriders to handle everything possible in the field and on the job, because they are closer to the detail operations; however, ditchriders are instructed to contact their supervisors (watermasters) if in doubt on particular cases. In the more difficult situations, even though corrective action has been taken, the supervisor should be acquainted with the circumstances. The ability of the ditchrider to handle complaints and problems without the assistance of the supervisor increases as experience is gained.

The ditchrider can help public relations by being familiar with the reasons for pertinent project regulations, as water users may sometimes be inclined to think that the project's regulations are arbitrary and feel the project administrators are being uncomprising and stern in enforcement of the regulations. When this occurs, a brief on-the-spot explanation by the ditchrider can go a long way to improving project water user relations. The difference between a good ditchrider and a poor ditchrider is often that a good ditchrider knows what he is doing and why he is doing it. The poor ditchrider is doing things from day to day without fully knowing why.

Ditchrider Beats

All of the ditchrides on the Columbia Basin Project are relatively similar in length, acreage and number of turnouts. However, one of the main things a ditchrider is instructed to keep in mind on any ditchride is the establishment of a regular schedule that will bring him to the same general area and turnout at the same time every day. When the water users can depend on such a schedule they will be able to have their water delivery request cards there and, if they so desire, may be able to be on the spot when water is turned on or off. Also, a regular schedule personally allows the watermaster or other supervisors to more easily make necessary field contacts with the ditchrider.

Water Orders

Before making any changes in water deliveries, the ditchrider will receive a water request card from the water user authorizing him to do so.

The project emphasizes the necessity of these water request cards as it is the ditchriders only authority to adjust a water delivery or to turn it on or off, unless the water user has used his water or definite word is received from the office that the water is supposed to be turned off.

The ditchrider can request water changes on 48 hours notice. Sometimes water can be delivered on 24 hours notice, and since water can be dispatched and moved within a 24-hour limitation, the Columbia Basin Project is not requiring 48-hour advance notice at this time. Undoubtedly, there may be cases in the future, as the number of users increases and a larger percentage of the lateral capacity is being used, that it will be necessary to have requests on a 48-hour basis; however, here again the water user should be served to the best of the project's ability.

The ditchrider should always remember that only as much water as has been ordered should be delivered, otherwise there is going to be some operational waste. When not needed, excess water should be ordered back into the system.

Locking Gates

Not only why gates are locked, but some of the benefits that are received from all gates being locked should be discussed with the prospective ditchriders.

Unlocked gates are a temptation to some people. There is always that certain someone who does not realize the total impact but only his own farm problems. Perhaps the turnout gate is on a bend in the lateral and all the weeds seem to jam into the gate, the farmer may want that

gate left open so he can clean out the weeds and save the ditchrider some trouble. The offer is commendable but the farmer will get into trouble some night and shut off the water. Having closed the gate, a couple of adjustable weirs on the end of the lateral may receive extra water. In the morning the ditchrider will find someone waiting for him with more trouble.

There have been cases of people cutting the chains and changing the gates in an emergency, and in other ways changing the rate of deliveries. Here again is a case of informing the farmers of the whole problem. His turnout is there to deliver his water; the rest of that lateral is there to serve other people. The ditchrider soon learns that any change made may necessitate changes to all deliveries on the lateral.

Another good reason for locking the gates is to avoid tampering by unauthorized persons such as fishermen, hunters, etc.

Pump Operations

The ditchrider not only must know the water users, but also must know their irrigation system and how they are using the water. The farmer whose water is supplied by pumps or who irrigates with sprinklers creates an entirely different situation than one with a gravity irrigated unit.

Some water users are served by project relift pumps so when the power goes off, the ditch is dry. However, delay restart devices are being placed on some of the project pumps and in case of a brief power outage, as soon as the power service is resumed, the pumps are automatically restarted.

People with sprinklers are one of the biggest offenders in not providing disposal or big enough ponds to store a 12- to 18-hour supply of water, another reason why the ditchrider must know his particular distribution system so that he may be able to plan ahead for emergencies.

Ditchrider Checks

Periodically, each established ride will be checked by the supervisor responsible. He will spot check measuring devices and record time of day and flow. As a followup to these checks, the supervisor will usually spend a day with a particular ditchrider on his ride and discuss the findings of his spot check. This type of check has several different purposes; it is of benefit to the project, to the watermaster and to the ditchrider himself in correcting deficiencies and helping to teach him more efficient methods of operation.

If a farmer is complaining about his water, the ditchrider should always investigate to see whether there is cause for complaint. He

should try to find out what the complaint is about, and if it cannot be resolved and if the farmer keeps complaining after the problem is explained to him, the matter should be reported to the watermaster.

Request for Repairs

Forms are available to the ditchrider to record not only repairs needed on the delivery system, but other situations that should be brought to the supervisor's attention, including seepage, erosion, etc.

Claims Against the Government

If a water user believes he has a complaint against the Government, the ditchrider should not agree, disagree, suggest, guess or suppose. The water user should be told to write the project manager and the ditchrider should make a report to his immediate supervisor.

Filling Pipelines

Ditchriders are instructed to use extreme care in filling pipelines. All available valves, turnouts, etc., should be opened and the pipe should be filled very slowly. Air trapped in a pipeline is compressible and with the tremendous weight of water pounding on it, high pressures can build up.

CHO vent pipes should also be kept clean as the effect of trapped air in this case reduces pipe area and thereby reduces the flow.

Weeds

Where noxious weeds, such as thistle, etc., are growing on rights-of-way, ditchriders are expected to treat or mark them for treatment. Portable spray cans are made available to ditchriders on the Columbia Basin Project. A good weed control program can only be maintained by ditchrider assistance in the investigation of any patches of weed on rights-of-way that are reported by farmers.

Rodents

Rodents can weaken canal banks and can be particularly disastrous around structures. The ditchriders should report all rodent activity and encourage rodent control by water users.

Encroachments

Because of problems that can be created during O&M operations, ditchriders may have to explain to the farmers the need to refrain from encroaching on rights-of-way. Common encroachments are: parking on ditchbanks, hauling produce on operating roads, using gates when cattle guards should be used, placing head ditches and other structures on rights-of-way where the space may be needed

to deposit spoil, stacking hay on rights-of-way, etc. In connection with encroachments, the ditchrider should not give advice which he is not sure about, but should report the encroachment if necessary after contacting the responsible farmer and explaining the problem.

Daily Reports

The water report is the ditchrider's report of accomplishment for the day and his order for what is needed tomorrow. On the Columbia Basin Project the report must be in by 4 p. m. to facilitate the work of others.

Record Keeping

All projects must have forms for record keeping. On the Columbia Basin Project, forms have been provided to facilitate uniformity of records on different colored paper stock for easy identification, as follows:

1. Diversion from canal - yellow
2. Wasteways - blue
3. Unit daily deliveries - white

A diversion is water ordered and for which responsibility is assumed by the ditchrider. Any changes in daily delivery are reported using the algebraic plus (+) and minus (-) signs. Wasteway flows recorded are those expected during the next 24-hour period. Unit daily deliveries are the quantities of water delivered to a unit during the preceding 24 hours.

As a part of the "trainee course" the turnout numbering system and map symbols for the different types of turnouts, pumps, checks, etc., are explained. Also a part of the course is a "ditchride problem" in which it is assumed that each trainee has to take over a ditchride without previous experience in record keeping, assuming that methods of regulation are known. Printed copies of a small lateral and farm unit map are distributed to the trainee which show the ride to be covered, and ditchride books containing diversion, delivery and wasteway sheets are passed out to each trainee to record each day's activity. Turnout discharge tables also are distributed for each of the different types of turnouts on the ride.

The "ditchride problem" starts with a "dry-run" over the lateral map noting and explaining all turnouts and getting a general idea of what is ahead. Each man individually assumes that he is the rider taking over and fills in his ditchride book as the group proceeds together down the lateral. Aside from recording the proper water delivery, the special circumstances that might be encountered, such as those given below, can be explained:

1. Diverting water into the head of the lateral to fill new orders taking into account the amount of waste at the end that can be used and also adding ditch losses that may require a greater diversion than the actual new orders.

2. Single unit delivery laterals with measuring device at the head and the application of a considered ditch loss allowance.

3. Diversion to a sublateral with four deliveries without a wasteway.

4. Units having two turnouts, and therefore two delivery sheets, but one water balance from which both deliveries must be subtracted.

5. How to handle water charges on relift pumps when power outages shut the pump off and curtail the delivery for several hours. Charging only for the hours run, divided by 24 times the discharge at the previous visit.

Example: Ran 8 hours at 2.00 cubic feet per second

$$\text{charge } \frac{8 \times 2.00}{24} = 0.67$$

6. Checking each turnout delivering water to determine previous 24-hour charge prior to making any changes or checking gates for weeds, etc.

7. Evening report of diversions, deliveries and waste which summarize what was done for the day with the water and whether or not more water is needed tomorrow (plus) or whether water is to be put back into the main lateral (minus).

8. Water request cards for turn on, turn off or changes must be handled and recorded in the ditchride book in the space provided and on the proper day.

9. The policy on the Columbia Basin Project is to never charge the farmer for more water than he orders. If he receives less than his order, charge him with what he receives.

10. How to charge if a weed is in a headgate and there has been a reduced flow for an unknown time. Policy on the Columbia Basin Project is to assume the headgate has been plugged for the previous 24 hours.

11. Constant head orifice corrections when gage differential is other than 0.20 foot should be applied to get a corrected discharge. Correction factors are available on the CHO tables and should be used. For example:

CHO set for 2.00 cubic feet per second, gages differential is only 0.15 foot. To get the proper charge select the correction factor for a head of 0.15 which is 0.87 x 2.00 = 1.74 charge.

12. Water purchase sheets sent to the ditchrider are the formal notice that water may be delivered to a unit. Verbal notice is often given from the office so that the ditchrider will know of new purchases in case the mail delivery is delayed.

13. Enter the amounts of supplemental purchases in the ditchride book and update the proper balance.

14. Limit the entries on any one order card to a single turnout. Units with more than one turnout should use a different card for each turnout to avoid confusion.

It is most important that a new employee understand that the ditchride book should be a complete record of everything that transpired each day on the ditchride. Nothing should be left to the imagination or memory.

Units of Water Measurement

The units of water measurement are covered in detail in the Columbia Basin Project training course and are presented as a part of the discussions so that questions may be encouraged. A few of the problems that might elicit other questions are given after explaining some of the more commonly used terms. The problems are then worked by the trainee and later discussed. Some of the typical problems are being included herein.

Cubic-foot-per-second

The basic unit of water measurement used on the Columbia Basin Project is the cubic-foot. This is a volume of water. Water deliveries and measurements are made and recorded in cubic-feet-per-second (cfs), a rate of flow of 1 cubic-foot of water passing a given point every second, not to be confused with a volume measurement.

In practice it works out like this, if a cubic-foot of water per second is delivered for 60 seconds, the total volume of water delivered will be 60 cubic-feet.

Second-foot-day

The two most common volume units of water measurement used on the project are the second-foot-day (sfd) and the acre-foot. One second-foot-day (sfd) is the amount or volume of water that has been delivered when 1 cubic-foot-per-second has been running for 24 hours or 1 day. Thus, 1 second-foot-day.

Problem No. 1

If a second-foot-day is the amount or volume of water delivered when 1 cubic-foot-per-second has been running for 24 hours, what is the amount or volume of water in cubic-feet that has been delivered in that 24 hours?

Ans.: $\frac{1 \text{ cu ft}}{\text{sec}} \times \frac{60 \text{ sec}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} \times 24 \text{ hours} = 86,400 \text{ cu ft}$

Problem No. 2

Two cubic-feet of water per second delivered for 24 hours would be 2 sfd. If 1 cubic-foot-per-second was delivered for 72 hours, how much water would that be in sfd?

Ans.: $1 \text{ cfs} \times \frac{72 \text{ hr}}{24 \text{ hr}} = 3 \text{ sfd}$

Acre-feet

The second volume measurement in use is the acre-foot. This is the amount of water necessary to cover 1 acre 1 foot deep. There are 43, 560 square feet in an acre.

Problem No. 3

How many cubic-feet are there in an acre-foot of water?

Ans.: $43,560 \frac{\text{sq ft}}{\text{acre}} \times 1 \text{ foot} = 43,560 \frac{\text{cu ft}}{\text{acre-feet}}$

Problem No. 4

If there are 43, 560 cubic-feet per acre-foot and 86, 400 cubic-feet per sfd, how many acre-feet are there in 1 sfd?

Ans.: $\frac{86,400 \text{ cu ft/sfd}}{43,560 \text{ cu ft/acre-feet}} = 1.9835 \text{ acre-ft/sfd}$

Problem No. 5

How many acre-feet in 2 cfs running for 24 hours?

Ans.: Two cfs running for 24 hours = 2 sfd = 2 x 1.9835 acre-ft = 3.9670 acre-feet or approximately 4 acre-feet.

Measuring Devices

Other matters covered in general discussions includes an explanation of the Constant Head Orifice and the effect of gate opening, variable head and/or tailwater; an explanation of weirs, including rectangular suppressed, rectangular contracted and Cipolletti types and weir boxes. Covered thoroughly are the effects of all types of approach channels, the velocity distribution going through the weir structure and also velocity of approach. Use of weir tables for estimating discharge at rectangular checks, etc., is demonstrated and a comparison of suppressed vs. contracted rectangular weirs is discussed as well as the reasons leading to the Cipolletti design and principles.

The streamlines of contraction in flow over weirs and their reduction in discharge, maintenance of the depth of pool below a weir crest to a minimum of 1 foot, as well as keeping side clearance above minimum, and measuring the flow over the weir by turning of the weir gage at a 45° angle when measuring with gage numbers turned upstream, are discussed in relation to proper measurement methods and procedures. It is also pointed out that there are correction factors available in handbooks for measuring water through submerged weirs, but that this practice is discouraged and farmers should be informed of irregular delivery under submerged conditions.

The ditchriders are instructed that inspections should be made by all riders on every CHO, by checking gate opening, comparing stem measurement with actual gate opening and always setting gates on the upturn so that tension is kept on the threads; by checking gages, closing back gate and open front gate, read gages to see if one of two conditions exist: (a) the gages are level or (b) there is 0.20-foot differential; and to be sure there are no rocks or other foreign objects or materials in vicinity of a gate opening to reduce the area and discharge.

Some of the advantages and disadvantages of various measuring devices are covered. For instance, meter gate turnouts are relatively inexpensive to build but are undesirable for the type of operation involving frequent changes. Adjustable Cipolletti weirs on a common distribution box must be regulated one in relation to the other, not set independently. When these weirs are preset with the proper relation between the weirs, the water will distribute proportionately.

Control Structures

Lateral regulation with control structures to minimize ups and downs and their resulting effect on all types of measuring devices are demonstrated and discussed. Preference for carrying all checks 0.05 to 0.20 foot over overflow portions of structures as a maximum are explained as permitting both slight ups and downs

of the water level with a minimum effect on upstream turnouts. By carrying and maintaining this overflow, an overflow ratio of 3:1 results, i. e., on a check and pipe inlet. At such a control there is a 3-foot check opening but with water flowing over all three sides there is a 9-foot overflow width.

Storage Between Checks

Another operating problem called to the attention of the trainees includes water storage between checks and the fact that such storage can be appreciable and, consequently, can greatly delay the movement of changes through a lateral system. Also, if performed regularly, check regulation is simpler than changing or correcting each turnout.

Field Observations

A further general discussion on regulation, especially setting checks and understanding water movement, was carried on during a field trip with some of the points covered specifically being:

Cipolletti weir - examination of weir pool, use of gage on weir crest and checking submergence.

CHO - setting opening and gages, further explanation of normal operating criteria and what to look for to explain possible changes in flow.

Check regulation - time-saving arrangement of check boards.

Weir box - checking baffle and weir gage.

Adjustable weir regulation - detailed methods of regulation.

General Operation and Maintenance Policy

All dealings with the water users should be on a businesslike basis. They are members of organized irrigation districts conforming to state law, and also contract with the United States for repayment of the reimbursable costs of project construction. The ditchriders should understand that the general project business operation as well as its operation and maintenance policies and this subject is included in the "trainee" curriculum. For instance, it is explained that the Columbia Basin Project is organized into three irrigation districts - Quincy, East and South; that each has a board of directors selected from the farms within their district and set up to take over the operation and maintenance at some future date; that each irrigation district has full-time secretaries to whom the farmers pay their water charges and through whom many problems are passed on to the Bureau; and that a joint board composed of members from each of the three district boards also exists.

Changing cfs to sfd or acre-feet is changing rate of flow into a volume.

1 cfs for 60 sec = 60 cu ft

1 cfs for 1 hour = 3, 600 cu ft

1 cfs for 24 hours = 86, 400 cu ft

$$\frac{86,400 \text{ cu ft/day}}{43,560 \text{ cu ft/acre-feet}} = 1.9835 \text{ acre-ft/day}$$

As a matter of general information, 1 sfd can cover approximately the following per day:

2 acres - 1 foot deep

4 acres - 6 inches deep

8 acres - 3 inches deep

Also 1 cfs running for 10 days would cover 80 acres 3 inches deep, assuming, of course, there is no loss due to evaporation, seepage, etc.

Miner's Inches

The miner's inch will vary with the states. In the State of Washington 50 miner's inches - 1cfs or in 24 hours = 1 sfd. This unit of measurement, however, is not used on the Columbia Basin Project.

Gallons-per-minute

Gallons-per-minute is a term that is used occasionally and must be understood in relation to other volume terms, 1 cfs - 448 gpm. Gallons-per-minute (gpm) conversion to cfs is explained in the following problem.

Problem No. 6

Irrigation with 100 sprinklers where each head puts out 6 gpm will require how much water?

Ans.: 100 x 6 = 600 gpm, but to convert to cfs we must divide 600 gpm by 448 gpm = 1.34 cfs required.

Variations in sprinkler systems due to pressure changes resulting from moving the laterals or wear in the sprinkler nozzles often occurs. This must be considered in system design along with the ever-present need for waste disposal and/or storage capacity.

General Flow Equation

The general flow equation for water is:

$Q = AV$ (Quantity = Area x Velocity)

In this form the equation relates to open flow channels, turnouts, all measuring devices and pipelines. Adding a coefficient for type of opening, the equation becomes: $Q = CAV$. Velocity can be shown by the equation: $V = \sqrt{2gh}$, (Velocity = the square root of 2 x gravity x the head difference). Now writing the general flow equation: $Q = CA\sqrt{2gh}$.

The general flow equation is illustrated in the following example. Lets say A is the size of chute a band of sheep is going to run through. Velocity is the speed the sheep move and requires energy to be changed. If the sheep are prodded they move faster, energy is added. Velocity being a function of the head, theoretically, head is added to the sheep to speed them up. The coefficient "C" is the slowing down of the sheep as they near the opening which retards the average speed a little so the sheep won't get stuck. In other words, the coefficient is applied to account for the confusion that occurs entering the chute. The rate "Q" is the actual number of sheep that get through the chute in a given time expressed as x number of sheep per minute. Reference material cited for study by the trainees includes simple hydraulics and the Bureau's Water Measurement Manual.

Factors Affecting Measurements and Waterflows

Pressure

Pressure and its relation to head and waterflow and also its effect on different areas is also discussed with the trainees as these terms may be encountered in daily operations. For instance, 50 pounds of force spread over 1 square foot equals only 0.35 pounds per square inch. A head of water 10 feet high creates a pressure of only about 5 pounds per square inch (psi). Suppose this is in a pipeline with a manhole that has 5 psi pressure on it. If the manhole is 15 inches square it has an area of 255 square inches. Five psi sounds like a very small pressure and would lead one to believe that it would be a simple matter to remove the cover, but 5 psi x 255 square inches = 1,275 pounds.

Erosion

The relationship of area to velocity involving erosion can be explained by water trying to get around a weed in the ditch. The reduced area due to the space occupied by the weed causes increased velocity around the weed and results in erosion.

Other points that require explanation are that the Irrigation Division of the Bureau of Reclamation on the Columbia Basin Project operates and maintains the works; determines the dollars to be provided annually in advance by the Irrigation Districts; and collects the entire sum of the operation and maintenance costs from the districts. The districts make their collections directly from the water users.

Maintaining the System

It should be stressed that water charges are estimated in advance and are set at a level to cover, without any surplus, the year's O&M expenditures. Some years there may be a surplus and in others there may be a deficit. One may offset the other. If funds are consistently accumulated in excess of costs, reductions will be made in the water charges.

Each district adds a percentage to the Bureau's charge to cover their cost of operation and to build up a reserve. The fund is necessary because the Bureau must be paid in full each year by May 1. Also, the reserve will be required when the districts take over the operation and maintenance of the irrigation system some time in the future.

Construction Repayment

Construction repayment is not a part of any of the foregoing charges. Each block after the test year goes into the 10 development years still paying only O&M charges. During the development years every unit must pay the yearly minimum charge for water whether they use it or not. Charges are graduated during those 10 development years beginning at 70 percent of the average and ending in the 10th year at 135 percent of the average. In the 11th year the construction charge is added, but the cost of water drops back to the average of 100 percent on top of which is added the construction charge.

Charges are based, for equality, on land classification. Minimum purchase of water is for one-half acre-foot less than the allotment. Supplemental and excess water make up the remainder of water available to any unit.

Preventive Maintenance

Preventive maintenance is given emphasis in the ditchrider training, pointing out that it should be done a bit every day to prevent the necessity of major emergency repairs, including:

1. Keeping weed racks clean so the water passage is not restricted or can cause erosion, washed-out structures and overtopped banks.

2. Encouraging grass growth to stabilize banks. A good sod limits weed growth but streambank grasses growing in the waters edge trap silt and later will require berming.

3. Prevention of wind erosion of soil if the land is bare. Weeds or other vegetation may be of help in holding soil. Possibly the weeds are temporarily doing some good but seeding grass in the weeds should be tried.

4. Removal of rocks in laterals that catch weeds.

5. Repairing operation roads which may consist of hauling a few loads of gravel and dirt for sinkholes, etc.

6. Making temporary repairs on small washouts. If the washout is too big when found, the water should be shut off first and a call made for help. The ditchrider must consider what can happen and weigh the values resulting if the water is shut off. Possibly the water can be taken in another lateral. The ditchrider must be careful about arbitrarily shutting off water, and in any event the watermaster should be notified of action taken as soon as possible.

Procedures in handling and repairing canal breaks are discussed. The fact that all breaks are different and present varied possibilities of control is stressed. The new employees are instructed that sacks or canvas should be carried to assist in stopping imminent ditch breaks and that baled hay and straw also are good tools for this purpose. They are informed, however, that at best, these procedures are only temporary, and accordingly, all possible regulations and diversions should be utilized to lower water levels in the vicinity of ditch breaks and that it may be possible to lower water levels enough to keep the water from going out through the break and still maintain deliveries to others on the lateral. The easiest way out, of course, is to turn the water off at the head of the lateral but with a little thought, the flow or a reduced flow might be maintained for deliveries.

One of the most important preventive maintenance jobs will be to develop a plan, even a very loose flexible plan, of attack when confronted with an emergency. A good ditchrider should be thinking all the time and take very little for granted.

Rodent control, covered very briefly previously, is becoming more important every year as stands of grass mature and spread on a new project such as the Columbia Basin. Gophers, squirrels, badgers and mice are of direct concern. Ditchriders will be expected to do a certain amount of trapping and poisoning.

Repairs should be made to damaged structures regardless of who caused the damage. Bent gate frames or broken gate wheels should be reported in the proper manner.

In pump operation, some of the things a ditchrider will need to watch are:

1. Lubrication, grease fitting or oil reservoirs for the main bearing will be filled by the pump maintenance man, more commonly called the plant mechanic.

2. Vibration, their causes and control, i. e., throttling a pump down too low or imminent bearing failure, etc.

The ditchriders were instructed concerning the data on relift pump operation that must be reported.

Pump motors must be kept clean and free from such accumulation as spider webs, dirt and occasional bird nests. Overheating for a particular motor should be checked, but it should be remembered that some motors are designed to run hotter than others. Loose connections can cause excessive heating or complete failure. Normal vibration will cause connections to loosen and the ditchrider should be alert to such possibilities. Motor and pump controls, the maze of relays, etc., all have important functions mainly of concern to the plant mechanic. Any malfunction that may be encountered in starting or stopping a pump should be reported immediately.

Float switches activated by the water can shut a pump off if the water level drops below a safe depth. It should be checked for freedom of operation to insure that it will move up and down with changes in water level.

Weed Control

Weed identification is also an important function and if the ditchrider finds a patch of weeds, he should identify the species, treat it properly and/or report its existence to the watermaster or weed control specialist for the area. The weed control program consists of three factors: (1) prevention, (2) control as a means of prevention, and (3) removal. Prevention is the process of seeding grasses to inhibit weed growth. Control is usually a chemical process of stunting the weed growth and planting grass with the weeds as protection. Removal is the bailing out from the laterals of windblown weeds that were not prevented or controlled. Using photographs the trainees were drilled in weed identification and it was emphasized that the common procedure to be followed by a ditchrider who locates a weed patch is: Locate, identify, mark, notify, kill and check back to assure kill.

The training sessions were brought to an end with a field trip for observance of weed control and preventive practices, both good and bad.

Summary

Summarizing the series of training sessions the major responsibilities of a ditchrider position were pointed out. It was emphasized that the

structures and equipment used daily by the ditchrider are valued at thousands of dollars and misuse or mistakes can cost additional thousands.

The training program is intended to acquaint the trainee ditchriders with as many facets of his job as possible in the hopes that through subsequent supervision, training and experience he can assume the full responsibility of a ditchride and become an important member of an important business venture - that of delivering and selling water.

APPENDIX

Outline

Ditchrider Training Program

Part 1 - Training School

Place:

Dates: Three days annually

Time: All day meetings, beginning at 8:30 a.m.

First day

Instructor:

Reference: Water Measurement Manual

I. Morning Session - Field Demonstrations with Trainees Making Dry-run Regulations

A. Weirs
1. Inspection of weir pool and farm weir
2. Delivery elevation instructions
3. Dry-run delivery and measurement
4. Submerged weir measurement
5. Weir box - discussion of characteristics and dry-run delivery and measurement along with checking 0 setting of gage
6. Adjustable weirs two or three in one location and dry-run water change on one delivery
7. Actual setting of a portable weir for single delivery lateral allowance determination

B. CHO (Constant Head Orifice)
1. Determination of size
2. Set 0 opening on orifice gate
3. Checking gage settings
4. Go through procedure for water delivery and change in diversion of delivery
5. Discussion of farm operations on delivery. Delivery elevation, etc.

C. Meter gate
1. Checking 0 gate opening
2. Head measurement
3. Check on meter well operation
4. Go through procedure for making delivery or change in diversion or delivery

D. Parshall flumes
   1. Visit to one of these if possible
   2. Go through measurement procedures

E. Lateral regulations
   1. Dry-run lateral diversion check regulation
   2. Downstream delivery change from lateral and check regulations continuing downstream making regulations as time permits

II. Afternoon Session - Water Measurement and Measuring Devices

A. General flow equation
   1. $Q = AV = A \times C\sqrt{2gh}$
   2. Determinations of A
   3. Determinations of H
   4. Determinations of C
   5. Tolerances or limits of accuracy

B. Weirs
   1. Cipolletti, rectangular, rectangular suppressed (weir boxes) sharp and broad crest
   2. Proper installation and maintenance of proper physical features for accurate weir measurement. Explanation of effects of each (page 9 of Water Measurement Manual).
   3. Approved method of measuring head over weir with weir gages and explanation of reasons for using this method
   4. Importance of clean weir pool and weir crest and opening being free of weeds, grass, etc.
   5. Submergence of weirs, submerged weir graphs and tables, quick calculation of flow over submerged weirs (upstream measurement in cfs one-half downstream measurement in cfs = discharge)
   6. Adjustable weirs - methods of regulating two or three located in the same weir pool or pipe division box
   7. Use of portable weirs for determination of lateral loss allowances for single delivery laterals

C. Constant head orifices
   1. Size of orifice determinations
   2. Checking or setting of 0 - gate openings
   3. Checking gage settings
   4. Explanation of advantages and disadvantages of this measuring device, proper procedure for making regulations, the functional purpose of each gate, influence farm operations have on flow variations, etc.
   5. Proper procedure for making water changes or water regulation

D. Meter gates
   1. Relationship to CHO or other orifice-type measuring devices
   2. Setting of zero gate opening
   3. Function of check facilities in caboose similar to that of backgate of CHO
   4. Method of measuring head
   5. Checking meter wells to see if they are functioning properly

E. Parshall flumes
   1. Characteristics of Parshall flumes
   2. Method of water measurement

F. Principles of other water measurement methods
   1. Use of current meters and recorders
   2. Measurement over check boards for waste measurements, checks on lateral losses, etc.

G. Units of measurement and terminology
   1. Gpm, miner's inches, cfs, sfd, acre-ft

H. Lateral regulation as it affects deliveries, downstream conditions, or other lateral systems

Second day

Instructor:

Reference: Ditchrider's Handbook

III. Morning Session - Discussion of Ditchrider Responsibilities

A. Personal conduct
   Hours of work

B. Operating a ditchrider beat
   1. Establishing a regular beat
   2. Payment in advance
   3. Water orders
   4. Water request cards
   5. Locking gates
   6. Filling pipelines

C. Inspection and maintenance of a beat
   1. Weeds
   2. Rodents
   3. Encroachments
   4. Farm structures affecting delivery
   5. Claims

D. Daily reports

E. Contacts with water users
Inquiries and complaints

IV. Afternoon Session - Water Records

Instruction and actual practice in interpreting and maintaining the following water records:

A. Canal diversion record

B. Daily deliveries

C. Wasteway records

D. Water request cards

E. Water purchase notice

Third Day - Morning Session

Instructor:

V. Relations with Irrigation Districts and Farmers - E. H. Neal

VI. Preventive Maintenance Work in Connection with Daily Water Regulation

A. General maintenance, Marvin Sektnan, Assistant Irrigation Manager, East Low Field Branch

Suggested items for discussion:
1. Effects of tumbleweeds, cattail growth, etc., on erosion control in laterals
2. Use of weeds, etc., to control bank erosion
3. Proper procedure for cleaning weeds from a lateral that is full of weeds (work from end upstream)
4. Checking turnout gates for weeds
5. Methods of available means of checking or temporary repair of incipient washouts - bags of sand, canvas, baled straw, etc.

B. Relift pumps - G. R. Burrows, Chief, Maintenance Engineering Branch, and Warren Heldenbrand, Pump Maintenance, Franklin Field Branch

C. Weed control - Delbert Suggs, Weed Specialist
Weed identification, hand spraying weeds, soil sterilants, etc.

Third Day - Afternoon Session

VII. Field Trip to Demonstrate Preventive Maintenance Work

Delbert Suggs

1. Grass plantings and identification
2. Erosion control by grass growth
3. Possibly some weed identification

Bill Gray

1. Bank erosion by wind
2. Water erosion of banks in sandy laterals
3. Weed racks (purpose and maintenance)

Personnel
Watermaster
Branch
Division

REPORT OF DITCHRIDER TRAINEE

For Month of _____

Name _____ Date Entered Program _____

Item	Assignment	Length	Follow-up by Assistant Irrigation Manager
1.	Accompany experienced Ditchrider (preferably an Assistant Watermaster candidate) when he performs the following duties.	1 day	Date and Comments:
	a. Checking with Watermaster Headquarters for changes in water orders or special instructions.		Completed
	b. Diverting water from canals to laterals, or from laterals to sublaterals in amounts required to fill day's orders.		
	c. Regulating water velocity and depth in laterals.		
	d. Reading measuring devices at farm turnouts, computing quantities delivered, and making adjustments to accomplish increases or decreases requested by water users.		
	e. Recording water measurements.		
	f. Operating and servicing pumps.		
	g. Inspecting channels and structures for proper functioning, and performing minor maintenance such as weed removal.		
	h. Assisting water users with problems referred them.		
	i. Advising Watermaster Headquarters of water requirements for the following day.		
	The instructor will explain the method and purpose of the tasks described; also, special problems ofhis ride such as estimating loss allowances for long channels, handling water in laterals lacking wasteways, etc. He will answer questions concerning the work, particularly regulation and measurement of water.		
2.	Accompany another experienced Ditchrider or the Watermaster over a different ride. Instructor will perform duties described in Item 1. The following day the Trainee will perform these duties assisted by the instructor. Since results of water regulation in channels and to individual farm units are not immediately apparent, the Trainee will make regulations on the third day in order to observe the results of his regulations the previous day. Instructor will explain the purpose and method of each step, have the trainee perform the work to insure that he comprehends the instructions, check closely to prevent erroneous water deliveries, and answer questions.	3 days	Dates and Comments: Completed
3.	Assume ditchride under direction of the Watermaster or Relief Rider. Trainee will receive specific instructions regarding changes to be made in water deliveries and assistance in calculating water orders; and his water measurements and regulations will be checked for accuracy by instructor.	6 days	Dates and Comments: Completed

Monthly Report of Ditchrider Trainee (Continued)

Items 4, 5, 6 and 7 must total 24 weeks with minimums and maximums as shown below:

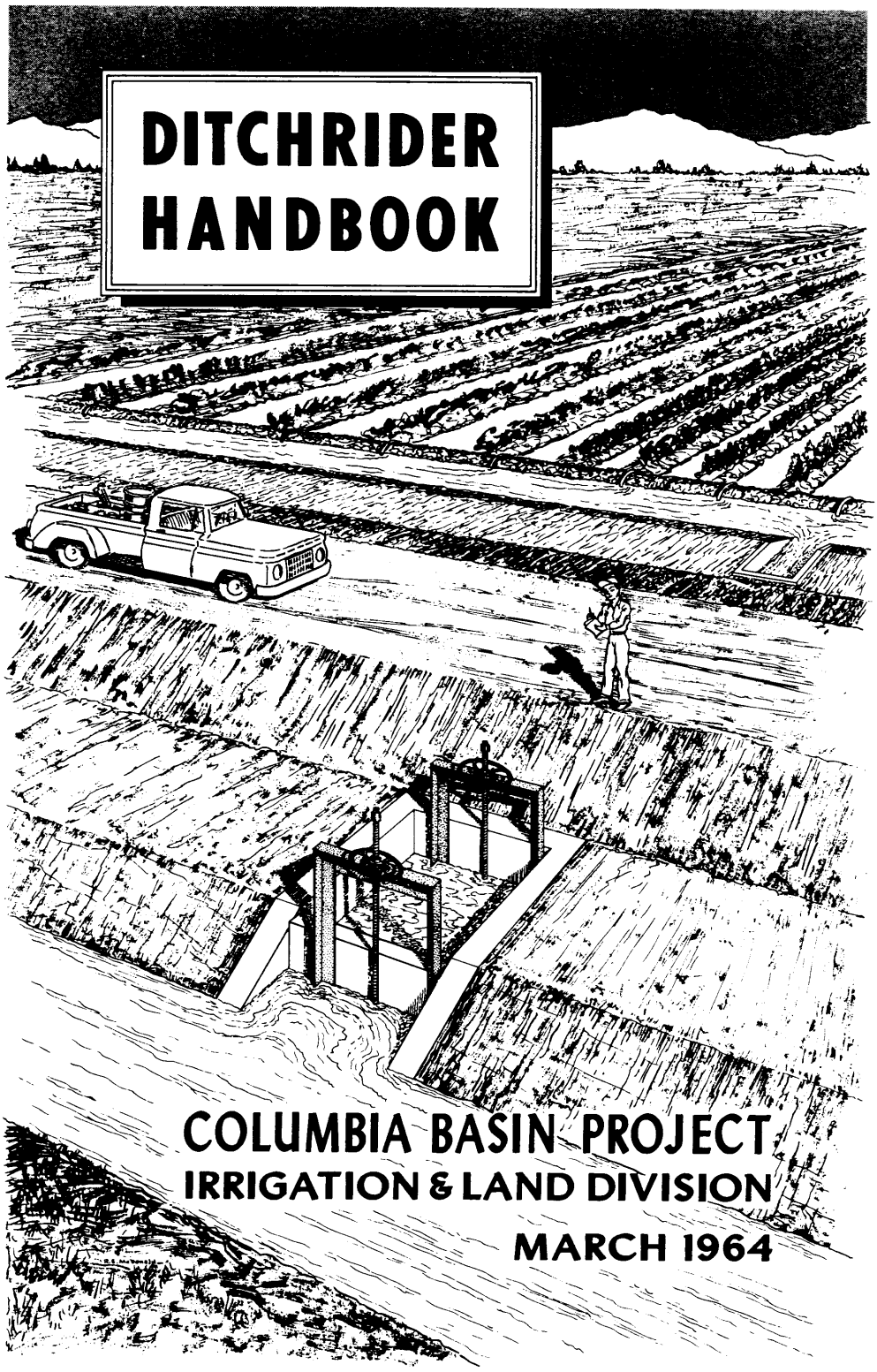
Item	Assignment	Length	Follow-up by Assistant Irrigation Manager
4.	Take over ditchride under close supervision of the Watermaster or Relief Rider. Supervisor will consult with Trainee before during and after the day's ride to answer questions; he will also review daily water orders and assist trainee to determine required system changes and water orders.	6 - 12 weeks	Dates and Comments: Completed
5.	Patrol the more critical areas of the main canals during night hours. Trainee accompanies an experienced ditchrider for several days; then is assigned to job with frequent follow-up by instructor to check on work practices and answer questions.	0 - 10 weeks (Not applicable in all Branches)	Dates and Comments: Not required
6.	Under close supervision of a person skilled in irrigation maintenance work, perform several of the following jobs, or similar duties:		
	a. Clearing weeds from channels.		
	b. Planting grass.	Nov. 18 - on East Low Canal - 1 day	
	c. Identifying weeds and using appropriate eradication measures.		
	d. Repairing concrete pipelines.	Nov. 1, 4,5,6,7,14,15,27 - 9 days	
	e. Building forms for concrete for uses in repair and modification of irrigation structures.		
	f. Cleaning sandblasting, and painting metalwork.	Nov. 19, clean off cables and metal work at checks on East Low Canal - 1 day	
	g. Helping Plant Mechanics to remove, dismantle, and repair irrigation pumps.	Nov 8, 12, 13 - 3 days	
	h. Removing and repairing irrigation structure gates and regulating devices.		
7.	Heavy equipment: Assist qualified operator in capacity of oiler, or helper. Performance of the following type duties will orient Trainee to the machine:	Individual coaching 1 - 3 weeks and on-the-job training.	Dates and Comments:
	a. Greasing machine.	Nov 22. Assist mechanic - 1 day	
	b. Removal of grease and dirt from machine including inside cab.	1 - week (not required for all Trainees)	
	c. Preparation of daily usage and maintenance records.		
	d. Advising operator regarding fences, power lines and other obstructions and hazards.		
	e. Stepping off footage.	Survey sand dune area fence line Nov 20-21 2 days	
	f. Inspecting cables for wear.		
	g. Checking machine while operating or idle for indications of maintenance or repair needs.		
	h. Assisting operator during breakdowns.	Total - 17 days	

Recommendation: Promotion _____ Further on-the-job training Yes Dismissal _____

Comments: Performed pipe leak repair under supervision of GS-5; Survey work - under supervision; Grass seeding and rodent control work performed under supervision.

R. W. Bolitho Nov. 1963
Watermaster

S/ Harvey Williams Branch Engineer
Assistant Irrigation Manager

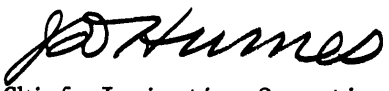

DITCHRIDER
HANDBOOK
COLUMBIA BASIN PROJECT
IRRIGATION & LAND DIVISION
MARCH 1964

FOREWORD

You, as a ditchrider, are the individual who has the most frequent contact with the project water user. The promotion of good relations between the project and water user is, therefore, largely dependent upon your competence, tact and general good judgment.

Always remember that the entire cost of operation and maintenance of irrigation facilities is paid for by the water users as a collective group. Therefore, we must be careful not to provide a service or facility which will benefit one or a few individuals and not be equitable to all. You may receive requests for service to which you will have to say; "No". A person who can say "no" with firm conviction when it is necessary and yet not offend the customer is a definite asset to the organization for which he works.

Delivery of water to the customer in accordance with his requests, at reasonable cost and consistent with established policy, regulations and procedures is the end result of all of our efforts. A job well done on the tasks assigned to you will be a major factor in the success of our entire operation.



Chief, Irrigation Operations Branch

Introduction

This booklet is intended as a general guide to assist you in carrying out your duties as a ditchrider. Primary technical assistance will be afforded by the Irrigation Advisor's Guide and the Handbook for Measurement. As changes are made, they will be furnished as supplements that can be inserted into the Handbook. It will be your responsibility to become familiar with these instructions and to use them as a convenient reference in carrying out your duties.

DITCHRIDER HANDBOOK CONTENTS

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Example No. 4 (CHO), Water Delivery Record
Example No. 5 (Weir), Water Delivery Record

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VI. Off-Season Work:

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Weed Control Guide (Revised March 1964)

Standards For Safety In Equipment Operating

I. PERSONAL CONDUCT

Hours of Work

The regular work week is Monday through Friday from 7:30 a.m. to 4:00 p.m. each day. This provides one-half hour for your lunch period and 15 minutes at end of shift, 3:45 to 4:00 p.m., for book time and reporting. A tour of duty of eight hours on Saturday or Sunday as overtime is required during the irrigation season. Also, during this period the entire operating force must be generally available at all times to perform emergency services to assure efficient operation and adequate protection of the irrigation system. If you are going to be out of the general area during your off-duty hours you must notify your watermaster where you can be reached in the event of emergency. You are responsible at all times for the safety and proper operation of channels and structures in your area. You are required to make prior arrangements with your watermaster for any absence from your beat during the irrigation season. Annual leave will normally be scheduled by your supervisor after the peak of the irrigation season and at such time as the workload will permit the absence of operating personnel. So that your beat can be adequately cared for on your day off or when you are on leave, you must report any special operating conditions or problems to your watermaster or assistant watermaster.

House and Grounds

Keep the house and grounds assigned to you attractive and in an orderly condition. Watch for fire hazards and correct them as soon as they develop. Special attention should be given to the proper care and maintenance of the hardwood floors. Water should never be used for cleaning these floors and any water accidentally coming into contact with the floor surface should

be removed at once. Your camp manager will recommend a commercial floor cleaner and wax which will keep the floors in good condition and make your job of cleaning and maintaining them much easier. You will be expected to perform minor repairs and maintenance with materials furnished by the Government. Obtain permission before making alterations or additions to the grounds, buildings, cabinets, wiring, plumbing, etc. You are responsible for protecting property from damage by fire or freezing. Refer to your lease and other regulations for details regarding your occupancy of Government quarters.

Your Relationship With The Water Users

Be careful to treat all water users alike. DO NOT accept favors which might obligate you to show preference to someone on your beat. Be extremely cautious about giving advice to the water user concerning his farming operations. The Soil Conservation Service and County Agents are available for this purpose.

II. DITCHRIDER BEAT OPERATION

Establishing A Regular Beat

Follow your beat so as to arrive at each turnout at about the same time each day. Visit each operating turnout once a day to check deliveries, to receive water orders, and to regulate and distribute water where changes have been requested. Each ditchrider will be required to furnish the watermaster office a schedule of his ride showing time at numerous stops on his ride. This is very necessary for the office to have in order to more readily locate you during the day in case of an emergency. Each rider will also furnish office with an order of ride showing the sequence of his stops. One copy of this should be carried in your water records book at all times for the use of relief rider in maintaining your schedule.

Sunday patrol of your ride which will be made by relief rider or watermaster will include checking pumps, reading principal gages and giving attention to known trouble spots. If you know of particular problem areas which should be checked on Sunday you are required to inform you watermaster of these areas.

Regulation of Water

Regulate your laterals as closely as possible so that measurements and deliveries can be made accurately and so operational waste can be kept at a minimum. This includes regulation of checks to maintain water level at control water surface with a minimum of fluctuation regardless of the channel flow. No checks will be operated above control water surface without the approval of your watermaster.

Eligibility to Receive Water

The law requires that water be paid for in advance of delivery. Deliver water only to those farm units which your watermaster or branch office has informed you are eligible. Do not permit water to be taken from one farm to another unless approval for combination of water deliveries and records has been obtained and cleared through the branch office. When a water user has used up the amount he has paid for, it is your duty to shut off his water until notified by the watermaster or branch office that he has purchased additional water. If the balance left to the credit is not enough to run the present order until the next regular visit to the turnout the water should be turned off unless the water user asks that the delivery be cut to the amount that will last until the next visit. Good public relations require that the water user be given some advance notice before shutting the water off.

Water Delivery

Measure and deliver water accurately in the amount ordered by the water user. Under normal conditions, settings will be made exact. A maximum acceptable tolérance.of plus or minus 0.01 foot will be allowed during checks of ride. Deliveries will be checked and corrected, if necessary, each day. Corrections must be shown on water record sheet. If correction is unusual, note reason on sheet. Charge him only for the water actually delivered, making allowance where necessary for loss between the measuring device and the delivery point at the farm unit boundary. The watermaster will assist you in determining this allowance. Never charge a water user for more water than ordered. In case of pump outages or other interruptions in service, make allowances for the period of outage in determining the actual amount of water delivered.

Water Orders

Water orders are required at least 24 hours in advance of delivery and up to 48 hours may be required under some circumstances. This time factor will vary, depending on the amount of water available in that part of the system and the length of time required to get additional water to the point of delivery. Changes in water delivery are only made Monday through Saturday. No changes will be made on Sunday except in emergencies. Record water orders in daily.

Water Request Cards

A water request card is required for each order to deliver water or to change delivery. If you receive a water order by telephone, write the information on a card and read it back to the farmer to avoid mistakes. Any water user who will not accept this procedure as an adequate

record of his orders should be requested to sign all his request cards personally. Turn in your water request cards bi-weekly with your water records. Each change on water records sheet must be accompanied by a water record card. When a farm unit is in multiple owernship you should require the owners, or operators, to select one of the group to represent them. He will be the only one you will take orders from and the card showing water used will be sent to him. Only one record for the entire amount of water being delivered to the farm unit will be kept. Dividing the water after it leaves our delivery is the responsibility of the water users and you should not enter into it. The office should be furnished with the name of the person selected as their representative.

Apportioning Deliveries

In cases where demand for water exceeds the capacity of the lateral, deliveries should be made of a percentage of the share system capacity available. Your watermaster will assist you in computing the percentage you should use.

Locking Gates

ALWAYS lock all regulating devices at the heads of laterals and at delivery structures unless your watermaster specifically gives other instructions. A practice of not locking them will cause more trouble than you can imagine.

Filling Pipelines

Fill pipelines slowly with all valves open until the air is exhausted. Do not permit sand or silt in the channel above the pipeline to be pulled into the pipe except when there is maximum flow through the pipeline. Be certain that automatic relief valves are working and functioning properly.

Operating Pumps

Where a relift pumping plant consists of more than one pump, operate the minimum number of pumps that will furnish the required discharge. For example, run one pump at full capacity rather than two pumps at half capacity. Alternate pumps when possible so that each unit accumulates equal hours per season.

Replace screens around motor openings if they have been removed for any reason.

Wipe up immediately any oil spilled in filling solenoid oilers.

If a pump is to be shut down for any length of time, open the circuit breaker and close and lock the control cabinet.

Record monthly KW demand meter and KWH meter readings on pump plant report form in duplicate promptly after the twentieth of each month. (Form CBP-286)

Pumps With Automatic Re-starts

Pulling the main switch when shutting down a pump equipped with an automatic re-start will prevent unwanted re-starts. Have the Plant Mechanic explain the operation of the automatic re-start so you will understand what it will and what it won't do.

Checking Pumps

Use the following check list in making daily check of relift pumps:

A. Note whether pumps and motor operation sounds normal.

B. Note oil levels and fill as required.

C. Grease bottom pump bearing according to instructions for each vertical pump.

D. Check for overheating of motor.

E. Check condition of pump sump and clean, if necessary. Back flush pump, if necessary, to clean any moss from impeller.

F. Check and clean trashracks.

G. Keep pumphouse and deck clean and orderly.

H. Keep a record of the beginning and end of pump operation.

I. In larger plants:

   a. Check and record all gage and meter readings.

   b. Check operation of cooling system.

   c. Check operation of special oiling system.

Report immediately to your watermaster any conditions out of the ordinary. When reporting pump outages, state the following: Pump plants and units affected, time off, time back on, reset used, reason for outage and corrective action taken. (Form CBP-797)

Patrol of Drains

Establish a periodic patrol of the drains in your area at intervals prescribed by your watermaster and report any conditions that interfere with the proper functioning of the drain or that may cause damage to side slopes or structures.

Night Patrol

You may be assigned to night patrol. In that

event, you will be provided special instructions by your watermaster and your Irrigation Manager.

Relief Rider

You may be assigned to relief rider. In that event you may work Tuesday through Sunday with Monday off during the irrigation season. You will be provided with special instructions by your watermaster. When assuming a regular assigned ride you should consult with the regular ditchrider to make certain that you will be aware of any trouble spots or special conditions.

III. INSPECTION AND MAINTENANCE

The inspection and maintenance of your beat should be considered as seriously as your water delivery responsibilities. Weeds cause extra cleaning, need for riprap work, poor delivery to water users and even ditch breaks. Tumbleweeds that are allowed to sink to the bottom of a lateral and remain there, for example, start a sandbar which encourages moss growth and channel erosion in the vicinity of the weeds. Stake with red-topped stakes and report to watermaster all seepage or wet areas.

Weeds

Know the noxious weeds by sight. When you find an infestation:

a. Mark location of weeds by staking with yellow-topped laths.

b. Report location of weeds on Form CBP-85 (Daily Weed Control Record).

c. Treat as instructed by your watermaster.

Keep channels clear of weeds and debris each day. Following high winds the first consideration

should be getting water through the system and making deliveries. If you need additional help contact your watermaster. The remainder of the weeds should be removed as soon as possible. Weeds should not be allowed to accumulate on weed racks where they might restrict the flow of water and raise the water surface. The area around the structures should be kept free of weeds. Check with your watermaster on seeding or sterilizing around the structures.

Rodents

Control of muskrats, brown rats, beaver and other rodents may be assigned to you. Keep your watermaster informed of new investations and their severity; request assistance from him if the problem is a major one. At least one man in your branch has received specialized training in the use of strychnine bait for poisoning pocket gophers. Untrained personnel should not attempt to use strychnine bait. Traps for control of small gopher population will be provided upon request. Encourage rodent control by water users, but avoid creating the impression of directing their operations. You will be expected to set traps for muskrats as instructed by your watermaster.

Encroachments

Watch for any encroachments on project rights-of-way such as banks cutting, fences, farm ditches, farm buildings, bridges, planted trees, erected power lines or any other encroachment which may interfere with maintenance. Prevent these actions if possible; consult your watermaster as necessary. Advance approval for encroachments upon project rights-of-way must be obtained through a permit issued by the Chief, Irrigation Operations Branch. Your watermaster has a supply of the permit applications available upon request. Watch for and prevent the taking of water from the lateral (except

through our measuring device) or the running of wastewater back into the lateral or drain indiscriminately. If you have any questions in regard to right-of-way consult your watermaster.

Farm Structures Affecting Delivery

Where new irrigation systems are being laid out, watch to be sure that an overflow is provided for sprinkler systems or pipelines which may not be able to accommodate the full flow of delivery. Watch for, and notify your watermaster of, any structures built by the farmer which will affect measurement and regulation or interfere with maintenance of facilities. Do not deliver more water at any delivery than can be accurately measured. When delivery approaches submergence, inform the water user that he will have to correct his problem before you can deliver a larger head. You must also notify your watermaster that you have so notified the water user. If condition warrants it, the watermaster may approve increasing the delivery.

Claims

Watch for and report by memorandum to watermaster with copy to branch office the facts regarding any project situation which has resulted or might result in damage to private property. This would include circumstances such as drowned livestock, fires, seeped land or canal or lateral breaks for which claims may be placed against the Government. Do not state your opinion of the cause of damage even where it appears obvious.

Roads

Observe regularly the condition of your service roads. Remove rocks and fill holes as necessary. Discourage the use of operating roads for other than official use.

Numbers on Turnouts

Turnouts are numbered with aluminum tags during the testing period. Observe their condition and replace as necessary to keep them legible. Turnout numbers should be updated where farm unit numbers have been revised. Aluminum tags used on structures for identification should also be updated where and when units are revised.

IV. REPORTS AND RECORDS

Daily Reports

Report water orders, water deliveries, diversions, waste, return flows, farm units served and pump outages to your watermaster office each day as soon as totals are known. Avoid waiting until the last minute to make your call by phone or radio because of the numerous other ditchriders that report to each watermaster. Reports should be in by or before 4;00 p.m.

Water Records

Instructions for careful preparation and submittal of water records will be provided by your watermaster. Legible and accurate records are of prime importance as they form the base upon which the water user will be charged.

Following is a list of basic rules which are to be followed when making water records:

General

1. The rider will measure and record the measurement and discharge for all measuring devices which are running water when he arrives and when he leaves the measuring device. If there is no change only one entry is required.

2. Ditto marks will not be used on the records. An entry will be made for each day water is running.

3. All on's and off's on the diversion and daily water record sheets will be marked with the words "on" and "off".

4. No entries will be made between the off's and on's when water is not running.

5. The loss allowance on a one unit delivery lateral will be shown in a circle on the top line of the order column.

6. All discharges which have been affected by weeds, power outages, etc., will have an explanation note in the order column.

7. The water balance for units with more than one turnout will be recorded on the last sheet in the turnout numbering sequence.

8. The water balance for units in combination will be recorded on the last unit in the numbering sequence of the combination.

9. All entries for a turnout will be recorded in the ditchride records before the rider leaves that turnout.

10. A water request card is required for all turn on's, turn off's and changes. The only exception, with the prior approval of your watermaster, will be for deliveries to units which have been combined for water record purposes at the end of a lateral without a wasteway when the total order for the combination does not change.

11. Carry the daily delivery to two decimal points and enter to the nearest lower 0.05 (1.94 enter as 1.90, 1.96 enter as 1.95).

12. Never charge the farmer for more water than he orders. If he receives less than his order, charge him with what he receives.

13. Do not charge the farmer for the first day when water is turned on, but charge for the day when water is turned off.

14. Never make any deliveries until you receive written notice from your watermaster or branch office that the unit is paid and eligible.

15. Never deliver more water to a unit than the unit has paid for.

16. Do not deliver water through a unit's turnout for another unit unless a combination is approved for the units. If in doubt, consult your watermaster.

17. If a weir is installed at the end of a delivery lateral, it is to be used for loss measurement only. The water for the unit will be measured over the original device constructed at the head of the delivery lateral.

Lateral Diversion Records

1. A lateral diversion record sheet will be kept for any measuring device which leads to two or more units where there is a possibility of loss in the lateral system.

2. All on's and off's on the diversion sheet will be marked with the words "on" and "off".

3. Measuring devices with two measuring gates will be recorded on one diversion sheet. A notation will be added to the bottom of the sheet stating that there are two gates

in the measuring device. The gates on the device are to be opened an equal amount unless otherwise noted in the explanation column.

4. When a lateral has a farm unit turnout between its turnout gate and measuring device, the diversion record will only be kept for the lateral measuring device.

5. On Sunday, enter a dash in the head and gate opening columns and record assumed discharge.

Wasteway Records

1. A wasteway record will be kept for each wasteway.

2. An entry will be made for each day including Sunday. If no water is estimated for the next 24 hours, enter zero (0).

3. The flow recorded on the wasteway sheet is not the measured flow but the estimated average flow in the wasteway for the next 24-hour period.

Water Delivery Record

1. A water delivery record will be kept for each farm unit turnout.

2. The entries for weirs, CHO's and meter gates will be recorded as shown in Example No. 1.

3. The order column may be maintained one of two ways or a combination of the two as directed by your watermaster. The two methods are shown in Example No. 2. This column will also be used for loss and explanation notes.

4. Turn on and turn off will be recorded as shown in Example No. 2.

5. When recording changes or adjusting flow outside of the tolerance limits, the measurement when the rider arrives will be shown on the left side of a slash and the measurement when leaving will be shown on the right side. See Example No. 2.

6. Explanation notes may be recorded as shown in Example No. 2.

7. Loss notations for end delivery lateral may be recorded as shown in Example No. 3.

8. On Sunday a dash should be entered in the head and gate opening columns and record assumed water delivery. See Example No. 4.

9. Changes from one measuring device to another made by a farm operator on end deliveries under combination <u>when total flow is not changed</u> may be handled as shown in Example No. 5. OC stands for operator change.

Example No. 1 - WATER DELIVERY RECORD

Head	Opening	Measured Discharge	Hours Run	Daily Delivery	Balance	Order
.45	Weir ----	2.00	24	2.00	10.00	
.20	CHO .48	3.00	24	3.00	10.00	
5"	Meter Gate 4½"	1.58	2½	1.55	10.00	

Example No. 2 (CHO) - WATER DELIVERY RECORD

Head	Opening	Measured Discharge	Hours Run	Daily Delivery	Balance	Order
on/.20	on/.20	on/1.00	--	----	10.00	+1.0 or on/1.0
..20	.20	1.00	24	1.00	9.00	
.20	.20/.40	1.00/2.01	24	1.00	8.00	+1.0 or 1.0/2.0
.20	.40	2.01	24	2.00	6.00	
.18/.20	.40	1.90/2.01	24	1.90	4.10	weed in back gate
.20/off	140/off	2.01/off	24	2.00	2.10	-2.0 or 2.0/off

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Example No. 3 (Weir) - WATER DELIVERY RECORD

Head	Opening	Measured Discharge	Hours Run	Daily Delivery	Balance	Order
						(.50)
.45	---	2.00	24	1.50	10.00	

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Example No. 4 (CHO) - WATER DELIVERY RECORD

Day	Head	Opening	Measured Discharge	Hours Run	Daily Delivery	Balance	Order
Sat.	.20	.48	3.00	24	3.00	9.00	
Sun.	---	---	----	24	3.00	6.00	
Mon.	.20	.48	3.00	24	3.00	3.00	

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Example No. 5 (Weir) - WATER DELIVERY RECORD

Head	Opening	Measured Discharge	Hours Run	Daily Delivery	Balance	Order
.45	---	2.00	24	2.00	12.00	
.28	---	1.00	24	1.00	11.00	OC
.28	---	1.00	24	1.00	10.00	
.37	---	1.50	24	1.50	8.50	OC

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V. CONTACTS WITH WATER USERS

Inquiries and Complaints

Refer complaints and inquiries relative to the height of water delivery, location of turnout, wastewater inlets, seepage, bridges, crossing, etc., to your watermaster. Inquiries as to why a farm unit is not eligible to receive water should be referred to the branch office who in turn will contact the district office if necessary.

High Land

Refer inquiries in regard to irrigating high land to the irrigation district office.

VI. OFF-SEASON WORK

Crop Census

You will be furnished forms and special instructions for taking a census of crop production on each farm on your beat before the end of each irrigation season. The validity and reliability of the completed crop census will be dependent upon your ability to acquire accurate information from the water users on your beat.

General Maintenance

During the post-irrigation season, you will be assigned special duties in the general maintenance of the project; these duties will include operation of various kinds of equipment.

VII. USE OF PRIVATELY-OWNED AUTOMOBILE

Public Law 87-258 provides for defense of suits against Federal employees or their estates arising out of their operation of motor vehicles in the scope of their office or employment with the Federal Government. This law became effective March 21, 1962.

Section 46.32.060 RCW of the Washington State Motor Vehicle Laws provides:

> "Any vehicle operating upon the public highways of this state and at any time found to be defective in equipment in such a manner that it may be considered unsafe shall be an unlawful vehicle and may be prevented from further operation until such equipment defect is corrected and any peace officer is empowered to impound such vehicle until the same has been placed in a condition satisfactory to vehicle inspection."

You conscious failure to keep your car in a sound mechanical and safe condition may have serious results under Public Law 87-258.

Your employment as a ditchrider on Beat No. ____ of the _____ requires that you furnish your own vehicle for performance of your official duties. You are reimbursed for the use of your vehicle at the rate of ___* per pay period. You are required to maintain the vehicle which you furnish in a satisfactory mechanical and safe operating condition in full compliance with the requirements of the Washington Motor Vehicle Laws and, in particular, that portion thereof set forth above.

*The mileage allowance during the irrigation season for Ride No. ____ can be found in the supplement sheets to this book.

In order to insure that vehicles will be maintained in an acceptable mechanical and safe operating condition, inspections will be initiated by the Government as they deem necessary. Such items as, but not necessarily restricted to, the following will be checked: Stop lights, turn indicators, seat belts, horn and rear-view mirror in addition to general mechanical condition.

Your failure to maintain your vehicle in proper operating condition may have repercussions in case of an accident and can be cause for disciplinary action. Failure to conform to this agreement may result in your vehicle being unacceptable for leasing purposes.

VIII. SAFETY

Your Safety Responsibility

To protect yourself and your fellow workers, give serious thought to prevention of accidents in your daily work. Watch for and correct or report defective equipment or any hazardous conditions which may cause accidents. Present your ideas on accident prevention at periodic safety meetings.

Carry your safety kit with you at all times and, as necessary, use the goggles, rope, gloves and first aid equipment supplied you. These items should be checked over periodically and replenished from stock carried in the watermaster office.

Suggestions concerning system or operating procedure improvement are welcomed and will be given due consideration.

* * * * *

March 1964 COLUMBIA BASIN PROJECT
WEED CONTROL GUIDE
WEED CONTROL CHEMICAL MIXTURES

1a. Early spring, on broadleaf annuals.
12 pounds 2,4-D amine (3 gallons of 4 lb. or 2 gallons of 6 lb.)
4 gallons diesel oil or aromatic solvent
1 pint emulsifier
Add water to make 380 to 400 gallons

1b. Late spring, early summer, broadleaf annuals
Increase: 2,4-D to 16 pounds
Emulsifier to 1 quart (2 quarts diluted)
Diesel oil or solvent to 8 gallons

2. Waterlines: Cattails and noxious weeds
12 pounds, 2,4-D amine (3 gallons of 4 lb. or 2 gallons of 6 lb.)
40 gallons diesel oil or aromatic solvent
1 quart emulsifier
Water to make 380 to 400 gallons

3. Copper sulfate for algae control: Average conditions.
Use 33 pounds of copper sulfate per 100 cfs, three to ten miles apart every two or three weeks. Suspend in porous bag over earth lined sections. May be dumped in bottom of clean concrete lined sections.

4. Aromatic solvent 100 gallons
Emulsifier 1.0 gallons
Apply through centrifugal mixing pump to submersed aquatic weeds at 6 inches to 12 inches of growth, before flowering, at the rate of 10 gallons per cfs. Measure flow in lateral. Reinforce after three or four miles, if white blanket is thin, with 5 gallons per cfs.

5. Monuron (CMU - Telvar) sterilant.
Add 5 to 10 gallons of water per pound of monuron. Use 20 pounds of monuron per acre on dry sites to prevent weed growth. Not for deep rooted perennial weeds. Apply in fall or winter, or add at least 1/2-inch of water to soak in.

6. 2,4-D as a temporary soil sterilant on deep rooted noxious weeds.
2,4-D amine 40 pounds
Water to make 380 or 400 gallons

Wet soil thoroughly with 200 to 400 gallons of mix per acre in fall or an open winter. Cover area at least 5 feet beyond visible weeds.

7. Dalapon 20 pounds
Wetting agent (emulsifier) 1 pint
Water 100 gallons

8. 2,4-D granular, 100 to 150 pounds per acre

9. Borate - TBA prills, 150 to 200 pounds per acre.

Note: 2,4-D is given in pounds of the active ingredient instead of in gallons. Until 1961, all brands in use on the project contained 4 pounds per gallon. The material purchased for new deliveries in 1961 contains 6 pounds per gallon. A 50-gallon tank would hold 200 pounds of the 4-pound material; 300 pounds of the 6-pound material.

WEED CONTROL

Use of Mixtures Under Typical Conditions

	Weed Condition	Season	Mix No.	Gallons Per Acre	1961 Materials Cost/Acre	Remarks
1.	Russian thistle, mustard, lambs-quarter, etc.	Spring	1	30 to 50	$0.45 to $0.81	5 MPH, 30 lbs. pressure
2.	Cattails, noxious weeds and willows	June & Sept.	2	150 to 300	$5.50 to $9.00	Thoroughly wet plant. Use No. 1 on willows alone
3.	Morning glory and noxious weeds in rough areas.	All Season	9	150 to 200 lbs.	$70.00 to $90.00	Measure and apply accurately.
4.	Algae	June to Sept.	3		$0.04 to $0.10/cfs per mile	Frog moss
5.	Pondweeds	June to Sept.	4		$0.80/cfs/ mile per treatment	Horsetail moss

	Weed Condition	Season	Mix No.	Gallons Per Acre	1962 Materials Cost/Acre	Remarks
6.	Late annuals to prevent fall growth	July	1	50 to 85	$1.15 to $1.70	
7.	Early annuals before beans are planted	April	1	20	$0.55	Increase 2,4-D to 16 pounds and increase speed to 6-8 MPH
8.	Annuals on storage yards, etc., required to be weed free	Nov.	5	100	$45.00	After 2-3 years, add 10 pounds per acre. Treat under eaves each year
9.	Perennials, deep roots. Area to support grass within 1 or 2 years	Oct. thru Jan.	9 8 6	125 lbs. 200 lbs. 200-400	$30.00 $90.00 $10 to $20	October thru February apply any time. Lasts six months to one year.
10.	Grasses: quackgrass, reed canary, etc.	May thru Oct.	7	100	$21.00	Spot treat to wet in May. Retreat once if necessary, same year.

CALENDAR OF WEED CONTROL

Columbia Basin Project

January

Seeding:	Complete dry banks if possible
Sterilant:	Finish jobs requiring dry material
Burning:	Clean up for seeding and where no weeds will blow in from adjacent land

February

Seeding:	Seed dry areas until February 15, only if moisture is high and need is great
Sterilant:	Use only in high volume of water, or prills
Burning:	Mostly clean up. Check equipment for March

March

Seeding:	Best month to skip
Sterilant:	No, unless can soak in; prills or granules
Burning:	Loose weeds; in channels; preparation for delivery of water
Spraying:	Earliest 2,4-D, pre-emergence, or contact depending on temperature

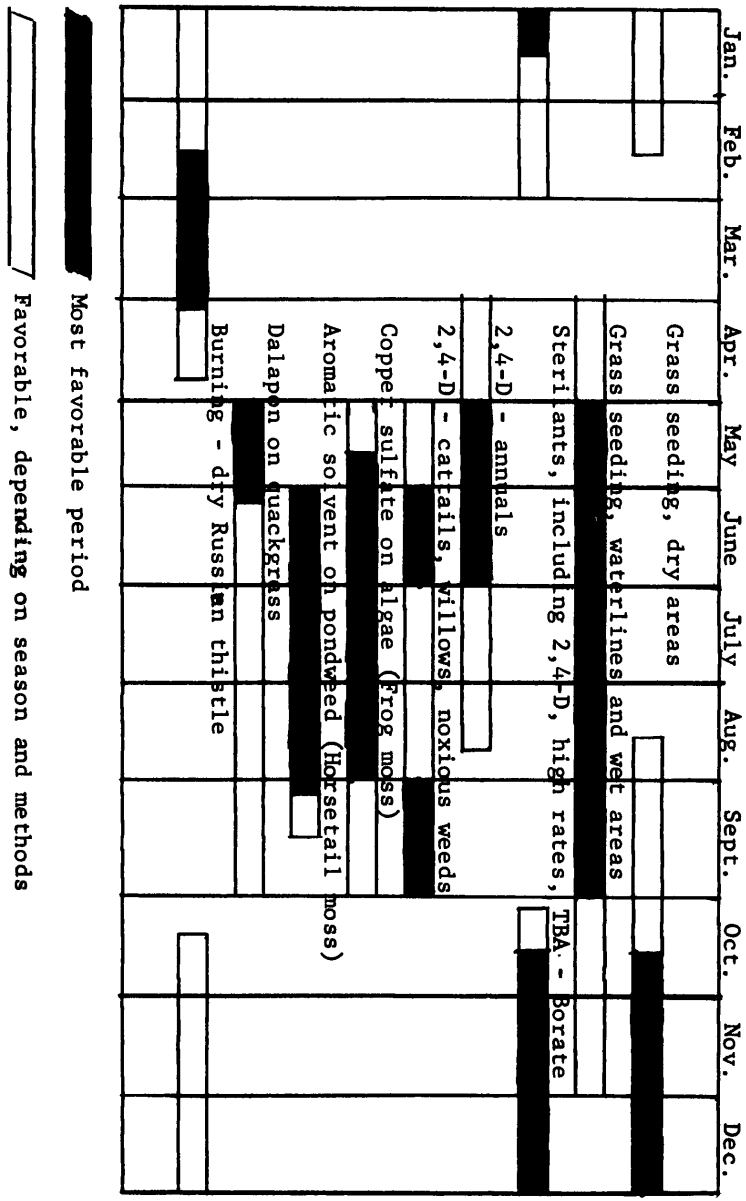
April

Seeding:	Waterlines only, time permitting
Sterilant:	No, except TBA prills
Burning:	Only as necessary to deliver water
Spraying:	Begin 2,4-D the 25th, average season, earlier if warm
Aquatics:	Check over pumps and equipment

May

Seeding:	Begin waterlines, average season
Sterilant:	No, except TBA prills
Spraying:	All large sprayers at work.

FAVORABLE PERIODS FOR SEEDING AND WEED CONTROL - Columbia Basin Project, Washington



Most favorable period

Favorable, depending on season and methods

Consider two shifts per day, if warm spring

Aquatics: Check algae increase and rate of growth of pondweeds. Start copper sulfate

June - Order seed for fall and winter planting

Seeding: Concentrate on waterlines, older areas

Spraying: Begin spot spraying noxious weeds and cattails. If warm spring check mix to use on older Russian thistle

Aquatics: Be ready to begin aromatic solvent on pondweeds by June 5, if warm weather

July

Seeding: Concentrate on waterlines, new areas

Spraying: Spot spraying as in June. Stop boom spraying except for contact

Aquatics: Copper sulfate as needed. Aromatic solvent as needed. Chaining if cheaper

August

Seeding: Waterlines, particularly test year

Spraying: Concentrate on cattails and broadleaf noxious weeds

Aquatics: Copper sulfate, aromatic solvent or chaining as needed

September

Seeding: Waterline, older areas and in watergrass infestations

Spraying: Begin fall spot work: Noxious weeds, cattails, willows

Aquatics: Last treatments

Equipment: Check over sprayers and drills for needed repairs

October

Seeding: Waterline. Drill all dry areas possible this month

Sterilant: Begin after October 20. Before if time permits

Spraying: Continue on cattails, willows, noxious weeds until frost, or job complete

November

Equipment: Repair and winterize sprayers and store aromatic solvent apparatus not used for other purposes

Seeding: Concentrate on dry areas by all methods. Try to complete by 12-1

Sterilant: Continue through December, if necessary

Spraying: No, except as sterilant

Report: Submit costs data for annual weed report, November 15, cutoff date, October 31.

December - Order: Equipment, parts for next season

Seeding: Continue dry areas all methods

Sterilant: Continue as necessary

Burning: Burn in place as required to alleviate March rush

Safe Spraying Practices - 400-gallon Sprayer

1.	Pressure at pump, boom spraying	not more than 35 p.s.i.
2.	Pressure at nozzles, boom spraying	not more than 30 p.s.i. (20 to 25 p.s.i. is better)
3.	Pressure for guns	40 to 65 p.s.i. at gun
4.	Safe engine speed (check with shop)	1800 to 2400 r.p.m.
5.	Refill rate at 15-foot lift	Up to 50 gal/min. not less than 25 gal/min. (fill the tank in 16 minutes or less)

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Output and Spray Angle of 8010 Nozzle at Various Pressures

Pressure in lbs/sq. in.	5	10	15	20	30	40	60
Capacity in gal/min.	0.35	0.50	0.61	0.70	0.86	1.0	1.22
Fan Angle	53°	63°	70°	73°	78°	80°	82°

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Width of Nozzle Swath in Inches

Height of Boom In Inches							
12	11.7	15.0	16.8	17.4	19.4	20.0	20.8
20	19.5	25.0	28.0	29.0	32.4	33.6	34.8
24	22.4	30.0	33.6	34.8	38.8	40.2	41.8

Standard nozzle spacing is 20 inches. Equivalent orifice diameter is 5/64-inch.

Sprayer Test Data - 400-gallon Sprayers

Sprayers which do not pass these test performances should be checked in the shop and repaired.

Pressure, measured at the pump, at 3300 rpm, all nozzles on	not less than 45 p.s.i.
Pressure drop, between pump and far nozzle	not more than 10 p.s.i.
Pressure, at end of 50 feet of hose, gun on	not less than 50 p.s.i.
Refilling rate at 15-foot of lift	not less than 25 gal/min.

Note: These are test data, not operating data. See page 9 for safe spraying practices.

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TABLE FOR DETERMINING SPRAY ACRES

Spray Acres = Miles X Acre Miles of Spray Swath

Spray Swath In Ft.	Miles Sprayed										
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1
8	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1
10	0.1	0.2	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.4
12	0.1	0.3	0.4	0.6	0.7	0.9	1.0	1.2	1.3	1.5	1.6
14	0.2	0.3	0.5	0.7	0.9	1.0	1.2	1.4	1.6	1.7	1.9
16	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2
18	0.2	0.4	0.7	0.9	1.1	1.3	1.6	1.8	2.0	2.2	2.5
20	0.2	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7
22	0.3	0.5	0.8	1.1	1.4	1.6	1.9	2.2	2.5	2.7	3.0
24	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3
26	0.3	0.6	1.0	1.3	1.6	1.9	2.3	2.6	2.9	3.2	3.6
28	0.3	0.7	1.0	1.4	1.7	2.1	2.4	2.8	3.1	3.5	3.8
30	0.4	0.7	1.1	1.5	1.9	2.2	2.6	3.0	3.4	3.7	4.1
32	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4
40	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
48	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	6.6
50	0.6	1.2	1.9	2.5	3.1	3.7	4.4	5.0	5.6	6.2	6.9

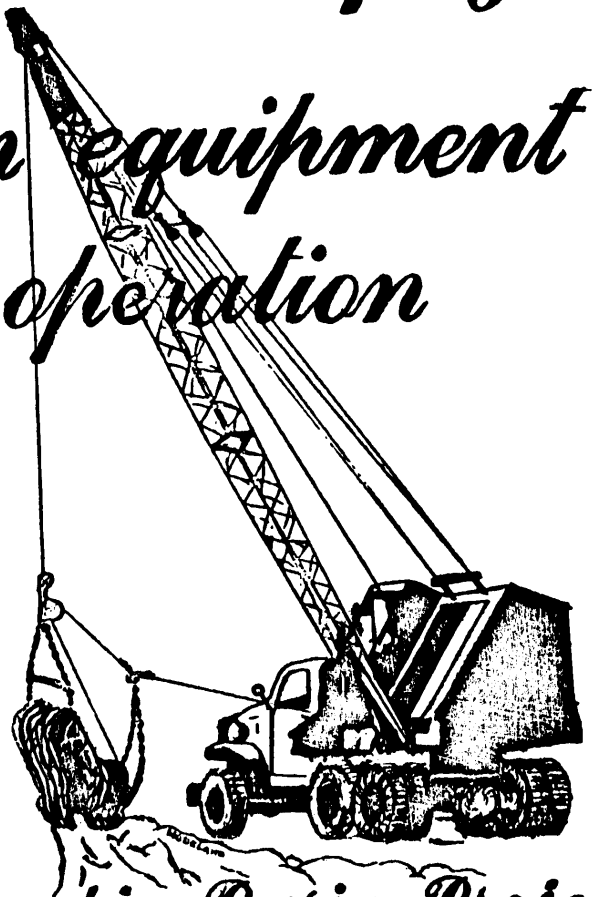
12

Columns are headed by speedometer mileage expressed in tenths. Lines begin with width of spray swath in feet.

To read spray acres where a 14-foot swath was sprayed 0.9 miles: Follow "14" feet line to right and read figure in "0.9" column, which is 1.6 spray acres.

* * * * *

Standards For Safety in equipment operation



Columbia Basin Project

IRRIGATION & LAND DIVISION

REVISED MARCH 1964

FOREWORD

Everyone who has worked with heavy equipment realizes that accidents which occur in equipment operation can very easily result in costly damage to property and severe personal injuries or loss of life. Yet many accidents can be traced to errors in judgment or failure to take necessary precautions to insure safety.

Our purpose in establishing these standards is to provide basic guidance for the safe operation of equipment in irrigation operation and maintenance work. All local, State and Federal safety codes must also be considered and applied as necessary. It is every employees responsibility to know and follow good safety practices.

Of course, there will be occasions which will require that you exercise your own judgment as to the best way to get a job done. In this kind of situation, always remember to take time to be safe and avoid needless risk. The life you save may be your own.

J. O. Humes

Chief, Irrigation Operations Branch

STANDARDS FOR SAFETY IN EQUIPMENT OPERATION

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STANDARDS FOR SAFETY IN EQUIPMENT OPERATING

I. Loading Equipment for Moving

1. Clean truck or trailer bed of rocks, dirt, and broken decking.

2. When fastening truck to trailer, be sure to connect the air hoses. Check that air pressure is up to safe operating pressure.

3. Place blocks under both sides of equipment transport trailer or flat car to prevent tipping while loading and unloading equipment.

4. Make sure the loading ramp is strong enough to hold the weight of the machine and secure enough to prevent slipping.

5. Watch for overhead wires and close clearances.

6. All persons assisting must stand well in clear during loading operations.

7. Block the machine to prevent creeping.

8. Bind the machine to the trailer securely with chain before moving.

II. Moving Equipment

1. Supervisors and transport drivers shall be familiar with State and County regulations for moving equipment on the road (including weight limits and requirements for flagmen or pilot cars).

2. Supervisors shall make sure transport drivers are aware of all regulations and the extent of their responsibilities.

3. Check your tires before moving. A low or flat tire places a double strain on the dual next to it. Should a blowout occur on a curve, the load will tip and possibly overturn.

4. In moving a machine by any method, drive at a safe speed in accordance with road conditions.

5. Check for adequate clearances at underpasses and overhead wires.

6. When moving track-mounted draglines under their own power, get clearance from railroad before crossing tracks.

7. Be courteous to traffic following you.

8. Be extremely cautious. You are handling enormous weight and wider than ordinary loads.

9. Check your load at intervals for possible shifting, loose binders, slack chains, etc.

10. When towing equipment to shop or elsewhere for mechanical repairs, use proper and safe equipment. Supervisors will assign sufficient numbers of workmen to insure safety at all times.

III. Preparing for Work at the Job Site

1. Observe the location of power lines. (See Sec. VII, II.) No equipment shall be moved or operated in dangerous proximity to power lines. Booms of draglines, power shovels, guy lines, or other equipment should not be operated within less than 6 feet of any power lines.

2. When it is necessary to work near or under power lines where minimum (6 feet) clearance cannot be observed, responsibilities are as follows:

   a. Supervisor shall notify power company of need for line to be de-energized.

   b. Operator not to proceed until supervisor advises line is de-energized.

   c. Operator to exercise extreme care to avoid contacting lines.

   d. All non-operating personnel shall stand clear of machine and attachments.

3. When rubber-tired vehicles equipped with boom or ginpoles are being operated in the vicinity of power lines, a chain shall be attached to the metal frame with the loose end dragging on the ground.

4. In preparing to operate unfamiliar equipment, get complete operating instructions and demonstration from qualified operator.

5. The supervisor shall discuss the work to be done with the machine operator and point out possible dangers. The operator shall look over all working conditions and plan his work accordingly. Look for wet ground, the condition of roads, etc.

6. Walk completely around machine before starting or moving to be sure it is safe.

IV. Operating Equipment in General - Trucks, Tractors, Tractor-loaders, Patrols, Draglines & Gradalls

1. The supervisor shall assign a competent

operator to work with each new employee until he has satisafactorily demonstrated his ability to operate the machine in a competent and safe manner.

2. The operator should keep the supervisor currently informed of unusual hazards encountered on the job.

3. If a helper is present on the job, he has a safety responsibility, in addition to his other duties, to watch for dangerous conditions and to ward the operator about them.

4. If two machines are working together, each operator should know the exact position of the other at all times.

5. Wait until the machine has come to a stop to mount or dismount.

6. If the terrain is rough and unsafe, prepare an adequate road before attempting the job.

7. If your machine is "stuck", avoid spinning or jumping the wheels or tracks which will place excessive strain on axles and driveshafts. Find some other way to get out or get help.

8. If the machine seems to be leaving the road or sinking in soft material, stop and investigate, then decide the best way to return to firm ground. Do not hesitate to get help to get out. Avoid placing the machine in a more dangerous position. Do not push the machine with the boom.

9. In turning around on a canal bank, it is usually best to head the machine towards the canal.

10. When operating parallel to a bank, use caution to avoid tipping over. When using a low boom, use the outriggers if tipping is possible.

11. With any kind of vehicle, shift down when climbing a hill to avoid lugging the motor.

12. Going downhill, shift to lower gear to keep vehicle under control. With gasoline engines, use compression together with brakes. Avoid constant braking but also avoid "winding up" your engine too high. With diesel engines, do not use compression for braking.

13. Do not leave equipment parked on fills, below fills on canal banks, or in grassy areas where there is possibility of fire.

14. When operating in heavy dust, use goggles and respirator.

15. When operating spray equipment wear goggles, respirator and gloves. Apply protective skin cream to exposed areas of the skin. Change to clean clothes daily, and take a shower after each spraying shift, be familiar with toxicity of chemicals used and first aid measures to combat them.

16. Do not wear loose or ragged clothes or unsuitable footwear around equipment.

17. Keep windshield wipers, lights and horn in good order. Keep glass clean.

18. Keep floors and decks clean.

19. No one shall ride on fenders or running boards or elsewhere on outside of equipment.

20. A tow cable of adequate strength shall be carried with each piece of equipment.

21. During cold weather, always clean tracks on track machines to prevent mud from freezing on sprockets, etc.

22. Do not operate or sit in tightly closed cabs with the engine running.

23. Do not grease, service, or make adjustments and repairs to running equipment.

V. Operating Trucks

1. Before taking truck to a job, check that directional lights or signal arm is working properly. Always use signals before making turns.

2. Drive at a speed which will be safe for the condition of the truck, the road, the traffic, the weather, and the visibility.

3. Do not follow too closely to the vehicle ahead. Leave space for cars to pass and to stop in an emergency. Sound horn when overtaking and passing vehicles.

4. When stopping on the highway, get all four wheels off the road. If equipment is immobilized, use flares, flags, etc., as required by law.

5. Use headlights when driving in heavy dust, fog or snow. Use caution. Parking lights on when moving not legal.

6. Keep lights and directional signals clean.

7. Make sure brakes are working well at all times. Do not depend on the handbrake

when backing to dump. Keep your foot on the footbrake.

8. When parking on a hill, leave the truck in gear and block the wheels.

9. When loading a truck with a dragline, if the truck does not have a rock shield the driver shall stay out and away from the truck.

10. Use special caution while backing. Open door and look back - don't depend entirely on rear view mirror. Sound horn before starting to back.

11. Do not back up square to ditchbanks. Back at an angle to keep one wheel on solid ground.

12. In raising the truck bed, run the motor just above idling speed.

13. Lower the truck bed before starting for the next load.

14. Take bed hoist out of gear before driving away.

15. Do not overload trucks. Load according to roads to be hauled over, but not above rated capacity.

VI. Operating Tractors

1. When parking - lower the blade, loader, bucket or can to the ground, take out of gear, engage the clutch and set the brakes.

2. While adjusting the power control unit, disengage the master clutch and put the transmission in high gear.

3. When adjusting the master clutch, lower the blade or can and shut off the motor.

4. When pulling a carryall, drop the can as a brake when going down an incline.

5. When backfilling deep excavation or cut bank, deposit first blade of material on edge of cut. Then push it in with second pass, repeating operation until there is no danger of cave-in.

6. When going into a canal, always use the master clutch in easing machine over embankment. Never use steering clutches in this operation because the steering clutches disengage only the tracks and not the transmission. Always back in so that the blade serves as a counterbalance.

7. Avoid working parallel to cut or steep bank. If absolutely necessary to do so, work slowly and exercise extreme care that the machine does not roll. The machine may roll if the blade strikes a solid object.

8. Keep deck free of mud, ice, snow, loose tools, chains and foreign objects.

VII. Operating Draglines and Gradalls

1. When moving up or down a steep incline, use a track tractor to help up or down. The tractor and cable should be heavy enough to hold the weight of the machine.

2. Lower the bucket down to the truck bed before dumping the load.

3. Do not use frayed or worn cable.

4. Make sure no one is standing below when raising or lowering the boom.

5. Lower the boom to a safe angle when parking.

6. Do not leave the machine parked below or above an embankment.

7. Any time you leave the machine, place the bucket flat on the ground. On the gradall, place the boom on the rack or the bucket on the ground.

8. Replace boom cable once a year and inspect frequently.

9. Use a cable wedge of the proper size to avoid pulling through the sockets.

10. Lorain Crane - Do not use operator cab control in difficult situations.

11. Operating near power lines:

    a. Make it a point to clear power lines by at least 6 feet. If this clearance is impossible, proceed as stated in Sec. III (1), and (2).

    b. Turn on crane boom warning device if working in vicinity of any power lines. However, be alert at all times. Do not depend entirely on boom warning or protective device. Remember that damp weather means increased danger.

    c. When a wheeled machine operates close to a power line, the helper should remain in the machine. For a track machine, the helper should remain away from the machine.

    d. If a rig does swing into a power line, the operator should stay on the rig and attempt to swing it away from the line. Ground men should not touch any part of the rig, the lines or the load - as all of these will be energized.

VIII. Using Cable and Slings

1. While winding cable on a drum, do not handle the cable with your hands while using power. If necessary to guide the cable, use a stick.

2. Cable slings used for lifting should be used for no other purpose. They should be kept in the warehouse when not in use to protect them from deterioration.

3. Use correct number of clamps properly spaced, with all saddles of the clips in contact with the lead end of the cable. After the cable has been in use short time, all clamps should be tightened again.

4. Have at least three turns of cable around the drum before putting a load on the cable.

5. Do not ride on sling loads or buckets.

IX. Repairing Equipment

1. Except in cases of emergency or unusual circumstances, heavy repairs to equipment will be done only in shops. Supervisors will not assign men to work alone on heavy repairs if work of hazardous nature is involved.

2. When working on a tractor with the blade or can in raised position, tie it up or

block it.

3. Place blocks under the bed before working under a raised dump bed on a truck.

4. In using coffin jacks or hoists to repair equipment, be sure the jack or hoist or sling are strong enough. Have a secure place to stand and work from, so that you will not be hurt in case the load should fall.

5. Do not trust a jack. Always block equipment before working under it.

6. Make sure the jack has a firm, flat footing. Stand clear of the handle.

7. When welding or burning around equipment, use extreme caution to avoid fire or explosion. When cutting or welding containers that have held flammable solids, liquids, gases, or substances that may produce flammable gases or liquids, follow the procedures stated in American Welding Society Pamphlet No. A6.0-52, "Safe Practices for Welding and Cutting Containers That Have Held Combustibles". A copy of this pamphlet shall be available for reference in each shop. Only experienced shop personnel shall do work of this nature.

8. Keep tools clean and free of grease.

9. Keep heads of chisels and punches ground off.

10. Use proper tools for all jobs.

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IRRIGATION SAFETY OPERATIONS
PROCEDURES FOR PUMPING PLANTS

With the approach of another irrigation season, it again becomes necessary to emphasize safe operations practice in regard to all pumping plants and relift stations. This applies to plant mechanics, helpers, ditchriders, electricians, and any others who may undertake to operate these plants.

The plant mechanics have been issued danger tags which are to be attached to the operating switchgear prior to irrigation season. When one of these tags is displayed, all personnel are required to secure clearance from the plant mechanic in charge or be accompanied by him before attempting to start any unit. These tags shall be dated and signed by the plant mechanic when attached and when removed, and shall be recorded. The smaller plants may be tagged "OK", signed and dated by the plant mechanic where time will not permit him to be there personally.

The procedures listed below will be followed:

1. Operating instructions for all major pumping plants will be prepared or updated. These will stress safety cautions and procedures and will be mounted in permanent form in a prominent place on the control panels.

2. Instructions and training on safe operating procedures will be reviewed with plant mechanics by their supervisor.

3. The plant mechanic will inspect, clean and adjust all control operating mechanisms each year prior to the start of the irrigation season. Should an unsafe condition be noted during the operating season, arrangements for its correction shall be made between personnel of the field branch and the Technical Services Branch.

4. At least once each year the operating ditchrider and his watermaster will review operating procedures with the plant mechanic at each plant. When a different ditchrider is assigned a ditchride during the operating season, he shall be instructed as to the proper operating procedures for each pumping plant by the plant mechanic and watermaster prior to assuming responsibility for the ditchride.

5. If something goes wrong or is not working properly, the ditchrider is to notify the plant mechanic or watermaster immediately, giving complete information concerning the malfunction.

6. An operator shall report any mistakes which he may have made.

7. Do not block contactors in place with a piece of wood.

8. Shut off motors with pushbutton switches.

9. When burning weeds and rubbish, exercise caution not to burn the galvanizing off fences, rubber cover on flexible conduit canvas motor covers and any other combustible property around the plants.

* * * * *

March 19, 1964

To: Irrigation Managers - 440, 450, 460, 470

From: Acting Irrigation Supervisor - 400

Subject: Flooded measuring devices - revised procedures for operating irrigation system

During the past winter, letters were sent to many water users asking that deficiencies to measuring devices be rectified where the trouble originated in his system.

Response to the recent reminder sent to the same water users indicates that the majority have either taken care of the trouble or are making arrangements to do so. Some have not responded, either by action or card.

The following instructions apply for handling the delivery of water:

1. Ditchriders shall not permit the flooding of any measuring device unless they have written approval regardless of whether the water user received a letter about his flooding measuring device or not.

2. Those who received letters and still have their problem but intend to take care of it may receive their full water delivery order after the irrigation manager has cleared such action and after the water user's irrigation district director has concurred in a limited extension of time for the rectification work to be done.

3. Those water users who received letters and have not responded by action or mail shall have their water limited to the extent stated in the original letter until such time as they have made arrangements to take care of the deficiency. If

the water user did not receive a letter as to his deficiency he must correct the problem or have the flooding of the measuring device cleared by the watermaster.

It is expected that in handling items 2 and 3, there may be modifications to the system at the water users expense and in some cases concessions on the part of the project. All such actions, however, will be controlled by and be at the discretion of the irrigation manager and in some cases with the collaboration of the irrigation district director or directors.

J D Humes

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Ditchrider Mileage Allowance

During 1964 you will be paid $0.10 a mile for actual speedometer mileage for the use of your privately-owned vehicle on your ditchride from the beginning of the irrigation season through April 25. From April 25 through August 29 you will be paid a beat allowance covering only the regular scheduled ditchride beat. If you are called out or have to go out, outside your regular working hours, to remove weeds, restart pumps, etc., you will be paid actual speedometer mileage.

From August 29 through the end of the irrigation season you will be paid actual speedometer mileage.

Mileage other than the regular beat ride must be reported on Form 115A (Statement of Travel-Mileage Claim).

Be sure that you and your watermaster sign the Form 115A. In filling out the Form 115A, it is not necessary to fill in the arrival and departure time columns.

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1 GPO 844-644