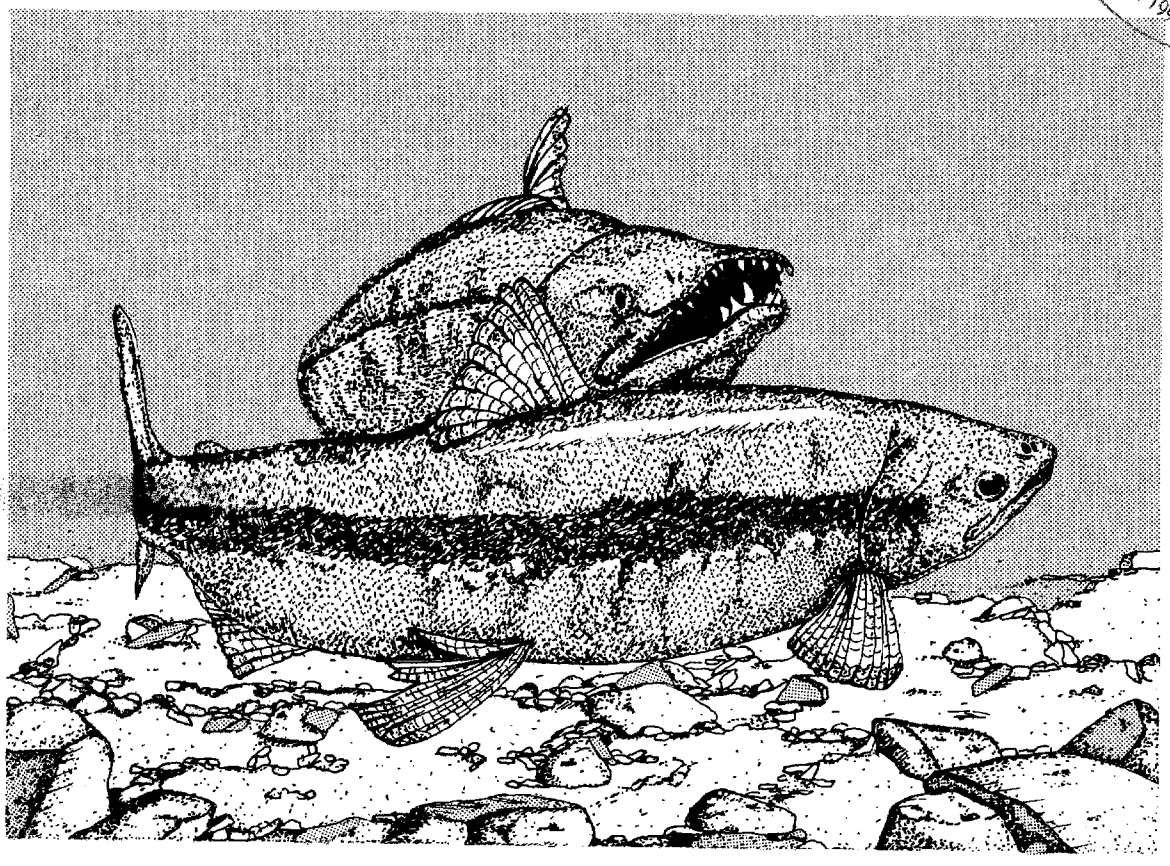

# ADF&G Su Hydro Aquatic Studies
May 1983 - June 1984

## Procedures Manual
Final Draft

## Appendices

ALASKA
DEPARTMENT OF FISH AND GAME

February 2, 1984
Alaska Power Authority
Susitna Hydroelectric Project

# ADF&G Su Hydro Aquatic Studies
# May 1983 - June 1984

## Procedures Manual
## Final Draft

## Appendices

- Prepared by -

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APPENDIX 1

ADULT ANADROMOUS FISHERIES STUDIES

Sonar Installation and Operation Manual

THE BENDIX CORPORATION

Electrodynamics
Division
North Hollywood
California

# INSTALLATION

# AND

# OPERATION

# MANUAL

# SIDE SCAN

# SALMON COUNTER

(1980 model)

Report No.
SP-78-017
10 March 1980

Prepared for:
The State of Alaska
Department of Fish and Game
Anchorage, Alaska

Revised October 1981 by
Susan L. Ellis
Su Hydro Project

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# I N D E X

# I N T R O D U C T I O N

Before attempting to operate or install the Side Scanner, thoroughly read this manual to become familiar with the system operation.

Section I will familiarize you with all the controls and their purpose. It is probably the most important section of this manual.

Section II will show you how to initially set up the unit and test it to determine that it is operating properly. Read this section before applying power to the unit.

Section III will aid you in pinpointing any source of problems and in making any necessary field repairs by replacing printed circuit cards.

Section V will show you how to install the artificial substrate in the river.

# I. FUNCTION OF FRONT PANEL CONTROLS

## A. PRINTER

### 1. Printout

The printer prints out 12 lines of data. The number at left designates the river sector, the next column is a letter identifying various conditions such as normal, command print or auto test. These letters are explained on the front panel. If normal, the letter "A" will be printed. This may appear as a dot on the 1978 model. The following four digits are the number of fish counts that have been accumulated in each sector. Each sector represents a length of river, perpendicular to the shore that is equal in length to 1/12 of the "COUNTING RANGE" control setting, with sector 1 being closest to shore. For example, if the "COUNTING RANGE" control is set to 60 feet, then each sector represents 5 feet in distance. A "+" in the third column indicates debris has been detected in the corresponding sector. Anytime PRINTOUT TIME OR AUTOTEST TIME is changed, the time must be reset.

### 2. Set Time (Printer)

The purpose of this pushbutton is to initially set the printout time and auto test time at any point. The "SAFETY SWITCH" must be off to do this. Set time to print out on the hour.

### 3. Print Command

The printer may be commanded to print its contents at any time without affecting the timing. The letter "C" is printed when this pushbutton is depressed to permit you to know that this is a command print and not in the normal time sequence. The printout timing is not affected but the counts are erased after printout. Erasure of data on 1978 and '79 models can be avoided by setting the DATA CLEAR TIME switch to the NEVER position until printout is over. On 1980 models the command printout should be added to the next hourly printout.

### 4. Printer On-Off Switch

This switch does not affect the timing or data in any way and is merely used to shut off the printer. The sounder will sound to alert you to put the printer ON-OFF switch back on. It normally takes only a minute to change paper so try to plan your paper change between prints or a complete printout may be missed without your knowledge. On models using the "DATEL" printer, be sure to shut off the printer switch when changing printer paper.

5. Replacing Printer Paper

A blue line on the paper alerts you about 1 day in advance of paper depletion. To change paper, shut off the printer switch and unscrew the 2 small silver knurled screws on the printer face. Lay a new pad of paper in the rear tray with the blue lines toward the tray bottom. Feed the paper over the silver roller in front and between the plastic face and rubber roller. Start the paper by revolving the rubber roller with your finger. During operation place a binder clip on the end of the tape as it comes out of the counter. Hanging the clip over the edge of the counter stand will allow tape to move smoothly out of the counter, eliminating printer malfunction. If the printer tape doesn't feed smoothly and hourly printouts are superimposed on each other, clean the black rubber roller thoroughly with alcohol. When the paper runs low the printer may skip printouts, so it is important to avoid letting the paper run too close to the end of the roll. When replacing the printer, push it in while making sure the paper is not pinched between the printer and panel by manually pulling some paper out of the slot. Make sure the printer seats completely flush with the panel since an electrical connector must make contact. Retighten the two knurled screws as tightly as possible with your fingers.1/ If the ink becomes dim after 2 to 4 years of operation, loosen the two black screws on the printer face and pull out the ink pad. A new pad may then be screwed in. Spare pads have been supplied to the State of Alaska and spare printers have been included. Any printers may be interchanged between systems, as they are identical.

B DATA CLEAR TIME

Data is cleared (erased from memory) after each printout. Set for AT PRINT position on 1978 and 1979 models.

C. CLEAR PUSHBUTTON

The red CLEAR pushbutton located on the left side of the panel will clear the data in the memories controlling the printer and 4 digit liquid crystal display. It does not affect the cumulative counter at right. To clear the data, the "SAFETY" switch must be "OFF". The sounder alerts you when this switch is left off.

1/ Screw on printers must be tightened daily as vibrations can cause them to loosen.

D. 4 Digit Display and Manual Sector Selector

The liquid crystal display shows you the number of counts accumulated in any of the 12 sectors that is selected by the black thumbwheel switch above it. It is always on since it uses only 1 microamp of current. Being liquid crystal, it is a reflective display and requires some ambient light to be seen At night a flashlight or match may be necessary to see it.

E. Meter, Meter Switch and Battery

When in the "BATT" position, the meter reads the condition of the GEL- CELL battery. When in the "SOLAR CHARGE" position, the meter reads the output of the solar panel. In full, unobscured sunlight the meter will read at the extreme right indicating the solar panel is supplying 12 times the current that the Side Scanner is using with the excess going to charge the supplied GEL-CELL battery. When the meter is at the point where the red and green meet (such as cloudy weather) the solar panel is supplying twice as much current as the Side Scanner is consuming with the excess going to charge the GEL-CELL battery. This would be enough to indefinitely carry it through the night hours. Although a 12V, 16 amp hour rechargeable GEL- CELL battery is supplied with each system, any 12V battery of equal or greater capacity may be used. The supplied battery, when fully charged, will operate the Side Scanner for approximately 300 hours, or about 2 weeks, day and night, with no solar charging. Internal protection is provided against battery overcharging in the event of constant full sun.

F. Fish Velocity Control

This thumbwheel switch controls the transmit repetition rate of the system. It has been observed that salmon migrate upstream at about 1.75 feet per second (ground speed). Since the switch is labeled in seconds per foot, the reciprocal of 1.75 feet per second is 0.571 seconds per foot so until new fish speed information is obtained, set the control to 0.571. To determine optimum velocity use the following formula after monitoring the oscilloscope for a minimum of 250 cumulative fish spikes:

$$\frac{\text{Fish counts on the SSS counter}}{\text{Fish spikes observed on oscilloscope}} \times \text{existing velocity} = \text{new velocity}$$

e.g., if the SSS count is 200 and the scope count is 250, 200/250 x 0.571 = .457, the new velocity setting. If the ratio of sonar counts to scope counts is within 0.8 and 1.2, do not adjust velocity. The reason behind this is as follows: When the side scan sonar is overcounting the fish are in the beam too long; the pulse repetition rate is too high. The solution is to decrease pulse repetition rate by dialing fish velocity up (remember, the velocity dial is the reciprocal of fish swimming speed). Likewise, when the sonar is undercounting, the fish are

F. Fish Velocity Control Cont.

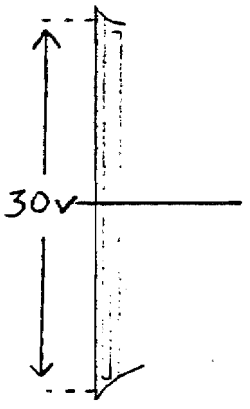
not in the beam long enough; the pulse repetition rate is too slow and the fish velocity should be dialed down.

It has been observed that at the lower extreme of the velocity setting (i.e.< .150) the side scan sonar counters tend to function erratically. Such settings should be avoided. If undercounting problems persist at higher settings, the transducer may be misaimed or the sensitivity set too low.

G. Sensitivity Control

This controls the amount of power transmitted to the transducer and is essentially a system sensitivity control.

To adjust it initially requires a fine bladed screwdriver or knife and an oscilloscope. It is adjusted as follows:




(1) Connect the oscilloscope input to the red test point on the panel marked XM2°. Set the vertical sensitivity of the scope to 5V per division and the scope trigger to internal. Set the horizontal scope sweep speed to 50μsec per division. Make sure the transducer is properly connected and in the water.

(2) Set the beamwidth switch to 2°. Adjust the front panel sensitivity control for an average peak to peak (top to bottom) signal of 30V. It will look something like the waveform at left so adjust for an average as shown.

(3) For a quick method to check sensitivity set the volts/div to 5 and time/div to 50μseconds. Turn both red "fine tuning" knobs fully clockwise. Make sure the lever on the for right of the scope face is in the bottom position (EXT TRIG OR HORIZ - DC). Plug the scope trigger lead in the XM2° test point and the vertical input lead in the back of the external trigger lead.

(4) A sensitivity setting of 30 volts is only a starting point and may be adjusted depending on individual situations. If the counter is undercounting, it may help to increase the sensitivity. However, at settings ≥ 60 volts minor bits of debris and water turbulence may cause false counts, so care should be taken not to set the sensitivity too high. Cloudy or muddy rivers usually require a higher sensitivity than clearer rivers.

H. Dead Range Control

This controls the distance from the face of the transducer that the system is "blanked out". That is, any echoes received within

H. Dead Range Control (Cont.)

this preset range will not be accepted for processing. The control may be set from 0 to 10 feet. This control is necessary to blank out transducer "ringing" which occurs for about 2-1/2 feet and would result in false counts. Sometimes a source of air bubbles near shore exists which could false counts. In this case, increase the DEAD RANGE control until the count stops in sector 1 (as evidenced by the #1 fish light blinking). The fish would then have to be weired out to beyond the dead range.

During periods of extreme high water false counts may register in the first one or two sectors possibly due to increased water velocity, increased turbidity or a combination of the two. In this case the dead range may be dialed out to 3 or more feet to avoid overcounting until the river returns to a normal level.

I. Counting Range Control

This controls the total perpendicular distance to which fish counts will be accepted. This preset distance starts immediately after the DEAD RANGE ceases, thus the total range from the face of the transducer is the total of both the "DEAD RANGE" and "COUNTING RANGE" settings.

J. Transducer Aiming

The end of the artificial substrate contains a target, approximately 60 feet from the transducer face. This is necessary for initial aiming of the transducer beam. Prior to submersion the transducer plate should be flushed on all sides with the transducer housing. This can be accomplished by "feel" or using a straight edge.

An oscilloscope should be used in lieu of the #12 FISH LIGHT for more precise aiming. To do so, trigger the oscilloscope from the XM2° panel test point, connect the scope ground to the GND test point and the scope input to the RCVR test point. Set the scope vertical control to 1 V/CM and the horizontal control to 5 millimeters per cm. 1/. The target will be observed on the scope 24 milliseconds from the start of the trace and the transducer may be manipulated for a maximum "spike" at that point. If the transducer is aimed to low, early echoes coming from rough surfaces on the pipe will be seen before 24 milliseconds.2/

The new (1978) artificial substrates have an improved method of transducer adjustment and have transducers modified for the new substrates (see figure on the last sheet.) The transducer plate

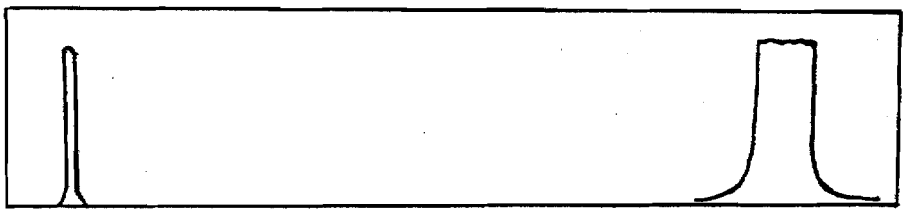
1/ See section titled Oscilloscope Operation for the Side Scanner.

2/ See section titled Typical Side Scanner Oscilloscope Waveforms for various transducer aiming conditions.

J. Transducer Aiming (Cont.)

should be installed in the shroud on the shore end member. The 3 studs attached to the plate will be secured to the plate with the 3/8-16 locknuts. Use lockwashers and tighten with channel lock pliers. About 1 1/2 inches away there will be a 1/2-20 nut followed by a flat washer, a spring and flat washer in that order. The three studs should be pushed through the three corresponding holes in the shroud with the last flat washer against the inside of the shroud. A hand wheel should then be screwed onto the outside of the shroud on each of the portruding studs. Extreme care should be taken when installing or removing the transducer from the housing as the springs tend to fall off and get lost in the river. To avoid this, tape the springs to the studs with a small piece of tape. The transducer and transducer cables should be fed over the top of the transducer and back to shore, securing them with tape to prevent chafing and to provide a little service loop to prevent their being torn off the transducer. The three hand wheels should be tightened with an equal amount of stud protruding through the wheel. The transducer will now be approximately aimed at the target end 60 feet away. (The remaining three hand wheels should be used after final transducer adjustment by running them up the stud and tightening them against the first wheel to lock them in place.)

To aim the transducer with the oscilloscope, set the beamwidth switch to 2° and the counting range to somewhat over 60 feet so that the target is counted (the #12 sector light will constantly blink). The beam should be low enough to just miss counting reflections from the pipe itself. To raise the beam, screw the upper wheel clockwise (to the right) one turn for each 3/4 foot beam movement 60 feet away (or counterclockwise to lower it). The scope trace should appear relatively clean (free of spikes) on 2° and show a few small spikes at the end of the substrate on 4° (see section titled Typical Sice Scanner Oscilloscope Waveforms for schematics of various transducer aiming conditions). A typical schematic of a strong target on 2° beam (expanded horizontally) is shown below:



transducer face target

A good target is broad and flat across the top and not varying in height. Once the target has been adjusted vertically it can be adjusted horizontally. To move the beam to the right, turn the lower right wheel clockwise and the lower left wheel the

same amount counterclockwise at the same time. To move the beam to the left, reverse the procedure. Horizontal movements should involve exactly the same amount of turning on each wheel to avoid "skewing" the beam out and up or down. Each full turn of both wheels together will move the beam horizontally 1 1/2 feet. By turning them together, the vertical aiming remains unchanged. Likewise, adjusting the upper knob does not affect horizontal beam movement.

From the "flushed" position, the transducer should be moved up or down stream as much as necessary to achieve a strong target. In a strong current the pipe tends to bow out so the transducer may need to be aimed a bit upstream to compensate. In cases where fish tend to migrate close to the surface over the substrate, the beam may need to be aimed high and downstream. Frequent monitoring of the oscilloscope and experience with aiming are the surest means of achieving a good target and counting maximum numbers of fish.

It has been observed that when water level rises considerably over a short period of time the target becomes weak or disappears completely. This may be caused by the increased velocity bending the tube, requiring an adjustment of the horizontal position of the beam. If no target can be found when making vertical adjustments of the beam, it may be due to irregularities of the river bottom. If the end of the tube is hanging over a ledge or if the tube is resting on a rock, the target end will be lower than the rest of the tube and may not be locatable by aiming the transducer. In this case the beam should be aimed low enough to just avoid reflecting echoes from the surface of the tube. When no target can be found at all and the printouts are all zeroes, it may be that a large piece of debris is lodged on the transducer, blocking transmission of the beam. This should be checked before adjusting the transducer.

K. Cumulative Counter

This counter maintains a running total of all counts. It is an 8-digit counter and being of the L.E.D. type, consumes a fair amount of power when lit. For this reason a "READ" pushbutton is provided below it to read the total when desired. To clear the cumulative counter, shut off the SAFETY switch and depress the CLEAR pushbutton located below the counter. The alarm will alert you that the SAFETY switch is OFF.

L. Safety Switch

This switch is an interlock provided to prevent accidental clearing of the data or accidental resetting of PRINTER time or

AUTOMATIC TEST time. Whenever it is left in the OFF position the sounder will sound, alerting you to this fact.

M. Sounder

The sounder will alert you whenever any of the following three switches are left in the "wrong" position to prevent walking away from the unit in that condition: (The sounder will "click" whenever a fish is counted).

a. Sounds when "DATA" switch is left OFF.
b. Sounds when "PRINTER" switch is left OFF.
c. Sounds when "SAFETY" switch is left OFF.

Speaker may be covered when working to lessen obnoxious noise. However, the speaker is not a gum repository.

N. Test Pushbutton and Data Switch

The purpose of this test is to verify proper functioning of almost the entire system (except the transmitter). This button, when depressed, electronically simulates fish in the first 11 sectors. When the system is operating properly, the first 11 fish lights will blink, the sounder will sound, the cumulative counter and the 4-digit counter at left will record these counts. If only a partial system test is desired, without interfering with data already present in the memories or the cumulative counter, the DATA switch should be left OFF. This will prevent these "false counts" from being recorded but will permit the FISH lights to blink. When a full system test is desired at the cost of losing the data already present, the DATA switch may be left ON.

O. Fish and Sector Lights

The two red SECTOR L.E.D.'s indicate that the electronics logic card is probably functioning properly. The sector lights must always blink. If a light(s) does not blink, the cause may be merely a burned out light. This can be verified by dialing the large thumbwheel switch to the sector in question and simulating fish by depressing the TEST pushbutton with the DATA switch ON. If data is recorded in that sector, it merely means that either the light is bad or the L.E.D. card in the system is bad, which will not affect proper operation.

To check sector 12, merely increase the RANGE control setting a few feet to "count" the target at the end of the substrate. The FISH lights will blink whenever fish are detected in the corresponding sector and the sounder will sound.

P. Automatic Test

This feature permits automatic self testing of the entire system

including the transducer and its proper aiming. It functions automatically each 12 hours (1978 and 1979 models can be set at 6, 12 or 24 hours. Set at 24 hours) as follows: To start the 12 hour timing sequence at any point in time, press the SET TIMES red pushbutton. This initiates both the printer and auto test times. Precisely 2 seconds after the normal printout 12 hours later, the system will go into an automatic test mode. It will automatically electronically simulate between 2 and 7 fish in each of the first 11 sectors and it will automatically extend its range by 3 feet, thus counting the artificial target 60 feet away and recording these counts in sector 12. It will then print out all these counts and the letter E in the second column to indicate a self start. 1978 and 1979 models will have letter I in the second column. None of these counts will enter the cumulative counter at right, and will be erased right after the print.

Q. Test Points on Panel

The test points have the following purposes:

1. XMALT. This test point is connected to the 4° section of the transducer which shows the transmitted voltage when the unit is transmitting at 4°.

2. The XM2° test point is directly connected to the transducer sector that is selected by the beamwidth switch and permits oscilloscope reading of the transmitted voltage, thus checking the transmitter card in the system. The 4° transmit will always by considerably higher than the 2° transmitted voltage except when the beamwidth switch is set to 2°. When the BEAM WIDTH switch is in the ALT position, the transmitted voltage can be seen to alternately go high and low as the 2° and 4° sectors are automatically selected.

3. RCVR test point. This test point is the receiver output and gives a true "analog picture" on an oscilloscope of what is happening in the water. Any echoes received are amplified and presented at this test point. Any time the echo exceeds 3 volts at this point for the proper pre-programmmed number of "hits" it will result in a count. To use this feature, the scope input is connected to the RCVR test point, the scope ground connected to the GND test point and the scope may be triggered from either the "XM" test point which permits observation of the entire 60 feet or from any one of the "SCOPE - TRIG" test points which starts the scope trace at the beginning of any of the 12 sector "listening times". The scope trigger must be set to - . By doing this and properly expanding the scope sweep speed, any one or more of the 12 sectors may be individually observed.

R. Beamwidth Switch

This switch electronically controls the transducer beamwidth by connecting only the center section of the transducer for a 4° beamwidth or paralleling both the center and outer transducer sections for a 2° beamwidth. Any of the three modes may be selected, but for optimum coverage, the ALT position should be used since this tends to make the lateral coverage more uniform. When in the ALT position, the system alternately transmits on the 2° sector then on the 4° sector and back to the 2° sector, etc. After transmittimg on the 4° sector, only those echoes received during the first half of the active range are accepted (sectors 1 through 6). When transmitting on the 2°sector, only those echoes received during the last half of the active range are accepted (sectors 7 through 12). The system electronically gives more weight to sectors closer to the transducer face since the fish will be in the beam a shorter period of time because of the fact that the closer to the transducer, the narrower the beamwidth. Anumber of samples of each fish are taken, permitting different "aspects" of the fish to be sampled as it crosses the beam. A varying number of valid "hits" are required before the system "decides" the target is a fish and enters it into permanent memory. The number of valid hits required for detection is a function of which of the 12 sectors the fish was detected. For example, although a fish travelling at 1.75 feet/sec is sampled 9 times, if it is detected in sector 9, only 5 valid "hits" are required to count, so if 5,6,7,8 or 9 hits are made during the passage of the fish only 1 count will result.

This feature essentially eliminates downstream passing debris which typically is travelling at the river velocity which is usually much faster than 1.75 ft/sec and which would not be in the beam long enough to count. To prevent single debris counts occurring over a period of time from adding up to the number required for a valid fish count, the temporary fish decision memories are automatically cleared 4 transmissions after receipt of any single echo.

S. Debris Alerting

Any time 24 counts are made in any one of the 12 sectors in a 35 second period (starting from the first count), the system assumes that this cannot be fish and is probably a piece of debris hung up on the artificial substrate. When the next printout occurs, the corresponding sector column will contain the symbol " + " in the third column next to the sector identification number. After printout, the debris detector is cleared and starts out "fresh" again. If the debris is still present, the system will again accept up to 24 counts in 35 seconds and indicate " + " again. If the debris has washed away, it will resume normal operation.

NOTE: Some of the front panel switches are of the PULL TO CHANGE types. This is to prevent inadvertent changing of the switch positions. The switch handle must be pulled away from the panel and then changed. Make sure that the switch is firmly seated in the desired position.

## II. INITIAL SET UP AND SYSTEM TEST

To verify proper system operation when first turned on or anytime desired, do the following:

Before the battery is plugged in, which turns on the system, place the following switches in the noted positions:

(1) PRINTER OFF.

(2) TRANSDUCER NOT PLUGGED IN.

(3) SAFETY SWITCH OFF.

(4) METER SWITCH IN BATT POSITION.

(5) FISH VELOCITY to 0.571.

(6) DATA ON.

(7) ACTIVE RANGE to about 50 feet.

The remainder of the controls may be left in any position.

Next, plug in the battery and then press the SET TIMES pushbutton (this synchronizes the system). Some of the FISH lights may remain on. To clear the system, press and hold the red TEST pushbutton, noting that each of the FISH lights blink in sectors 1 through 11. The system is now cleared and ready for operation. At this time, the SECTOR lights should be blinking and the BATTERY CONDITION METER should be in the green. Press the two red CLEAR pushbuttons to erase any counts from the memories. Press and hold the red TEST pushbutton. This will simulate counts on sectors 1 through 11. Hold it in until a few hundred counts appear on the CUMUL counter. (You have to press the black READ pushbutton to see this.)

The next step will be to verify that counts have been registered on each section of the 4-digit liquid crystal display and that the printer is functioning, and that all counts agree. To do this, turn on the PRINTER switch and momentarily press the black PRINT COMM pushbutton. The printer should now print out 12 lines of data. The column at left will be the sector identification number and should sequentially read 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2. The next column should have

printed the letter "C". Dial the large black thumbwheel switch through its 12 positions and compare the numbers in the 4-digit numerical display with the corresponding blue printed columns. They should agree.

Next, add up the column of figures. The total should agree with the total CUMUL count within one or two digits.

Solar Panel

The purpose of the solar panel is to charge the 16AH GEL-CELL battery supplied with the system.

Mount the solar panel such that it will receive a maximum average amount of light throughout the day. Plug it into the side connector marked SOLAR PANEL, observing polarity (this means red to red and black to black). If the solar panel is connected backward, no damage will result, but the meter will read no solar charge when exposed to light. Put the METER switch in the SOLAR CHARGE position. If full sunlight is falling directly on the solar panel, the meter will be at the extreme right. In very cloudy weather the meter will probably be in the red. When it is at the red/green crossover point, the solar panel is supplying twice as much current as the system is consuming, with the excess going to the battery. This condition will be adequate to indefinitely carry the system through the night hours. Make sure no part of the solar panel is shaded because shading one cell is the same as shading the entire panel.

## III. TROUBLESHOOTING

Many complete sets of printed circuit card spares have been supplied to Alaska Department of Fish and Game. They contain pre-tested cards of every type used in the Side Scanner System. They are identified by a function name etched on the component side of the cards at the upper left corner of the card. The following table lists the P.C. card names and their functions to aid in troubleshooting.

| Printed Circuit Card Name & Location in P.C. Card File | Card Function |
|---|---|
| MEMORIES<br><br>(Slot 1 & Slot 2) These 2 cards are identical. | The memory cards store valid fish counts after the electronic decision has been made if debris or fish. They drive the 4 digit liquid crystal display and the printer. They have nothing to do with the cumulative counter display. The 2 cards are identical and interchangeable. The memory card in slot 1 controls the two most significant digits of the display and printer fish counts, i.e., the two digits on the left. The memory card in slot 3 controls the 2 least significant digits of the display and printer fish counts, i.e., the two digits on the right. |

| Printed Circuit Card Name & Location in P.C. Card File | Card Function |
|---|---|
| LOGIC<br><br>(Slot 5) | The logic card controls the system repetition rate (or "ping" rate). It controls the duration of the transmit signal, the 11 simulated fish counts for test, the automatic range extension during auto test, the counting range, the dead range, the smolt vs. fish function, the power to receiver, all the L.E.D. functions, the 12 sector scan, the cumulative counter, the sounder duration when fish are detected and the temporary memories which decide whether the echo detected is fish or debris. If debris, it is erased; if fish it is routed to the previously mentioned permanent memories cards for storage and then erased from this card. This card also controls the 2°, 4° and ALT beam routing in conjunction with the beam-width switch. |
| PRINTER<br><br>(Slot 7) | The printer card controls the printer time clock the printer command, the 12 print sequencing, the printer sector I.D. number printed on the left of the printed paper, the letters printed next to the left on the printed paper, the automatic self test timing, the erasure or automatic clearing of the data after print, the tape recorder automatic power turn-on for 3.6 minutes after each print, and makes the decision whether a very high rate of counts is fish or debris and if debris it tells the printer to print the symbol "+". |
| RECEIVER<br><br>(Slot 11)<br><br>CAUTION:<br>If this card is changed, it will be necessary to readjust the sensitivity screwdriver control on the front panel as discussed earlier in this manual. | The receiver card contains the receiver which takes the minute fish echoes, amplifies them 23,000 times and if the echo exceed a predetermined threshold it triggers a device which sends a signal to the temporary memory card for subsequent decision as to whether it was fish or debris. This card also contains a 9V regulator to power the entire system. It also controls the battery and solar charge meter and provides T.V.G. which means time variable gain which causes fish echoes detected far away to be amplified at a greater factor than fish close by since the echo decreases with distance in a log manner. This card also contains the transmitter which transmits a 515 kHz signal to the transducer. The card also contains part of the circuitry to electronically simulate fish in the first 11 sectors for automatic and manual test. The tape recorder power regulator is located on this card also. |

| Printed Circuit Card Name & Location in P.C. Card File | Card Function |
|---|---|
| LIQUID CRYSTAL DISPLAY CARD<br><br>Located on front panel. | This card contains a 4-digit liquid crystal display on the front panel. If it becomes defective it may be removed from the inside by removing the two retaining 6-32 nuts and replacing it with a spare display card. If this is done, be sure the two flat plugs that are inserted in its connector are firmly inserted in the new card in identical orientation. The display has an average life of about 7 years. It will be noticed that in cold weather the display takes longer to change its numbers. This is a normal characteristic of liquid crystal displays. |

Most of the card functions are self-explanatory so that in the event of trouble, a card may be replaced. Since many of the card functions are inter-related, a problem may sometimes not be definitely localized to a specific card and more than one card may have to be interchanged to cure the problem (one at a time).

To change a printed circuit card, disconnect the battery and solar panel. Remove the 6 screws holding the front panel and carefully lift the front panel straight up. It may then be turned and laid down next to the electronics.

CAUTION: The electronic components on the cards are susceptible to immediate destruction by static electricity. They should never be handled in an office where carpets generate static electricity.

Replace the suspect card with a new one and retest. The system can be operated in the open position so it will not be necessary to close the system to test it, but be very careful not to short anything.

To remove a card, pull up on the two card ejectors. To replace a card, press the card firmly down and hook the combination black card ejector/inserter under the ridge of the card file and push the two black inserters down. These will force the card into its sockets and may have to alternately be "rocked" until the card is firmly seated in its socket.

CAUTION: NEVER remove or replace a card with power from the battery or solar panel connected.

To replace the panel, reverse the removal procedure being careful not to

pinch any cables between the panel and the case. The 6 nuts are on sliding plates and may have to be repositioned with a knife blade if they were moved.

Some problems with the counter can be solved without changing cards. If the printer is malfunctioning, check to see that it is flush with the counter and thescrews are fully tightened. Also make sure the tape is feeding out smoothly. If it is pulled out crookedly, the paper will become jammed. If the printer begins skipping hours and changing cards does not help, there is plenty of paper, the roller is clean and the battery is tightly plugged in, the problem may be a faulty power inverter. This requires repair by Bendix.

## IV. SIDE SCAN ARTIFICIAL SUBSTRATE

### General Description

The array (Figure 1A, 1B and 3) is made up of three 18½ foot long sections of tubes that plug together with an 18 inch overlap forming a single tube. Offshore and onshore sections terminate the assembly ends. A ¼ inch diameter wire rope runs through the assembly and is pinned to the offshore cap. The onshore cap has a threaded shaft and handwheel which is used to provide tension holding the array sections together by tensioning the cable. Cable should be threaded on the downstream side of bolts which hold sections together. Alignment of the vortex shedding fins on each section is required in order to prevent oscillation or vibration of the array in fast currents. Install and tighten the ¼" bolts on the welded brackets. These will squeeze the slots together thus securing the pipes together. On 1978 and 1979 arrays tighten bolts to 45 ft/lbs (second bolt from target end - tighten to 20 ft/lbs only). If too loose, the array will bend excessively, allowing fish to escape under the beam. If tightened to greater than 60 ft/lbs the bolts will break or the tube deform.

NOTE: The bolts should be tightened with the pipe upside down from the way it will lie on the river bottom. This will help straighten the pipe.

The offshore cap provides the wire rope termination, has a water check valve used for blowing out and floating the array, mounts the offshore cable attachment point and has a target attached for acoustic signal alignment. The onshore cap has a 2 inch diameter hole in the end which is used to stake the array in position on the shore. A second 2 inch hole may be used to tie off the array for safety. A mount for the transducer is provided on the cap. Both vertical and horizontal adjustment of the transducer is possible. A ½ inch diameter x 2 ft. long bar is provided to use as a lever for aligning the transducer on the 1976 systems. The new systems have adjustment handwheels. Mount the transducer in the upper 3 holes of its housing. A traveler, attached to the cable swivel, rides on a bar preventing rotation of the cable when tightening.

NOTE: The cable must be as tight as possible to prevent array breakup in fast river. Hand tighten only.

A ½ inch threaded plug is provided for an air hose to blow out and float the array prior to removal from the river bed. Netting is tied to the lower vortex fin. 1/8 inch diameter holes spaced at 1½ inch intervals provide net tie points. Holes are provided on both top and bottom fins as installation on the opposite shore requires turning the array end for end and rotating 180°.

NOTE: It has been found by A.D.F.& G. that if no air is available, the array may be raised by allowing the pipe to tilt down inthe direction of the water flow. The fairings act as ailerons and will raise the pipe to the surface. Conversely, when sinking the array, the stake on the shore end should be attached via a "come-along" to a tree and should be tilted upstream a few degrees to help sink the array and hold it firmly on the river bottom.

Assembly Procedure for 60 Foot Array

1. Lay out the following parts on a reasonably level surface parallel to the river bed in the order listed. Leave 1 foot of space between parts.

   1 each Offshore Cap.

   2 each 18½ foot section with couplers attached.

   1 each 18½ foot section without coupler.

   1 each Onshore Cap (screw in tension screw handwheel all the way).

2. Attach swivel end of ¼ inch cable to eye on threaded tension screw.

3. Feed opposite end of cable (with eye) through the 18½ foot tube sections. Cable must pass through center hole in bulkheads (two places), and on downstream side of 3/8 inch bolts.

4. With the onshore cap transducer housing straight up, slip the first 18½ foot section onto the shore cap (male), reduced diameter, align the bolt holes and install ¼ inch diameter bolts. Fitting coupler sections into 18½ foot sections is made much easier by spreading the welded brackets apart with 2 or 3 disc brake pad spreaders. Before fitting sections together, coat the outside of coupler sections with clear silicone to prevent air leaks. Also coat both ends of bolts, cable anchor bolt, endplate and offshore cap. Be sure 18½ foot sections face in the right direction. Fins go downstream.

5. Install second and third section in similar manner. If couplings hang up and do not seat, the cable and tension screw can be used to pull the couplings together. However, care must be taken to align the fins during coupling insertion as turning the sections after complete assembly may be difficult.

6. Insert cable eye through the offshore cap and install cap on last section. Insert bolt. Target (curved projection) should be up.

7. Install end plate (with slot for pin) onto offshore cap. Cable should project through cap center hole and extend out about 12 inches if all couplings are seated.

8. Start to tighten the handwheel inside onshore cap until cable eye is aligned with slot in end plate.

9. Install pin through eye and seat in slot of end plate.

10. Tighten cable hand tight, using handwheel. All couplings should now be fully seated. When tightening, insert a long screwdriver in the far end of the swivel assembly to keep the traveler bar from twisting as the cable is tightened. The cable tightens by turning the knob counterclockwise and loosens by turning it clockwise. Two nuts should be screwed on both in front of and behind the handwheel to allow the shaft to turn as the knob is turned.

11. Install coupling bolts and cap nuts not previously installed. Tighten to 20 ft/lbs only; apply silicone.

12. Install end cap onto end plate covering cable.

13. All seams must be sealed to prevent air leaks when raising the tube. Apply silicone generously to each joint and wrap with insulation tape (such as 3M Scotchfill Insulation Putty Tape). Cover this tightly with gray 2" PVC tape, overlapping the seam 2 inches on each side. Place 2 connected 8 inch hose clamps on each side of the seam and over tape. Tighten clamps, being careful to keep clamp nuts to the downstream side of the tube and out of the beam path.

14. The array is now ready for placing into the river.

Array Installation Procedure

1. Before placing the array in the river, the chain anchoring the net should be tied up to prevent it from snagging on debris during deployment. It is easiest to thread a line through the links and tie it to the holes in the fins. This can be readily cut when releasing the net. Make sure the ½ inch plug on top and 3 inch floodcap on the side are in before putting the array in the water.

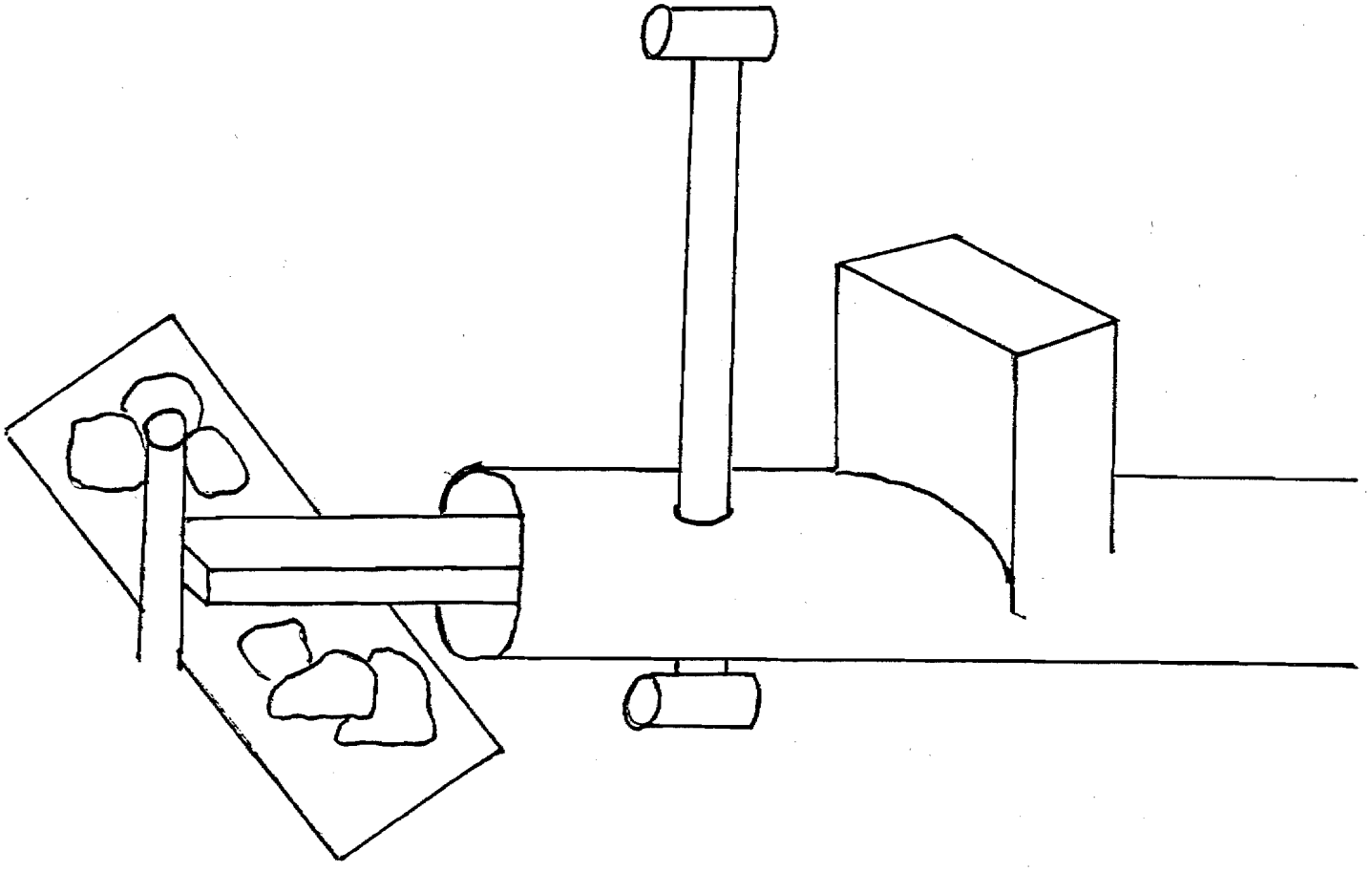
2. Attach an appropriate shore cable ¼ inch minimum diameter to upstream end of collar provided on offshore cap. The longer the cable, the easier it will be to move the array in and out. Attach the other end of the cable to a stake, tree or other available attachment point. CAUTION: In 7 foot per second currents cable tension of floating array will be as high as 850 pounds.

3. Attach another cable to the 2 inch hole on the upstream side of the inshore end of the array. The other end of the cable should be attached to a tree or stake onshore. Moving the array out will be much easier if the cable runs as closely to parallel with the bank as possible.

4. Once both cables are attached, the offshore end should be gradually let out, allowing the array to swing out into the current until it is perpendicualr to the bank. In fast rivers the current may tend to push the tube out parallel to the bank as the offshore cable is being let out. As a safety precaution against this, it is a good idea to tie a short rope from the standpipe to a stake or tree onshore. (The standpipe is a 4 foot x 2 inch O.D. steel pipe inserted in the 2 inch holes behind the transducer housing with T-caps screwed onto both ends. This allows easier movement of the array and is a handle by which you can "aileron" the array).

5. Someone on the onshore end should be ready to place a boom log in the end of the pipe to hold the array out far enough so that about 6 inches of water covers the top of the transducer housing. The boom log can be held in place by weights or stakes (see drawing below).

6. When in place, cut the line holding the chain up and remove the ½ inch plug on top and the 3 inch floodcap on the side to allow the pipe to sink.



Array Removal Procedure

1. Blow out water in the array through the check valve located in the shore cap. This is done by removing the ½ inch pipe plug located in the shore cap and replacing with an air hose. Air pressure applied here (as from an air compressor) will force water out the check valve, floating the array.

   If no air is available, the alternate raising method described earlier may be used, i.e., allow the shore end stake to tilt forward (downstream) which will raise the array by the aileron action of the fins.

2. The floating array can now be hauled ashore either by pulling straight out or by pulling in the offshore cable.

Array Disassembly Procedure, See Figures 1A, 1B and 3

1. With the array on a reasonably level area, remove the end cap.

2. Untighten (screw in) the handwheel inside the onshore cap. This will loosen the tension cable and allow removal of the pin on the offshore end plate.

3. Remove the end plate.

4. Drive a stake through the 2 inch shore cap hole into the ground. Also drive a second stake into the ground about 10 feet from the opposite end of the array.

5. Attach the "Y" cable to the offshore cap, see Figure 3. Install come-along between stake and "Y" cable.

6. Remove through bolt of first section to be disassembled (any order is OK).

7. Pull apart with come-along.

8. Install 2 eye short cable between sections pulled apart. See Figure 3.

9. Remove next through bolt and pull apart next section.

10. Continue process until all sections are pulled apart.

General Caution Notes

1. Before placing array in water inspect check valve operation.

2. Cable must be tensioned before array deployment.

3. Do not turn array vortex fins into current in currents over 4 feet per second. Excessive load may damage array.

4. Installation of a cable around the onshore cap to a stake upstream on shore may be useful in a fast current river.

5. If corrosion prevents loosening of cable tension wheel on assembled array, the offshore cap pin may be driven out, after removal of the cap, thus releasing cable tension.

6. Handle exposed section ends with reasonable care to avoid nicks or tube distortion.

7. Be sure ½ inch diameter carriage bolt in coupling sections are tightened to 45 ft/lbs in order to eliminate coupling to tube clearance thus preventing array sag. Never exceed 50 ft/lbs.

8. Transducer. The transducer, although reasonably rugged would be destroyed if dropped on a rock. Before use, the radiating polyurethane face should be washed with a detergent, preferably liquid detergent with the liquid left on the face. This cleans off finger oils. Any oil or grease will completely block the high frequency output and make the transducer inoperative. In some rivers, a buildup of various forms of "crud" may develop on the transducer face after a week or two, so a quantity of liquid detergent should be placed in the hand and the hand quickly put under water to rub the face of the transducer. This should be done whenever too much buildup of "crud" is felt or seen on the transducer face. A moderate amount of detritus will not affect normal operation.

Shortened Arrays

In situations where the current is swift or the fish hug the bank tightly it may be desirable to use only one or two of the 18½ foot sections to assemble a 20 or 40 foot array. Assembly procedures are the same as for a full size 60 foot array except that the inner cable must be shortened.

When using a 40 foot tube the beamwidth switch should be set to ALT and the counting range to a distance of about 38 feet. Beamwidth for a 20 foot array should be set on XM2° and counting range to about 18 feet.

February 2, 1984
Alaska Power Authority
Susitna Hydroelectric Project

# ADF&G Su Hydro Aquatic Studies
# May 1983 - June 1984

## Procedures Manual
## Final Draft

## Appendices

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APPENDIX 1

ADULT ANADROMOUS FISHERIES STUDIES

Sonar Installation and Operation Manual

THE BENDIX CORPORATION

Electrodynamics
Division
North Hollywood
California

# INSTALLATION

# AND

# OPERATION

# MANUAL

# SIDE SCAN

# SALMON COUNTER

(1980 model)

Report No.
SP-78-017
10 March 1980

Prepared for:
The State of Alaska
Department of Fish and Game
Anchorage, Alaska

Revised October 1981 by
Susan L. Ellis
Su Hydro Project

# TABLE OF CONTENTS

# I N D E X

# I N T R O D U C T I O N

Before attempting to operate or install the Side Scanner, thoroughly read this manual to become familiar with the system operation.

Section I will familiarize you with all the controls and their purpose. It is probably the most important section of this manual.

Section II will show you how to initially set up the unit and test it to determine that it is operating properly. Read this section before applying power to the unit.

Section III will aid you in pinpointing any source of problems and in making any necessary field repairs by replacing printed circuit cards.

Section V will show you how to install the artificial substrate in the river.

# I. FUNCTION OF FRONT PANEL CONTROLS

## A. PRINTER

### 1. Printout

The printer prints out 12 lines of data. The number at left designates the river sector, the next column is a letter identifying various conditions such as normal, command print or auto test. These letters are explained on the front panel. If normal, the letter "A" will be printed. This may appear as a dot on the 1978 model. The following four digits are the number of fish counts that have been accumulated in each sector. Each sector represents a length of river, perpendicular to the shore that is equal in length to 1/12 of the "COUNTING RANGE" control setting, with sector 1 being closest to shore. For example, if the "COUNTING RANGE" control is set to 60 feet, then each sector represents 5 feet in distance. A "+" in the third column indicates debris has been detected in the corresponding sector. Anytime PRINTOUT TIME OR AUTOTEST TIME is changed, the time must be reset.

### 2. Set Time (Printer)

The purpose of this pushbutton is to initially set the printout time and auto test time at any point. The "SAFETY SWITCH" must be off to do this. Set time to print out on the hour.

### 3. Print Command

The printer may be commanded to print its contents at any time without affecting the timing. The letter "C" is printed when this pushbutton is depressed to permit you to know that this is a command print and not in the normal time sequence. The printout timing is not affected but the counts are erased after printout. Erasure of data on 1978 and '79 models can be avoided by setting the DATA CLEAR TIME switch to the NEVER position until printout is over. On 1980 models the command printout should be added to the next hourly printout.

### 4. Printer On-Off Switch

This switch does not affect the timing or data in any way and is merely used to shut off the printer. The sounder will sound to alert you to put the printer ON-OFF switch back on. It normally takes only a minute to change paper so try to plan your paper change between prints or a complete printout may be missed without your knowledge. On models using the "DATEL" printer, be sure to shut off the printer switch when changing printer paper.

5. Replacing Printer Paper

A blue line on the paper alerts you about 1 day in advance of paper depletion. To change paper, shut off the printer switch and unscrew the 2 small silver knurled screws on the printer face. Lay a new pad of paper in the rear tray with the blue lines toward the tray bottom. Feed the paper over the silver roller in front and between the plastic face and rubber roller. Start the paper by revolving the rubber roller with your finger. During operation place a binder clip on the end of the tape as it comes out of the counter. Hanging the clip over the edge of the counter stand will allow tape to move smoothly out of the counter, eliminating printer malfunction. If the printer tape doesn't feed smoothly and hourly printouts are superimposed on each other, clean the black rubber roller thoroughly with alcohol. When the paper runs low the printer may skip printouts, so it is important to avoid letting the paper run too close to the end of the roll. When replacing the printer, push it in while making sure the paper is not pinched between the printer and panel by manually pulling some paper out of the slot. Make sure the printer seats completely flush with the panel since an electrical connector must make contact. Retighten the two knurled screws as tightly as possible with your fingers.1/ If the ink becomes dim after 2 to 4 years of operation, loosen the two black screws on the printer face and pull out the ink pad. A new pad may then be screwed in. Spare pads have been supplied to the State of Alaska and spare printers have been included. Any printers may be interchanged between systems, as they are identical.

B DATA CLEAR TIME

Data is cleared (erased from memory) after each printout. Set for AT PRINT position on 1978 and 1979 models.

C. CLEAR PUSHBUTTON

The red CLEAR pushbutton located on the left side of the panel will clear the data in the memories controlling the printer and 4 digit liquid crystal display. It does not affect the cumulative counter at right. To clear the data, the "SAFETY" switch must be "OFF". The sounder alerts you when this switch is left off.

1/ Screw on printers must be tightened daily as vibrations can cause them to loosen.

D. 4 Digit Display and Manual Sector Selector

The liquid crystal display shows you the number of counts accumulated in any of the 12 sectors that is selected by the black thumbwheel switch above it. It is always on since it uses only 1 microamp of current. Being liquid crystal, it is a reflective display and requires some ambient light to be seen At night a flashlight or match may be necessary to see it.

E. Meter, Meter Switch and Battery

When in the "BATT" position, the meter reads the condition of the GEL- CELL battery. When in the "SOLAR CHARGE" position, the meter reads the output of the solar panel. In full, unobscured sunlight the meter will read at the extreme right indicating the solar panel is supplying 12 times the current that the Side Scanner is using with the excess going to charge the supplied GEL-CELL battery. When the meter is at the point where the red and green meet (such as cloudy weather) the solar panel is supplying twice as much current as the Side Scanner is consuming with the excess going to charge the GEL-CELL battery. This would be enough to indefinitely carry it through the night hours. Although a 12V, 16 amp hour rechargeable GEL- CELL battery is supplied with each system, any 12V battery of equal or greater capacity may be used. The supplied battery, when fully charged, will operate the Side Scanner for approximately 300 hours, or about 2 weeks, day and night, with no solar charging. Internal protection is provided against battery overcharging in the event of constant full sun.

F. Fish Velocity Control

This thumbwheel switch controls the transmit repetition rate of the system. It has been observed that salmon migrate upstream at about 1.75 feet per second (ground speed). Since the switch is labeled in seconds per foot, the reciprocal of 1.75 feet per second is 0.571 seconds per foot so until new fish speed information is obtained, set the control to 0.571. To determine optimum velocity use the following formula after monitoring the oscilloscope for a minimum of 250 cumulative fish spikes:

$$\frac{\text{Fish counts on the SSS counter}}{\text{Fish spikes observed on oscilloscope}} \times \text{existing velocity} = \text{new velocity}$$

e.g., if the SSS count is 200 and the scope count is 250, 200/250 x 0.571 = .457, the new velocity setting. If the ratio of sonar counts to scope counts is within 0.8 and 1.2, do not adjust velocity. The reason behind this is as follows: When the side scan sonar is overcounting the fish are in the beam too long; the pulse repetition rate is too high. The solution is to decrease pulse repetition rate by dialing fish velocity up (remember, the velocity dial is the reciprocal of fish swimming speed). Likewise, when the sonar is undercounting, the fish are

F. Fish Velocity Control Cont.

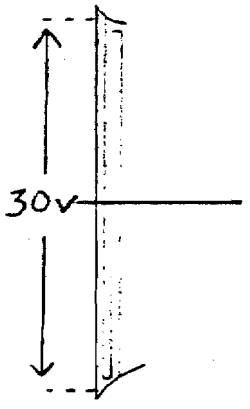
not in the beam long enough; the pulse repetition rate is too slow and the fish velocity should be dialed down.

It has been observed that at the lower extreme of the velocity setting (i.e.< .150) the side scan sonar counters tend to function erratically. Such settings should be avoided. If undercounting problems persist at higher settings, the transducer may be misaimed or the sensitivity set too low.

G. Sensitivity Control

This controls the amount of power transmitted to the transducer and is essentially a system sensitivity control.

To adjust it initially requires a fine bladed screwdriver or knife and an oscilloscope. It is adjusted as follows:




(1) Connect the oscilloscope input to the red test point on the panel marked XM2°. Set the vertical sensitivity of the scope to 5V per division and the scope trigger to internal. Set the horizontal scope sweep speed to 50μsec per division. Make sure the transducer is properly connected and in the water.

(2) Set the beamwidth switch to 2°. Adjust the front panel sensitivity control for an average peak to peak (top to bottom) signal of 30V. It will look something like the waveform at left so adjust for an average as shown.

(3) For a quick method to check sensitivity set the volts/div to 5 and time/div to 50μseconds. Turn both red "fine tuning" knobs fully clockwise. Make sure the lever on the for right of the scope face is in the bottom position (EXT TRIG OR HORIZ - DC). Plug the scope trigger lead in the XM2° test point and the vertical input lead in the back of the external trigger lead.

(4) A sensitivity setting of 30 volts is only a starting point and may be adjusted depending on individual situations. If the counter is undercounting, it may help to increase the sensitivity. However, at settings ≥ 60 volts minor bits of debris and water turbulence may cause false counts, so care should be taken not to set the sensitivity too high. Cloudy or muddy rivers usually require a higher sensitivity than clearer rivers.

H. Dead Range Control

This controls the distance from the face of the transducer that the system is "blanked out". That is, any echoes received within

H. Dead Range Control (Cont.)

this preset range will not be accepted for processing. The control may be set from 0 to 10 feet. This control is necessary to blank out transducer "ringing" which occurs for about 2-1/2 feet and would result in false counts. Sometimes a source of air bubbles near shore exists which could false counts. In this case, increase the DEAD RANGE control until the count stops in sector 1 (as evidenced by the #1 fish light blinking). The fish would then have to be weired out to beyond the dead range.

During periods of extreme high water false counts may register in the first one or two sectors possibly due to increased water velocity, increased turbidity or a combination of the two. In this case the dead range may be dialed out to 3 or more feet to avoid overcounting until the river returns to a normal level.

I. Counting Range Control

This controls the total perpendicular distance to which fish counts will be accepted. This preset distance starts immediately after the DEAD RANGE ceases, thus the total range from the face of the transducer is the total of both the "DEAD RANGE" and "COUNTING RANGE" settings.

J. Transducer Aiming

The end of the artificial substrate contains a target, approximately 60 feet from the transducer face. This is necessary for initial aiming of the transducer beam. Prior to submersion the transducer plate should be flushed on all sides with the transducer housing. This can be accomplished by "feel" or using a straight edge.

An oscilloscope should be used in lieu of the #12 FISH LIGHT for more precise aiming. To do so, trigger the oscilloscope from the XM2° panel test point, connect the scope ground to the GND test point and the scope input to the RCVR test point. Set the scope vertical control to 1 V/CM and the horizontal control to 5 millimeters per cm. 1/. The target will be observed on the scope 24 milliseconds from the start of the trace and the transducer may be manipulated for a maximum "spike" at that point. If the transducer is aimed to low, early echoes coming from rough surfaces on the pipe will be seen before 24 milliseconds.2/

The new (1978) artificial substrates have an improved method of transducer adjustment and have transducers modified for the new substrates (see figure on the last sheet.) The transducer plate

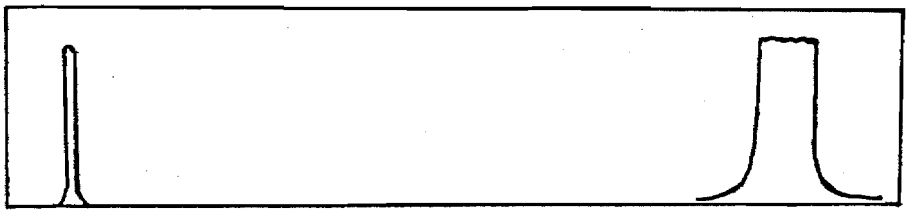
1/ See section titled Oscilloscope Operation for the Side Scanner.

2/ See section titled Typical Side Scanner Oscilloscope Waveforms for various transducer aiming conditions.

J. Transducer Aiming (Cont.)

should be installed in the shroud on the shore end member. The 3 studs attached to the plate will be secured to the plate with the 3/8-16 locknuts. Use lockwashers and tighten with channel lock pliers. About 1 1/2 inches away there will be a 1/2-20 nut followed by a flat washer, a spring and flat washer in that order. The three studs should be pushed through the three corresponding holes in the shroud with the last flat washer against the inside of the shroud. A hand wheel should then be screwed onto the outside of the shroud on each of the portruding studs. Extreme care should be taken when installing or removing the transducer from the housing as the springs tend to fall off and get lost in the river. To avoid this, tape the springs to the studs with a small piece of tape. The transducer and transducer cables should be fed over the top of the transducer and back to shore, securing them with tape to prevent chafing and to provide a little service loop to prevent their being torn off the transducer. The three hand wheels should be tightened with an equal amount of stud protruding through the wheel. The transducer will now be approximately aimed at the target end 60 feet away. (The remaining three hand wheels should be used after final transducer adjustment by running them up the stud and tightening them against the first wheel to lock them in place.)

To aim the transducer with the oscilloscope, set the beamwidth switch to 2° and the counting range to somewhat over 60 feet so that the target is counted (the #12 sector light will constantly blink). The beam should be low enough to just miss counting reflections from the pipe itself. To raise the beam, screw the upper wheel clockwise (to the right) one turn for each 3/4 foot beam movement 60 feet away (or counterclockwise to lower it). The scope trace should appear relatively clean (free of spikes) on 2° and show a few small spikes at the end of the substrate on 4° (see section titled Typical Sice Scanner Oscilloscope Waveforms for schematics of various transducer aiming conditions). A typical schematic of a strong target on 2° beam (expanded horizontally) is shown below:



transducer face target

A good target is broad and flat across the top and not varying in height. Once the target has been adjusted vertically it can be adjusted horizontally. To move the beam to the right, turn the lower right wheel clockwise and the lower left wheel the

same amount counterclockwise at the same time. To move the beam to the left, reverse the procedure. Horizontal movements should involve exactly the same amount of turning on each wheel to avoid "skewing" the beam out and up or down. Each full turn of both wheels together will move the beam horizontally 1 1/2 feet. By turning them together, the vertical aiming remains unchanged. Likewise, adjusting the upper knob does not affect horizontal beam movement.

From the "flushed" position, the transducer should be moved up or down stream as much as necessary to achieve a strong target. In a strong current the pipe tends to bow out so the transducer may need to be aimed a bit upstream to compensate. In cases where fish tend to migrate close to the surface over the substrate, the beam may need to be aimed high and downstream. Frequent monitoring of the oscilloscope and experience with aiming are the surest means of achieving a good target and counting maximum numbers of fish.

It has been observed that when water level rises considerably over a short period of time the target becomes weak or disappears completely. This may be caused by the increased velocity bending the tube, requiring an adjustment of the horizontal position of the beam. If no target can be found when making vertical adjustments of the beam, it may be due to irregularities of the river bottom. If the end of the tube is hanging over a ledge or if the tube is resting on a rock, the target end will be lower than the rest of the tube and may not be locatable by aiming the transducer. In this case the beam should be aimed low enough to just avoid reflecting echoes from the surface of the tube. When no target can be found at all and the printouts are all zeroes, it may be that a large piece of debris is lodged on the transducer, blocking transmission of the beam. This should be checked before adjusting the transducer.

K. Cumulative Counter

This counter maintains a running total of all counts. It is an 8-digit counter and being of the L.E.D. type, consumes a fair amount of power when lit. For this reason a "READ" pushbutton is provided below it to read the total when desired. To clear the cumulative counter, shut off the SAFETY switch and depress the CLEAR pushbutton located below the counter. The alarm will alert you that the SAFETY switch is OFF.

L. Safety Switch

This switch is an interlock provided to prevent accidental clearing of the data or accidental resetting of PRINTER time or

AUTOMATIC TEST time. Whenever it is left in the OFF position the sounder will sound, alerting you to this fact.

M. Sounder

The sounder will alert you whenever any of the following three switches are left in the "wrong" position to prevent walking away from the unit in that condition: (The sounder will "click" whenever a fish is counted).

a. Sounds when "DATA" switch is left OFF.
b. Sounds when "PRINTER" switch is left OFF.
c. Sounds when "SAFETY" switch is left OFF.

Speaker may be covered when working to lessen obnoxious noise. However, the speaker is not a gum repository.

N. Test Pushbutton and Data Switch

The purpose of this test is to verify proper functioning of almost the entire system (except the transmitter). This button, when depressed, electronically simulates fish in the first 11 sectors. When the system is operating properly, the first 11 fish lights will blink, the sounder will sound, the cumulative counter and the 4-digit counter at left will record these counts. If only a partial system test is desired, without interfering with data already present in the memories or the cumulative counter, the DATA switch should be left OFF. This will prevent these "false counts" from being recorded but will permit the FISH lights to blink. When a full system test is desired at the cost of losing the data already present, the DATA switch may be left ON.

O. Fish and Sector Lights

The two red SECTOR L.E.D.'s indicate that the electronics logic card is probably functioning properly. The sector lights must always blink. If a light(s) does not blink, the cause may be merely a burned out light. This can be verified by dialing the large thumbwheel switch to the sector in question and simulating fish by depressing the TEST pushbutton with the DATA switch ON. If data is recorded in that sector, it merely means that either the light is bad or the L.E.D. card in the system is bad, which will not affect proper operation.

To check sector 12, merely increase the RANGE control setting a few feet to "count" the target at the end of the substrate. The FISH lights will blink whenever fish are detected in the corresponding sector and the sounder will sound.

P. Automatic Test

This feature permits automatic self testing of the entire system

including the transducer and its proper aiming. It functions automatically each 12 hours (1978 and 1979 models can be set at 6, 12 or 24 hours. Set at 24 hours) as follows: To start the 12 hour timing sequence at any point in time, press the SET TIMES red pushbutton. This initiates both the printer and auto test times. Precisely 2 seconds after the normal printout 12 hours later, the system will go into an automatic test mode. It will automatically electronically simulate between 2 and 7 fish in each of the first 11 sectors and it will automatically extend its range by 3 feet, thus counting the artificial target 60 feet away and recording these counts in sector 12. It will then print out all these counts and the letter E in the second column to indicate a self start. 1978 and 1979 models will have letter I in the second column. None of these counts will enter the cumulative counter at right, and will be erased right after the print.

Q. Test Points on Panel

The test points have the following purposes:

1. XMALT. This test point is connected to the 4° section of the transducer which shows the transmitted voltage when the unit is transmitting at 4°.

2. The XM2° test point is directly connected to the transducer sector that is selected by the beamwidth switch and permits oscilloscope reading of the transmitted voltage, thus checking the transmitter card in the system. The 4° transmit will always by considerably higher than the 2° transmitted voltage except when the beamwidth switch is set to 2°. When the BEAM WIDTH switch is in the ALT position, the transmitted voltage can be seen to alternately go high and low as the 2° and 4° sectors are automatically selected.

3. RCVR test point. This test point is the receiver output and gives a true "analog picture" on an oscilloscope of what is happening in the water. Any echoes received are amplified and presented at this test point. Any time the echo exceeds 3 volts at this point for the proper pre-programmmed number of "hits" it will result in a count. To use this feature, the scope input is connected to the RCVR test point, the scope ground connected to the GND test point and the scope may be triggered from either the "XM" test point which permits observation of the entire 60 feet or from any one of the "SCOPE - TRIG" test points which starts the scope trace at the beginning of any of the 12 sector "listening times". The scope trigger must be set to - . By doing this and properly expanding the scope sweep speed, any one or more of the 12 sectors may be individually observed.

R. Beamwidth Switch

This switch electronically controls the transducer beamwidth by connecting only the center section of the transducer for a 4° beamwidth or paralleling both the center and outer transducer sections for a 2° beamwidth. Any of the three modes may be selected, but for optimum coverage, the ALT position should be used since this tends to make the lateral coverage more uniform. When in the ALT position, the system alternately transmits on the 2° sector then on the 4° sector and back to the 2° sector, etc. After transmittimg on the 4° sector, only those echoes received during the first half of the active range are accepted (sectors 1 through 6). When transmitting on the 2°sector, only those echoes received during the last half of the active range are accepted (sectors 7 through 12). The system electronically gives more weight to sectors closer to the transducer face since the fish will be in the beam a shorter period of time because of the fact that the closer to the transducer, the narrower the beamwidth. Anumber of samples of each fish are taken, permitting different "aspects" of the fish to be sampled as it crosses the beam. A varying number of valid "hits" are required before the system "decides" the target is a fish and enters it into permanent memory. The number of valid hits required for detection is a function of which of the 12 sectors the fish was detected. For example, although a fish travelling at 1.75 feet/sec is sampled 9 times, if it is detected in sector 9, only 5 valid "hits" are required to count, so if 5,6,7,8 or 9 hits are made during the passage of the fish only 1 count will result.

This feature essentially eliminates downstream passing debris which typically is travelling at the river velocity which is usually much faster than 1.75 ft/sec and which would not be in the beam long enough to count. To prevent single debris counts occurring over a period of time from adding up to the number required for a valid fish count, the temporary fish decision memories are automatically cleared 4 transmissions after receipt of any single echo.

S. Debris Alerting

Any time 24 counts are made in any one of the 12 sectors in a 35 second period (starting from the first count), the system assumes that this cannot be fish and is probably a piece of debris hung up on the artificial substrate. When the next printout occurs, the corresponding sector column will contain the symbol " + " in the third column next to the sector identification number. After printout, the debris detector is cleared and starts out "fresh" again. If the debris is still present, the system will again accept up to 24 counts in 35 seconds and indicate " + " again. If the debris has washed away, it will resume normal operation.

NOTE: Some of the front panel switches are of the PULL TO CHANGE types. This is to prevent inadvertent changing of the switch positions. The switch handle must be pulled away from the panel and then changed. Make sure that the switch is firmly seated in the desired position.

## II. INITIAL SET UP AND SYSTEM TEST

To verify proper system operation when first turned on or anytime desired, do the following:

Before the battery is plugged in, which turns on the system, place the following switches in the noted positions:

(1) PRINTER OFF.

(2) TRANSDUCER NOT PLUGGED IN.

(3) SAFETY SWITCH OFF.

(4) METER SWITCH IN BATT POSITION.

(5) FISH VELOCITY to 0.571.

(6) DATA ON.

(7) ACTIVE RANGE to about 50 feet.

The remainder of the controls may be left in any position.

Next, plug in the battery and then press the SET TIMES pushbutton (this synchronizes the system). Some of the FISH lights may remain on. To clear the system, press and hold the red TEST pushbutton, noting that each of the FISH lights blink in sectors 1 through 11. The system is now cleared and ready for operation. At this time, the SECTOR lights should be blinking and the BATTERY CONDITION METER should be in the green. Press the two red CLEAR pushbuttons to erase any counts from the memories. Press and hold the red TEST pushbutton. This will simulate counts on sectors 1 through 11. Hold it in until a few hundred counts appear on the CUMUL counter. (You have to press the black READ pushbutton to see this.)

The next step will be to verify that counts have been registered on each section of the 4-digit liquid crystal display and that the printer is functioning, and that all counts agree. To do this, turn on the PRINTER switch and momentarily press the black PRINT COMM pushbutton. The printer should now print out 12 lines of data. The column at left will be the sector identification number and should sequentially read 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2. The next column should have

printed the letter "C". Dial the large black thumbwheel switch through its 12 positions and compare the numbers in the 4-digit numerical display with the corresponding blue printed columns. They should agree.

Next, add up the column of figures. The total should agree with the total CUMUL count within one or two digits.

Solar Panel

The purpose of the solar panel is to charge the 16AH GEL-CELL battery supplied with the system.

Mount the solar panel such that it will receive a maximum average amount of light throughout the day. Plug it into the side connector marked SOLAR PANEL, observing polarity (this means red to red and black to black). If the solar panel is connected backward, no damage will result, but the meter will read no solar charge when exposed to light. Put the METER switch in the SOLAR CHARGE position. If full sunlight is falling directly on the solar panel, the meter will be at the extreme right. In very cloudy weather the meter will probably be in the red. When it is at the red/green crossover point, the solar panel is supplying twice as much current as the system is consuming, with the excess going to the battery. This condition will be adequate to indefinitely carry the system through the night hours. Make sure no part of the solar panel is shaded because shading one cell is the same as shading the entire panel.

## III. TROUBLESHOOTING

Many complete sets of printed circuit card spares have been supplied to Alaska Department of Fish and Game. They contain pre-tested cards of every type used in the Side Scanner System. They are identified by a function name etched on the component side of the cards at the upper left corner of the card. The following table lists the P.C. card names and their functions to aid in troubleshooting.

| Printed Circuit Card Name & Location in P.C. Card File | Card Function |
|---|---|
| MEMORIES<br><br>(Slot 1 & Slot 2) These 2 cards are identical. | The memory cards store valid fish counts after the electronic decision has been made if debris or fish. They drive the 4 digit liquid crystal display and the printer. They have nothing to do with the cumulative counter display. The 2 cards are identical and interchangeable. The memory card in slot 1 controls the two most significant digits of the display and printer fish counts, i.e., the two digits on the left. The memory card in slot 3 controls the 2 least significant digits of the display and printer fish counts, i.e., the two digits on the right. |

| Printed Circuit Card Name & Location in P.C. Card File | Card Function |
|---|---|
| LOGIC<br><br>(Slot 5) | The logic card controls the system repetition rate (or "ping" rate). It controls the duration of the transmit signal, the 11 simulated fish counts for test, the automatic range extension during auto test, the counting range, the dead range, the smolt vs. fish function, the power to receiver, all the L.E.D. functions, the 12 sector scan, the cumulative counter, the sounder duration when fish are detected and the temporary memories which decide whether the echo detected is fish or debris. If debris, it is erased; if fish it is routed to the previously mentioned permanent memories cards for storage and then erased from this card. This card also controls the 2°, 4° and ALT beam routing in conjunction with the beam-width switch. |
| PRINTER<br><br>(Slot 7) | The printer card controls the printer time clock the printer command, the 12 print sequencing, the printer sector I.D. number printed on the left of the printed paper, the letters printed next to the left on the printed paper, the automatic self test timing, the erasure or automatic clearing of the data after print, the tape recorder automatic power turn-on for 3.6 minutes after each print, and makes the decision whether a very high rate of counts is fish or debris and if debris it tells the printer to print the symbol "+". |
| RECEIVER<br><br>(Slot 11)<br><br>CAUTION:<br>If this card is changed, it will be necessary to readjust the sensitivity screwdriver control on the front panel as discussed earlier in this manual. | The receiver card contains the receiver which takes the minute fish echoes, amplifies them 23,000 times and if the echo exceed a predetermined threshold it triggers a device which sends a signal to the temporary memory card for subsequent decision as to whether it was fish or debris. This card also contains a 9V regulator to power the entire system. It also controls the battery and solar charge meter and provides T.V.G. which means time variable gain which causes fish echoes detected far away to be amplified at a greater factor than fish close by since the echo decreases with distance in a log manner. This card also contains the transmitter which transmits a 515 kHz signal to the transducer. The card also contains part of the circuitry to electronically simulate fish in the first 11 sectors for automatic and manual test. The tape recorder power regulator is located on this card also. |

| Printed Circuit Card Name & Location in P.C. Card File | Card Function |
|---|---|
| LIQUID CRYSTAL DISPLAY CARD<br><br>Located on front panel. | This card contains a 4-digit liquid crystal display on the front panel. If it becomes defective it may be removed from the inside by removing the two retaining 6-32 nuts and replacing it with a spare display card. If this is done, be sure the two flat plugs that are inserted in its connector are firmly inserted in the new card in identical orientation. The display has an average life of about 7 years. It will be noticed that in cold weather the display takes longer to change its numbers. This is a normal characteristic of liquid crystal displays. |

Most of the card functions are self-explanatory so that in the event of trouble, a card may be replaced. Since many of the card functions are inter-related, a problem may sometimes not be definitely localized to a specific card and more than one card may have to be interchanged to cure the problem (one at a time).

To change a printed circuit card, disconnect the battery and solar panel. Remove the 6 screws holding the front panel and carefully lift the front panel straight up. It may then be turned and laid down next to the electronics.

CAUTION: The electronic components on the cards are susceptible to immediate destruction by static electricity. They should never be handled in an office where carpets generate static electricity.

Replace the suspect card with a new one and retest. The system can be operated in the open position so it will not be necessary to close the system to test it, but be very careful not to short anything.

To remove a card, pull up on the two card ejectors. To replace a card, press the card firmly down and hook the combination black card ejector/inserter under the ridge of the card file and push the two black inserters down. These will force the card into its sockets and may have to alternately be "rocked" until the card is firmly seated in its socket.

CAUTION: NEVER remove or replace a card with power from the battery or solar panel connected.

To replace the panel, reverse the removal procedure being careful not to

pinch any cables between the panel and the case. The 6 nuts are on sliding plates and may have to be repositioned with a knife blade if they were moved.

Some problems with the counter can be solved without changing cards. If the printer is malfunctioning, check to see that it is flush with the counter and thescrews are fully tightened. Also make sure the tape is feeding out smoothly. If it is pulled out crookedly, the paper will become jammed. If the printer begins skipping hours and changing cards does not help, there is plenty of paper, the roller is clean and the battery is tightly plugged in, the problem may be a faulty power inverter. This requires repair by Bendix.

## IV. SIDE SCAN ARTIFICIAL SUBSTRATE

### General Description

The array (Figure 1A, 1B and 3) is made up of three 18½ foot long sections of tubes that plug together with an 18 inch overlap forming a single tube. Offshore and onshore sections terminate the assembly ends. A ¼ inch diameter wire rope runs through the assembly and is pinned to the offshore cap. The onshore cap has a threaded shaft and handwheel which is used to provide tension holding the array sections together by tensioning the cable. Cable should be threaded on the downstream side of bolts which hold sections together. Alignment of the vortex shedding fins on each section is required in order to prevent oscillation or vibration of the array in fast currents. Install and tighten the ¼" bolts on the welded brackets. These will squeeze the slots together thus securing the pipes together. On 1978 and 1979 arrays tighten bolts to 45 ft/lbs (second bolt from target end - tighten to 20 ft/lbs only). If too loose, the array will bend excessively, allowing fish to escape under the beam. If tightened to greater than 60 ft/lbs the bolts will break or the tube deform.

NOTE: The bolts should be tightened with the pipe upside down from the way it will lie on the river bottom. This will help straighten the pipe.

The offshore cap provides the wire rope termination, has a water check valve used for blowing out and floating the array, mounts the offshore cable attachment point and has a target attached for acoustic signal alignment. The onshore cap has a 2 inch diameter hole in the end which is used to stake the array in position on the shore. A second 2 inch hole may be used to tie off the array for safety. A mount for the transducer is provided on the cap. Both vertical and horizontal adjustment of the transducer is possible. A ½ inch diameter x 2 ft. long bar is provided to use as a lever for aligning the transducer on the 1976 systems. The new systems have adjustment handwheels. Mount the transducer in the upper 3 holes of its housing. A traveler, attached to the cable swivel, rides on a bar preventing rotation of the cable when tightening.

NOTE: The cable must be as tight as possible to prevent array breakup in fast river. Hand tighten only.

A ½ inch threaded plug is provided for an air hose to blow out and float the array prior to removal from the river bed. Netting is tied to the lower vortex fin. 1/8 inch diameter holes spaced at 1½ inch intervals provide net tie points. Holes are provided on both top and bottom fins as installation on the opposite shore requires turning the array end for end and rotating 180°.

NOTE: It has been found by A.D.F.& G. that if no air is available, the array may be raised by allowing the pipe to tilt down inthe direction of the water flow. The fairings act as ailerons and will raise the pipe to the surface. Conversely, when sinking the array, the stake on the shore end should be attached via a "come-along" to a tree and should be tilted upstream a few degrees to help sink the array and hold it firmly on the river bottom.

Assembly Procedure for 60 Foot Array

1. Lay out the following parts on a reasonably level surface parallel to the river bed in the order listed. Leave 1 foot of space between parts.

   1 each Offshore Cap.

   2 each 18½ foot section with couplers attached.

   1 each 18½ foot section without coupler.

   1 each Onshore Cap (screw in tension screw handwheel all the way).

2. Attach swivel end of ¼ inch cable to eye on threaded tension screw.

3. Feed opposite end of cable (with eye) through the 18½ foot tube sections. Cable must pass through center hole in bulkheads (two places), and on downstream side of 3/8 inch bolts.

4. With the onshore cap transducer housing straight up, slip the first 18½ foot section onto the shore cap (male), reduced diameter, align the bolt holes and install ¼ inch diameter bolts. Fitting coupler sections into 18½ foot sections is made much easier by spreading the welded brackets apart with 2 or 3 disc brake pad spreaders. Before fitting sections together, coat the outside of coupler sections with clear silicone to prevent air leaks. Also coat both ends of bolts, cable anchor bolt, endplate and offshore cap. Be sure 18½ foot sections face in the right direction. Fins go downstream.

5. Install second and third section in similar manner. If couplings hang up and do not seat, the cable and tension screw can be used to pull the couplings together. However, care must be taken to align the fins during coupling insertion as turning the sections after complete assembly may be difficult.

6. Insert cable eye through the offshore cap and install cap on last section. Insert bolt. Target (curved projection) should be up.

7. Install end plate (with slot for pin) onto offshore cap. Cable should project through cap center hole and extend out about 12 inches if all couplings are seated.

8. Start to tighten the handwheel inside onshore cap until cable eye is aligned with slot in end plate.

9. Install pin through eye and seat in slot of end plate.

10. Tighten cable hand tight, using handwheel. All couplings should now be fully seated. When tightening, insert a long screwdriver in the far end of the swivel assembly to keep the traveler bar from twisting as the cable is tightened. The cable tightens by turning the knob counterclockwise and loosens by turning it clockwise. Two nuts should be screwed on both in front of and behind the handwheel to allow the shaft to turn as the knob is turned.

11. Install coupling bolts and cap nuts not previously installed. Tighten to 20 ft/lbs only; apply silicone.

12. Install end cap onto end plate covering cable.

13. All seams must be sealed to prevent air leaks when raising the tube. Apply silicone generously to each joint and wrap with insulation tape (such as 3M Scotchfill Insulation Putty Tape). Cover this tightly with gray 2" PVC tape, overlapping the seam 2 inches on each side. Place 2 connected 8 inch hose clamps on each side of the seam and over tape. Tighten clamps, being careful to keep clamp nuts to the downstream side of the tube and out of the beam path.

14. The array is now ready for placing into the river.

Array Installation Procedure

1. Before placing the array in the river, the chain anchoring the net should be tied up to prevent it from snagging on debris during deployment. It is easiest to thread a line through the links and tie it to the holes in the fins. This can be readily cut when releasing the net. Make sure the ½ inch plug on top and 3 inch floodcap on the side are in before putting the array in the water.

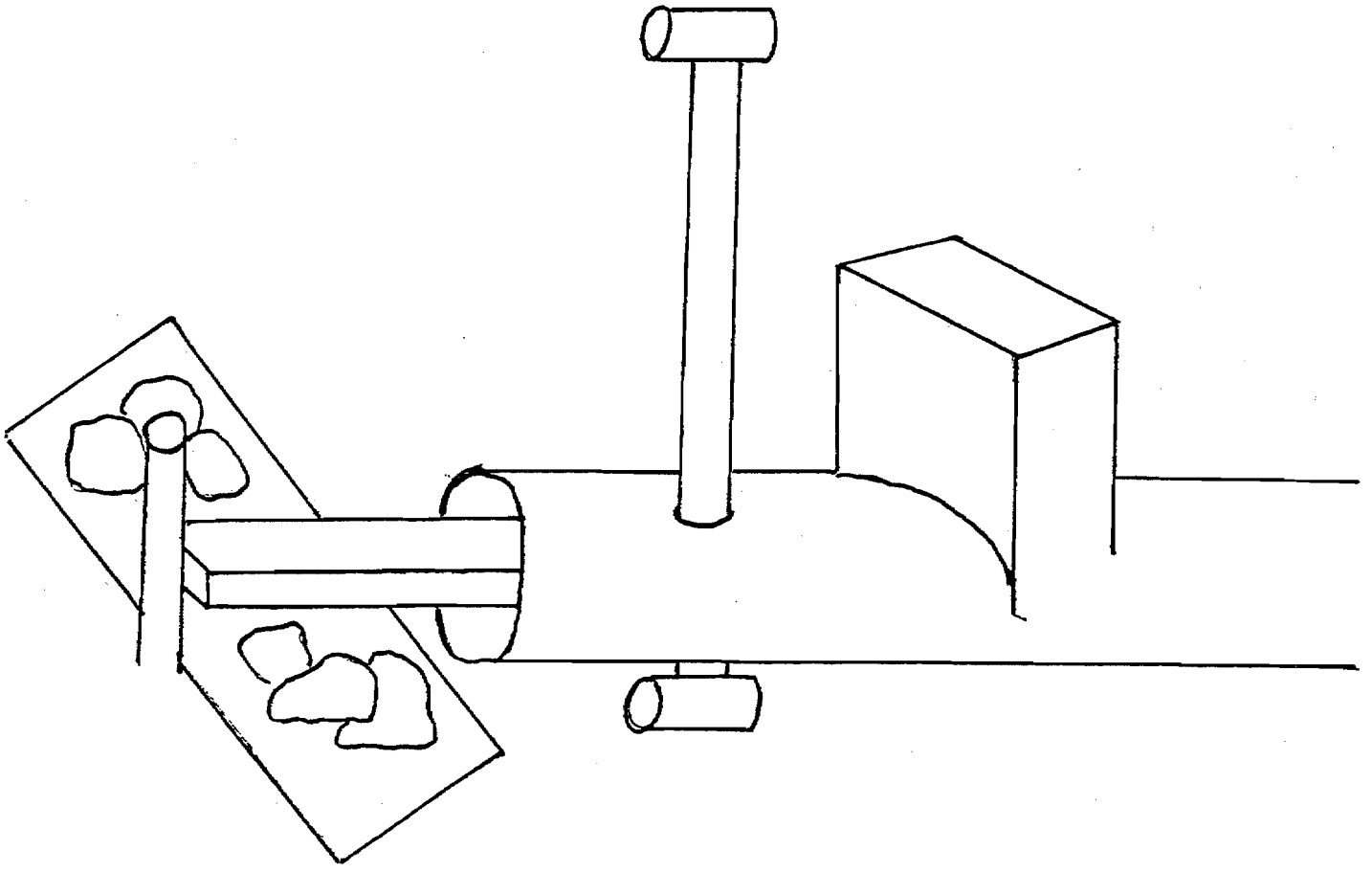
2. Attach an appropriate shore cable ¼ inch minimum diameter to upstream end of collar provided on offshore cap. The longer the cable, the easier it will be to move the array in and out. Attach the other end of the cable to a stake, tree or other available attachment point. CAUTION: In 7 foot per second currents cable tension of floating array will be as high as 850 pounds.

3. Attach another cable to the 2 inch hole on the upstream side of the inshore end of the array. The other end of the cable should be attached to a tree or stake onshore. Moving the array out will be much easier if the cable runs as closely to parallel with the bank as possible.

4. Once both cables are attached, the offshore end should be gradually let out, allowing the array to swing out into the current until it is perpendicualr to the bank. In fast rivers the current may tend to push the tube out parallel to the bank as the offshore cable is being let out. As a safety precaution against this, it is a good idea to tie a short rope from the standpipe to a stake or tree onshore. (The standpipe is a 4 foot x 2 inch O.D. steel pipe inserted in the 2 inch holes behind the transducer housing with T-caps screwed onto both ends. This allows easier movement of the array and is a handle by which you can "aileron" the array).

5. Someone on the onshore end should be ready to place a boom log in the end of the pipe to hold the array out far enough so that about 6 inches of water covers the top of the transducer housing. The boom log can be held in place by weights or stakes (see drawing below).

6. When in place, cut the line holding the chain up and remove the ½ inch plug on top and the 3 inch floodcap on the side to allow the pipe to sink.



## Array Removal Procedure

1. Blow out water in the array through the check valve located in the shore cap. This is done by removing the ½ inch pipe plug located in the shore cap and replacing with an air hose. Air pressure applied here (as from an air compressor) will force water out the check valve, floating the array.

   If no air is available, the alternate raising method described earlier may be used, i.e., allow the shore end stake to tilt forward (downstream) which will raise the array by the aileron action of the fins.

2. The floating array can now be hauled ashore either by pulling straight out or by pulling in the offshore cable.

## Array Disassembly Procedure, See Figures 1A, 1B and 3

1. With the array on a reasonably level area, remove the end cap.

2. Untighten (screw in) the handwheel inside the onshore cap. This will loosen the tension cable and allow removal of the pin on the offshore end plate.

3. Remove the end plate.

4. Drive a stake through the 2 inch shore cap hole into the ground. Also drive a second stake into the ground about 10 feet from the opposite end of the array.

5. Attach the "Y" cable to the offshore cap, see Figure 3. Install come-along between stake and "Y" cable.

6. Remove through bolt of first section to be disassembled (any order is OK).

7. Pull apart with come-along.

8. Install 2 eye short cable between sections pulled apart. See Figure 3.

9. Remove next through bolt and pull apart next section.

10. Continue process until all sections are pulled apart.

## General Caution Notes

1. Before placing array in water inspect check valve operation.

2. Cable must be tensioned before array deployment.

3. Do not turn array vortex fins into current in currents over 4 feet per second. Excessive load may damage array.

4. Installation of a cable around the onshore cap to a stake upstream on shore may be useful in a fast current river.

5. If corrosion prevents loosening of cable tension wheel on assembled array, the offshore cap pin may be driven out, after removal of the cap, thus releasing cable tension.

6. Handle exposed section ends with reasonable care to avoid nicks or tube distortion.

7. Be sure ½ inch diameter carriage bolt in coupling sections are tightened to 45 ft/lbs in order to eliminate coupling to tube clearance thus preventing array sag. Never exceed 50 ft/lbs.

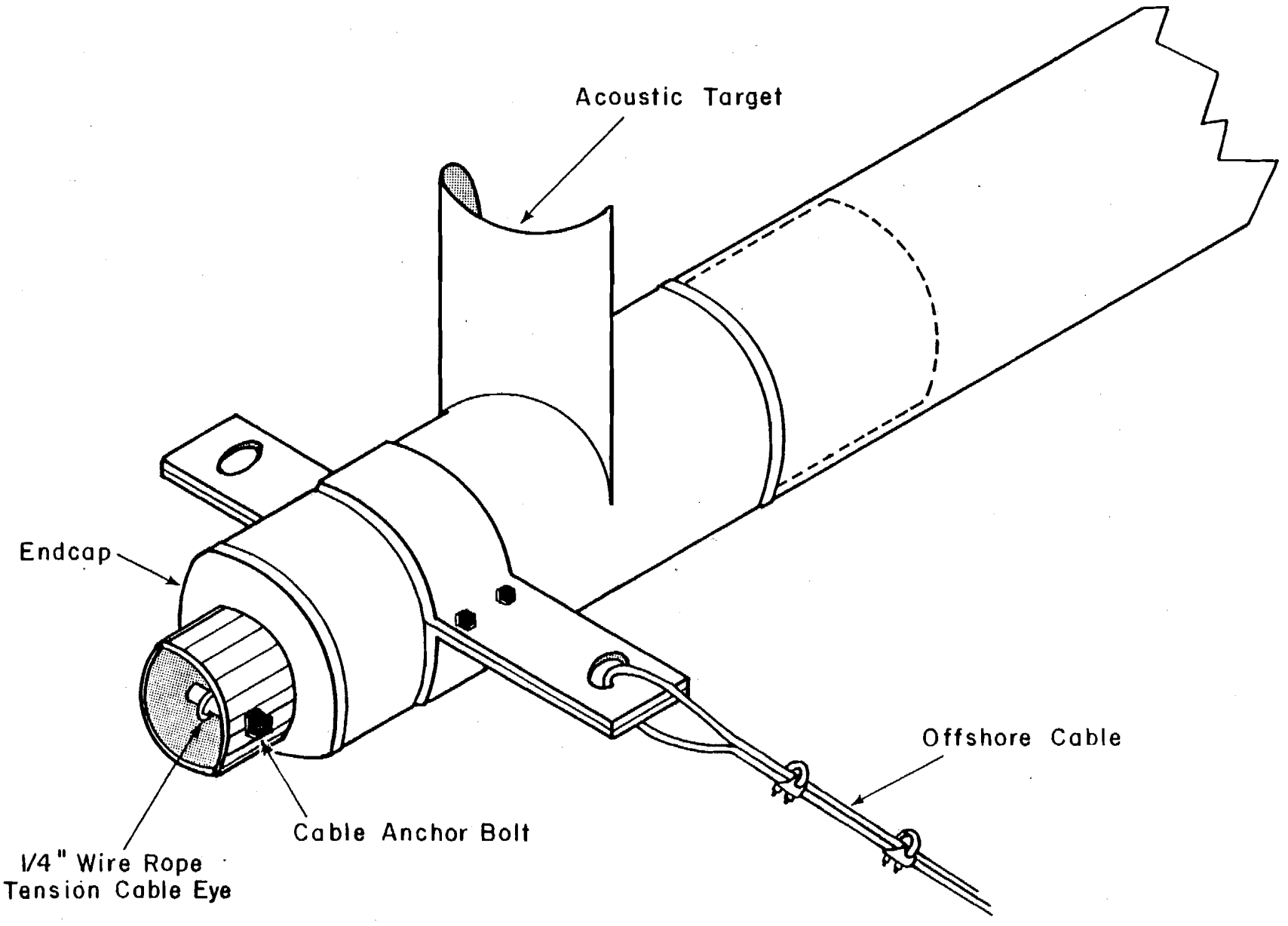
8. Transducer. The transducer, although reasonably rugged would be destroyed if dropped on a rock. Before use, the radiating polyurethane face should be washed with a detergent, preferably liquid detergent with the liquid left on the face. This cleans off finger oils. Any oil or grease will completely block the high frequency output and make the transducer inoperative. In some rivers, a buildup of various forms of "crud" may develop on the transducer face after a week or two, so a quantity of liquid detergent should be placed i the hand and the hand quickly put under water to rub the face of the transducer. This should be done whenever too much buildup of "crud" is felt or seen on the transducer face. A moderate amount of detritus will not affect normal operation.

Shortened Arrays

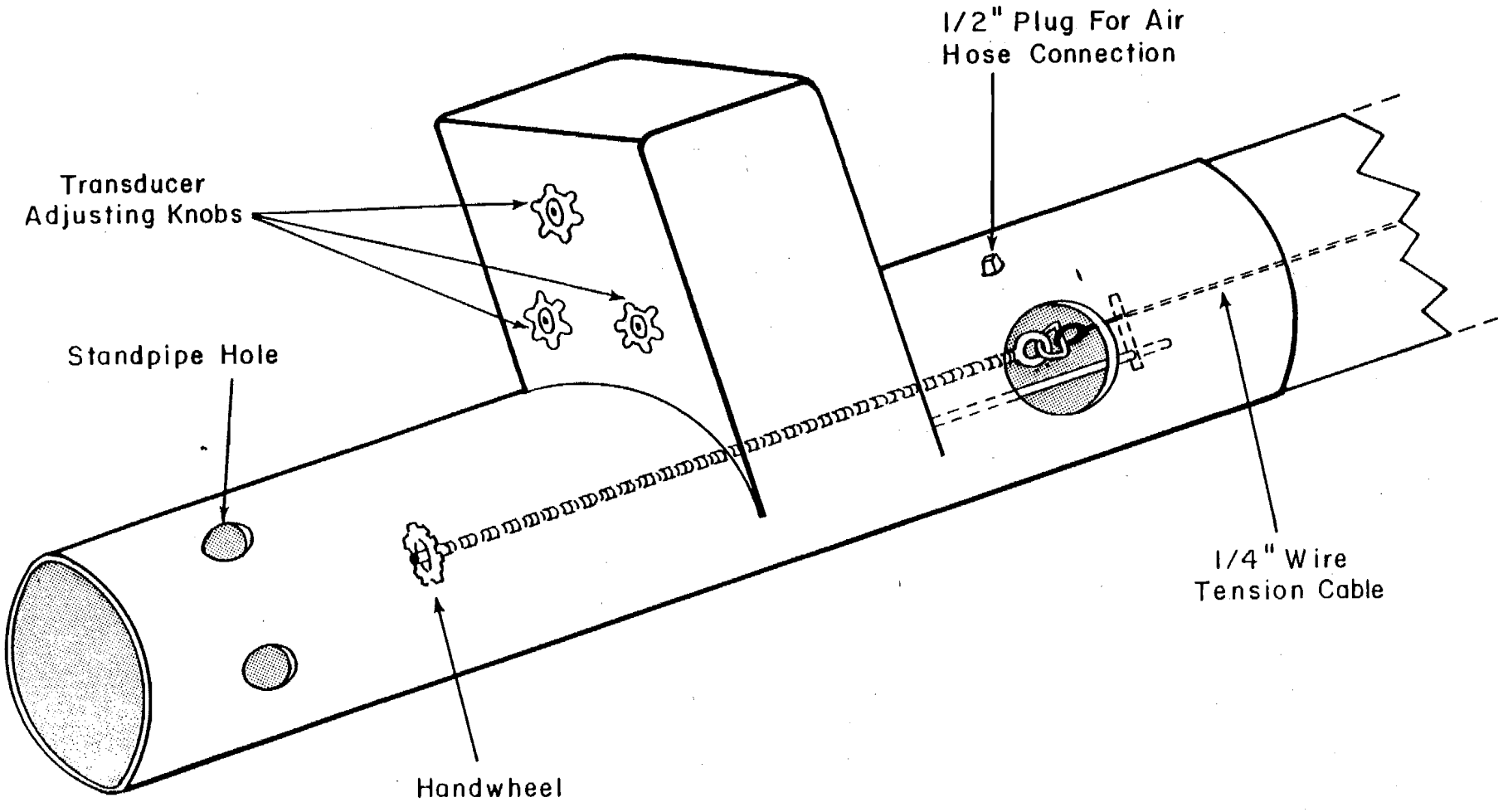
In situations where the current is swift or the fish hug the bank tightly it may be desirable to use only one or two of the 18½ foot sections to assemble a 20 or 40 foot array. Assembly procedures are the same as for a full size 60 foot array except that the inner cable must be shortened.

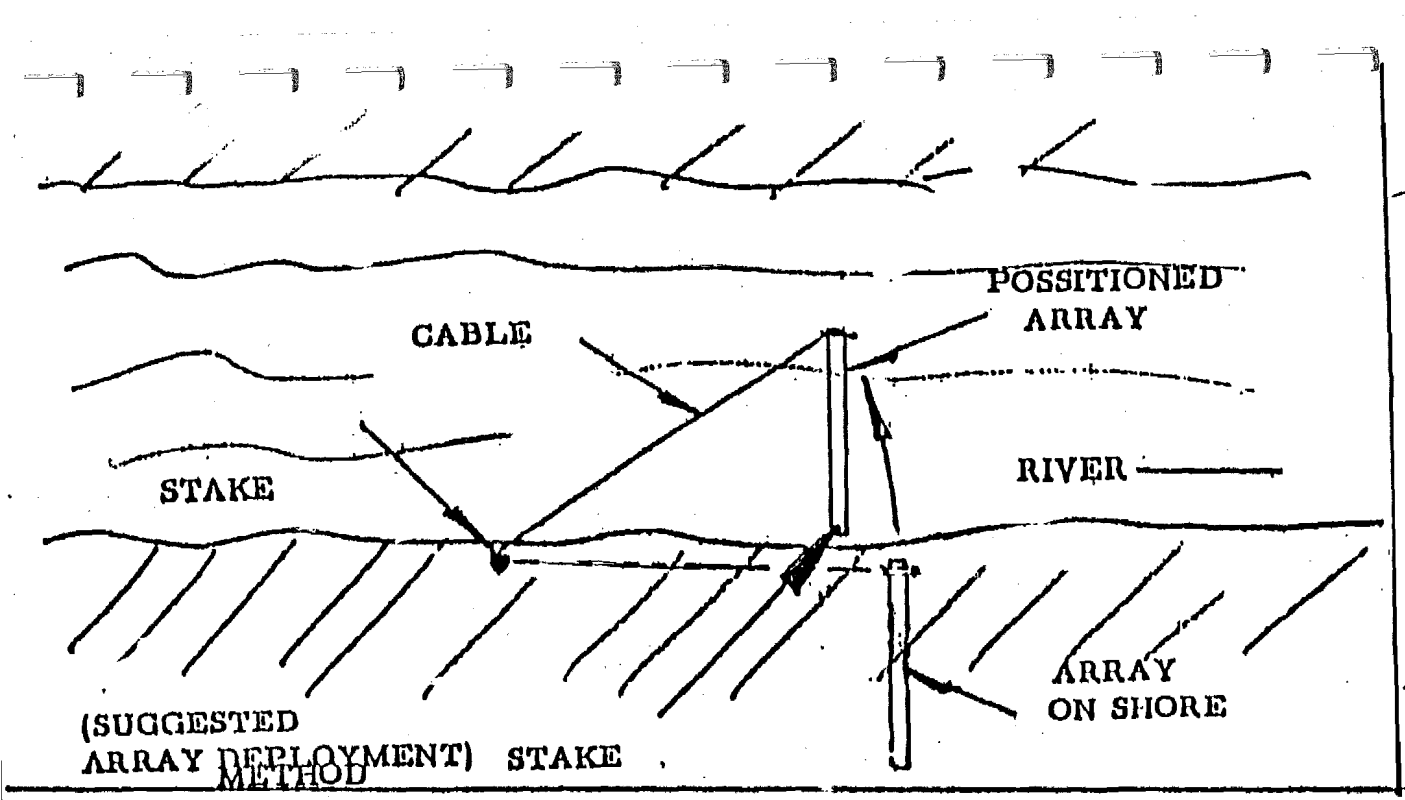
When using a 40 foot tube the beamwidth switch should be set to ALT and the counting range to a distance of about 38 feet. Beamwidth for a 20 foot array should be set on XM2° and counting range to about 18 feet.

# SIDE SCAN SONAR OFFSHORE CAP

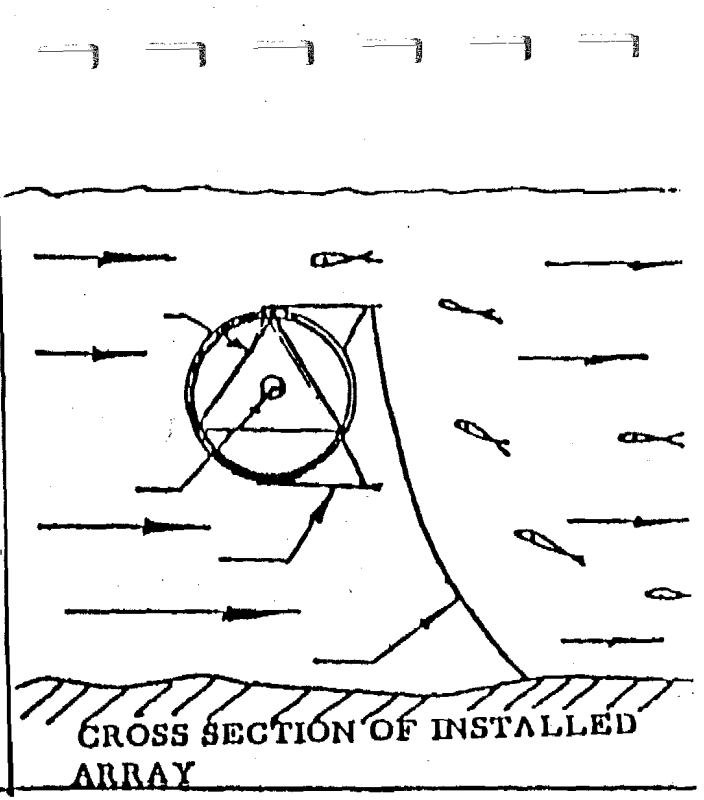


# SIDE SCAN SONAR ONSHORE CAP

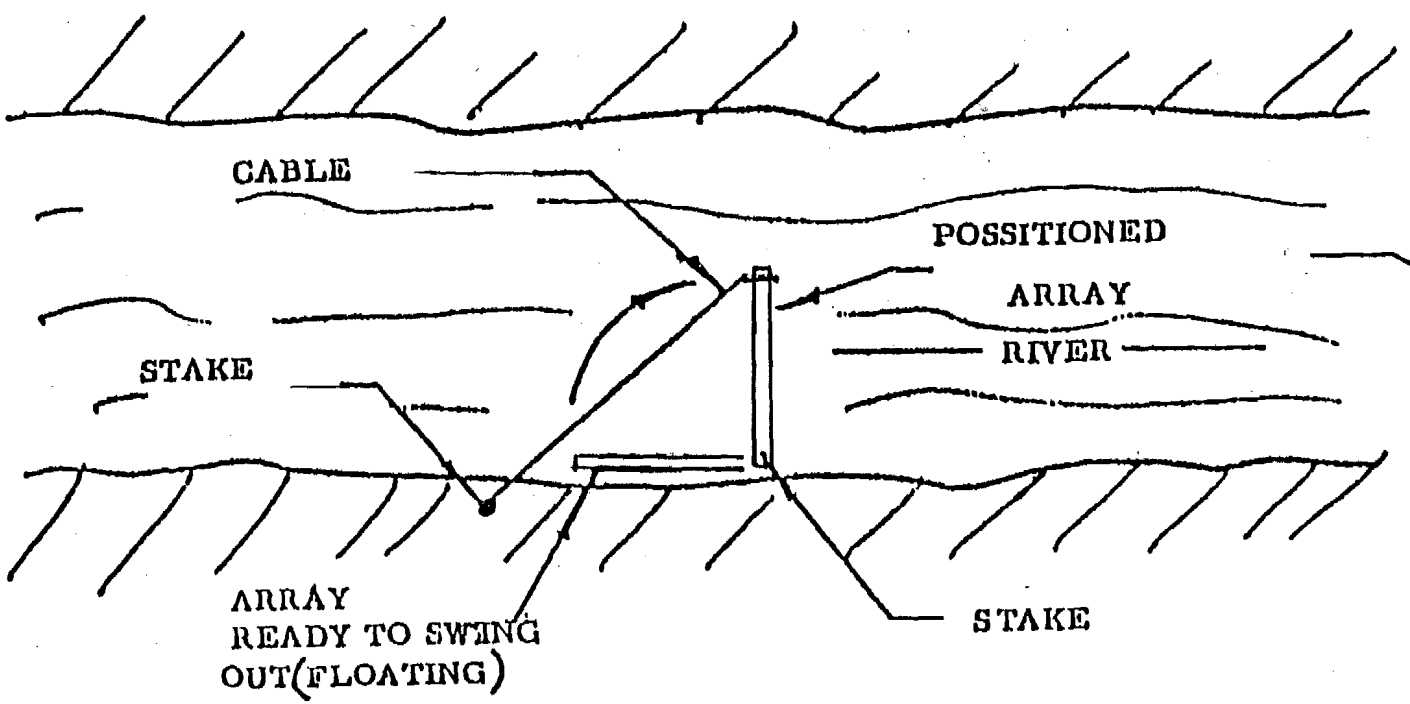


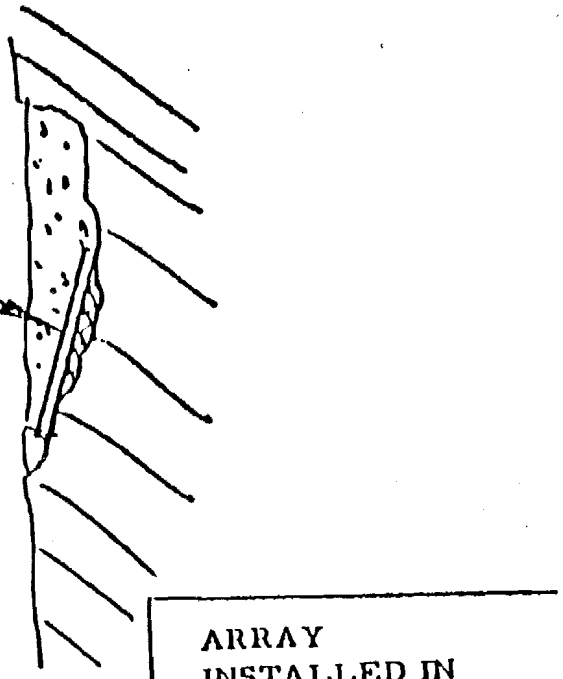



(SUGGESTED ARRAY DEPLOYMENT METHOD)



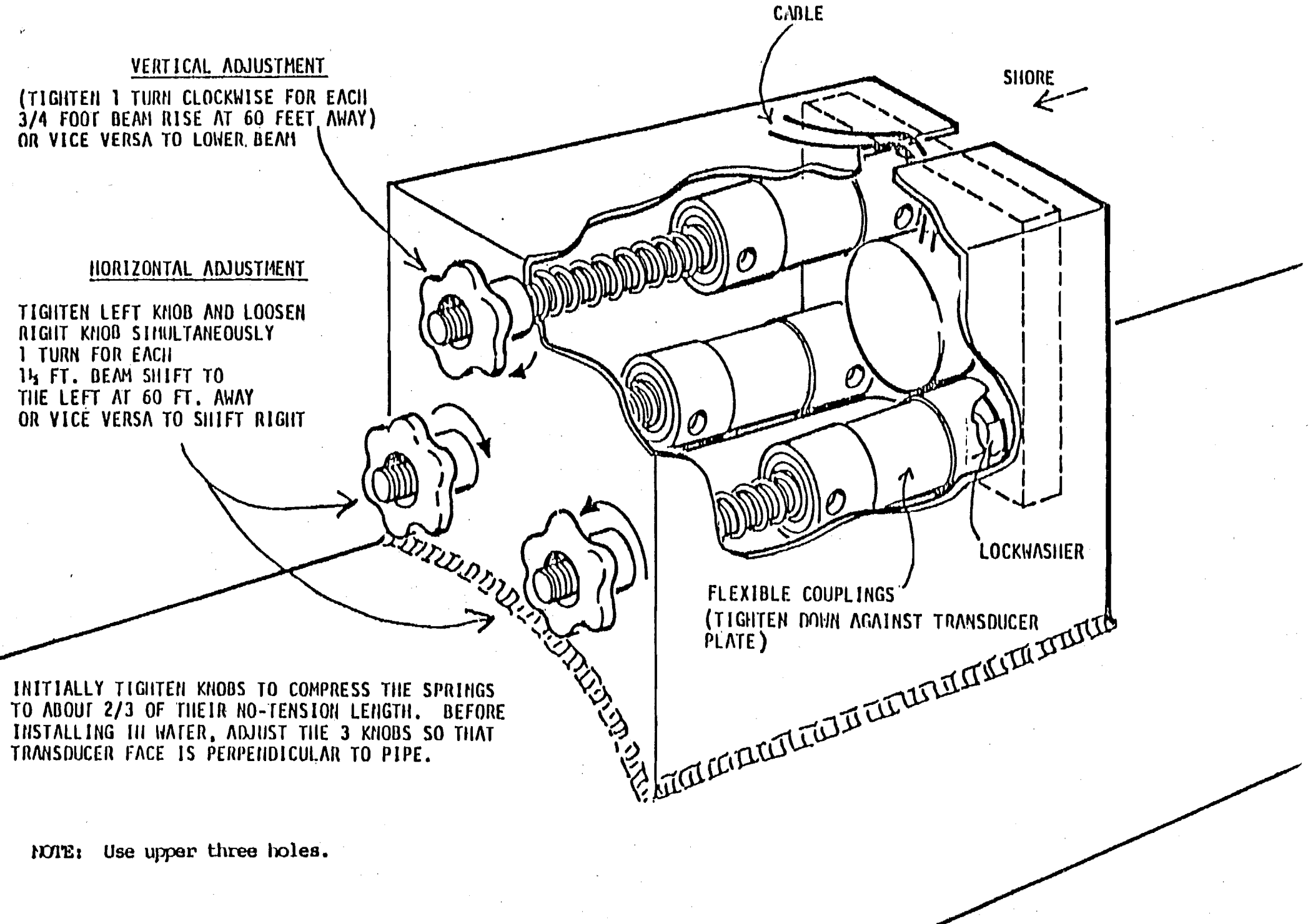
CROSS SECTION OF INSTALLED ARRAY



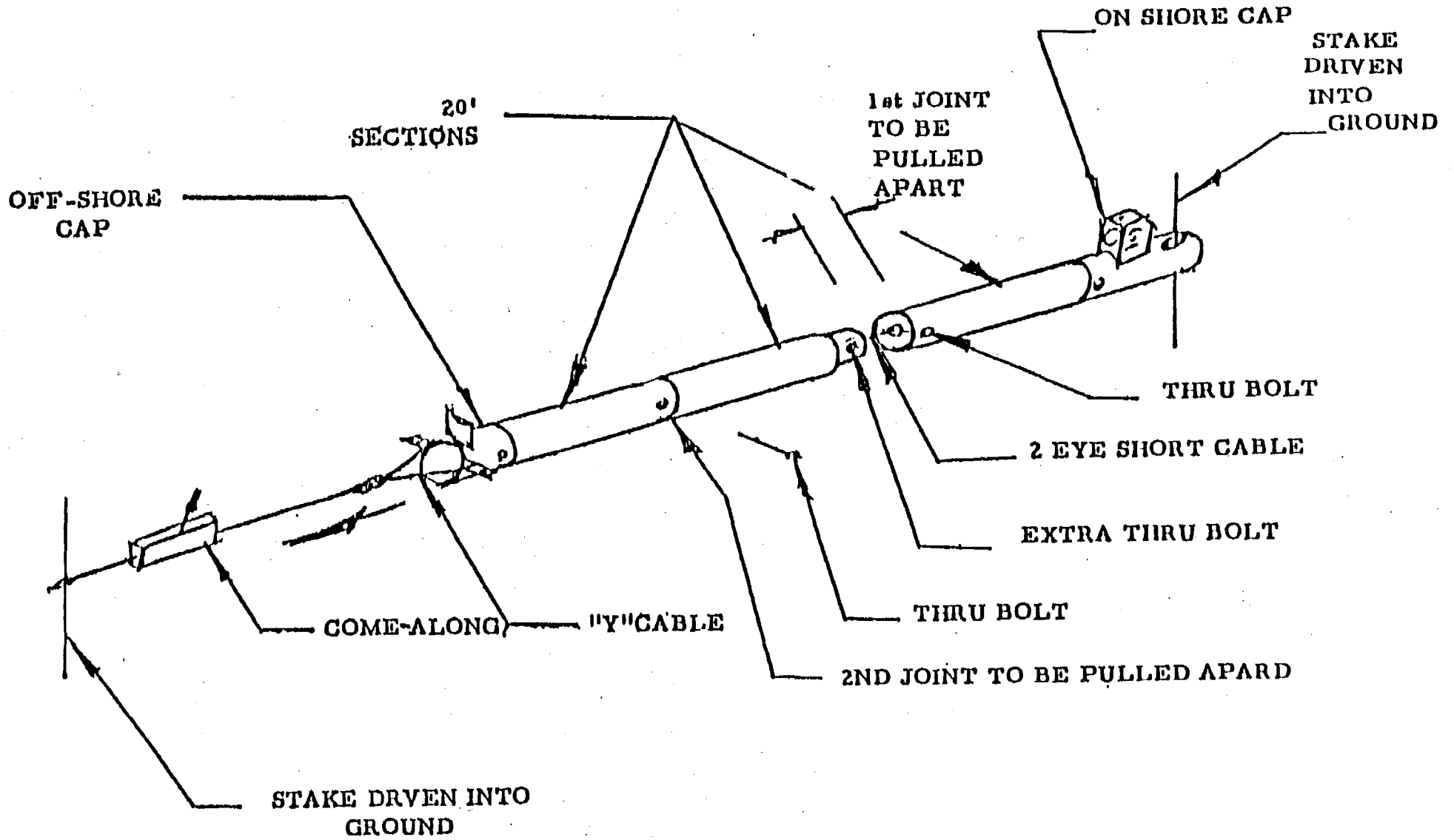



ARRAY INSTALLED IN RIVER

ALTERNATE ARRAY DEPLOYMENT METHOD
(SLOW CURRENT STREAMS)




NOTE: Use upper three holes.




ARRAY DISASSEMBLY

# APPENDIX 2

## ADULT ANADROMOUS FISHERIES STUDIES

### Oscilloscope Operation

July 16, 1979

A. Menin

# OSCILLOSCOPE OPERATION

for the

# SIDE SCANNER

This manual describes how to use the oscilloscope in conjunction with the side scanner. Although it is specificially written around the Tektronix model 323 "scope", the same basic rules apply to virtually any model scope except for the location of controls.

## THEORY OF SCOPE OPERATION

The scope is basically a time variable voltmeter. A bright dot moves across the screen at a constant rate from left to right. The speed at which it moves is determined by the TIME/DIV control setting on the scope. At most settings, the dot moves so quickly that it looks like a continuous horizontal line to the human eye.

The VERTICAL INPUT of the scope (on the left side of scope) is the same as the + & - input leads on a voltmeter except that a voltage connected to VERTICAL INPUT scope connector will cause an upward vertical deflection of the moving dot of light proportional to the amount of voltage at the input at the point in time that the moving dot happens to be when that voltage is connected. For example, if there is no voltage on the scope input for the first half of the trace, you will see a straight line. If a + voltage is then applied during the middle of the trace (or sweep as it is usually called), the bright dot will go vertically up to the corresponding place on the scope's face as determined by the VOLTS/DIV setting of the scope. Example: With a 2V/DIV setting, the dot would rise three divisions at the precise instant in time that you connected the + of a 6V battery to the scope's VERTICAL INPUT with the - of the battery connected to the scope ground.

## TRIGGERING

The bright dot on the screen requires an electrical voltage on the TRIGGER INPUT of the scope (on the left side of scope) to start the dot moving at the

rate (or speed) set by the TIME/DIV control on the scope's front panel. This trigger is required for each "sweep" of the dot. At the instant in time that a voltage is applied to the TRIGGER INPUT of the scope, the dot will start moving from left to right. This provides synchronization of what you see on the screen with the side scanner. In the case of the side scanner, the TRIGGER INPUT will be connected to either XM2°, XM4° (or XM ALT. in the latest version of the side scanner). Each time the side scanner transmits a "burst of sound", the transmitted voltage momentarily appears on the XM pin connector of the side scanner. At this instant in time, this voltage causes the dot to start moving from left to right. Since you will have the TIME/DIV set to 2 ms (MILLISECONDS) for proper operation with the side scanner, this dot is now moving across the screen at the rate of 2 milliseconds (2 thousanths of a second) per division. This of course is too fast for the human eye to follow so it looks like a straight line to the eye. Since sound travels (in water) at about 5000 feet per second which equals 5 feet per milliseconds (1 thousanth of a second), when the scope's VERTICAL INPUT is connected to the RCVR (receiver) pin connector of the side scanner, an echo (a vertical line) from a fish (or other object) 25 feet away from the transducer would be seen as a vertical line at 5 divisions from the left of the start of the sweep of the bright dot. This is because it took 5 milliseconds for the sound to travel the 25 feet to the "fish" and another 5 milliseconds for the "echo" from the fish to return to the transducer for a total of 10 milliseconds round trip travel time. Since the scope is set to 2 milliseconds per division, 10 milliseconds would be 5 divisions.

To see the metal target at the end of the pipe which is about 59 feet away from the transducer, you should expect to see this target 23.6 milliseconds from the face of the transducer (the start of the sweep) because at 5 feet per

millisecond travel time, it will take 11.8 milliseconds for the sound to hit the metal target and another 11.8 milliseconds for the "echo" to return to the transducer or a round trip travel time of 11.8 + 11.8 = 23.6 milliseconds. Since the TIME/DIVISION of the scope is set to 2 Msec/DIVISION, that would be just beyond the 10 divisions on the scope screen and would not be seen, so a fine variable adjustment knob located in the center of the TIME/DIV coarse control should be rotated a little counter clockwise so that the echo from the metal target can be seen on the scope's face. Rotating this small control counterclockwise increases the time per division to some amount greater than the 2 milliseconds per division that the coarse control was set to.

## SCOPE CONTROLS AND THEIR FUNCTIONS

1. POWER SWITCH-ON (see fig. 1) - CAUTION: Be sure to shut off power when scope is not being used since it draws much more power than the side scanner and would rapidly discharge the battery.

2. POWER SOURCE SELECT SWITCH (see fig. 2) - This is a small slide switch on the rear of the scope and should be pushed down to the EXT DC position which means that the scope is being powered by an external 12V from the side scanner.

3. VOLTS/DIV. ROTARY CONTROL (see fig. 1) - This switch may be set as desired for viewing the side scanner RCVR output. It should be set to either 1V or 2V. If it is set to 1V per division you may want to rotate the small "fine control" center knob inside the coarse control VOLTS/DIV to reduce the height of the vertical lines or fish echos to about 1 inch.

4. POSITION CONTROLS (see fig. 1) - These 2 controls merely affect the horizontal and vertical position of the scope display. You may want to set the vertical position control so that the horizontal trace of the scope is a little above the bottom of the screen and the first vertical line on the left

is about 1/4 inch inside of the screen. (This corresponds to the transmitted burst of sound or the transducer position).

5. INPUT LEVER SWITCH (see fig. 1) - This should be down (in the DC position).

6. TRIGGER LEVER SWITCH (see fig. 1) - This important switch should be in one of the 2 bottom external trigger positions, either AC or DC. This switch is located on the right side of the model 323 scope.

7. TRIGGER KNOB (see fig. 1) - This is probably the most important (and most often mis-set control). Its function is to assure that the start of the sweep of the scope picture exactly coincides with the instant the side scanner transmits its burst of sound. This will cause the transmit burst vertical line to be at the start of the sweep (the extreme left side of the trace). If this knob is rotated completely clockwise or completely counterclockwise, the scope trace will "free run", that is to say, it will never be synchronized with the transmit burst and therefore the transmit burst vertical line on the scope's face may occur anywhere along the scope sweep.

8. TIME/DIV. ROTARY CONTROL (see fig. 1) - This controls the speed at which the bright dot crosses the screen. For use with the side scanner, it should be set to the 2 Ms (MILLISECONDS) position.

9. ATTEN. SLIDE SWITCH (see fig. 1) - This switch is located on the left side of the scope. Although it can be operated in either position, stable triggering is a little easier to adjust if this slide switch is in the 10X position.

10. FOCUS AND INTENSITY (see fig. 1) - These two controls are located on top of the scope.

The intensity control should be rotated fully clockwise for maximum brightness of the trace. After adjusting the brightness, rotate the focus control for the sharpest vertical lines.

At night you may want to decrease the brightness. If you do, refocus the FOCUS control.

## OSCILLOSCOPE CONNECTIONS TO SIDE SCANNER

1. EXT. D.C. POWER (see fig. 2) - This twin connection is located on the right side of scope. This should be connected to the mating connector labeled "SCOPE" on the right side of the side scanner. CAUTION: This is the 12 volt power connection to the scope and does not have reverse polarity protection. If these leads are reversed, the scope will burn out instantly.

2. EXT TRIG. (see fig. 1) - This connector is located on the left side of scope. It should be connected to either the 2° or 4° (or ALT. in 1980 model side scanner). This is to provide triggering of the scope from the side scanner. Use either one of the supplied connector cables. The black pin on the connector cable is ground and may be connected to the gnd. pin of the side scanner or left disconnected if you like, since the scope will be grounded anyway through the power connector.

3. VERT. INPUT (see fig. 1) - This connector is also located on the left side of the scope. It should be connected to the RCVR connector on the face of the side scanner using the supplied connector cord which is identical to the ext. trig. cord. The black pin is ground and need not be connected to the side scanner ground since the scope is already grounded through the 12V power cord.

This is the vertical input to the scope and causes the bright moving dot of the scope to go up vertically when a voltage is present on the RCVR output of the side scanner as it would be when a fish echo is present.

## OSCILLOSCOPE ADJUSTMENTS

1. After all three connectors are in place (trigger, vertical input and external 12V power) turn on the scope power.

2. Turn the brightness control fully clockwise.

3. Place the rear slide switch in the down (ext DC) position (Fig. 2).

4. Place the ext. trig. switch on the left side of scope to the 10X position.

5. Place the inout lever switch on the scope face to the DC position (down).

6. Place the trigger lever switch (on the right side of scope face) down, to the EXT TRIG DC position.

7. Set the TIME/DIV rotary switch to 2 ms.

8. Rotate the small center knob inside the TIME/DIV switch about 1/3 of a revolution counterclockwise from its fully clockwise (detent) position.

9. Set the VOLTS/DIV rotary switch to 1 volt.

10. Rotate the small center knob inside the VOLTS/DIV switch about 1/3 of a revolution counterclockwise from its fully clockwise (detent) position.

11. Push in the 2 POSITION controls located on the bottom center of the scope face. These 2 rotary controls are also push-pull switches and should always be pushed in.

12. Rotate the trigger knob on the lower right side of scope face fully counterclockwise to its detent position. This will cause the scope to operate even without an external trigger so that you can adjust the two position controls.

13. Rotate the vertical position knob on the bottom center of the scope until the trace on the screen is about 1 division from the bottom of the screen.

14. Rotate the horizontal position control on the lower center of the scope face until the trace starts about one division from the left side of the scope screen.

The scope is now ready for final trigger adjustments.

15. Put the side scanner beamwidth switch in the 2° position and connect the EXT TRIG. cable to the XM2° pin connector on the face of the scope.

Rotate the TRIGGER knob on the right side of scope face to about the 10 o'clock position. Somewhere near this point, the scope should be triggering properly as evidenced by a stable vertical "spike" being seen on the extreme left (the beginning) of the scope trace. Now place the beamwidth switch on the side scanner to the Alternate position. The scope trace should look the same as it did in the 2° position meaning that you are still triggering only on 2°. If it looks different or seems to speed up or get brighter that means you are slightly misadjusted. If so, rotate the TRIGGER knob a bit until the scope picture does not change as you switch between the 2° to the ALT positions on the side scanners beamwidth switch.

Now put the EXT TRIG connector cord in the XM4° connector (or the XM ALT. on the 1980 model). When the side scanner beamwidth switch is in the ALT position the trace on the scope should now be triggering twice as fast (brighter) as in the 2° position since now you are alternately triggering the scope twice as fast as you were. You are causing the scope to alternately trigger on 2°, 4°, 2°, 4° etc. If you now move the EXT TRIG. cable connector back to the XM2° connector you will see a change in the trace since it will only be triggering on the 2° beam (half as often).

You should now see a stable vertical spike, about 1 inch high on the left side of the trace and you should see the metal target echo (about 1 inch high) near the right side of the trace if you increase the COUNTING RANGE control on the side scanner to beyond 60 feet. To operate the side scanner normally, you should now reduce the COUNTING RANGE control slowly until it just ceases to count the target (on sector 12) and then reduce it about one foot more for safety.

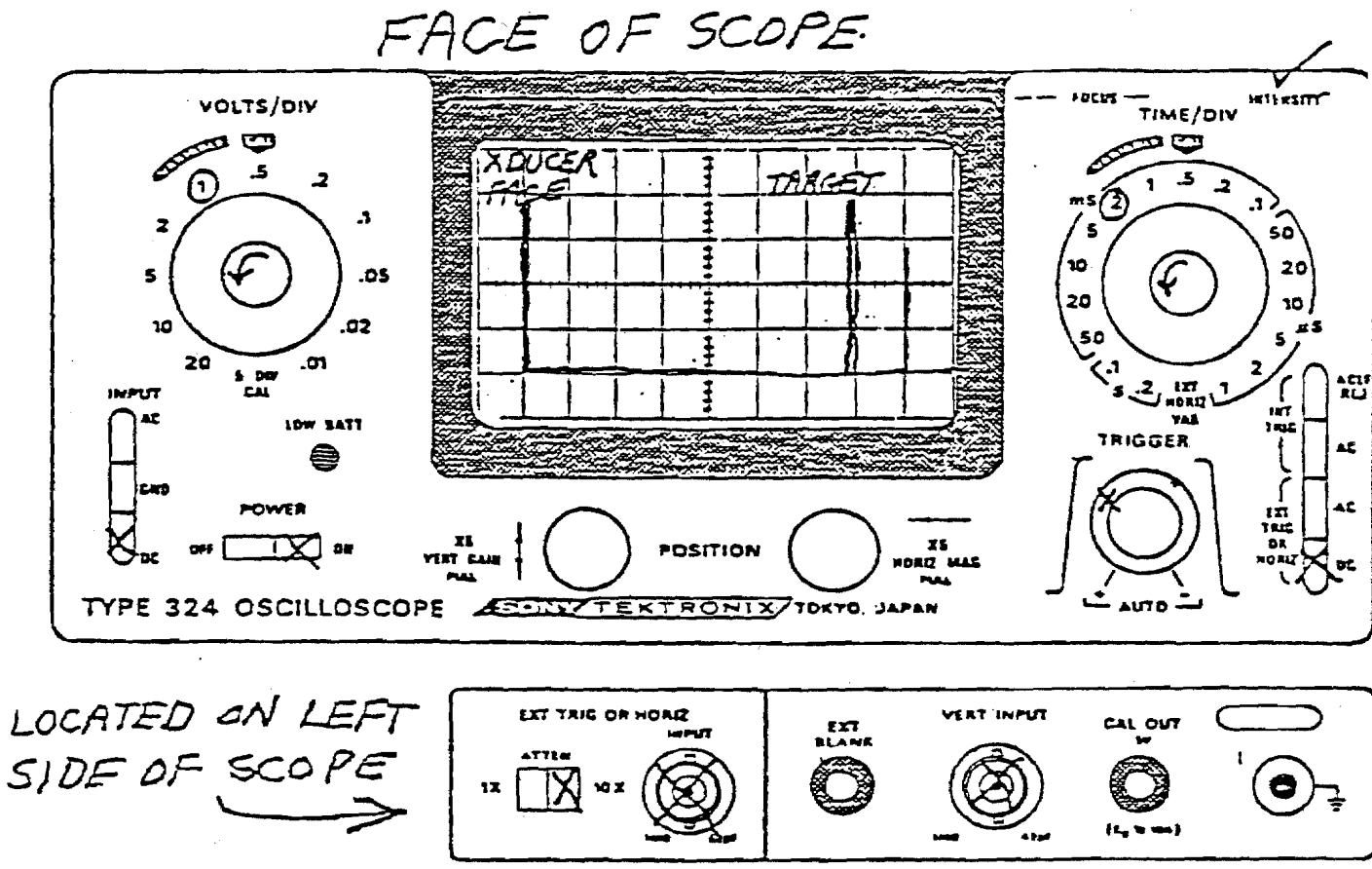



Figure II-1. Oscilloscope controls. Sony Tektronix type 324 oscilloscope.

FIG, 1

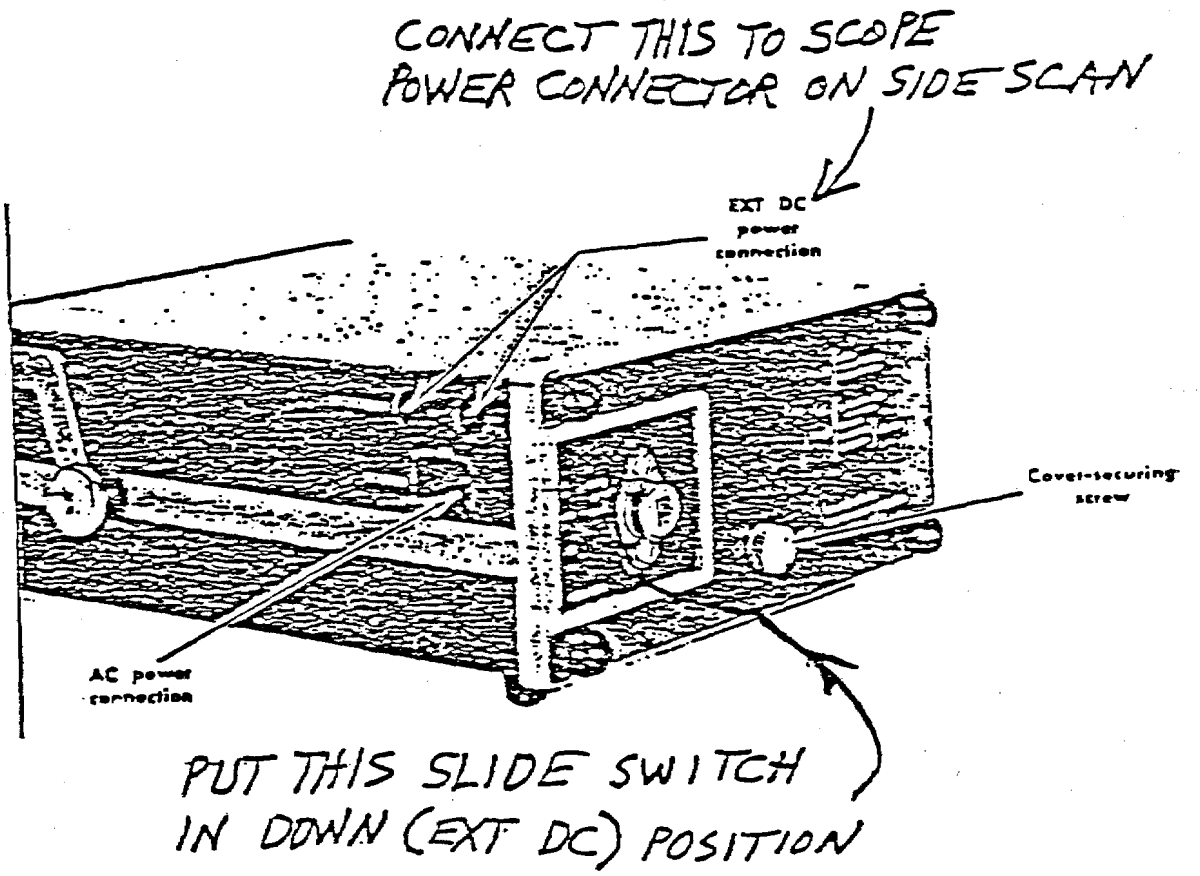
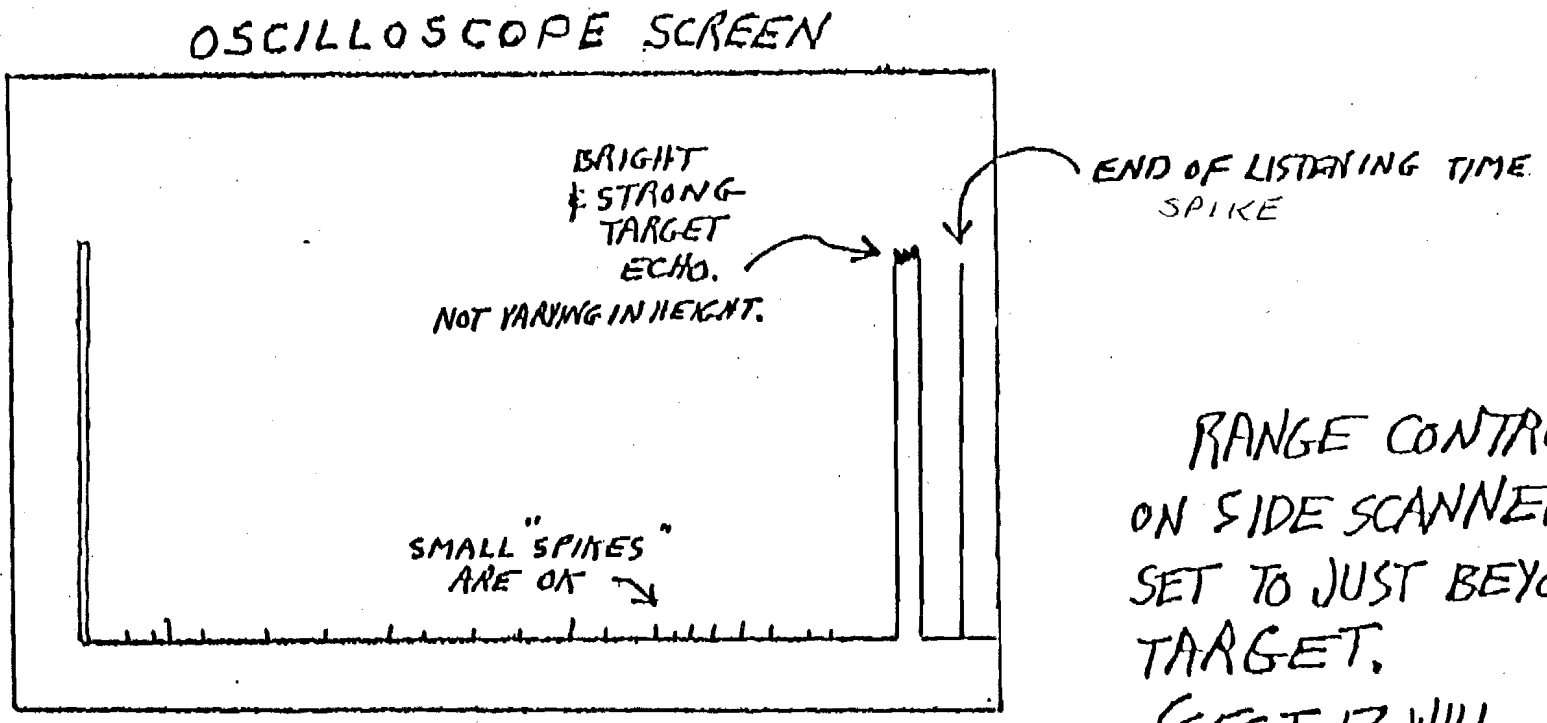



Figure II-2. Oscilloscope adjustments. Sony Tektronix type 324 oscilloscope.

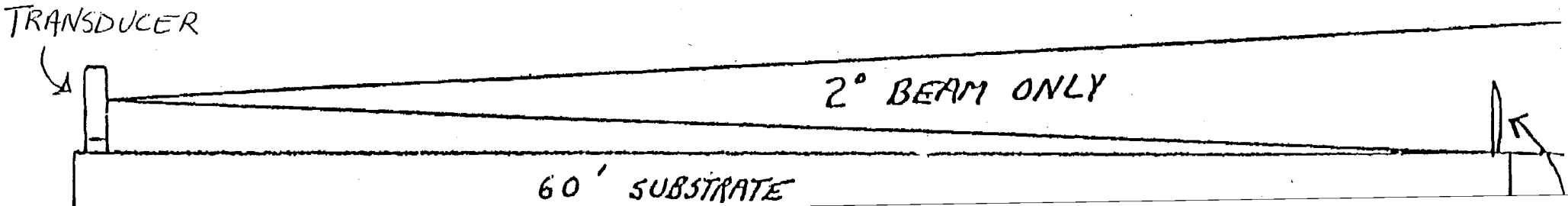
Table II-1. TYPICAL SIDE SCANNER OSCILLOSCOPE WAVEFORMS FOR VARIOUS TRANSDUCER AIMING CONDITIONS

| FIGURE # | CONDITION |
|---|---|
| II-3. | PROPER VERTICAL AIMING. 2° |
| II-4. | PROPER VERTICAL AIMING. ALT. BUT SCOPE TRIG. ON 4° |
| II-5. | PROPER VERTICAL AIMING. ALT. BUT SCOPE TRIG. ON 2° |
| II-6. | IMPROPER VERTICAL AIMING. (AIMED TOO LOW) |
| II-7. | IMPROPER VERTICAL AIMING. (AIMED TOO HIGH). 2° |
| II-8. | IMPROPER VERTICAL AIMING. (AIMED TOO HIGH). 4° |
| II-9. | IMPROPER HORIZONTAL AIMING. (AIMED TOO FAR DOWNSTREAM) |
| II-10. | PROPER HORIZONTAL AIMING. |
| II-11. | IMPROPER VERTICAL AIMING. (TOO LOW AND BOUNCING OFF SUBSTRATE |
| II-12. | ECHOS FROM BOAT WAKE |
| II-13. | IMPROPER VERTICAL AIMING IN SHALLOW WATER |




RANGE CONTROL ON SIDE SCANNER SET TO JUST BEYOND TARGET. (SECT 12 WILL COUNT)

Figure II-3. PROPERLY AIMED TRANSDUCER WHEN BEAMWIDTH SWITCH IS SET TO 2° AND SCOPE TRIGGERED FROM XMT 2°



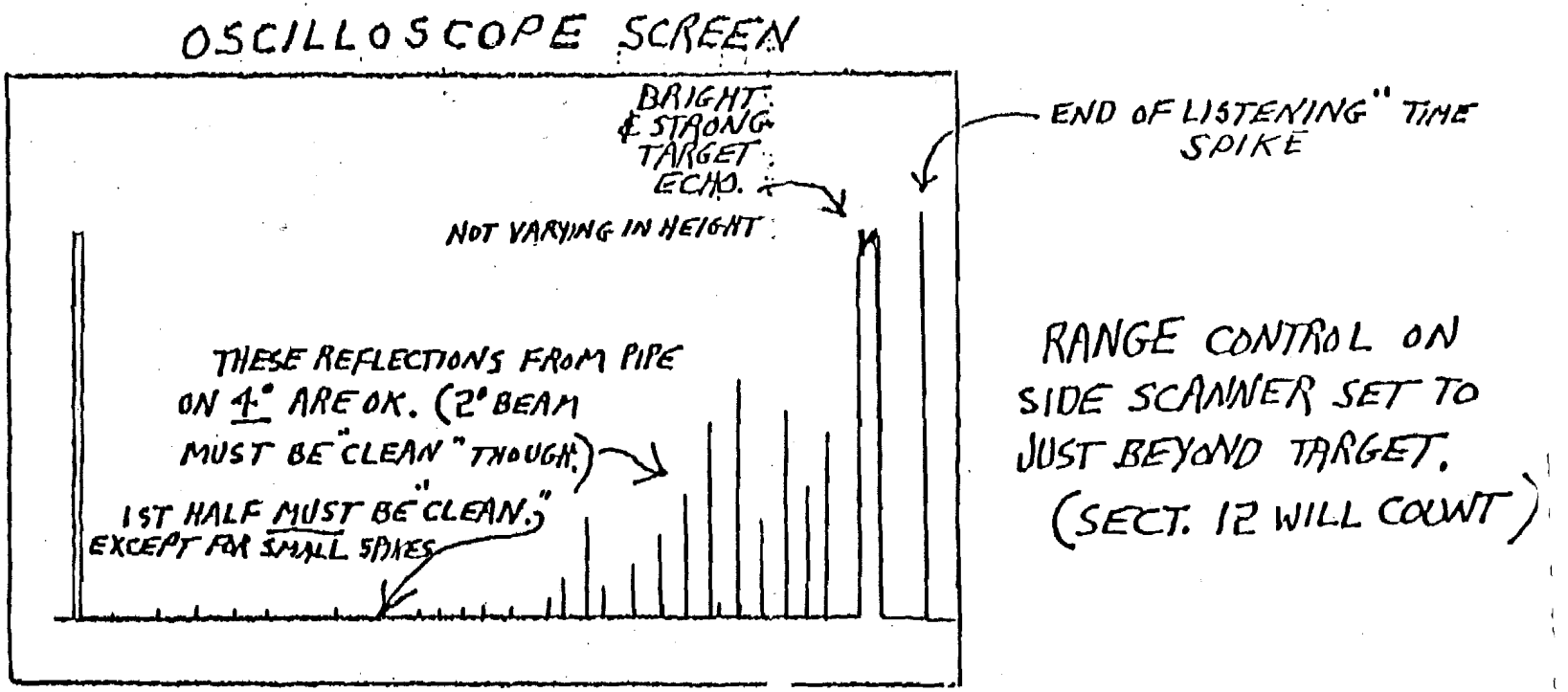
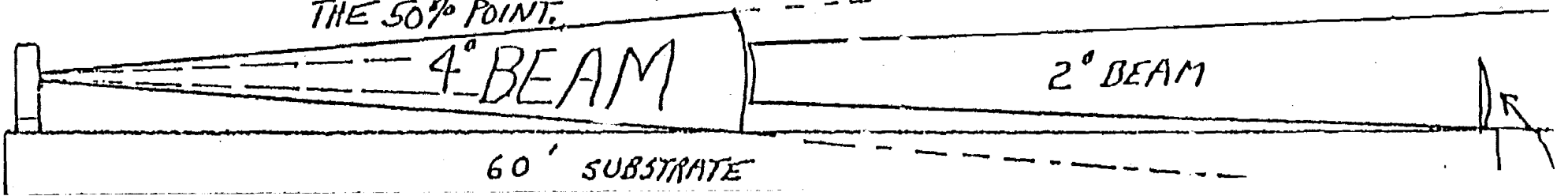



Figure III-4.

PROPERLY AIMED TRANSDUCER WHEN BEAMWIDTH SWITCH IS SET TO ALTERNATE & SCOPE IS TRIGGERED FROM XM 4°. NOTE 4° BEAM IS SKIMMING SURFACE OF SUBSTRATE BEYOND THE 50% POINT ON SUBSTRATE THUS CAUSING REFLECTIONS FROM IMPERFECTIONS ON SUBSTRATE SURFACE. THIS IS OK, SINCE THE 4° BEAM WILL NOT COUNT ANY ECHOS BEYOND THE 50% POINT.



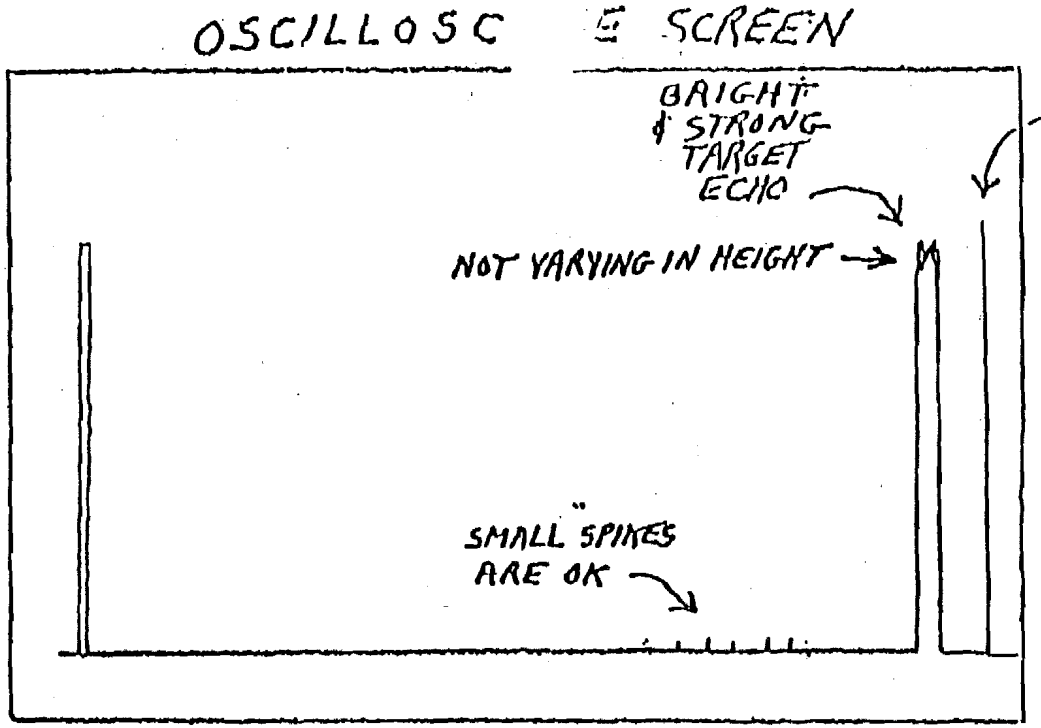
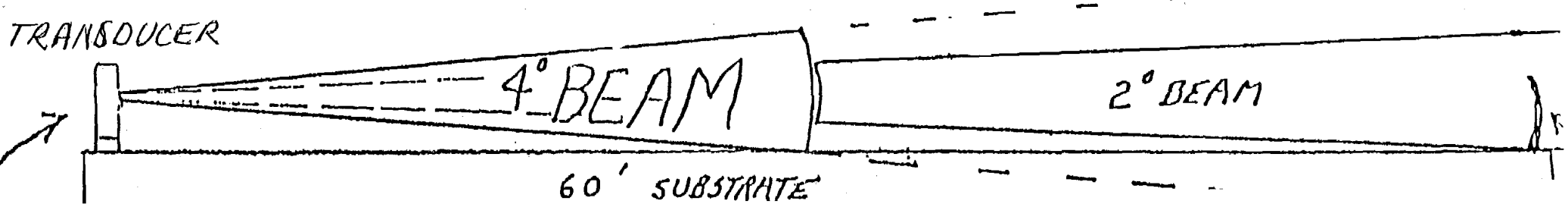
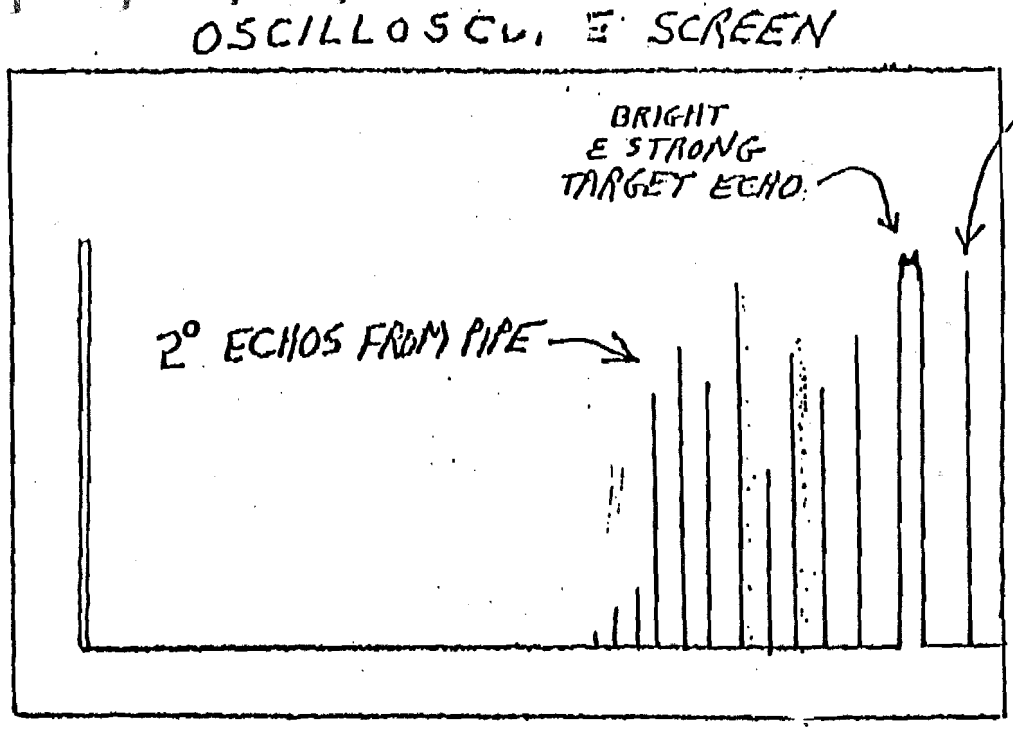



Figure II-5. PROPERLY AIMED TRANSDUCER WHEN BEAMWIDTH SWITCH IS SET TO ALTERNATE BUT SCOPE TRIGGERED FROM XM 2°

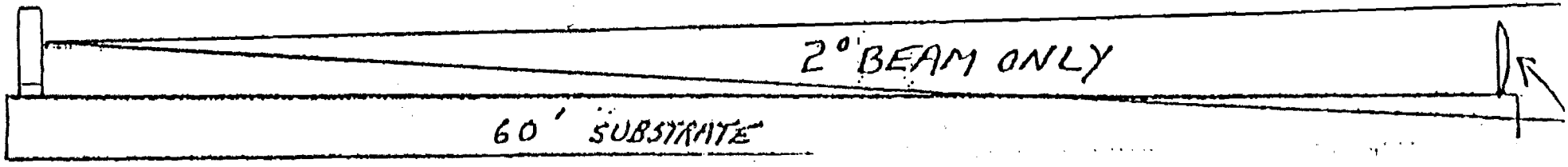





RANGE CONTROL SIDE SCANNER SET JUST BEYOND TARGE

(SECTS. 9, 10, 11 & 12 WILL G

Figure II-6. IMPROPERLY AIMED TRANSDUCER WHEN BEAMWIDTH SWITCH IS SET TO 2° & SCOPE IS TRIGGERED FROM XM 2°. NOTE THAT BEAM IS AIMED TOO LOW, CAUSING ECHOS TO BE RETURNED FROM LAST 1/3 OF SUBSTRATE IMPERFECTIONS. EVEN THOUGH TARGET ECHO IS STRONG & DOESN'T VARY IN HEIGHT



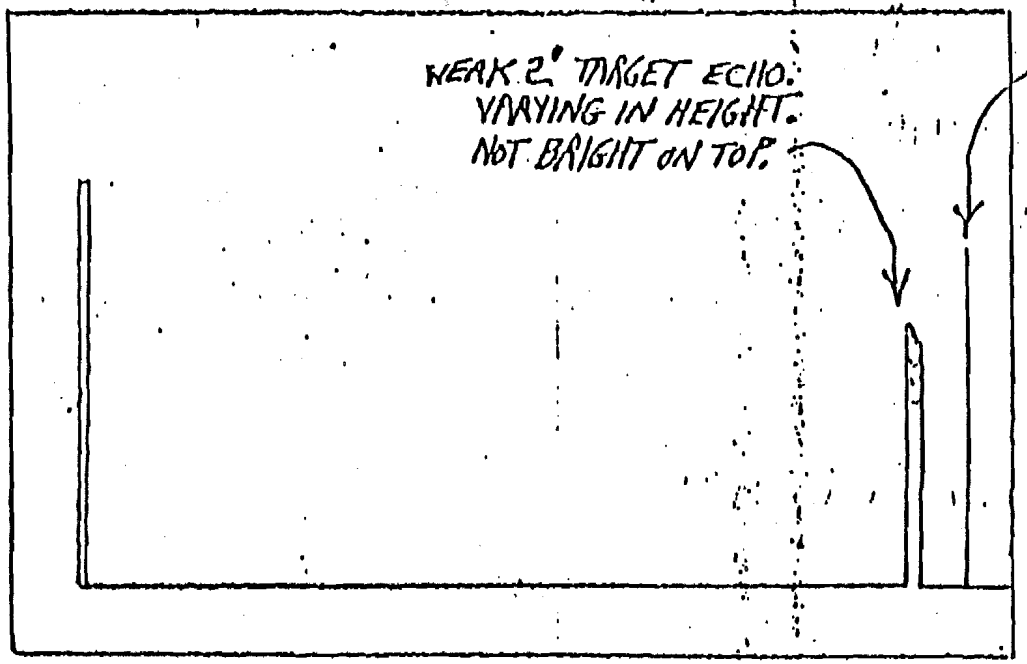
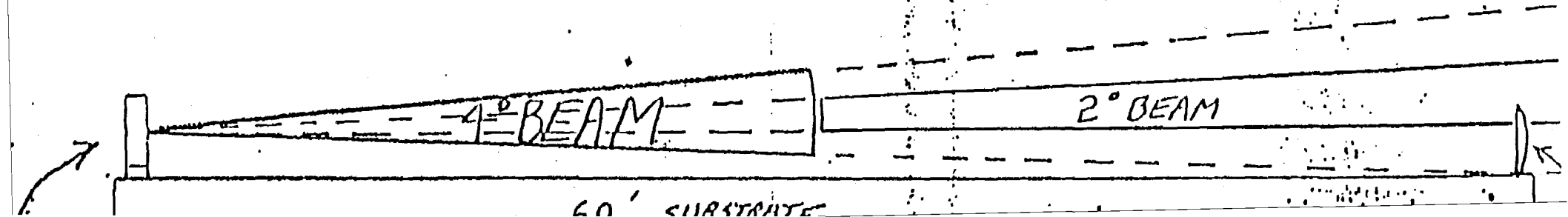



Figure II-7.

IMPROPERLY AIMED TRANSDUCER. BEAMWIDTH SWITCH IS SET TO A
& SCOPE IS TRIGGERRED FROM XM 2°. NOTE THAT BEAM IS AIMED TOO HIGH,
JUST BARELY CATCHING TARGET IN 2° BEAM ALTHOUGH 4° BEAM DOES
HIT TARGET. (SEE FIG. 6.) LOW PASSING FISH MAY BE MISSED.



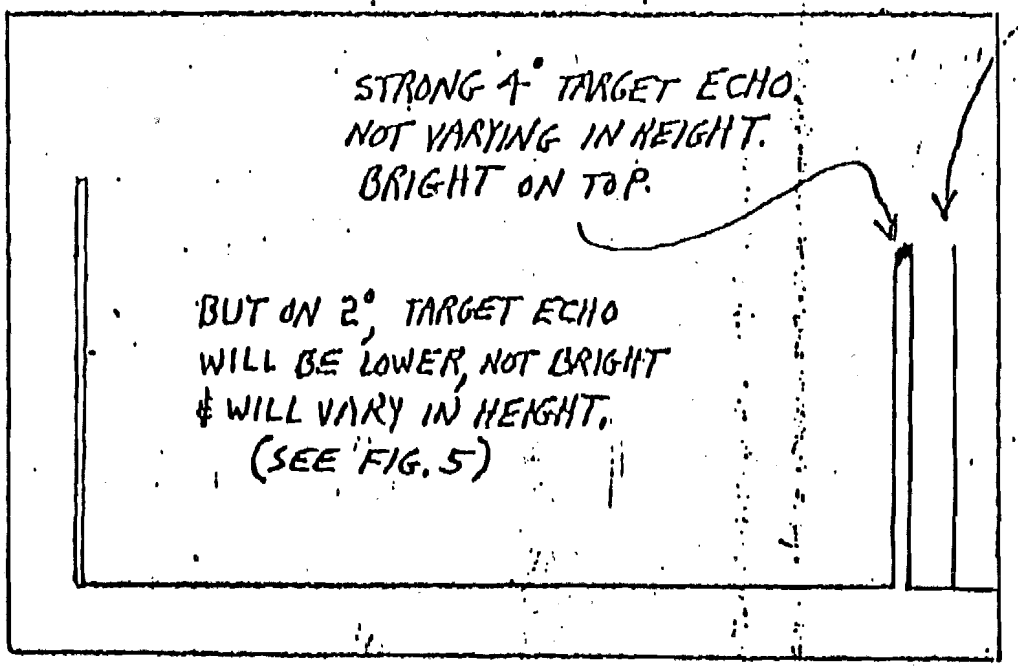
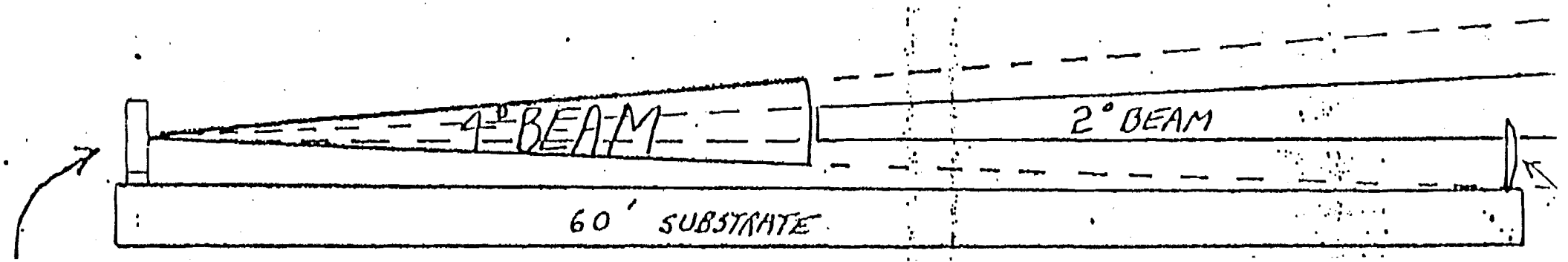



Figure II-8. IMPROPERLY AIMED TRANSDUCER. BEAMWIDTH SWITCH IS SET TO ALT. (OR 4°). SCOPE IS TRIGGERED FROM XM 4°. NOTE THAT BEAM IS AIMED TOO HIGH. ALTHOUGH THE 4° BEAM SOLIDLY HITS THE TARGET, THE 2° BEAM JUST BARE HITS TARGET (SEE FIG. 5 FOR 2° SCOPE WAVEFORM). FISH MAY BE MISSED.



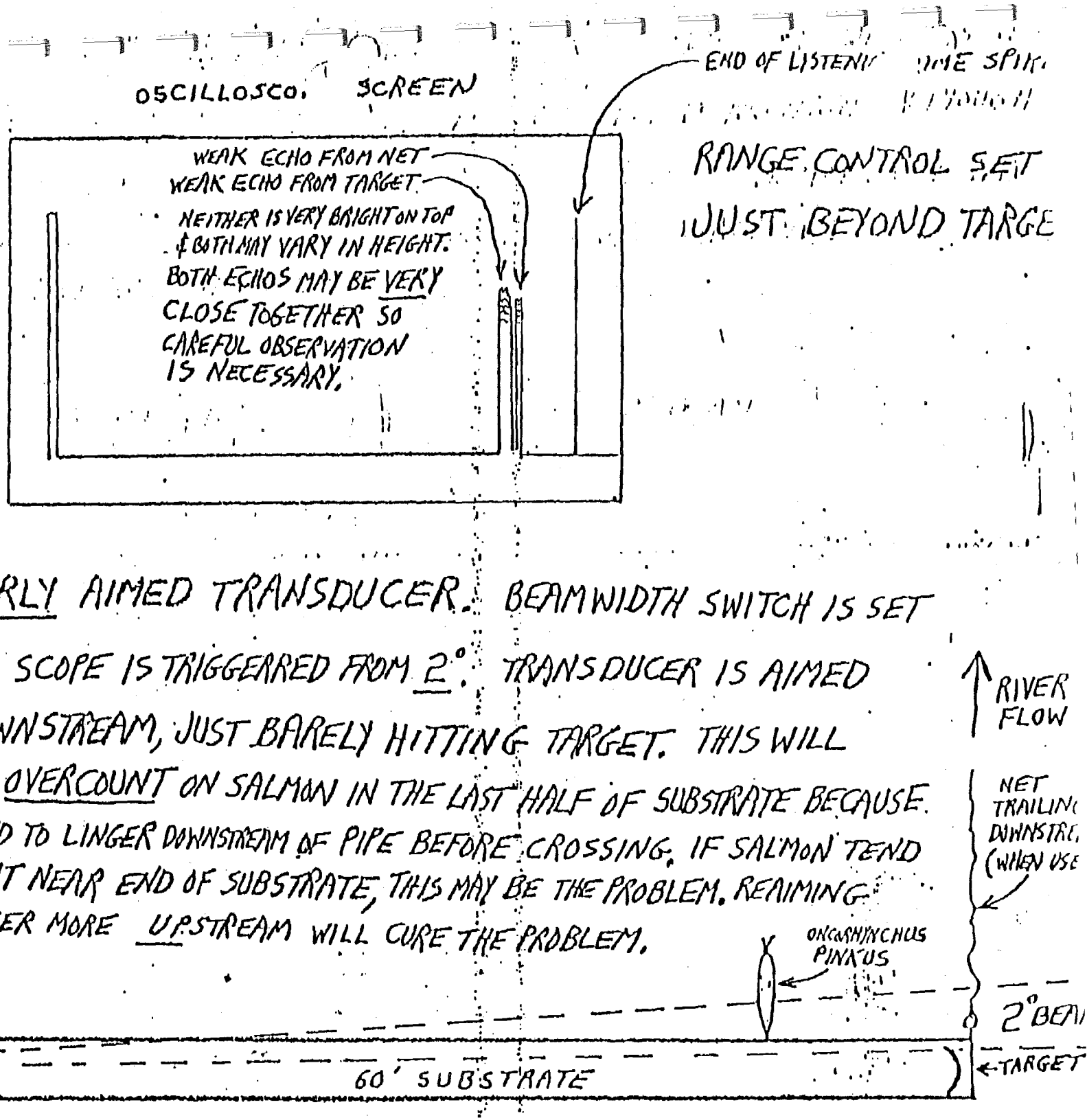
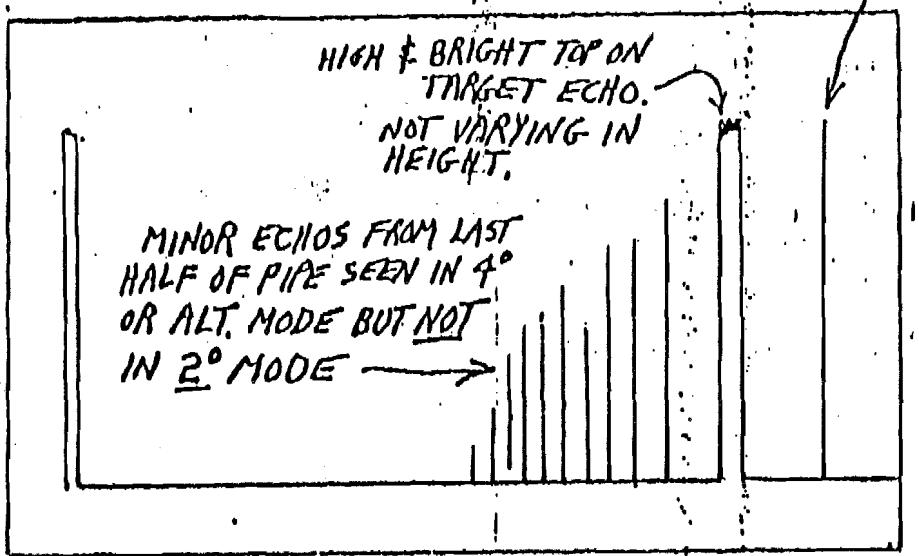

OSCILLOSCO. SCREEN
END OF LISTENI ME SPA
WEAK ECHO FROM NET
WEAK ECHO FROM TARGET
NEITHER IS VERY BRIGHT ON TOP & BOTH MAY VARY IN HEIGHT. BOTH ECHOS MAY BE VERY CLOSE TOGETHER SO CAREFUL OBSERVATION IS NECESSARY.
RANGE CONTROL SET JUST BEYOND TARGE
IMPROPERLY AIMED TRANSDUCER. BEAMWIDTH SWITCH IS SET TO 2° & SCOPE IS TRIGGERRED FROM 2°. TRANSDUCER IS AIMED TOO FAR DOWNSTREAM, JUST BARELY HITTING TARGET. THIS WILL CAUSE AN OVERCOUNT ON SALMON IN THE LAST HALF OF SUBSTRATE BECAUSE SALMON TEND TO LINGER DOWNSTREAM OF PIPE BEFORE CROSSING. IF SALMON TEND TO OVERCOUNT NEAR END OF SUBSTRATE, THIS MAY BE THE PROBLEM. REAIMING THE TRANSDUCER MORE UPSTREAM WILL CURE THE PROBLEM.
RIVER FLOW
NET TRAILIN DOWNSTR (WHEN USE
ONCORHYNCHUS PINATUS
2° BEA
60' SUBSTRATE
TARGET

Figure II-9.

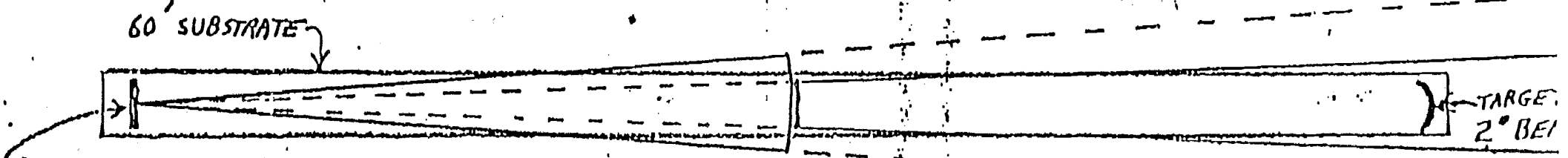


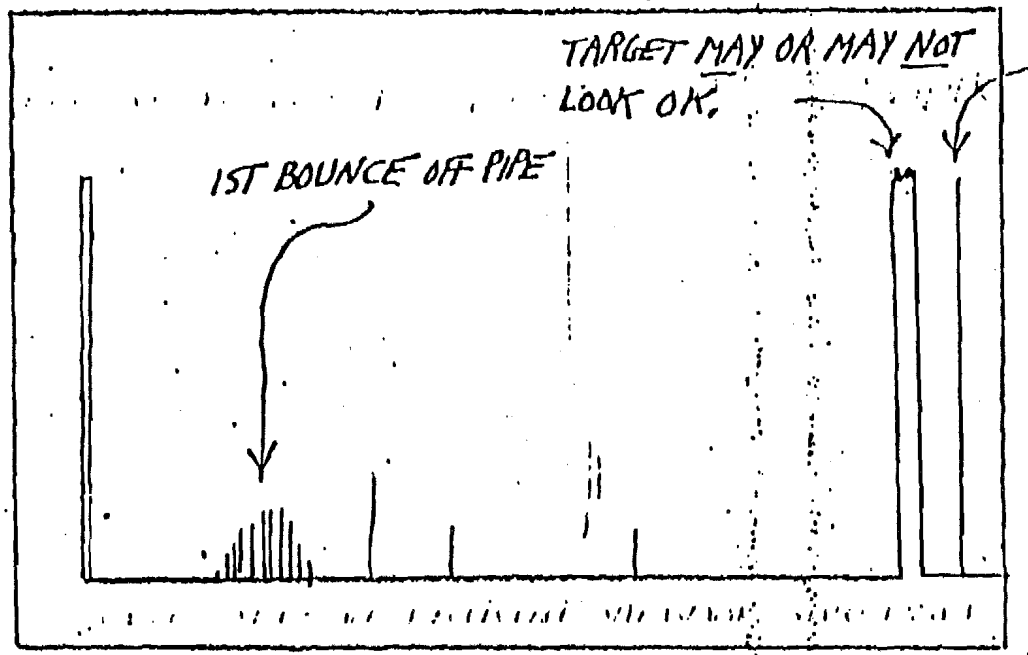

RANGE CONTROL SET JUST BEYOND TARGE
(SECT. 12' ONLY WILL COUNT.)

Figure II-10. PROPERLY AIMED TRANSDUCER.

TRANSDUCER BEAMWIDTH SWITCH IS SET TO ALT.
SCOPE IS TRIGGERRED FROM XM 4°

(ASSUMING VERTICAL AIMING OF TRANSDUCER IS CORRECT.)



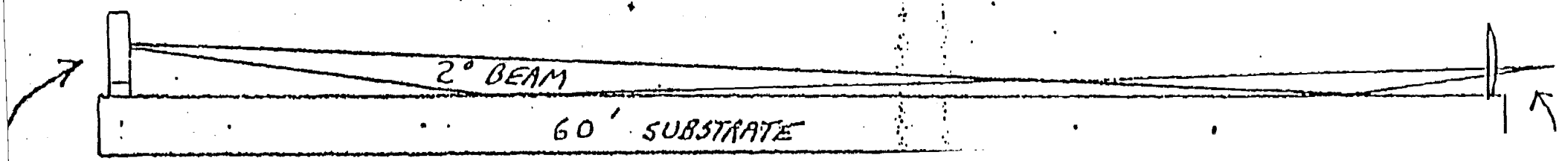



RANGE CONTROL SE
TO JUST BEYOND TARG

(VARIOUS SECTS, MAY COUNT,

Figure II-11. IMPROPER TRANSDUCER AIMING.

BEAMWIDTH SWITCH SET TO 2° & SCOPE TRIGGER TO XM 2°. TRANSDUCER IS AIMED MUCH TOO LOW & BEAM IS BOUNCING OFF PIPE NEAR TRANSDUCER, THEN HITS TARGET & RETURNS BY SAME PATH.



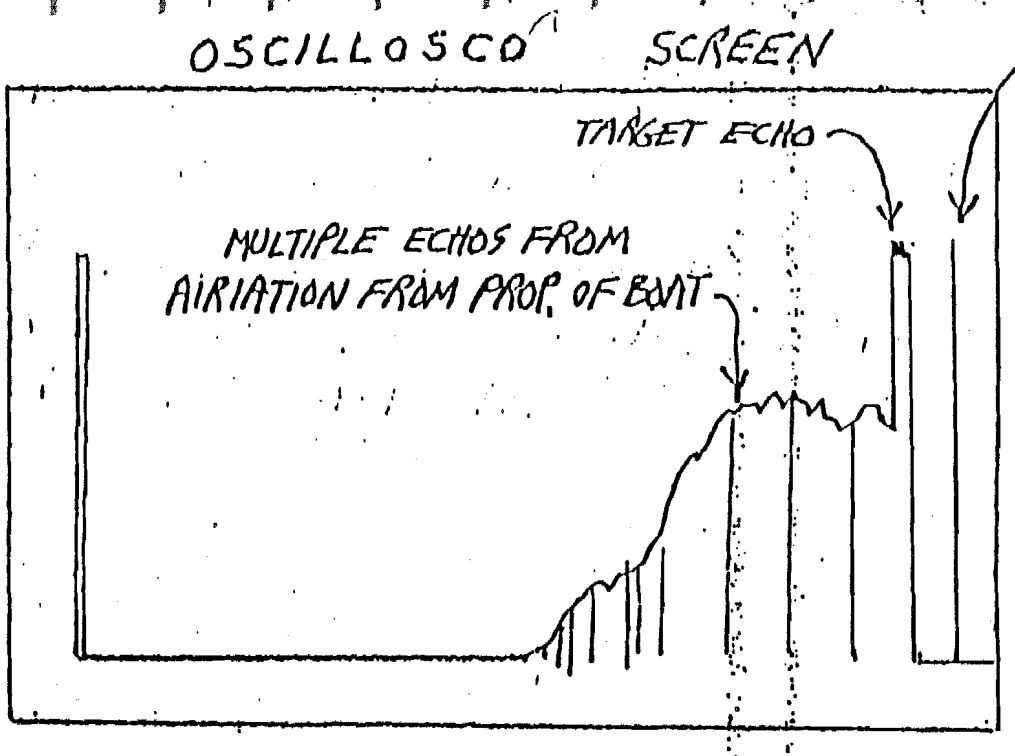
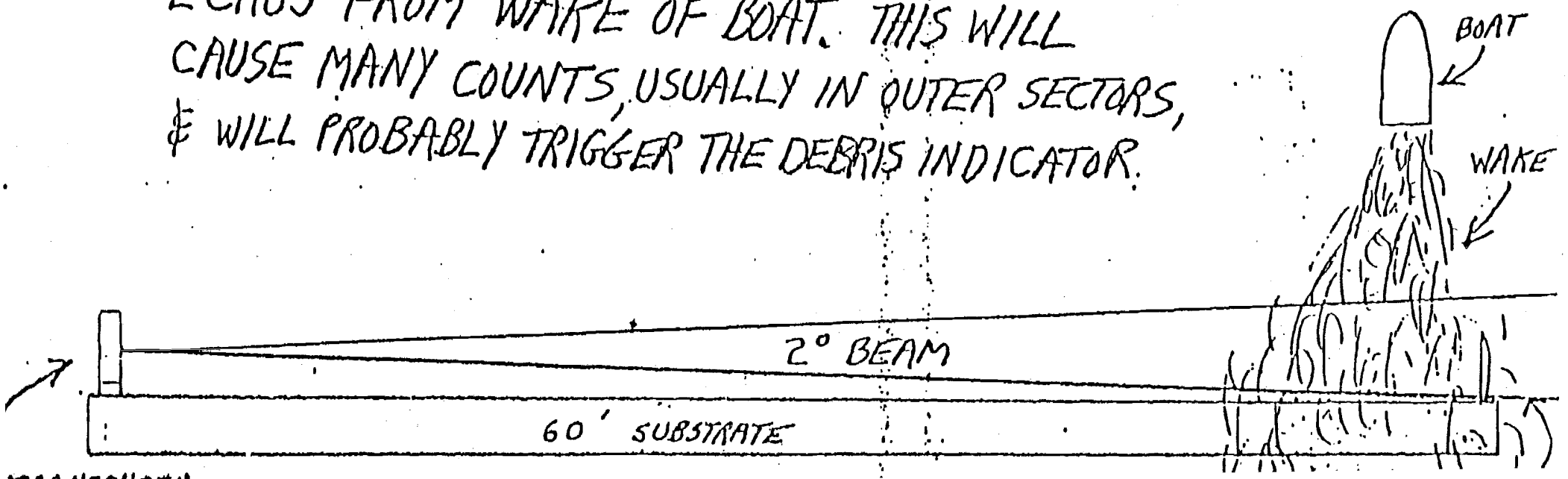
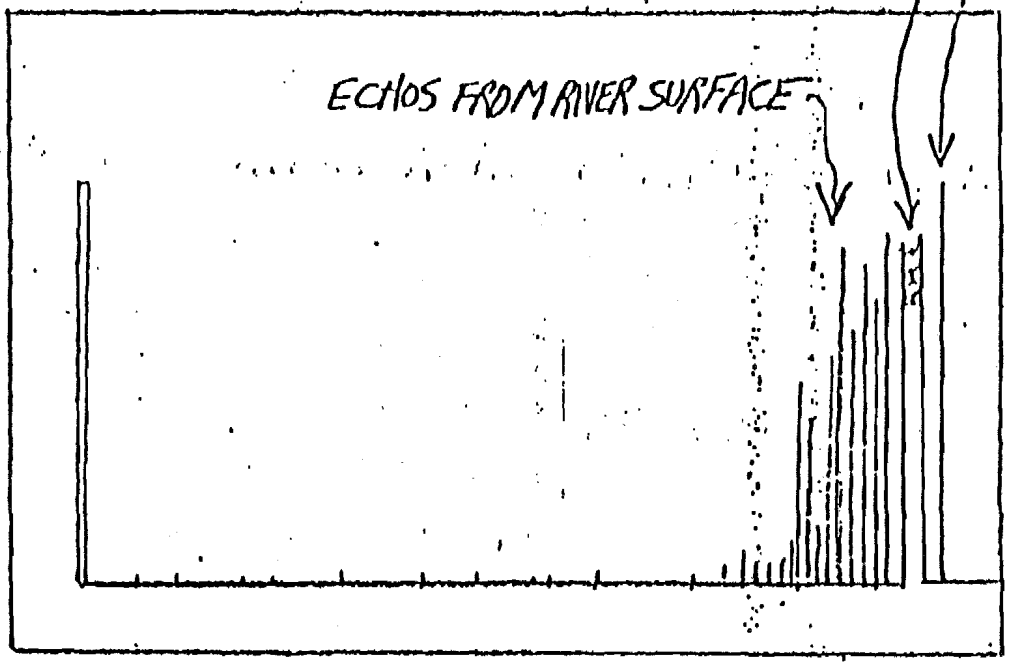



Figure II-12.

PROPERLY AIMED TRANSDUCER BUT MULTIPLE ECHOS FROM WAKE OF BOAT. THIS WILL CAUSE MANY COUNTS, USUALLY IN OUTER SECTORS, & WILL PROBABLY TRIGGER THE DEBRIS INDICATOR.



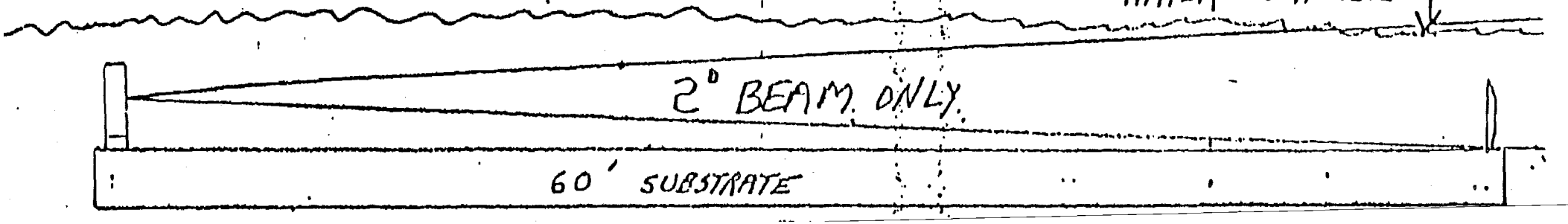



RANGE CONTROL SET JUST BEYOND TARGET.

(WILL PROBABLY COUNT ON SECTS 10, 11 & 12.)

Figure II-13.

IMPROPERLY AIMED TRANSDUCER. BEAMWIDTH SWITCH SET TO 2° AND SCOPE TRIGGERED FROM 2°. NOTE WATER IS TOO SHALLOW EVEN FOR 2° BEAM WHICH IS "BOXED IN". COUNTING RANGE ON SIDE SCANNER WOULD HAVE TO BE REDUCED TO ABOUT 50' TO PREVE SURFACE ECHOS FROM COUNTING. TARGET WILL BE OBSCURED BY SURFACE ECHOS.



# APPENDIX 3

## ADULT ANADROMOUS FISHERIES STUDIES

### Fishwheel Operation

# APPENDIX 3

## A. ADULT ANADROMOUS FISHERIES STUDIES

### Fishwheel Operation

APPENDIX 3

## A. ADULT ANADROMOUS FISHERIES STUDIES

### Fishwheel Operation

#### Design

The fishwheels used at Yentna, Sunshine, Talkeetna and Curry stations are of identical design with two baskets and two paddles. Floation is provided by styrofoam logs covered with a plywood frame or polysealed floats. The baskets are constructed of native spruce and have an average length, width and depth of 7.5 feet, 6.0 feet and 30 inches respectively. The paddles, also constructed of native spruce poles, have the same width and length as the baskets. The baskets are netted with 2.5 inch square creosate coated webbing. The axle is an eight inch squared spruce log capped at each end with a steel collar fitted with a 1.5 inch steel shaft. The side assembly rotates on self adjusting bearings which bolt to an adjustable wood frame on each float that permits the axle to be raised or lowered at 6 inch steps. A live box is attached to the inshore side of each fishwheel. The fishwheel is held off shore by a cable bridle anchored to an onshore deadman located upstream of the fishwheel. The wheel is kept offshore by an inshore mounted boom log lodged between the bank and the inshore float.

#### Lead Weir

A lead weir is a critical component of a successfully operating fishwheel. The purpose of a lead weir is to direct inshore migrant fish into the fishing area of the wheel. The weir is constructed out of a series of framed panels averaging five feet long and covered with 2.5 inch mesh fencing fabric. The panels are built to contour the of the river bottom and are held in place by a boom log extending perpendicular from the downstream end of the live box to the river bank.

#### Operation

Fishwheels are designed to rotate at a speed ranging from 2.0 and 3.5 rpm. Maximum catch efficiency normally occurs at 2.5 rpm. At fishwheel locations where velocity causes a wheel to turn at a speed greater than 3.5 rpm and experimental brake system will be used that creates a negative lifting force to slow the wheel. The brake will consist of two water releasing boxes that attach to the paddles.

Properly sited and adjusted fishwheel baskets should reach within six inches or less of the bottom. If the baskets do not reach within six or less inches of the bottom, a high percentage of fish will pass underneath the baskets and not be caught.

#### Maintenance

Fishing depth of the baskets must be checked twice daily and appropriate adjustments made. Lead weirs should also be inspected twice daily to insure that they are properly functioning. Additionally, once a

day each wheel should be rigorously inspected for wear, damaged components, loose rigging and protuding nails or rough surfaces which can inflict catch injuries. Appropriate repairs must be effected at first indication of a problem.

# APPENDIX 4

## A. ADULT ANADROMOUS FISHERIES STUDIES

### Fish Tagging

# APPENDIX 4

## ADULT ANADROMOUS FISHERIES STUDIES

### Fish Tagging

## A. ADULT ANADROMOUS FISHERIES STUDIES

### Fish Tagging (ADF&G, 1976)

#### Development of Marking of Fish

A mark can be defined as a brand, label, seal or tag which identifies an object to show the maker or owner. Early tagging of fish was begun by land owners along streams who were interested in conserving salmon and trout runs. Charles Atking tagged Atlantic salmon in 1873 in Maine's Penobscot River and several recoveries were noted in following years. T.W. Fulton of Scotland (1893) and C.G.J. Petersen of Denmark (1984) both used numbered buttons or disks on plaice (flatfish) and other fish species in the Atlantic Ocean. The Petersen disk has been one of the most successful types of tags and most widely used over the years.

Exact figures on the rate of development of tagging are hard to accumulate, but there are estimates that by 1910 about 100,000 fish had been marked with tags. By 1936, the total was around 600,000 marked fish. Presently many millions of fish (also molluscs, crustacea and sea mammals) are being tagged every year for the purpose of studying population dynamics and migrations.

#### Ideal Fish Marks

Information on what constitutes an ideal fish mark, the types of marks, purposed of tagging and methods of tagging and recovery are spread through the fisheries literature.

Arnold (1966) suggested the following criteria for an ideal fish mark.

1. It should be retained essentially unaltered for life of fish regardless of the age at which applied.

2. It should have absolutely no effect of fish's behavior, reproductions, life-span, growth, feeding, movement, vulnerability to predation, angling or other external factors.

3. It should not tangle in vegetation or nets of any kind.

4. It should be inexpensive and easily manufactured.

5. It should be usable on any size fish without significant alteration.

6. It should not be found in nature nor should it be possible to confuse it with any other mark, natural or artificial.

7. It should be easily applied to fish in the field without the need for an anesthetic.

8. It should be easily detected in the field by untrained personnel or the public.

9. If the marked fish is preserved as a scientific specimen, or for later examination, the mark would not be affected by the preservation.

10. There should be enough possible variations of the mark so that many individuals or many small groups can be identified separately.

11. The marking substance should not present any health or safety hazard to the biologist, fish, or the public.

12. The mark should not cause adverse public relations by spoiling edible parts of the fish.

Obviously, no one mark satisfies all the above listed requirements and it generally only satisfies a few of them. One of the critical problems of a research project is to decide on the best mark for the particular circumstances.

Both Floy and Petersen disc tags have been utilized in the Susitna River drainage in the past and will be used to tag fish at the Sunshine, Talkeetna and Curry tag/recapture sites.

Petersen Disc Tags

One (1) inch diameter, sequentially numbered Petersen disc tags will be utilized on adult salmon at Curry Station, and at Sunshine and Talkeetna stations on chinook salmon. The color code will be international orange at Curry, and wh./red and green respectively at Sunshine and Talkeetna stations.

Tagging procedures will be reviewed in the field as it is difficult to explain without having tags and a fish in hand. Generally, the following steps are as followed:

1. Hold prepared tag (pin, disc, and numbered tag) with pliers and insert through the cartilage immediately under the dorsal fin.

2. Place a blank tag on the pin and cut off all by 3/8 inch of the pin with a cutting pliers.

3. Twist remaining pin in an inward and rolling motion so that the pin lies flat against the disc and forms a loop.

Here are a couple suggestions that will help:

1. Use a sharpening stone to make a sharp point on the tagging pins. This can be done ahead of time and will make penetration easier.

2. Prepare tags prior to making fishwheel checks. Assemble tags in sequential order and stick them in a piece of styrofoam: pin, clear buffer disc, tag.

Floy Tags

Sequentially numbered FT-4 Floy tags will be utilized on sockeye, pink, chum and coho salmon at the Sunshine and Talkeetna stations. Color code for Sunshine Station will be pink and blue for Talkeetna Station.

Tagging procedures will be demonstrated in the field; generally the following steps are followed:

1. Slide one end of the tag into the hollow end of tagging needle. Insert the needle completely through the fish in the cartilage immediately under the dorsal fin.

2. Slide the tag off the needle and tie the tag firmly against the posterior end of the dorsal fin with an overhand knot making sure that the tag does not over ride or vertically compress the dorsal fin.

Several suggestions are:

1. Keep two (2) or three (3) tagging needles available in the event of a loss.

2. Use a sharpening stone to maintain a sharp point on the tagging needle. This can be done ahead of time, making the tagging easier.

3. Prepare tags prior to making fishwheel checks. Assemble tags in sequential order on a board and tape them in place, thus allowing them to be easily withdrawn.

# APPENDIX 5

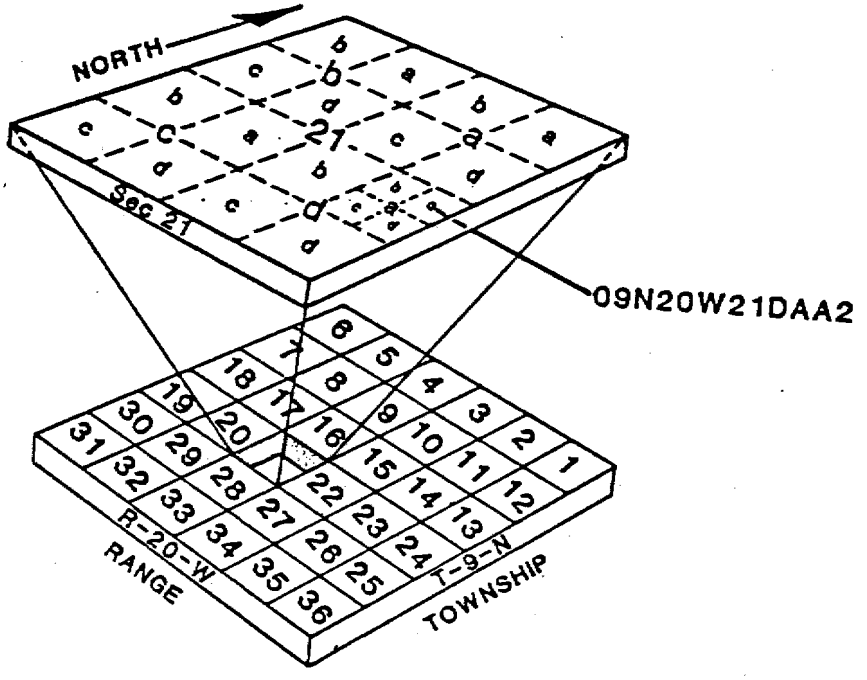
## ADULT ANADROMOUS FISHERIES STUDIES

Geographic Location Code and General Maps

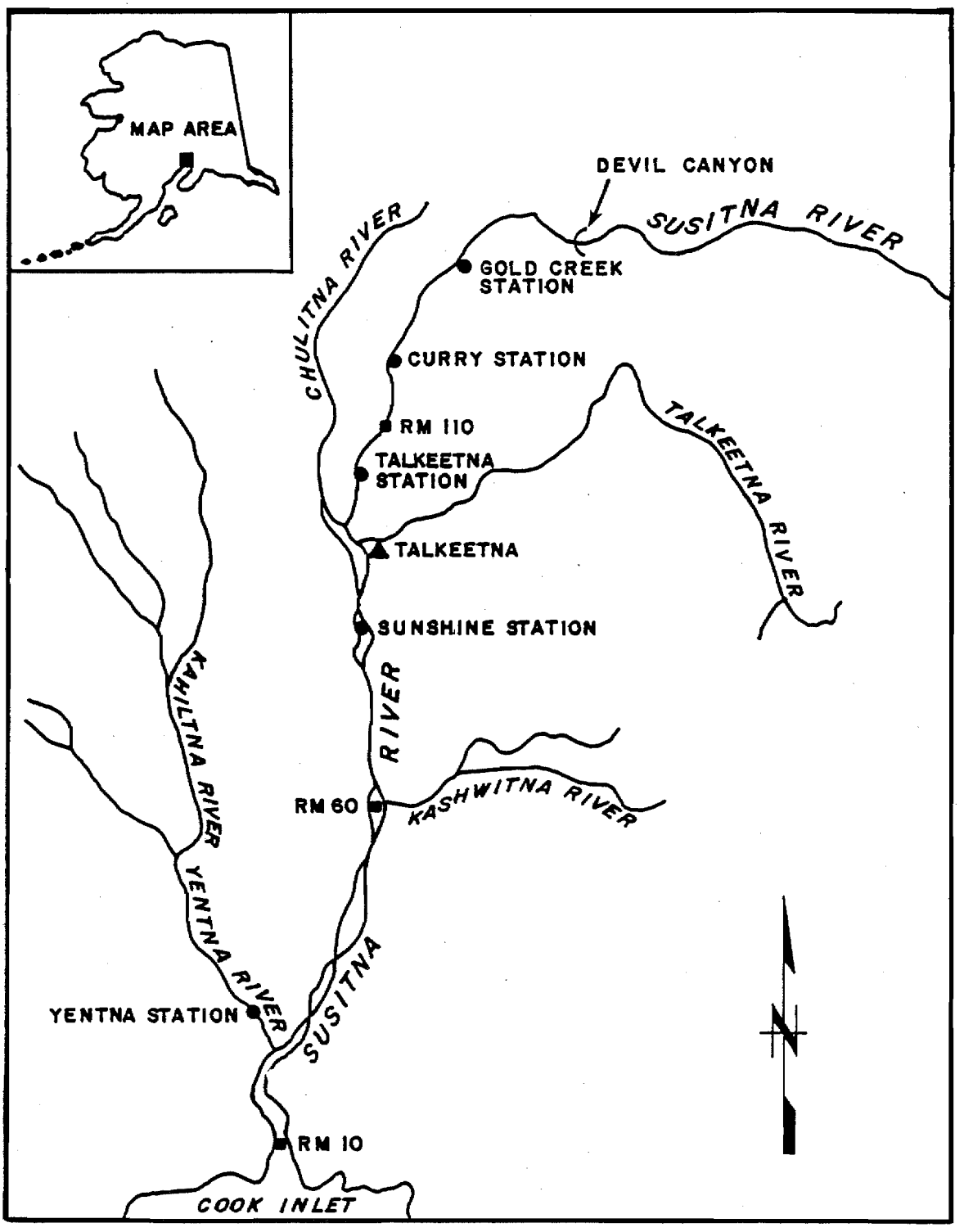
## System of Specifying Geographic Locations

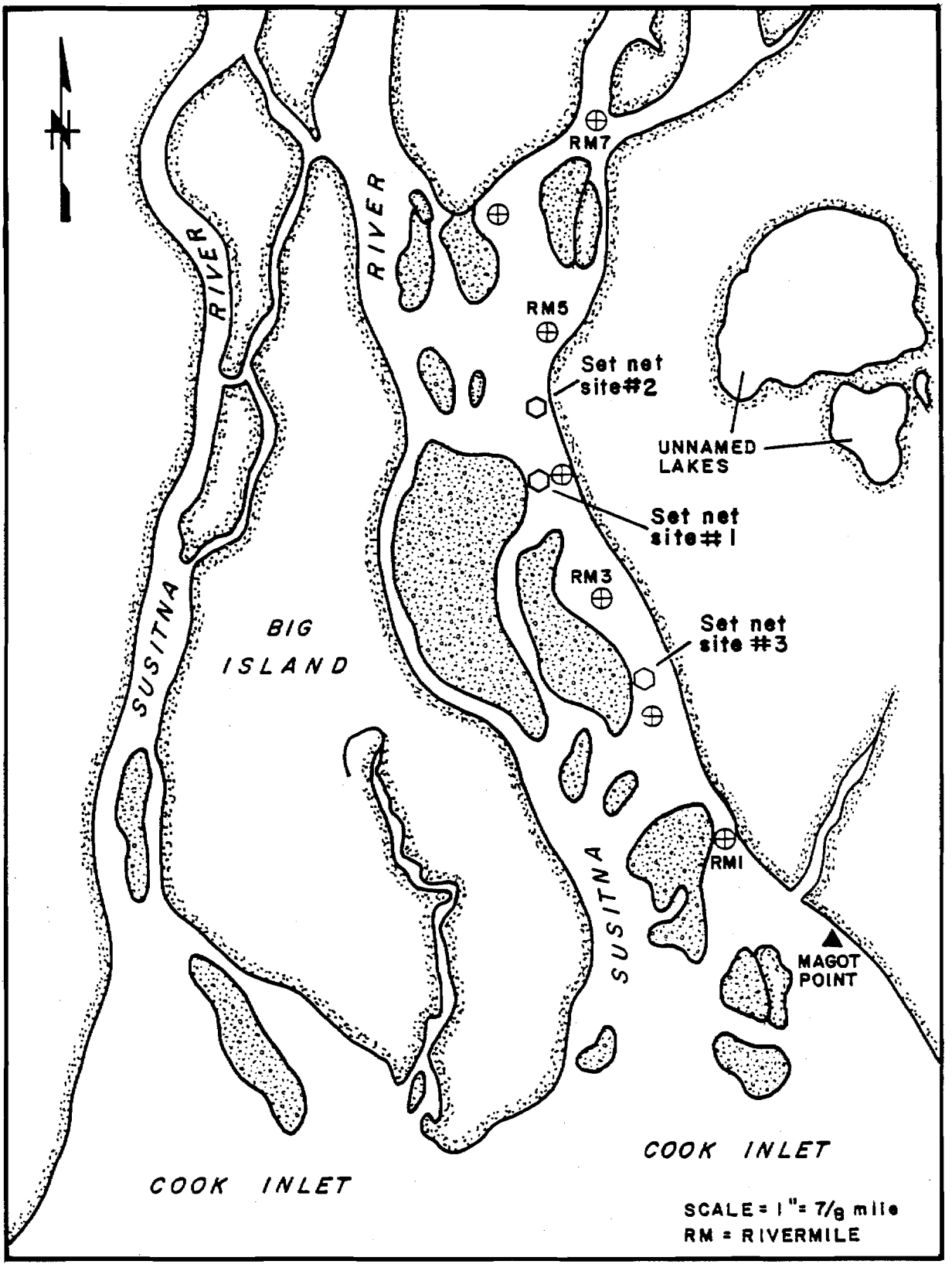
For conciseness and for use in the computer processing, it is convenient to use a modification of the General Land Office method of specifying locations as developed by federal and state agencies in Montana (MDFWP, 1979).

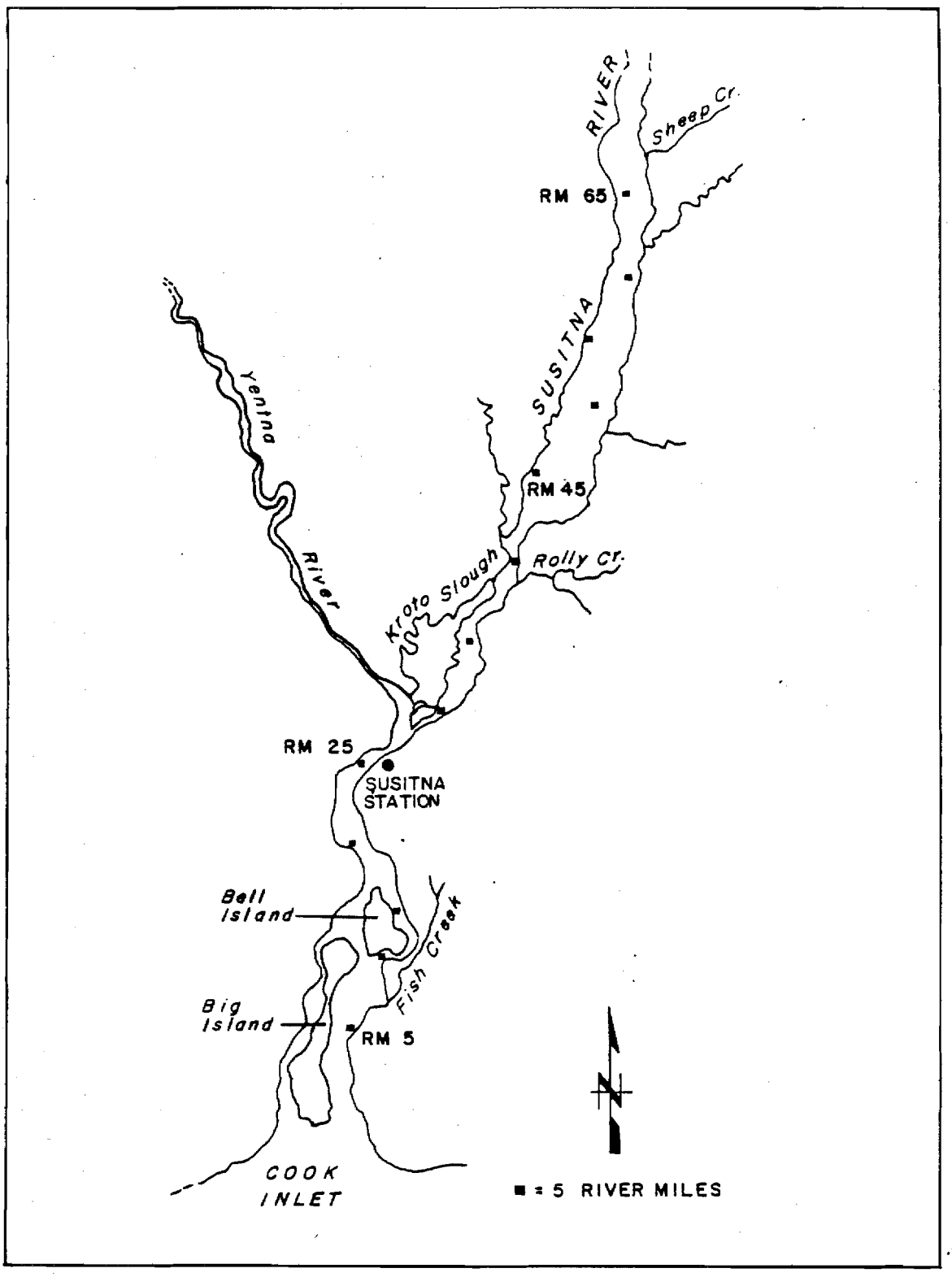
In this report, locations of features such as sampling points are specified by using 12 characters. The first three characters of the location give the township, the next three characters the range. The next two give the section number within the township, and the next tract, the quarter-quarter section (40-acre tract), and the quarter-quarter-quarter section (10-acre tract). These subdivisions of the 640-acre section in the northeast quadrant. If there is more than one feature in a 10-acre tract, consecutive digits beginning with 2 are added to the number. For example, if a sample was collected in Section 21, Township 9 North, Range 20 West, it would be numbered 09N20E21DAA2. The letters DAA indicate that the site is in the N1/4 of the N1/4 of the SE1/4, and the number 2 following the letters DAA indicates there are at least two sampling locations in this 10-acre tract.

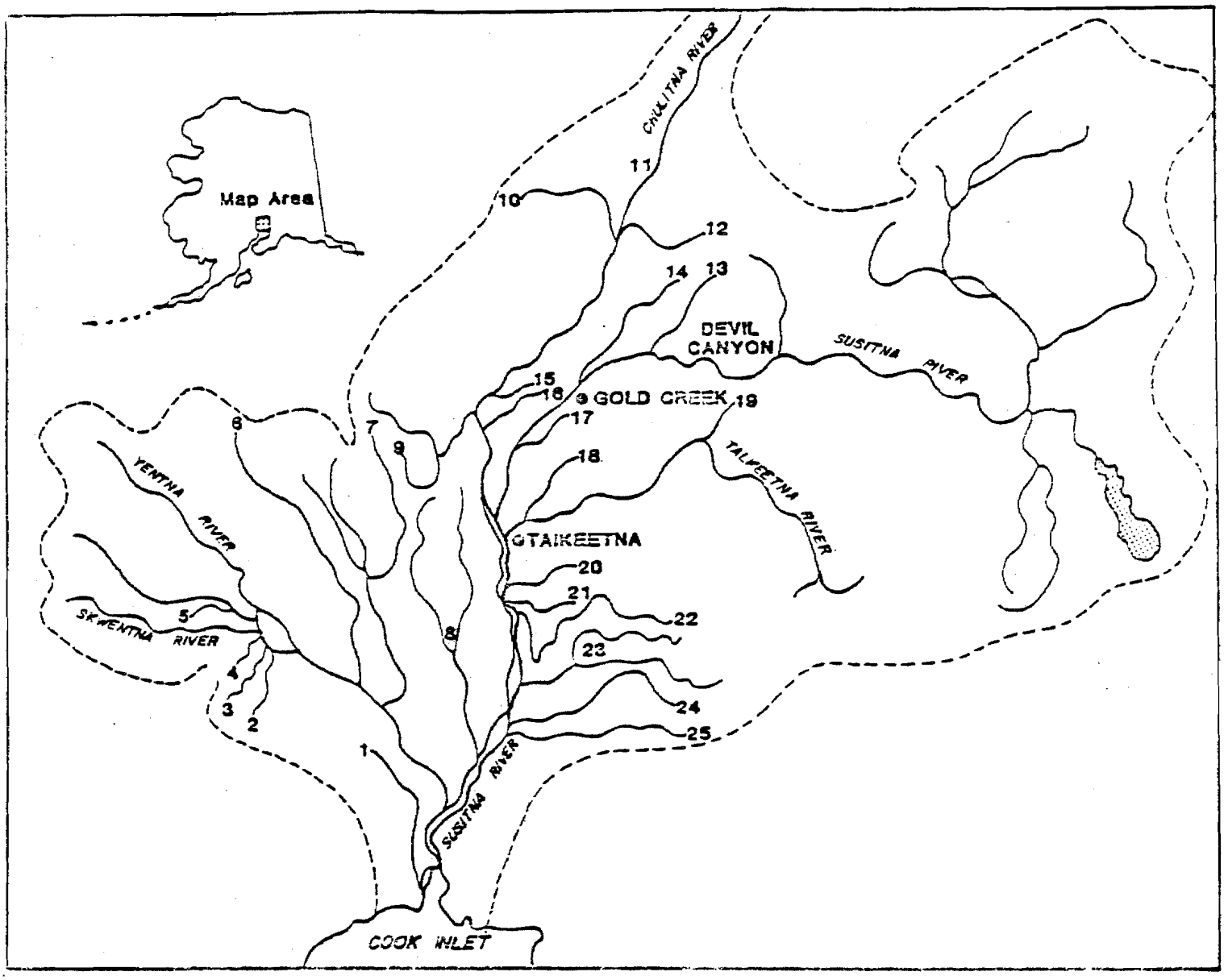



System used by ADF&G in this study to specify geographic locations.


MAP AREA
DEVIL CANYON
SUSITNA RIVER
CHULITNA RIVER
GOLD CREEK STATION
CURRY STATION
RM 110
TALKEETNA STATION
TALKEETNA
TALKEETNA RIVER
SUNSHINE STATION
KAHILTNA RIVER
SUSITNA RIVER
RM 60
KASHWITNA RIVER
YENTNA RIVER
YENTNA STATION
SUSITNA
RM 10
COOK INLET
N

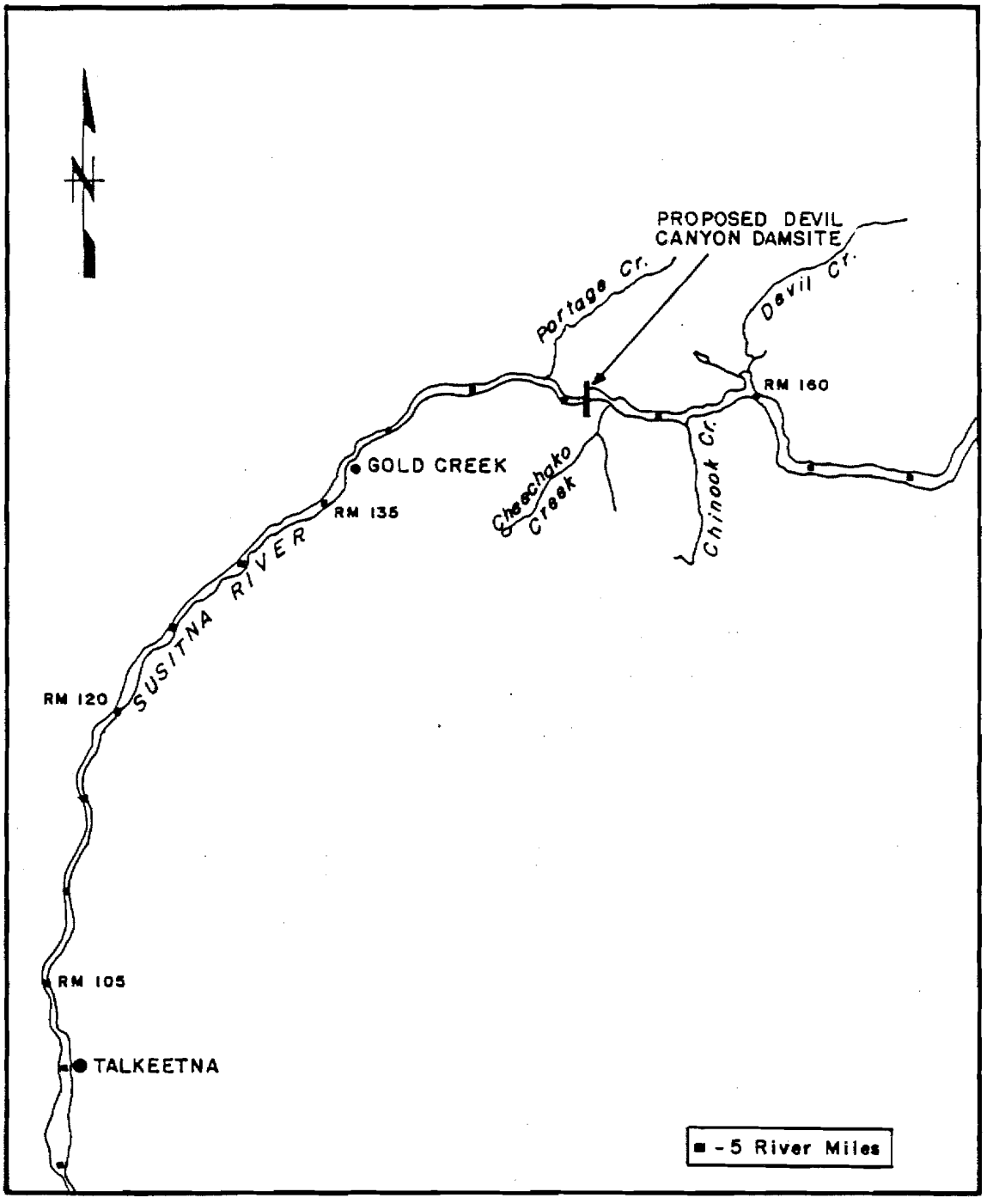

RM7
RM5
Set net site#2
UNNAMED LAKES
Set net site#1
RM3
Set net site #3
RM1
MAGOT POINT
SUSITNA RIVER
SUSITNA RIVER
BIG ISLAND
COOK INLET
COOK INLET
SCALE = 1" = 7/8 mile
RM = RIVERMILE

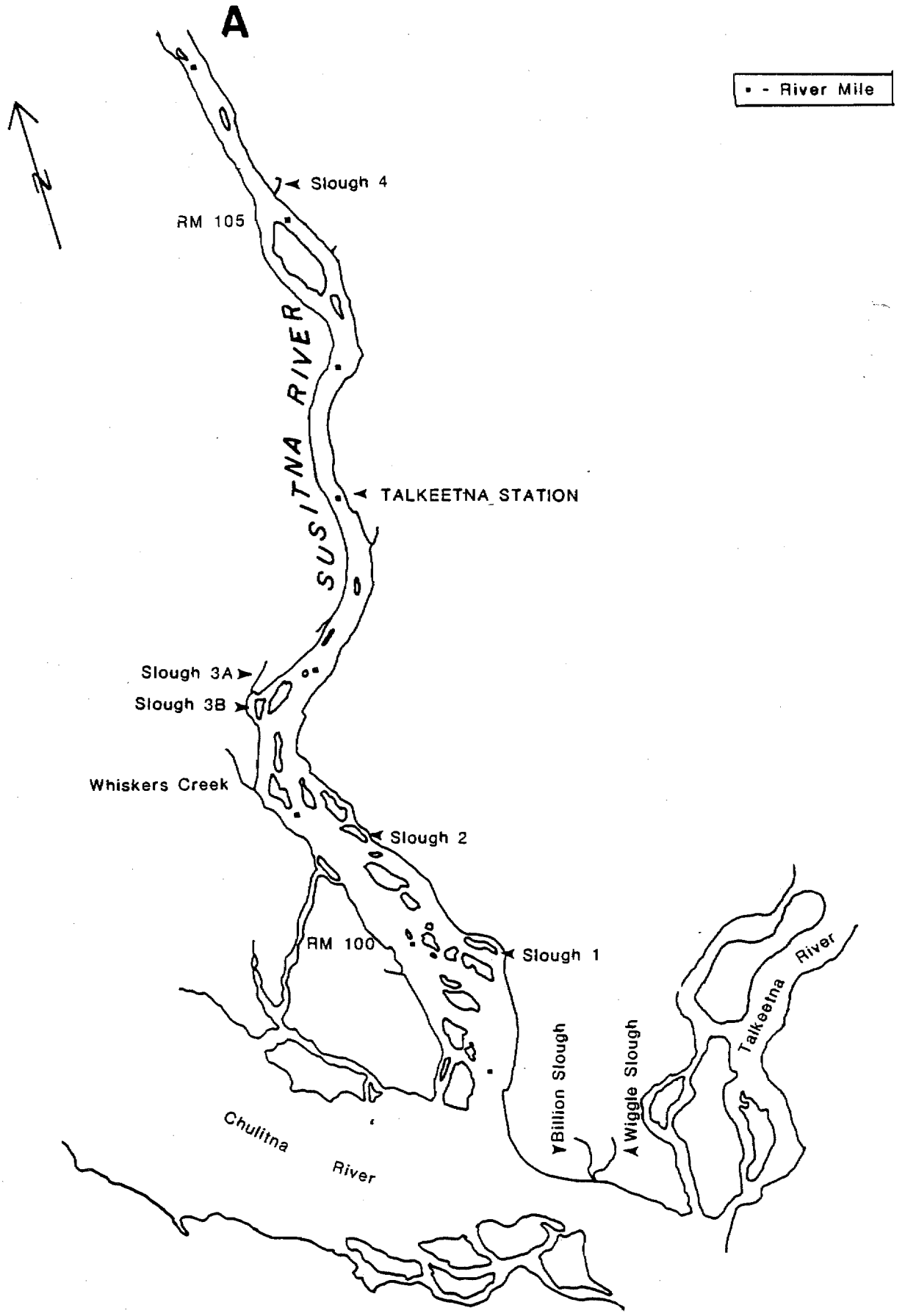

RIVER
Sheep Cr.
RM 65
SUSITNA
Yentna
River
RM 45
Kroto Slough
Rolly Cr.
RM 25
SUSITNA
STATION
Bell
Island
Fish Creek
Big
Island
RM 5
COOK
INLET
■ = 5 RIVER MILES

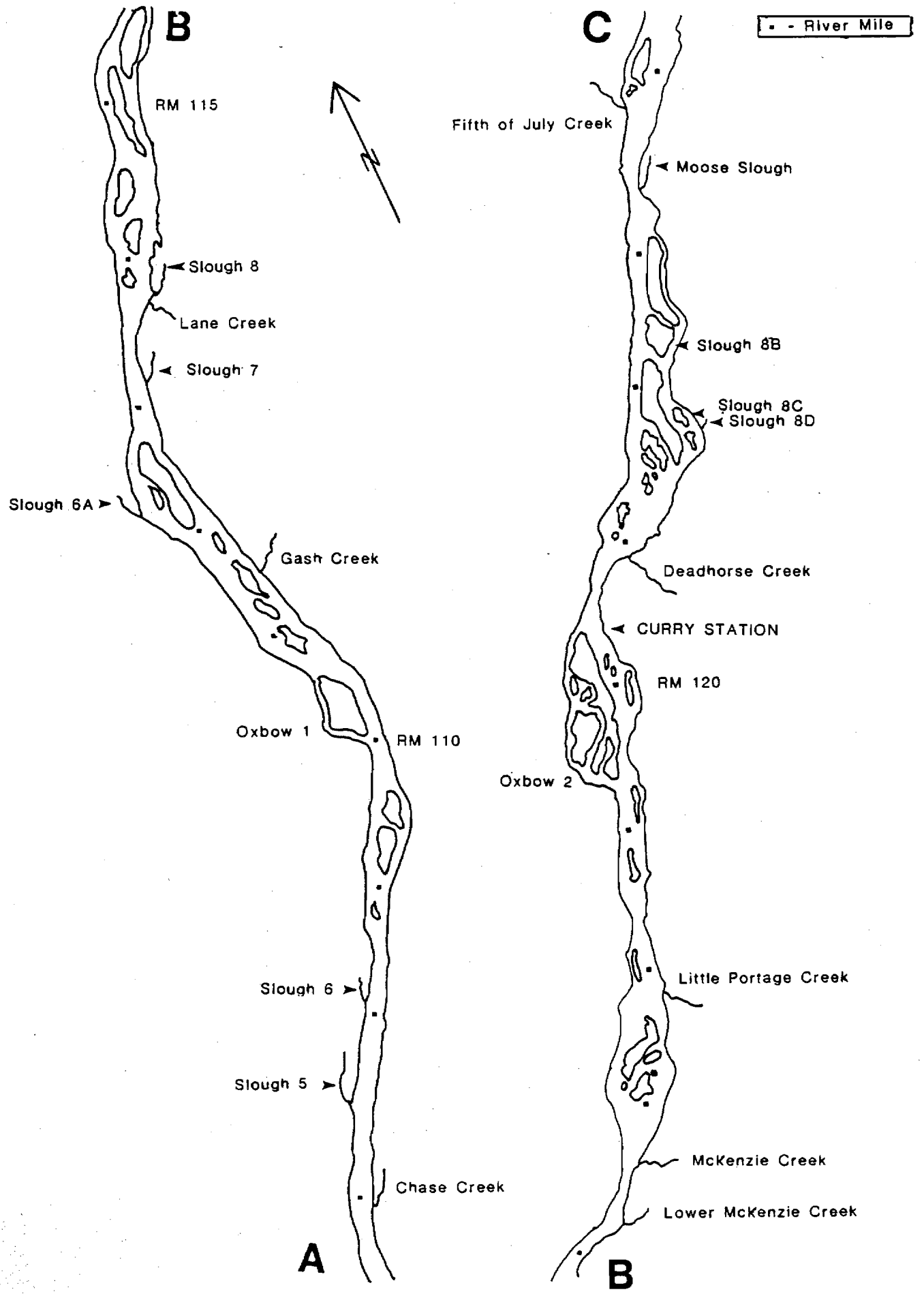


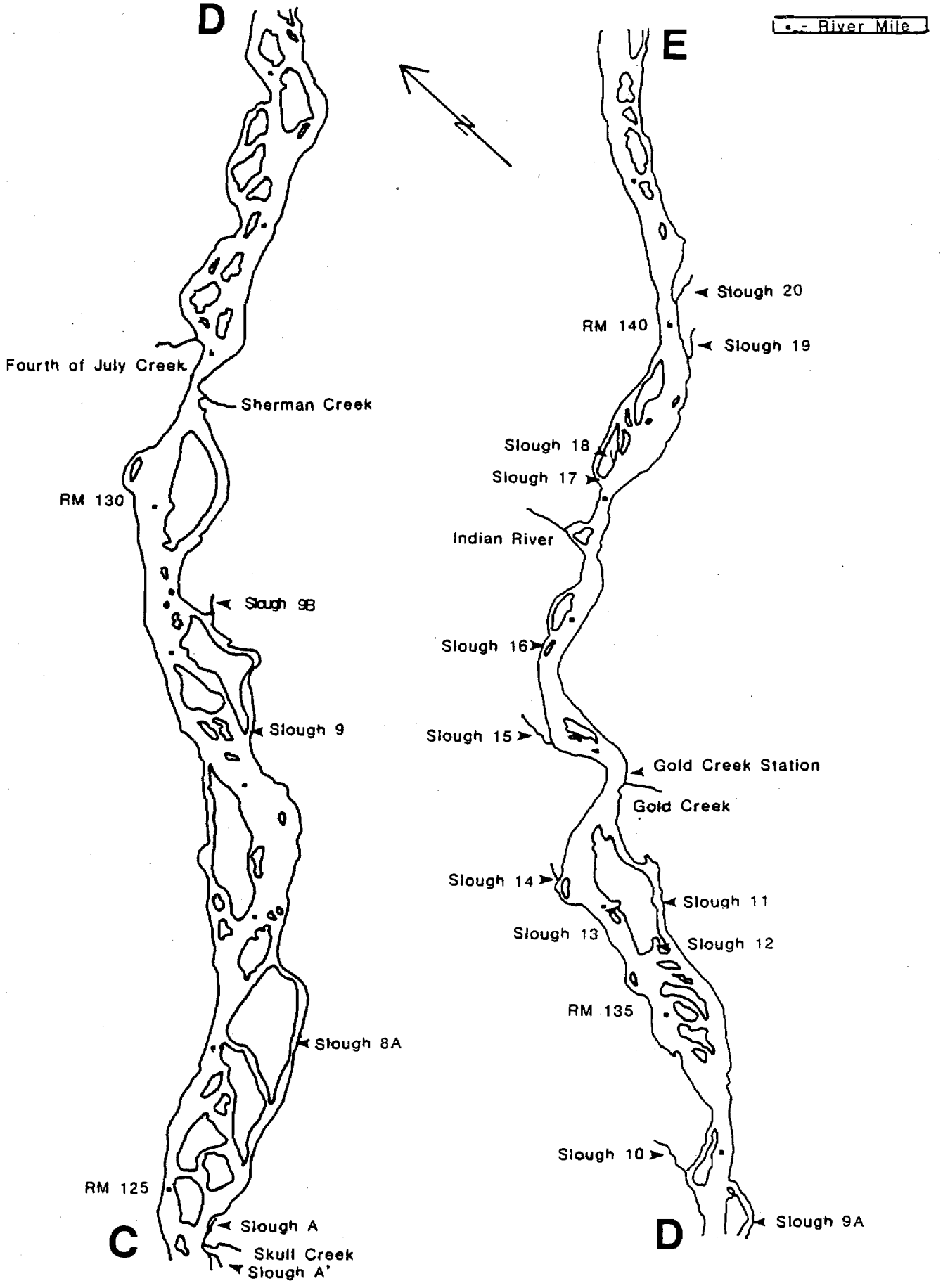

1. ALEXANDER CREEK
2. TALACHULITNA
3. QUARTZ CREEK
4. CANYON CREEK
5. RED CREEK
6. LAKE CREEK
7. PETERS CREEK
8. DESHKA RIVER
9. BUNCO CREEK
10. CHULITNA WEST FORK
11. CHULITNA MIDDLE FORK
12. HONOLULU CREEK
13. PORTAGE CREEK
14. INDIAN CREEK
15. BYERS CREEK
16. TROUBLESOME CREEK
17. LANE CREEK
18. CLEAR CREEK
19. PRAIRIE CREEK
20. MONTANA CREEK
21. GOOSE CREEK
22. SHEEP CREEK
23. KASHWITNA RIVER NORTH FORK
24. LITTLE WILLOW CREEK
25. WILLOW CREEK

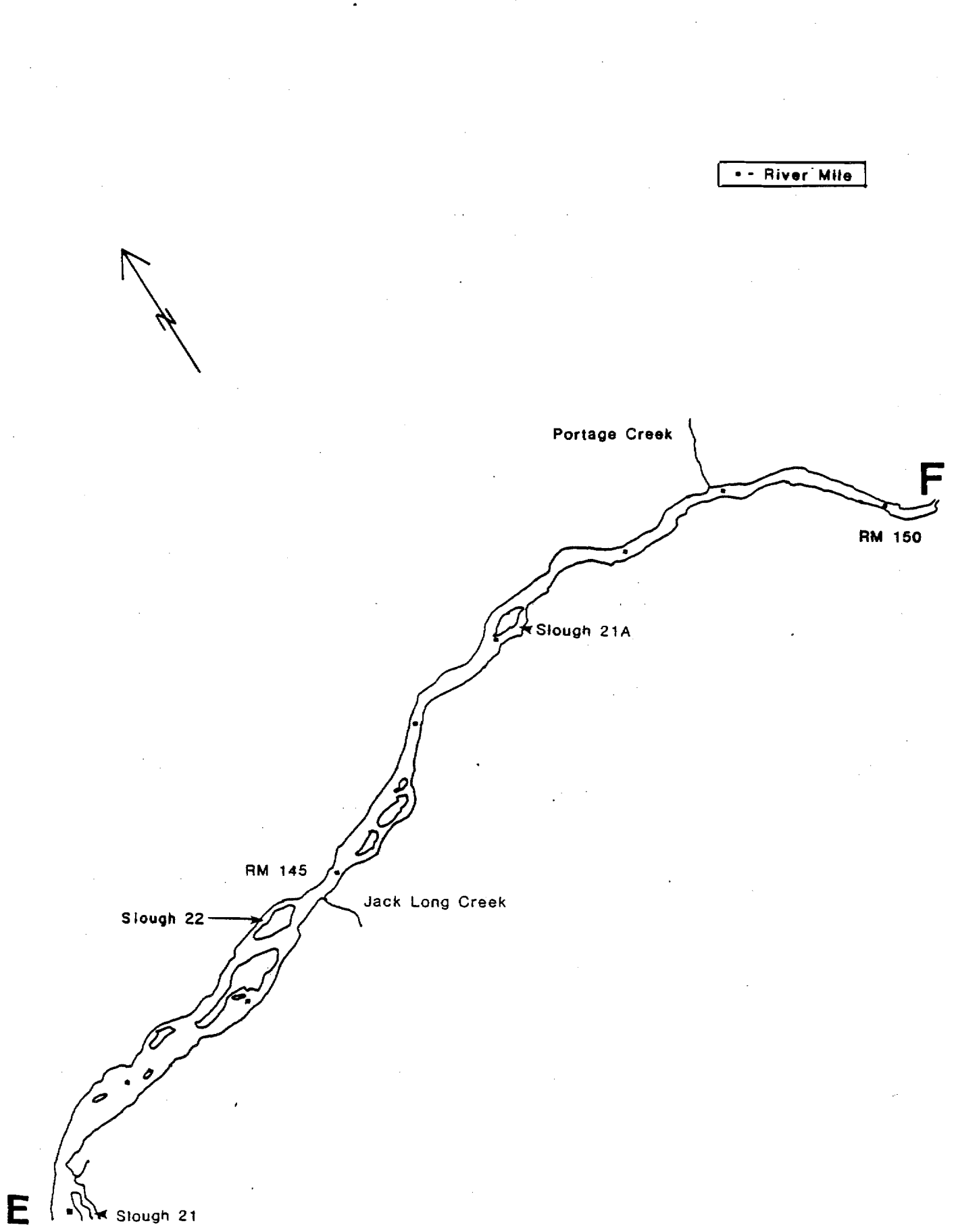
Figure . Susitna basin map showing chinook salmon survey streams

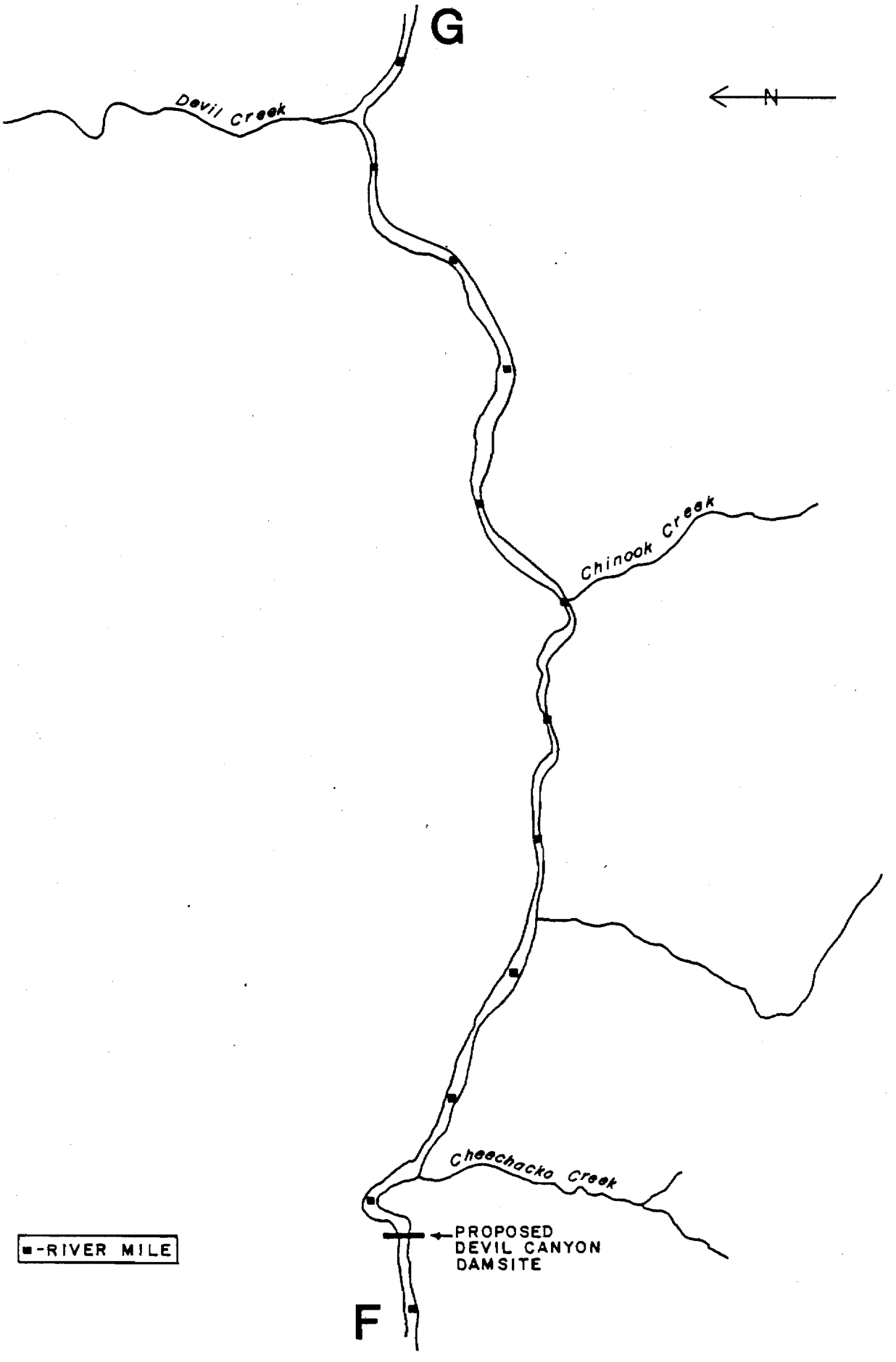

PROPOSED DEVIL
CANYON DAMSITE
Portage Cr.
Devil Cr.
RM 160
Chinook Cr.
GOLD CREEK
Chacchako
Creek
RM 135
SUSITNA RIVER
RM 120
RM 105
TALKEETNA
■ - 5 River Miles

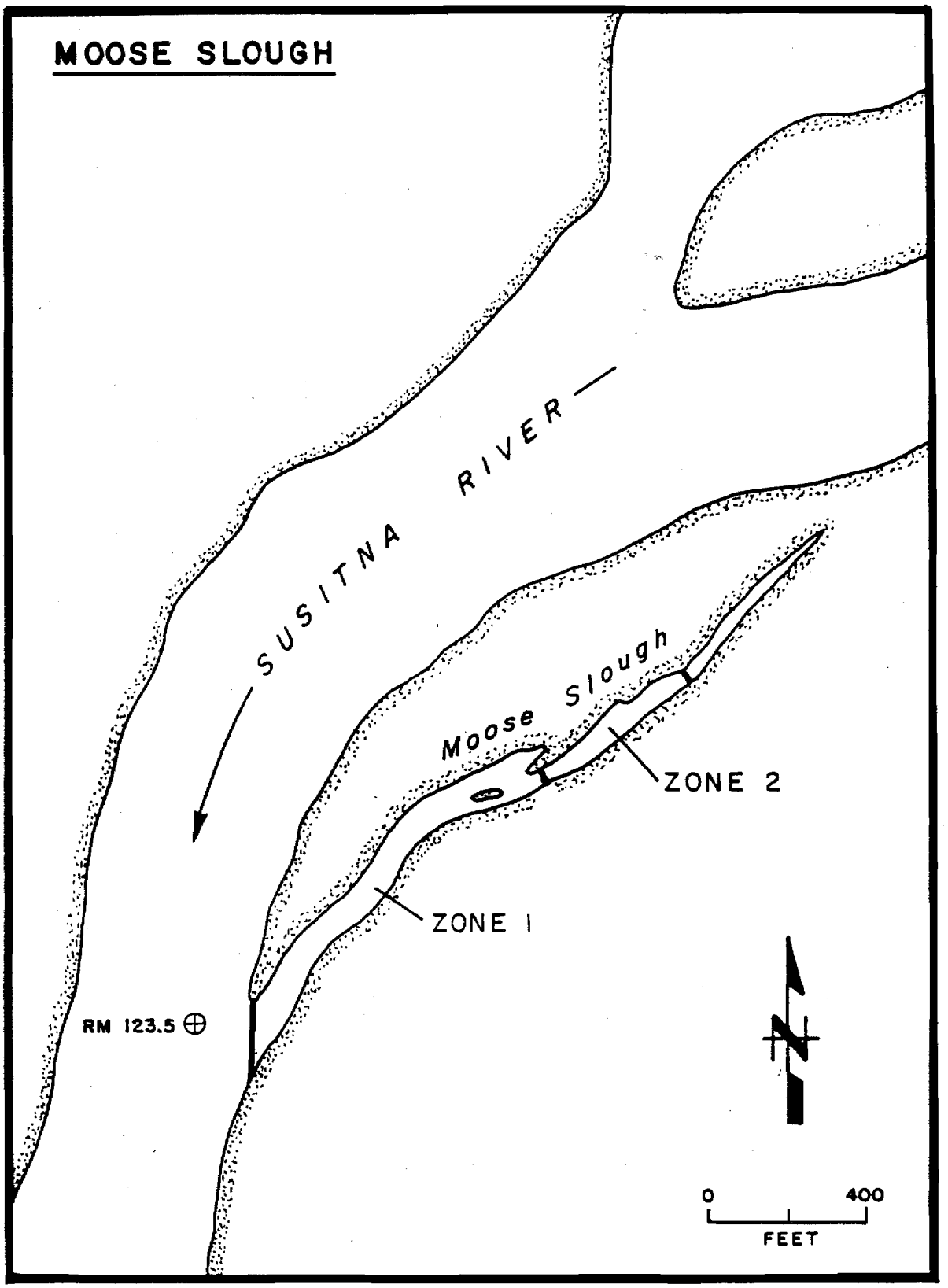

A
• - River Mile
N
Slough 4
RM 105
SUSITNA RIVER
TALKEETNA STATION
Slough 3A
Slough 3B
Whiskers Creek
Slough 2
RM 100
Slough 1
Billion Slough
Wiggle Slough
Talkeetna River
Chulitna River

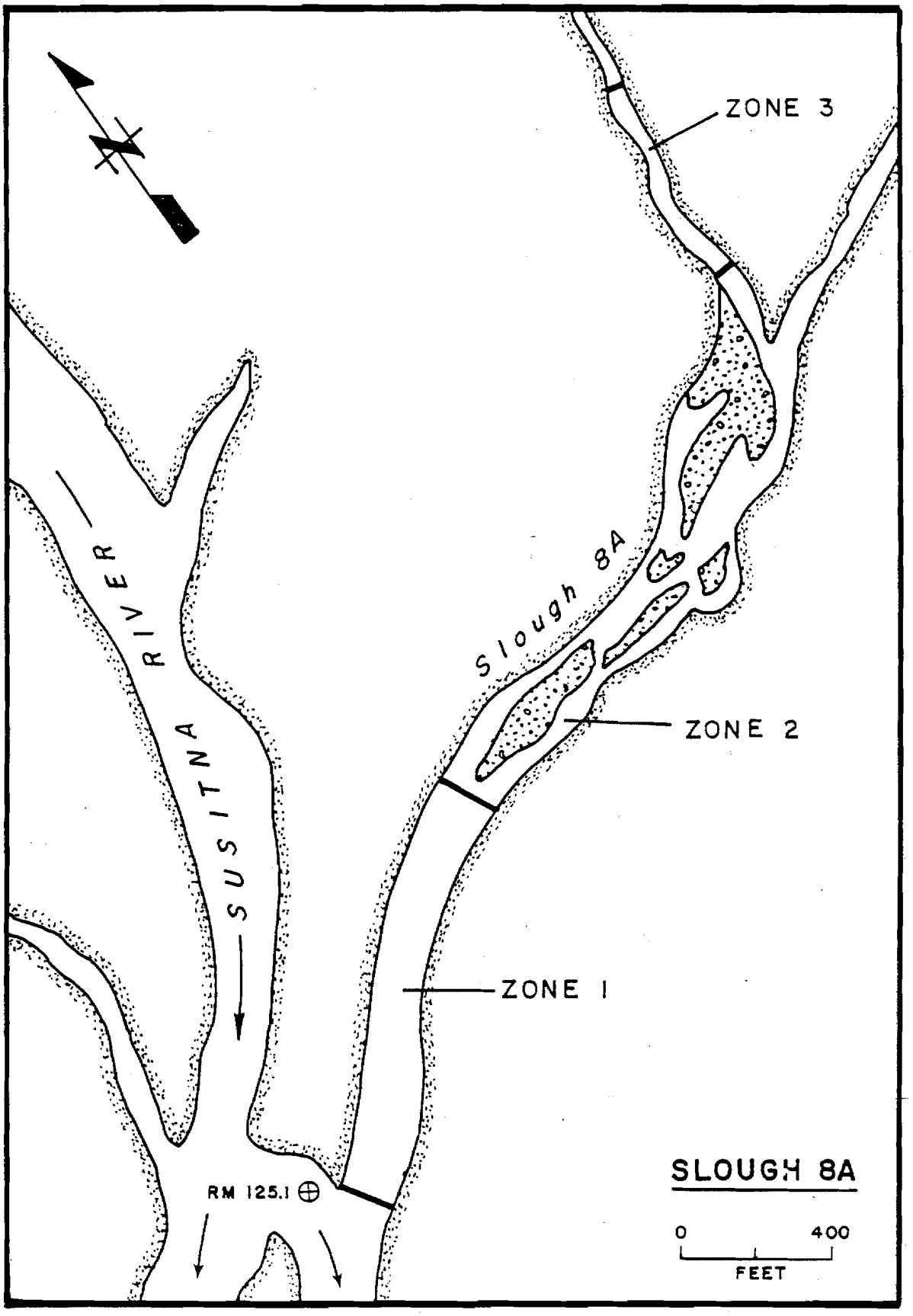

B
RM 115
Slough 8
Lane Creek
Slough 7
Slough 6A
Gash Creek
Oxbow 1
RM 110
Slough 6
Slough 5
Chase Creek
A
C
• - River Mile
Fifth of July Creek
Moose Slough
Slough 8B
Slough 8C
Slough 8D
Deadhorse Creek
CURRY STATION
RM 120
Oxbow 2
Little Portage Creek
McKenzie Creek
Lower McKenzie Creek
B

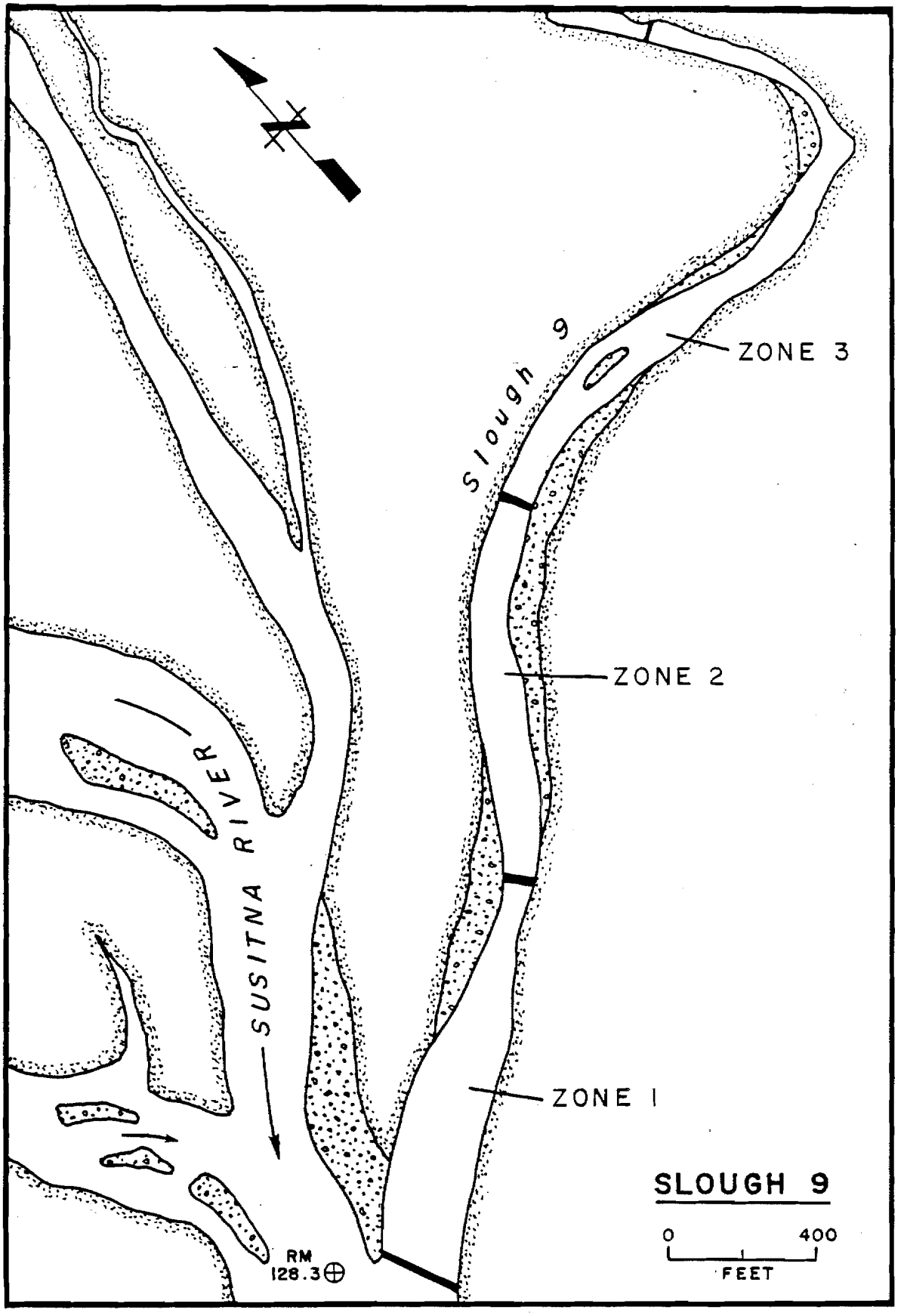

D
E
River Mile
Fourth of July Creek
Sherman Creek
RM 130
Slough 9B
Slough 9
Slough 8A
RM 125
Slough A
Skull Creek
Slough A'
C
Slough 20
RM 140
Slough 19
Slough 18
Slough 17
Indian River
Slough 16
Slough 15
Gold Creek Station
Gold Creek
Slough 14
Slough 11
Slough 13
Slough 12
RM 135
Slough 10
Slough 9A
D

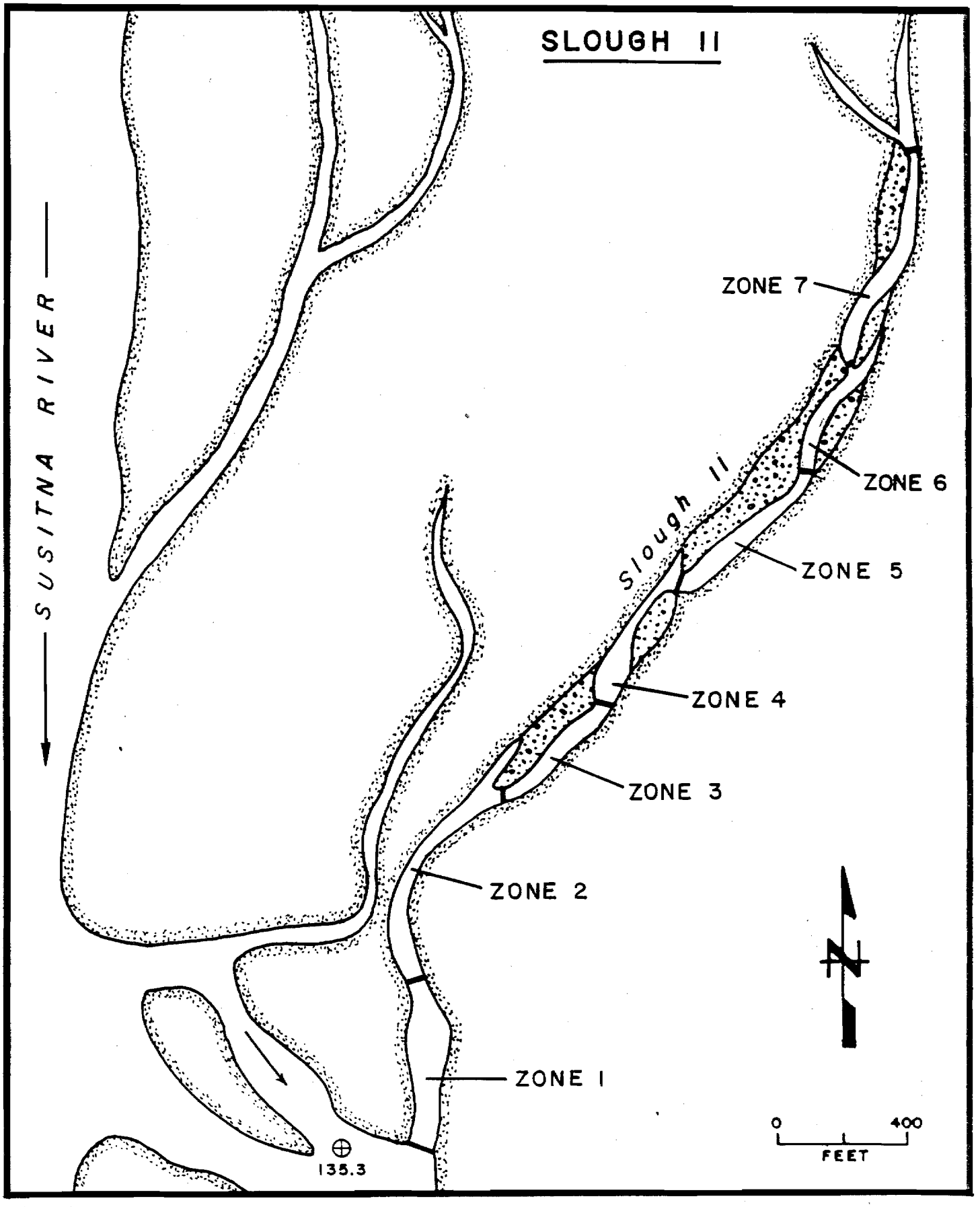

• - River Mile
N
Portage Creek
F
RM 150
Slough 21A
RM 145
Jack Long Creek
Slough 22
E
Slough 21


G
N
Devil Creek
Chinook Creek
Cheechacko Creek
PROPOSED
DEVIL CANYON
DAMSITE
■-RIVER MILE
F


MOOSE SLOUGH
SUSITNA RIVER
Moose Slough
ZONE 2
ZONE 1
RM 123.5
0
400
FEET


ZONE 3
RIVER
SUSITNA
Slough 8A
ZONE 2
ZONE 1
RM 125.1
SLOUGH 8A
0
400
FEET


Slough 9
ZONE 3
ZONE 2
ZONE 1
SUSITNA RIVER
RM
128.3
SLOUGH 9
0
400
FEET


SLOUGH 11
SUSITNA RIVER
ZONE 7
ZONE 6
Slough 11
ZONE 5
ZONE 4
ZONE 3
ZONE 2
ZONE 1
135.3
0
400
FEET

# APPENDIX 6

## ADULT ANADROMOUS FISHERIES STUDIES

### General Equipment, Camp Maintenance and Camp Policy

# GENERAL EQUIPMENT AND CAMP MAINTENANCE, AND CAMP POLICY

## Camp Maintenance

Maintaining a clean and efficient camp site is required. A few of the things to check are:

1. Maintenance of tent camp and other installations will be performed as necessary. All materials necessary will be provided.

2. Grounds will be kept free of liter. All garbage will be bagged up and at minimum disposed of at the nearest sanitary landfill once a week. Special precautions should be observed to insure that garbage does not attract bears and other scavenger species.

3. Upon completion of the summer season, all camp equipment will be cleaned preparatory to winter storage.

4. All sampling nets, tents and tarps must be dry before being stored.

5. A complete camp inventory will be taken by the crew leader at the close of the field season.

6. All equipment will be brought in when the field station is disbanded in the fall.

## Camp Policy

1. No alcoholic beverages are to be stored in areas open to public view including cook tents. If alcohol is consumed at a camp an employee must be off-duty and under no circumstances shall he or she engage in the operation of any state equipment, including boats and motors nor shall he or she return to duty status under the influence of alcohol.

2. The crew leader of each sampling station shall establish a policy on living standards and personnel behavior in accordance with normal guidelines.

3. All sampling stations will operate seven days a week, 24 hours a day. No crew leader shall be off location for more than 24 hours unless specifically authorized by the A/A Project Leader or one of his assistants. Time-off for individual crew members shall be scheduled by the crew leader and it shall be his option as to whether sampling duties allow time-off from the location.

4. All A/A employees will be required to act in a professional manner at all times and shall be especially courteous to the public.

5. It will be the responsibility of the crew leader to report any equipment abuse to the A/A Project Leader or one of his assistants and to insure that no abuse does occur. Additionally, the crew leader must also report within 24 hours to the above cited authority, any Line 500 equipment loss which occurs.

## Equipment Maintenance

Equipment maintenance is perhaps one of the most important operations you will perform during the field season. The outboard motors and generators must be kept in good operating condition or the whole program will suffer.

It will be the crew leader's responsibility to assign the most knowledgeable member of the crew to the job of maintaining and servicing the equipment. It will be this persons responsibility to see that all equipment is kept in operating condition.

## Outboard Motors

Your outboard motor will perform longer and give less trouble if these suggestions are followed:

1. The correct outboard fuel mixture is 50:1. Always pour the oil into the tank first, then add 2 or 3 gallons of gas and mix thoroughly, then fill tank to capacity always using a large funnel and chamois filter.
2. Chainsaws have a fuel mixture of 25:1. Chainsaw gas should be mixed in a 5 gallon can and clearly marked that it is chainsaw fuel.
3. When mixing gasoline or filling the tanks of the generator, stove or lantern, keep the following in mind:
   a. Always mix fuel tanks or equipment under cover to prevent water contamination. Always use a funnel and filter.
   b. Fill camp stoves and lanterns outside as the danger of fire is very real.
   c. A little extra effort toward cleanliness will pay in hours of trouble free operation.
4. Always place outboard in neutral when starting.
5. Check daily the clamp screws that hold the outboard to the transom. Also routinely check the motor for loose screws and bolts, cracks, and break, especially in the area of the lower unit.
6. Never start or run an outboard in the tilted position.
7. In the normal operation of a water pump, a "tell-tale" stream of water is discharged from a hole in the bottom edge of the cowling or from the back of the shaft. If this stream of water stops, the water pump is not working and the motor should be shut off. The side plate over the water intake can be removed for temporary relief as it may be plugged. If the pump continues not to function, the outboard should not be run, and a report to base camp should be made.
8. Check the grease in the lower unit of prop outboards once a week, and drain and replace grease every three weeks. Jet units must be greased daily. This is crucial. Special grease guns will be provided.
9. If the skeg or jet unit hits bottom, check the screws for tightness and housing damage.
10. If your outboard will not start, check the following:
    a. Check to see if the fuel line is connected to the motor and the tank and not pinched or kinked.
    b. Check to see if there is water in the gasoline.
    c. Check to see that the engine is not flooded.

d. Check the spark plugs as they may be fouled or defective (replace if needed).

11. All outboards are to be tilted in the up position when moored at mainstem stations to preclude silt accumulation in the jet unit or water pump and skeg or housing damage.

Lastly, it should be emphasized that the salmon enumeration counts and sampling must continue, as they are very important to the program. All stations will be provided with a spare outboard and Anchorage will replace all inoperative outboards as soon as possible.

Boats

1. Boats are to be kept clean and free of loose tools and debris, and moored at locations where they are not subject to damage by wave action or through contact with the river bottom in rock laden areas.

2. Each crew leader will be responsible for maintaining mooring stakes on the river bank sufficient for the boats assigned to his subproject plus one transient craft. Further responsibility includes maintaining a skookum bow line on each assigned craft and insuring that each boat is properly moored at the end of each work day to preclude possible loss or damage.

Generators

Portable generators will be supplied to all field camps. Their maintenance follows the same line as for the outboards. Since the generators have 4-cycle engines, mixed gas must not be used. The crankcase oil reservoir should be checked daily and maintained at the full level. After 25 hours of operation the oil should be changed. Spark plugs should be checked after every five (5) hours of operation.

Food Orders

Grocery orders will be placed with the Anchorage office once a week. A grocery request list will be supplied to each camp. Please order all food by corresponding numbers. This saves a lot of time on the radio and/or telephone and also lessens the changes of mix-ups of orders.

BEANS

1. baked beans
2. chili
3. kidney beans
4. pinto beans
5. pork and beans
6. small red beans, packaged
7. small white beans, packaged

BEEF - CANNED

8. corned "Dinty Moore"
9. hash
10. roast with gravy
11. sloppy joes
12. stew, "Dinty Moore"

BEER (pay from personal account)

13. case
14. 6-pack

BEVERAGES

15. canned soda
16. coffee, instant
17. coffee, regular grind
18. tea, bags
19. tea, instant

BREAD AND CRACKERS

20. pilot bread
21. ritz crackers
22. soda crackers
23. white, loaf
24. whole wheat, loaf

CAKE AND MUFFIN MIXES

25. blueberry muffins
26. brownies
27. chocolate
28. corn bread muffins
29. snack-n-cake
30. white
31. yellow

CEREALS

32. cream of rice
33. cream of wheat
34. quick rolled oats
35. variety pack
36. wheaties

CHEESE

37. Parmesan
38. monterey jack
39. swiss
40. tillamook, mild
41. tillamook, sharp

CHOCOLATE

42. hot instant Nestles
43. Nestles baking chocolate
44. Swiss Miss

CONDIMENTS

45. cucumber pickles
46. dill pickles
47. honey
48. horseradish
49. ketchup
50. mayonaise
51. mixed nuts
52. mustard
53. olives
54. sweet pickles
55. syrup, Log Cabin
56. vinegar

DAIRY

57. "Coffeemate"
58. evaporated milk
59. Milkman

DESSERTS (cookies, jello, candy, gum

60. candy bars
61. chocolate chip cookies
62. chocolate cream filled cookies
63. fig newtons
64. gum, assorted
65. Jello gelatin

Jello pudding

66. Chocolate
67. Vanilla
68. Butterscotch
69. Banana cream

70. marshmallows
71. oatmeal cookies
72. vanilla cream filled cookies

DETERGENTS AND CLEANSERS

73. Ajax
74. bar soap
75. bleach
76. Boraxo
77. cold water "All"
78. green soap
79. liquid Ivory
80. scouring pads (Brillo & S.O.S.
81. sponges

FLOUR

82. bisquick
83. krusteaz
84. white
85. whole wheat

FROSTING MIX

86. chocolate
87. white

FRUIT-FRESH

88. apples
89. bananas
90. grapes
91. melons
92. oranges
93. peaches
94. pears
95. other, in season

FRUIT-CANNED

96. applesauce
97. apricots
98. fruit cocktail
99. grapefruit slices
100. mandarin oranges
101. peaches
102. pears
103. pineapple
104. raisins

GRAIN PRODUCTS

105. egg noodles
106. elbow macaroni
107. shell macaroni
108. spaghetti

JUICE

109. apple
110. grape
111. grapefruit
112. lemon
113. orange
114. pineapple
115. tang
116. V-8

MEATS

117. bacon
118. ham
119. hamburger
120. hot dogs
121. pork chops
122. pot roast
123. sandwich meats
124. sausage
125. steak
126. veal cutlet

MIXES (packaged)

127. dream whip
128. frying mix
129. pie crust
130. sour cream
131. spaghetti sauce

NON-EDIBLE

132. aluminum foil
133. "Cutters"
134. lye
135. matches
136. paper towels
137. pic or buhach
138. sandwich bags
139. toilet paper
140. toothpicks

OIL AND BUTTER

141. butter, canned
142. margarine
143. olive oil

Peanut butter

144. creamy
145. chunky

146. shortening, canned
147. "Wesson"

POULTRY

148. chicken, fresh
149. chicken, prepared
150. chicken, canned
151. eggs, 1 dozen

PRESERVES

152. apple butter
153. apricot
154. blackberry
155. boysenberry
156. grape
157. raspberry
158. strawberry

RICE

159. brown, long grain
160. minute
161. misc. mixes
162. white, long grain

SAUCES

163. A-I
164. barbeque
165. soy
166. tobasco
167. Worchestershire

SOUP

168. bean with bacon
169. bullion cubes, beef
170. bullion cubes, chicken
171. clam chowder
172. chicken noodle
173. cream of mushroom
174. minestrone
175. onion
176. package mixes, dehydrated

SPICES

180. allspice
181. baking powder
182. baking soda
183. basil, sweet
184. bay leaves
185. chili powder
186. cinnamon
187. garlic salt
188. garlic powder
189. onion salt
190. oregono
191. paprika
192. pepper, black
193. table salt
194. vanilla

SUGAR

195. brown, light
196. granulated
197. powdered
198. raw

VEGETABLES, CANNED

199. asparagus
200. beets
201. carrots

Corn

202. cream style
203. whole kernal
204. on the cob

Green beans

205. french style
206. cut

207. mushrooms
208. peas
209. sauerkraut
210. spinach
211. tomatoes, stewed
212. tomatoes, solid pack
213. tomato sauce
214. tomato paste

VEGETABLES, FRESH

216. lettuce
217. mushrooms
218. onions
219. potatoes, 10 lb. sac
220. radishes
221. tomatoes
222. misc, in season

# APPENDIX 7

## ADULT ANADROMOUS FISHERIES STUDIES

### Electroshocking Boat Operations

## A. ADULT ANADROMOUS FISHERIES STUDIES

### Electro-Fishing Boat Operations

#### Operational Procedures

1) The power source for electrofishing will be a 3.5 kilowatt Homelite Voltmatic generator. The four-cycle engine uses regular unmixed gasoline. Do not use mixed outboard motor fuel. The crankcase oil reservoir must be checked daily and should be changed with 30 weight automotive oil after the initial 10 hour break-in period and every 25 hours thereafter.

2) For optimum electrofishing success a Coffelt electro-shocker, model VVP-3E, will be used to regulate the output amperage, voltage, frequency and current type. A knowledge of electrical terms and uses as they relate to electrofishing will help in a better understanding of the effects that occur when adjusting the power output. The basic unit of electric charge is the coulomb and the rate at which this charge moves through a circuit is defined as the amperage. The volt or potential difference generates the energy (joules) needed to move the electric charge through the circuit. The amount of voltage required to move X amount of current through a circuit will vary with water temperature, water conductivity and the circuit resistance. The amperage, in particular, is the parameter that should be monitored as excessive electrical current will result in physiological damage to the fish being sampled. The output current types are: alternating current (A.C.), direct current (D.C.) and pulsed A.C. and D.C. The literature suggests that pulsed D.C. has the best effective capture range with the least amount of harm to the fish.

3) A 20 foot riverboat with a 75 HP outboard will be used for electrofishing. A 36" high non-conductive safety railing and a non-skid platform will be placed on the bow of the boat. Two electrode systems will be available and selection will be predicated by the type of habitat being assessed.
   A) Mobile electrode system (MES)
      The MES utilizes the boat as the cathode electrode and a dipnet as the anode electrode. This electrode system will be used in shallow water or in areas of restricted maneuverability.
   B) Stationary electrode system (SES)
      The SES will have two retractable booms which will allow the anode electrode to be extended 10 feet in front of the bow. The boat itself or braided steel wire trailing from the stern will be the cathode electrode. The SES should be used in deeper waters and areas of unrestricted maneuverability.

## Safety Precautions

These procedures must be adhered to for the safety of all operators of this equipment.

1. A minimum of two (2) persons is required to safely and efficiently operate the unit, provided the control box can be easily monitored by the boat operator. For two (2) man operations, the boat operator should be capable of adjusting voltage and amperage, activating the power switches on the control box, and shuting down the generator without having to leave his station as outboard operator.

   Should these conditions not be met, then a minimum crew would be three (3). One(1) person should monitor the control box at all times.

2. All personnel should be throughly familiar with the equipment and its operation. Personnel should briefed as to emergency procedures should the situation arise.

3. All equipment, connections and wiring should be checked before each day's operation. Particular attention should be payed to the platform railing and safety foot switch. The railing should be strong and secure enought to support a man's weight. The safety switch must be free of rust and corrosion. It would be advisable to have the metal railing insulated with foam pipe insulation or plastic electrical tape. Wiring should be left exposed to facilitate inspection of the insulation.

4. Only dip nets with fully insulated handles will be used.

5. Personnel will wear only hip boots or chest waders that are completely lead proof. The platform surface should be of a non-skid type. Rubber gloves are advisable as an added safety measure.

6. All personnel will wear life jackets or other adequate floatation devices. Should anyone fall overboard, it is unlikely that he will have enought muscle control to swim.

7. Never start the generator until all connections for the particular mode of operation are complete. While traveling between points of operation, the electrodes should be disconnected from the electrical source if the generator is to be left running, i.e., for night operations.

8. Never change the position of the boom or handle the electrodes unless the leads are disconnected and all switches on the control box are in the "off" position.

9. When disconnections are made or lines left disconnected, all switches on the control box should remain in the "off" position to preclude any load on the wiring.

10. All personnel should be familiar with first aid treatment for shock victims and be trained in artificial respiration. At least one (1) member of the crew should have completed a recognized first aid course (hopefully he will not be the one injured).

11. The equipment shall not be operated in such a manner so as to endanger the public. The current shall be turned off anytime the public is in the immediate proximity of the aparatus, be it on shore, in the water, or in a boat.

In an emergency, the electrical current into the water may be broken in three ways:

1. By releasing the foot pedal switch which is located on the platform and controlled by the dip net operator.

2. By turning off all switches on the control box. One (1) man must be operating the control box at all times.

3. By actuating the grounding switch effectively killing the generator. If possible, switches should be located both on the dipping platform and near the motor generator and wired so that activation of either switch will kill the generator.

First Aid for Victims of Electrical Shock

Should anyone fall overboard or receive an electrical shock, the unit will be immediately shut off. Rescue the victim from the water or free him from the electrical circuit as quickly as possible. Act quickly, as any delay in removing the person from the electrical field or circuit will lessen the change of resuscitating him. Do not endanger yourself attempting to rescue someone with the power on.

If the victim is not breathing, begin artificial respiration at once. Mouth-to-mouth resuscitation is recommended. Continue resuscitation until you are certain breathing is restored. Frequently, after a temporary recovery, a victim will stop breathing again. If natural breathing stops, resume artificial respiration at once.

Physical shock is a serious complication that is likely to occur after electrical shock. Shock can interfere with the normal action of the heart, respiration and circulation, so every precaution should be taken to prevent this condition from further weakening the victim. The victim should be lying flat and it is most important that he be kept as warm as possible, even during artificial respiration.

The following procedure is recommended in cases where it appears the victim's heart has stopped:

1. Place the victim on his back.

2. Position yourself on your knees beside his chest.

3. Find the lower end of his breast bone.

4. Place the heel of your hand one inch above that end.

5. Place your other hand on top of the first hand.

6. Press down firmly with about sixty (60) pounds of weight.

7. Repeat every second until heart starts.

8. If necessary, apply mouth-to-mouth resuscitation as follows: one (1) operator - 15 compressions, two breaths or two (2) operators - one breath every fifth compression.

The above procedure would be life sustaining should the victim go into ventricular fibrillation.

Admittedly, the above first aid procedures are brief, but due to lack of more competent means to deal with electrical accidents, this should serve as a guide for emergency treatment until the patient can be taken to medical facilities.

NOTE: A COPY OF THIS PROCEDURE MUST BE ONBOARD THE SHOCKING BOAT AT ALL TIMES!!!!!

# Electrical Safety and Electrofishing

## INTRODUCTION

Electrofishing uses voltages and currents which can be lethal for the operator. Portable, electrical equipment used in a moist, outdoor environment is more prone to fail and cause shock hazards. An understanding of the problem by the operator and proper design of the equipment can do much to insure safe operation.

This report will discuss the electrical parameters associated with electrical safety and then describe some of the design details that aid in safe operation of electrofishing equipment.

## PHYSIOLOGY AND ELECTRICAL SHOCK

Most of the data available on electrical shock parameters deal with 60 Hz currents and voltages. Some work has been done with direct and pulse currents but the results are still not conclusive. Results of animal experiments and some human experiments seem to indicate that 20 to 500 Hz currents are more dangerous than direct current or higher frequency currents.

It is generally agreed that it is the current which passes through a body that does the damage. The voltage in a circuit is only important insofar as it can produce current in the body. Large currents passing through or around a person can cause serious injury because of the heating and burning of tissue. This type of injury is more common at higher voltages used by power companies.

Death at lower voltages, such as 120 to 240 V found around homes, can usually be attributed to one of three causes:

a. Ventricular fibrillation
b. Respiratory arrest
c. Asphyxia

### Ventricular Fibrillation

Ventricular fibrillation is an uncoordinated asynchronous contraction of the ventricular muscle fibers of the heart in contrast to their normal coordinated and rhythmic contraction. The heart seems to quiver rather than to beat. This condition is caused by an electrical shock where the path of current is through the chest, such as between two arms or between an arm and a leg. Once a person goes into ventricular fibrillation, the only way to stop the fibrillation is to use a defibrillator which applies a pulse shock to the chest to restore the heart rhythm. Closed chest heart massage and artificial respiration may help until the victim can be defibrillated.

### Respiratory Arrest

Shocks with a current path through the respiratory center can cause respiratory arrest. The respiratory center is at the base of the skull slightly above a horizontal line from the back of the throat. Thus, shocks from the head to a limb could lead to respiratory arrest. Artificial respiration can help in this case.

### Asphyxia

Asphyxia is caused by contraction of the chest muscles. When current is above a certain level, a person cannot let go of an electrically hot wire. Currents somewhat above this level may not be sufficient to cause ventricular fibrillation but may be sufficient to cause the contraction of the chest muscles and asphyxia since the victim cannot let go of the wire.

## ELECTRICAL PARAMETERS

The electrical resistance between the limbs of an individual is highly variable. It depends on the contact conditions such as dry skin versus moist skin, the tough skin of a laborer versus a baby's tender skin, and so on. Tests indicate that a good approximation for the resistance between any two limbs is 500 ohms. This is the estimated resistance with good contact through the skin. Using this figure, a person across a 120 V line, touching the line with any two limbs, might have a current of approximately 0.24 A through his body since the current might be approximately 120/500 A. Across 240 V, the current might be on the order of 0.48 A.

The threshold for perception of 60 Hz is 0.0002 A. A current of 0.00036 A can be perceived by 50% of a group of men while 50% of a group of women can percieve 0.00024 A. This is an important parameter since a shock of such low level in itself is not dangerous but it might startle an individual so that he falls from a ladder, falls out of a boat, or has some other involuntary action which could be hazardous to him or an associate.

When a person grasps a wire at 60 Hz, one man in 200 cannot let go of the wire when the current is 0.009 A or less. At 5 Hz this one man in 200 cannot let go at 0.015 A or less while at 1 kHz the let-go current is 0.013 A. At 60 Hz, 50% of a group of men cannot let go 0.016 A while only one man in 200 can let go 0.022 A at 60 Hz. For women the let-go current is less such that one woman in 200 cannot let go 0.006 A at 60 Hz. This current level is important because the victim is held to the wire. His resistance may then decrease so that more harmful currents can pass through his body.

Asphyxia can be caused by 60 Hz currents of 0.04 to 0.06 A. The victim should be pulled off the line or better yet the line should be de-energized to allow the chest muscles to relax and permit breathing.

Respiratory arrest is not as common as asphyxia and ventricular fibrillation since people usually keep their heads out of electrical equipment. There is no figure readily available as to current level causing this condition but it is probably on the order of 0.1 A between the head and a limb. Artificial respiration will certainly help.

Ventricular fibrillation is the killer since the only real relief involves the use of a defibrillator available at a good hospital. From experiments with animals extrapolated to possible human application, the 60 Hz current range which will produce ventricular fibrillation in one out of 200 people is given by the expression

$$I = \frac{0.116 \text{ to } 0.185}{\sqrt{T}} \text{ A rms}$$

*By T. Bernstein, Electrical Eng. Dept., Univ. of Wis., Madison.

where T is in seconds. This equation is valid for a range of T from 8.3 milliseconds to 5 seconds. Tests seem to indicate that from 5 to 20 or 30 seconds the threshold is essentially the same.

From this information it should be evident that 20 to 500 Hz currents as low as 0.0002 A can be dangerous. A current of 0.009 A might prevent a person from letting go of a conductor while a current of approximately 0.15 A for 1 second could cause ventricular fibrillation. Direct current values are higher by a factor of approximately 3.

## DESIGN FEATURES FOR SAFE ELECTROFISHING EQUIPMENT

The dc and ac generators used in electrofishing provide more than enough voltage and current to electrocute a person. Safe design tries to insure that electrically energized conductors cannot be touched. This is done by carefully insulating all leads associated with the generator. Any switches which must be operated should be carefully insulated if voltages over 24 volts are used in the switching circuit. It is better to use low voltages for the switching circuits and have these circuits isolated by a relay from the higher voltage power circuits. All metal parts of the boat should be carefully bonded, electrically connected, to make sure that there will be no voltage between metal parts in the event of an insulation failure.

Safety switches are of value. There might be a switch on the seat used by the outboard motor operator so that if he falls in the water the power might be interrupted. Switches on the boom handle for a stream shocker or on the front deck of the lake shocker might be designed so that power is removed if the operator lets go of a handle or falls into the water.

Periodic tests should be performed on the system to insure the integrity of the insulation system. A simple continuity check would be quite useful to make sure that no part of the generator electrical output is in contact with the boat.

Many articles have been written on the subject of electrical safety. Three recent articles of interest containing many references are Lee (1966). Dalziel and Lee (1968) and Bernstein (1973).

Ref: Bernstein, T. 1974. Electrical Safety and Electrofishing. Pages 32-33 in D.W. Novotny and G.R. Priegel. Electrofishing Boats. Wisconsin Dep. Nat. Resour., Tech. Bull. No. 73.

APPENDIX 1

RESIDENT AND JUVENILE ANADROMOUS FISHERIES PROJECT

Instructions for completing Juvenile Anadromous Habitat Studies (JAHS) sampling forms and field data notes.

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Instructions for Completing Juvenile Anadromous Habitat Studies (JAHS) Sampling Forms and Field Data Notes.

# APPENDIX 1

RESIDENT AND JUVENILE ANADROMOUS FISHERIES PROJECT

## Instructions for Completing Juvenile Anadromous Habitat Studies (JAHS) Sampling Forms and Field Data Notes.

Instructions for Completing Forms RJ 83-01:

1. DATE - Year Month Date

2. LOCATION - Enter name identifying study site.

3. GRID NUMBER - Enter the established identification number.

4. HABITAT MODEL - Enter Yes or No.

5. COLLECTORS INITIALS - Initials of person who records habitat and catch data.

6. PAGE NUMBER - Indicate the page number and total number of pages used.

7. TIME - Military time.

8. HYDROLAB NUMBER - Enter equipment serial number located near digital readout.

9. TURBIDITY - Enter the turbidity, expressed in NTU's.

10. WATER CHEMISTRY - Enter the correct hydrolab readings in the correct heading for pH, D.O. (dissolved oxygen in ppm), temperature (°C), and specific conductance.

11. CELL NUMBER - Enter the number that identifies the cell sampled.

12. CELL AREA - Computed by multiplying mean cell width (6 ft) with cell length (50 ft). Generally cell area is constant 300 $ft^2$, however on occasion this value could be more than or less than 300 $ft^2$.

14. CELL MEAN DEPTH - Enter the average depth of the cell taken approximately 3 ft from the bank in an area in which the water depth is representative of the entire cell.

15. VELOCITY - Point velocity obtained from the rating table using revolution and time information or the velocity reading from a direct readout meter. The velocity was measured at 0.6 the depth of the water column.

16. SUBSTRATE - The substrate of each cell will be classified with a one or two digit substrate code number which expresses the dominant and subdominant substrates represented within the cell. Enter the dominant substrate code as the first digit in the column marked substrate. If a subdominant substrate is represented within the cell and exceeds ten percent then enter the subdominant substrate code as the second digit. For example a two digit substrate code of 17 would indicate that the dominant substrate consisted of silt, and the subdominant substrate consisted of boulders.

| Substrate Code | Description |
|---|---|
| 1 | Silt |
| 2 | Sand |
| 3 | Small Gravel (1/8" - 1") |
| 4 | Large Gravel (1" - 3") |
| 5 | Rubble (3" - 5") |
| 6 | Cobble (5" - 10") |
| 7 | Boulder (greater than 10") |

17. PERCENT COVER - Percent cover of each cell will be classified as a single digit code. Enter the percent cover code which represents the sum total of all available cover classes within an individual cell.

| Percent Cover Code | Percentage |
|---|---|
| 1 | 0 - 5 |
| 2 | 6 - 25 |
| 3 | 26 - 50 |
| 4 | 51 - 75 |
| 5 | 76 - 95 |
| 6 | 96 - 100 |

18. COVER CLASSIFICATION - The cover types of each cell will be classified with a one or two digit cover code, which will express the dominant and subdominant cover types represented within the cell. Enter the dominant and subdominant numerical cover codes in the same manner as detailed in the substrate classification.

| Cover Code | Description |
|---|---|
| 1 | No cover |
| 2 | Emergence cover |
| 3 | Aquatic vegetation |
| 4 | Debris deadfall |
| 5 | Overhanging riparian |
| 6 | Undercut banks |
| 7 | Large gravel (1" - 3") |
| 8 | Rubble (3" - 5") |
| 9 | Cobble or boulder (greater than 5") |

19. GEAR CODE - Enter appropriate gear code; 003 for beach seines, 002 for electrofishing.

20. EFFORT - Record beach seine effort as one for each seine haul. Electrofishing effort will be recorded in seconds.

21. SPECIES CODE - Enter the code that identifies the species of fish captured.

22. NO. OF FISH - Enter the number of fish caught.

23. LENGTH - Enter total length measured from tip of nose to tip of caudal lobe.

24. FATE - Enter the fate of the fish, whether the fish will be preserved, or released alive.

Instructions for Completing Form RJ 83-03:

1. DATE - Year, Month, Date

2. LOCATION - Name identifying study site.

3. GRID NUMBER - Enter the established identification number.

4. COLLECTOR'S INITIALS - Initials of person who records site map data.

5. STAFF GAGE NUMBER - Enter established identification number.

6. STAFF GAGE HEIGHT - Record stage height to the nearest 0.01 foot.

7. TRANSECT NUMBER - Enter established identification number.

8. LEFT (W) EDGE OF WATER - Enter distance rounded to feet from left transect marker to left edge of water.

9. RIGHT (E) BANK OF WATER - Enter distance rounded to feet from left transect marker to right bank of water.

10. RIGHT BOUNDARY - Enter distance in feet from left transect marker to right transect marker.

11. COMPASS BEARING TO RIGHT - Enter compass bearing from left transect marker toward right transect marker.

12. PAGE - Indicate the page number and total number of pages used.

Field Notes

Daily field notes recorded by biologists conducting JAHS studies will address the following items:

1. Hydraulic Conditions

This will include preparation of a narrative description of the mainstem Susitna stage and discharge that affect the hydraulic conditions within the grid system at each site. Changes between sampling periods and other phenomena such as changes in channel morphology caused by high water or icing conditions will also be recorded. A description of how changes in discharge of the mainstem have affected the availability of micro-habitat for juvenile salmon will also be noted in general terms. Problems with the data base recorded or keys to assist in its interpretation will also be noted.

2. Habitat, Temperature, Turbidity Data

This section will discuss any information required in interpreting the temperature data, turbidity data, cover or substrate descriptions on the data sheets. Factors such as observed upwelling of ground water, unusual readings or other conditions that depart from the expected and hypotheses as to the cause of the anomalies will be described. Any other unusual habitat, water depth or velocity conditions that may affect the micro-habitat availability, distribution, abundance of the fisheries in the area will be included.

3. Biology

This section will include any observations that are pertinent to the objectives of this study with regards to the juvenile anadromous fisheries. Observed juvenile fish, that were not collected from cells within the grid system and their distribution within backwater zones, and any interpretation required for the collected specimens will be included. The narrative should also include changes in the distribution observed during previous sampling periods and any new phenomena observed that are of particular interest to the objectives of the study. Hypothesis as to the factors that are, in the opinion of the field biologist, influencing the micro-habitat utilization and abundance of the juvenile salmon fisheries within the cell and sample grid will be described.

The notes will be recorded so that a continual journal of the events occurring at a site through the open water season can be followed from one sampling period to another. The response of the fisheries and habitat conditions within individual cells and grids at each site can be followed over time and can then be described with regards to effects of mainstem discharge that may differ from sampling period to sampling period.

Any other field notes that will assist in the interpretation of the data should also be recorded during the sampling period. These field notes will provide an additional basis for the preparation of

the final reports on the fisheries at these sites and the response of the fisheries to changes in the micro-habitat that occur during the course of the field season because of different mainstem Susitna discharges.

APPENDIX 2

RESIDENT AND JUVENILE ANADROMOUS FISHERIES PROJECT

Operational procedures for the Epson HX-20
microcomputer data form program.

# OPERATIONAL PROCEDURES FOR THE EPSON HX-20 DATA FORM PROGRAM

Note to operator: You must type underlined material exactly as it appears.

TO OPERATE:

1. Turn on computer; turn printer switch on.

2. A menu (numbered list) should appear on the screen; choose the selection labelled "FORM" by typing the appropriate number.

3. A series of questions will follow. The statement "This is entry # " will appear, with the question "New Count?". If the observation number is correct, just hit the RETURN key. If the observation number appearing is incorrect, type Y. The question "What is the count?" should now appear; type in the new correct observation number followed with the RETURN key.

   The question "New tape?" will follow. If the tape is new or you are changing to the reverse side, type Y. The computer will ask you to enter a new tape at this time. Hit any key once the new tape is inserted. If this is not a new tape, hit the RETURN key in response to the "New tape?" question.

4. If a statement "Warning-tape has only ### units left" appears, you should replace or turn the tape over and type Y to above question unless you have only a very small number of entries.

5. Now the statement "Initializing - Data erased" will appear and, after a few seconds, a new menu. Choose "Enter Data" from the menu by typing 1. "Header data" and habitat questions should now appear on the screen. If the information is correct as displayed, hit RETURN key, otherwise type in the complete correct entry data followed by the RETURN key. If you hear a warning buzzer sound, you should reexamine the data entry by use of the arrow keys going backward or forward. Either the up or down arrows or the left-right arrows will take you back to the previous entry or the next entry, as appropriate. Correct the data entry as needed. If a number is 1.0, enter 1.0, not 1. If the set or check time is midnight, enter 0000 and the date of the coming day.

   After all general header information is entered, the buzzer will sound and two boxes will appear with "###" under the left one and "species" under the right one. The left box will contain a "1". Enter correct species code followed by RETURN or right arrow key. Enter remaining data according to prompts indicated below boxes. If the warning buzzer sounds, use the left arrow key to re-examine last entry. After entering the fate code (or RETURN key if the fate code is correct as listed), fish #2 will appear. Continue entering data as appropriate until all fish are accounted for. You may use the arrow keys to correct any previous entry or to enter

only one field, such as length, if all other fields are constant between fishes; there is no need to hit RETURN key after entries as the arrow keys perform the same function. After completing the last entry, enter ! (hold down SHIFT key while pressing the ! key) and then press the RETURN key to end data entering. Maximum number of fish entries allowed is 100.

6. The data form menu will reappear. Choose #2 on the menu (type 2) to print data out on the Epson printer. Review this data to ensure its accuracy. Choose #1 to correct any errors in the habitat and header data, exiting the data entry after the fish # comes up by typing ! followed by the RETURN key. Correct any errors in the fish data entry by choosing #5 on the menu (type 5). To eliminate entries on the end of the list, choose selection #6 from the menu (type 6). The question "Last fish # to save? will appear. Enter the last valid fish number and press the RETURN key. Another method to correct errors in the fish entry data is to edit individual fish entries. To edit individual fish, also choose # 6 and then hit RETURN key in response to the first question. The questions "Fish # on print out?, Species Code?, Number of Fish?" etc., will appear. Enter complete information in response to each question. The menu will reappear after entering the fate code.

7. Reprint the data using selection #2 if the changes are extensive. Otherwise, just make pencil corrections on the paper printed out earlier. Note whether or not pencil changes on paper have been made on the Epson.

8. Select "File/Print" from the menu (type 3). After the data is stored, answer Y to the "Hit Y for Backup?" question. You must make a backup copy of the tape. After the backup copy is completed, the computer will ask "Backup OK?" If there were no problems with the backup procedure, such as inserting the wrong tape, etc., type Y to this question, otherwise insert new backup tape and repeat. You must exit this routine with a Y to "Backup O.K.?" in order to ensure that the next entry session will be properly updated.

9. To enter a new data set or the next trap number, choose "KILL" on the menu (type 4) or turn the computer off and repeat the process from item 1 on this list.

ADDITIONAL HELPFUL HINTS:

If you have entered a large amount of data and the program breaks, you can resume operation by typing CONT followed by the RETURN key. If an abort message appears, you must reenter all of the data. If typing CONT does not work, type GOTO 90. This will allow the menu to reappear and you can resave the data to file or edit any errors without updating the observation number. If this occurs before you have exited the "Backup OK?" question properly, the data set will overwrite the data entered earlier using the "Print/File option". Be sure this is what you want to happen before completing this procedure.

Any errors observed after the data are stored should be noted on both printouts with a large indication of the fact that they are inaccurate and need editing in the office. Any repeated or omitted observation numbers on the printouts should likewise be noted.

IF PROBLEMS OCCUR:

If the program will not run properly, you may have to erase the program and reload it from tape.

To reload the program:

1. Insert program tape.

2. Turn computer on and select "BASIC" from the main menu (type 2).

3. Type LOGIN 2, then hit RETURN key; type TITLE"", then hit RETURN key; type NEW, then hit RETURN key.

4. Type WIND, then hit RETURN; after cursor reappears, type LOAD, then hit RETURN.

5. After the tape stops running (cursor reappears) and no errors occurred, type TITLE "FORM" then hit RETURN. If an 10 ERROR" occurs, repeat steps 4 and 5.

6. Type CLEAR 350,120 then hit RETURN. Now hit the MENU key and select "FORM". The program should now run normally.

If the program still will not run properly or the computer malfunctions, you may have to press the RESET key, the red one on the right side of the box. This erases the program and any data not saved. Then repeat the last six steps to reload the program.

Appendix 1

AQUATIC HABITAT AND INSTREAM FLOW PROJECT

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Outline describing flow chart for salmon spawning habitat evaluation.

ALASKA DEPARTMENT OF FISH AND GAME/SU HYDRO

AQUATIC HABITAT AND INSTREAM FLOW (AH)

FY 84 APPROACH FOR

SALMON SPAWNING HABITAT EVALUATION

IN SLOUGHS AND SIDE CHANNELS

I. Availability Model Assessment (Includes An Assessment Of Flow Related Velocity, Depth, And Substrate Characteristics.)[1]

A. Hydraulic Model Data Sites.

1) Slough Models (IFG-4)

a) Slough 8A

b) Slough 9

c) Slough 21

2) Side Channel Models (IFG-4)

a) Side Channel 10

b) Upper Side Channel 11

c) Side Channel 21

3) Side Channel Model (IFG-2)

a) Lower Side Channel 11

B. Calibration by EWT&A and ADF&G.

C. Evaluate Whether Model Output Corresponds To The Range Of Flows Which Occurred When Spawning Habitat Utilization Conditions Were Measured.

1) Determine slough flows which occurred during the periods when redd measurements were recorded at each modeling site (see II-A-2).

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[1] See also IV-2

2) Determine if hydraulic model output for these flows can be generated in order to determine available depth, velocity, and substrate characteristics, or whether additional data must be collected.

D. Collect The Following FY85 Availability Data If Required:

1) velocity, depth, and substrate;

2) surface and intragravel water temperature; and,

3) upwelling presence or absence.

E. Develop Scatter Plots Of Available Habitat Which Illustrate Depth Versus Velocity With Substrate Indicated As Acceptable (+) Or Unacceptable (-).

II. Spawning Habitat Utilization Assessment (Includes An Assessment Of Point Specific Velocity, Depth, Substrate, Temperature And Upwelling Characteristics At Redd Locations.)

A. Spawning Habitat Utilization Data Base Source Evaluation To Assess Which Spawning Habitat Utilization Data Sets Can Or Should Be Used And/Or Combined To Develop Adult Salmon Spawning Habitat Curves.

1) Sites and data sets are listed below. Number in parenthesis indicates the number of redd observations. An asterisk (*) indicates that a hydraulic model is available for the site.

Chum

1982 Field Data
- Slough 9* (45)
- Slough 8A* (37)
- Slough 21* (34)
- Slough 11 (15)

1983 Field Data
- Slough 9* (31)
- Slough 8A* (15)
- Slough 21* (49)
- Side Channel 21* (2)
- Upper Side Channel 11* (2)
- Slough 11 (15)
- Other sloughs [sloughs 9A(24), 17(6), 20(11), 22(12)]
- Mouth of 4th of July Creek (28)
- Mouth of Indian River (3)

Sockeye

1982 Field Data
- Slough 8A* (1)
- Slough 11 (23)

1983 Field Data
- Slough 8A* (16)
- Slough 21* (20)
- Slough 11 (22)
- Slough 17 (2)

Chinook

1983 Field Data
- Portage Creek (136)
- Indian River (125)

Pink

1982 and 1983 Field Data
- Insufficient Data (15)

Coho

1982 and 1983 Field Data
- Insufficient Data (0)

Other

Literature Data
- Bradley Lake
- Terror Lake
- Chakachamna
- Willow Creek
- Other sources if available

2) Compile spawning habitat utilization data from ADF&G Su Hydro modeling sites (*) and reduce above data into a scatter plot format for evaluation and overlay on scatter plots of available habitat from section I-E above.

   a) Scatter plots of spawning habitat utilization data will be developed which illustrate:

      i) depths vs velocities with acceptable (+) or unacceptable substrate (-);

      ii) depths vs differences in surface and intragravel water temperature and;

      iii) depths vs velocities with upwelling presence (+) or absence (-).

   b) Spawning habitat utilization scatter plots from a-i above will be overlayed on scatter plots of available habitat from I-E above.

3) Evaluate trends shown by scatter plots.

4) Evaluate whether spawning habitat utilization data from modeling sites above (II-A-2) are sufficient to develop adequate curves; or, will it be necessary to combine these data with non-modeling site (II-A-5) and/or literature data (I-A-6)? If data are sufficient, continue to Step II-A-7 or if insufficient proceed to step II-A-5 following solid line processes only.

5) Compile ADF&G spawning habitat utilization data for non-modeled sites to evaluate whether these data can be combined with data from modeling sites for use in developing spawning habitat curves.

   a) Develop scatter plots of non-modeling sites data.

   b) Evaluate trends shown by scatter plots.

   c) Compare the above (II-A-5-a) spawning habitat utilization scatter plots to scatter plots of ADF&G Su Hydro modeling sites (II-A-2) to determine whether these data can be combined; and, if so, continue to step 5-d. If the data can not be combined, proceed to step II-A-6 to evaluate the use of literature data.

   d) Determine if the combined data bases are adequate and if they are, continue to step II-A-7. If they are insufficient, proceed to step II-A-6 to consider the use of literature data.

6) Compile spawning habitat utilization data from literature sources to evaluate whether these data can be combined with data from modeling sites for use in developing habitat curves.

a) Develop scatter plots of literature data.

b) Evaluate trends shown by scatter plots.

c) Compare the above (II-A-6-a) spawning habitat utilization scatter plots to scatter plots of ADF&G Su Hydro modeling sites (II-A-2) to determine whether these data can be combined and if so continue to step 6-d. If they cannot be combined, additional field data must be collected if FY85 (II-A-10).

d) Determine if the combined data bases are adequate and if they are, continue to step II-A-7. If they are insufficient, collect additional field data in FY85 (II-A-10).

7) Overlay utilization scatter plots of temperature and upwelling from II-A-2-a-ii and iii above and velocity, depth and substrate scatter plots of utilized and available spawning habitat from II-A-2-b (II-A-5-d and II-A-6-d data would also be included if these loops were required) above.

8) Evaluate trends shown by these scatter plots to determine if temperature and/or upwelling are limiting. If they are limiting, proceed to step II-A-9 and if not, continue to II-B.

9) Evaluate whether a portion or all of the:

a) temperature, upwelling, velocity, depth and substrate spawning habitat utilization data are adequate;

b) whether temperature and upwelling availability data are required; and

c) whether to continue to the combined step II-A-10 and I-D or to II-B.

10) Collect FY85 spawning habitat utilization data if required:

a) velocity, depth and substrate;

b) surface and intragravel water temperature; and

c) upwelling presence or absence.

B. Evaluate Whether the Following Approaches or a Combination of Them Can or Should Be Used to Develop Spawning Habitat Curves:

- Standard U.S. Fish and Wildlife Service IFG approach (Bovee and Cochnauer 1977);
- Baldrige and Amos (1981);
- Voos (1980);
- Prewitt (1982);
- ADF&G (1983) AH technique; and
- Other possible approaches or combinations of the above.

C. If data base appears adequate continue to step II-D; if data are inadequate, proceed to step II-A-5 following solid line process only. This only applies if II-A-5 and II-A-6 were not incorporated into development of curves at step II-A-4.

D. Develop Spawning Habitat Curves.

E. If data from II-A-5 and II-A-6 Were Not Incorporated Into Initial Development Of Curves Proceed to Step II-A-5 Following Dashed Line Processes Only To Determine If These Data Can Be Used To Refine Curves. If Previously Used Or If It Is Determined That These Data Should Not Be Used For This Purpose, Continue To Step III-A.

III. Habitat Model [Combination of Spawning Habitat Curves and Calibrated Hydraulic Models To Determine Weighted Usable Area (WUA)]

A. Evaluation of Linkage Approaches of Spawning Habitat Curves with Hydraulic Models.

1) WUA Calculation Technique Evaluation

a) IFG WUA calculations:

i) standard calculation with three matrices

ii) lowest limiting factor

iii) Geometric mean

b) Multi-variate calculation

2) Consider calculation of WUA using optimum, preferred, utilized, and available categories of ADF&G AH, 1983 analysis.

B. Use Habitat Model to Generate WUA.

IV. Miscellaneous (These Items Are Not Included In Flow Chart.)

1) Assess whether spawning habitat utilization behavior criteria can be evaluated and combined with other spawning habitat utilization data, i.e., Fanning (F), Quivering (Q), Aggression (A) and Holding (H). This task has been assigned a low priority but may be useful for determining "outliers" in spawning habitat utilization data sets (II-A-3).

2) Availability data sets for temperature and upwelling are not available. Cost effective methods for collecting and analyzing these data are being evaluated in the event it is necessary to input these data into the model in the future.

3) The evaluation of tributary mouth hydraulic and spawning habitat availability and utilization data will be treated independently of this analysis.

4) Develop changes in hydraulic and habitat models to enable the RJ staff to incorporate juvenile habitat data for their analysis.

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Appendix 2

AQUATIC HABITAT AND INSTREAM FLOW PROJECT

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Revisions to the operation and maintenance instructions, Hydrolab Digital 4041.

The following table summarizes the revisions made by ADF&G to the manufacturer's calibration and maintenance procedures for the Hydrolab 4041 meter. These modifications were made after consultation with qualified individuals associated with USGS and Hydrolab. A revised manual is available at ADF&G/Su Hydro Office, 2207 Spenard Road, Anchorage, Alaska 99503.

| Page | Paragraph | Revision |
|---|---|---|
| 2 | 3 | Conductivity is measured using the four-electrode or six-electrode technique. Meter S/N's 0877A, 0890C, and 0890Q have four-electrode conductivity probes. |
| 5 | 2 | CONDITIONS:...If calibrating in the field, morning is the preferred time since instrument and solutions will probably be closest to being at equal temperatures then. |
| 5 | 3 | REQUIRED MATERIALS:... 2) Three reliable KCI solutions (known conductivity) (292, 147, 37 micromhos).<br><br>3) Two freshly prepared pH buffer solutions. Generally, pH 7.0 and either 4.0 or 10.0 are used, depending upon the measuring assignment. |
| 6 | 1 | CALIBTATION PROCEDURE:... 3) Check D.O. membrane and replace if necessary (see page 11, #3). |
| 6 | 1 | Item #3 changed to #4, item #4 changed to #5. Add item #6: 6) Check battery voltage; change if necessary. |
| 6 | 3 | A RINSE STEP...Remove the cup and shake as much of the rinse water as possible from the electrodes. Rinse twice with calibration solution. |

| | | |
|---|---|---|
| 7 | 1 | ...Refer to the USGS solubility table for the correct oxygen concentration at this temperature. The current barometric pressure can be determined by calling the U.S. Weather Service at 271-5105 or by using a barometer if you are in the field.<br><br>Remove sentences and example: "Since the table values refer to.... This should be done in the following manner:..." |
| 8 | 1,2 | pH CALIBRATION Change "pH 9.18" to pH 10.0. |
| 8 | 3 | Remove Sentence: "After the second RINSE STEP,..." Replace with: Rinse three times with distilled water and twice with the calibtation solution to be used next. |
| 8 | 4 | The conductivity system is calibtated using the three prepared KCI solutions with known conductivities at 25°C (292, 147, and 37 micromhos).<br><br>Delete sentences: "From a table...in the field. For example,...and a 0.005M standard."<br><br>Change next sentence: The meter will be calibrated using the 292 micromhos solution. Pour it slowly... |
| 9 | 1 | ...Pour in the second standard (147 micromhos)...Pour out the standard solution. Repeat, using the 37 micromhos standard. |

| | | |
|---|---|---|
| 10 | 1 | ...record the value for each parameter. It may take five minutes or more for readings to stabilize. |
| 10 | 3 | Delete third paragraph. Insert: Upon returning from the field, check the battery voltage and charge the battery long enough to bring the charge up to approximately 13.0 volts. Gel cell batteries can be recharged regularly after each use, regardless of the charge remaining (see Table 1 for charging times, p. 31). |
| 11 | 3 | ...Fill the reference electrode sleeve to the brim with fresh KCI solution (D.O. electrolyte).... The KCI solution should have... |
| 12 | 2 | ...Replace D.O. guard. Allow 12-24 hours for the new membrane to become saturated with KCI and to ensure that no air bubbles form. |
| 13 | | Item 3: ...install the new battery. Make sure that the negative and positive ends are correctly oriented. Replace the retaining clip. |