UNITED STATES MARINE CORPS
Utilities Instruction Company
Marine Corps Engineer School
PSC Box 20069
Camp Lejeune, North Carolina 28542-0069

U-10B01
OCT 99

STUDENT HANDOUT

WATER RECONNAISSANCE

Terminal Learning Objectives: Provided a field environment with a water source, water Reconnaissance Report (DA FORM 1712-R), TDS meter, and a color comparator perform a water reconnaissance in accordance with FM 10-52-1. (1171.03.04)

Enabling Learning Objectives:

a. Provided a water source, Water Reconnaissance Report (DA FORM 1712-R), and a total dissolved solids meter, perform a TDS test of the water, in accordance with TM-09241B-12&P and FM 10-52-1. (1171.03.04a)

b. Provided a water source, Water Reconnaissance Report (DA FORM 1712-R), and a color comparator, perform a pH value test of the water in accordance with TM-09241B-12&P and FM 10-52-1. (1171.03.04b)

c. Provided a water source, Water Reconnaissance Report (DA FORM 1712-R), and a color comparator, perform a chlorine residual test of the water in accordance with TM-09241B-12&P and FM 10-52-1. (1171.03.04c)

d. Provided a water source and a Water Reconnaissance Report (DA FORM 1712-R), determine the quantity of the water available from the source in accordance with FM 10-52-1. (1171.03.04d)

e. Provided a water source and a Water Reconnaissance Report (DA FORM 1712-R), complete a water reconnaissance report in accordance with FM 10-52-1. (1171.03.04e)

BODY:

1. Conducting a water reconnaissance:

a. The purpose of a water reconnaissance is to gather information about water sources for it's possible use and development. There are two types of reconnaissance:

(1) Air reconnaissance: may be utilized if aircraft are available. An air reconnaissance is generally a reliable means for rapidly securing information about water sources over a large area.

(a) If a helicopter is used, air and ground reconnaissance can be conducted as one.

(b) The use of aircraft for reconnaissance is limited by adverse weather conditions and security conditions.

(2) Ground reconnaissance: is the only positive way of gathering accurate information from which to select a water point. The factors to be considered during the ground reconnaissance are:

(a) Water Quantity: know the projected water requirements to support the operation. Use the formula for determining the quantity of water available from a source.

(b) Water Quality: Should be of such quality that it can be approved by medical personnel as meeting raw water standards and at the same time be readily purified with available water purification equipment.

(c) Accessibility: Area must be accessible to vehicles and personnel. It should have good road nets with turnarounds, cover and concealment at the water source, and an adequate staging area. The roads should be able to withstand, under all conditions, the heaviest of vehicles.

(d) Site conditions: Consider drainage, security, and adequacy of the bivouac area in that order of importance.

1 Drainage: The site must be on high, porous ground.

2 Security: The site should provide cover and concealment with security against ground attack and sabotage.

3 Bivouac: At least 100 feet downstream from the water purification operations. It should also be located near the water point to ensure personnel availability for work or emergencies.

b. Responsibilities:

(1) Unit Commander: Responsible to make sure that Marines have an adequate amount of water for all purposes.

(2) S-4 (logistics): Coordinates reconnaissance activities with the S-2 (intelligence).

(3) Unit leader: Tasked with locating the water sources.

(4) Medical department: Inspects the water quality and makes recommendations for improvements to the water point.

2. Performing a total dissolved solids test:

a. The purpose of performing a total dissolved solids (TDS) test is to determine if the water is fresh, brackish, or salt. The TDS meter measures how much electric current can flow through a sample of water and registers the reading on a scale in parts per million (ppm). Water sources are identified according to the categories listed below:

(1) **Fresh 0 ppm - 1500 ppm**

(2) **Brackish 1501 ppm - 15,000 ppm**

(3) **Salt 15,001 ppm - Above**

NOTE: Parts per million is a ratio by weight of parts of a substance in one million parts of water.

b. Open case and carefully remove equipment and supplies as needed. Note location for repacking.

c. Calibrate the TDS meter:

(1) With meter off, adjust pointer to zero by turning meter zero adjust screw.

(2) Remove bottom cover by carefully prying it off TDS meter and install a battery or DC adapter if available. Be sure the battery removal clip is in place prior to installing battery.

(3) Check battery condition:

(a) Adjust range switch to "S" position.

(b) Press button and adjust the master calibration control to the maximum. Pointer must indicate full scale or above. If not, replace battery.

(c) Press button and adjust master calibration control until the meter reading matches the internal value on label attached to bottom cover.

d. Calibrate the range extender:

(1) Fill the cell cup with standard solution to ¼ inch above upper electrode.

(2) Position range switch to 1000.

(3) Rinse the range extender in standard solution 442-30,000. Discard the solution.

(4) Fill the cell cup with the standard solution 442-30,00 and insert the range extender, seating the O-ring seal.

NOTE: Range extender is adjusted to correct meter reading. Do not adjust internal calibration controls.

(5) Press button. Pointer should be at 3 plus or minus 0.1 on the scale, if not, adjust range extender as follows:

(a) Remove range extender from cell cup.

(b) If reading was too high, push or tap white insert into the range extender body.

(c) If reading was too low, twist and pull white insert out of

the range extender body.

(d) Insert the range extender into the cell cup, seating O-ring seal.

(e) Press the button. The pointer should be at 3 plus or minus 0.1 on scale, if not, repeat steps **1-5**.

(f) Discard solution and flush the cell cup and range extender with demineralized or distilled water. Discard wash water and thoroughly dry cell cup.

e. Operate the TDS meter:

(1) Turn the range switch to “S” position.

(2) Press button and compare meter reading with the internal standard value on label attached to bottom cover. If reading is different, remove bottom cover and adjust the master calibration control until it matches.

(3) Turn the range switch to 1000.

(4) Rinse the cell cup three times with water to be tested.

CAUTION: Do not dip the meter into the water being tested to fill cell cup. Damage to meter can result.

(5) Fill the cell cup with water to be tested to at least ¼ inch (6mm) above the upper electrode.

(6) Press the button and take the reading as follows:

(a) If the pointer is below 0.5 on the scale, adjust the range switch to 100. If pointer is still below 0.5 on the scale, adjust range switch to 10.

(b) If the pointer goes off the 0.5 scale, to the right on the 1000 range, use the range extender which will increase the range 10 times by performing the following steps:

1 Rinse the range extender three times with the water tested, discarding between rinses.

2 Push the range extender into the filled cell cup, seating the O-ring seal.

3 Press the button and adjust the range switch as indicated in step (6).

(c) If the pointer goes off the scale to the right on the 1000 range setting, the meter must be adjusted for range doubling as follows:

1 Discard water in cell cup.

2 Rinse cell cup with demineralized water and dry thoroughly.

3 Remove bottom cover and adjust range switch to "S" position.

4 Press button and adjust master calibration control until pointer reaches half the internal standard value on label attached to bottom cover.

5 Attach bottom cover and retest the water.

(d) To determine Total Dissolved Solids in Parts Per Million, multiply pointer reading range setting by the range switch.

(EXAMPLE: IF THE POINTER READING IS 3 AND THE RANGE SWITCH WAS SET AT 10, MULTIPLY 3 X 10 = 30 PARTS PER MILLION. IF THE RANGE SETTING WAS SET AT 100, MULTIPLY 3 X 100 = 300 PPM. IF THE RANGE SETTING WAS SET AT 1000, MULTIPLY, 3 X 1000 = 3000 PPM.)

(e) To determine Total Dissolved Solids in Parts Per Million, If the meter was adjusted for doubling, multiply the answer by 2.

(f) Remove range extender if used, and empty cell cup.

(g) Thoroughly rinse cell cup, collection bottle, and any equipment used with demineralized water. Dry thoroughly with paper towels after rinsing and repack meter.

(h) If the meter was adjusted for range doubling, readjust for standard range.

3. Performing a pH test using the color comparator:

a. The purpose of performing a pH test is to measure the amount of acid or alkalinity in water. pH stands for “potential of electricity for positive Hydrogen ions”. pH measures the quantity of free hydrogen ions which are the foundation for all acids that are present in a know liquid. The color comparator uses chemicals that changes color when add to the water being tested.

b. pH is based on a scale ranging from 0 which is the maximum acidity, to 14 which is the maximum alkalinity. 7.0 on the scale indicates neutral water. Acid and alkaline are balanced at this point on the scale, but this does not mean that water is free from germs.

c. Perform pH test:

(1) Unlatch and open carrying case cover. Remove comparator housing and eyepiece. Fit eyepiece onto housing.

(2) Remove pH color disc and insert into housing. Numbers must be visible through indicator window.

(3) Rinse two comparator cells three times with water being tested.

(4) Fill two comparator cells to the 15ml mark with the water to be tested and insert in housing..

(5) Fill the dropper with wide range indicator solution to the 0.50ml mark.

(6) Add the wide range indicator solution from the dropper to the comparator cell on the left. Use sufficient force to mix.

(7) Hold the comparator housing up and look through the eyepiece. Face a good light source. Be sure your fingers do not cover the light window in the back of the comparator housing. Rotate the color disc until a color on the disc matches the color comparator housing. If color falls between readings, estimate.

(8) Remove comparator cells from comparator housing and discard water samples and solution. Thoroughly rinse all equipment with demineralized water or distilled water.

d. Perform chlorine residual test:

(1) Remove Chlorine color disc and insert into housing. Numbers must be visible through indicator window.

(2) Rinse two comparator cells three times with water being tested.

(3) Fill two comparator cells to the 15ml mark with the water to be tested and insert in housing.

(4) Add two DPD no. 1 chlorine tablets to the comparator cell on the left. Crush tablets with a plastic rod until dissolved.

NOTE: DPD NO. 1 Chlorine tablets are irritating to the eyes, respiratory tract, and may cause allergic skin reaction. Provide ventilation when handling and wear safety glasses and gloves.

(5) Hold the comparator housing up and look through the eyepiece. Face a good light source. Be sure your fingers do not cover the light window in the back of the comparator housing. Rotate the color disc until a color on the disc matches the color comparator housing. If color falls between readings, estimate.

(6) Remove comparator cells from comparator housing and discard water samples and solution. Thoroughly rinse all equipment with demineralized water or distilled water.

(7) Remove eyepiece and color disc from housing and carefully pack all equipment back into carrying case. Close latch and cover.

4. Determining the quantity of a source:

a. Below are formulas for use in solving water supply problems that are often found in the field.

b. Calculation of quantity of water flowing from a stream:

(1) Q = 6.4 x A x V

Q = quantity of water in gpm.

6.4 = a constant - there are 7.5 gallons of water per cubic foot. However, because of error in stream measurement, 7.5 has been reduced to 6.4

A = The area always equals your answer in square feet. This is obtained by measuring the width of a stream and multiplying it by the depth of the stream.

V = the velocity of a stream in feet per minute. This is obtained by noting the time it takes an object to travel a known distance.

(2) Illustrative problem: A stream has an average depth of two feet and a width of sixteen feet. If an object flows fifteen feet in one minute, how many gallons per minute are flowing in the stream?

Q = 6.4 x A x V

Q = 6.4 x 32 x 15

Q = 3,072 gallons per minute

c. Calculation of volume of water tanks.

(1) Formula for a cubic tank(ponds, lakes, and reservoirs):

V = L x W x D

V = Volume in cubic feet

L = Length in feet

W = Width in feet

D = Depth in feet

(2) Illustrative problem: What is the volume of a cubic tank that is 10' long, 7' wide and 4' deep?

V = L x W x D

= 10 x 7 x 4

= 280 cubic feet

(3) Formula for a cylindrical tank:

V = 3.14 x Radius square x Height

V = Volume in cubic feet

3.14 = a constant

r = Radius (half of the diameter) of the tank

H = Height in feet

(4) Illustrative problem: What is the volume of a cylindrical tank that has a radius of 4' and is 7' high?

V = 3.14 x 4 sq. x 7

= 3.14 x 16 x 7

= 351.68 cubic feet

d. Conversion of volume to gallons of water:

(1) Gallons of water = Cubic feet of water x 7.5

(2) Illustrative problem: How many gallons of water are in a tank with 400 cubic feet of water?

Gallons of water = Cubic feet of water x 7.5

= 400 x 7.5

= 3,000 gallons

e. Converting Celsius and Fahrenheit:

(1) Fahrenheit = 1.8 (Celsius) + 32

(2) Illustrative problem: What does 25 degrees Celsius equal in Fahrenheit?

Fahrenheit = 1.8 (25) + 32

= 45 + 32

= 77 degrees

(3) Celsius = (Fahrenheit - 32)/1.8

(4) Illustrative Problem: What does 77 degrees Fahrenheit equal in Celsius?

Celsius = (77 - 32)/1.8

= 45/1.8

= 25 degrees

5. Reports and data:

a. Field reports are the most important and reliable source of information. The S-2 section may provide information which has been gathered from local inhabitants or from interrogation of prisoners of war.

b. Map studies should be taken into consideration. Aerial photos, if available, should be studied before conducting the actual ground reconnaissance. The information obtained from maps are:

(1) Type of source: Indicate if the source is a stream, river, pond, lake, ocean, or natural well.

(2) Roads/Road nets: Description of roads in and out of the water point, such as dirt, gravel, or paved.

(3) Terrain: Give general description such as flat, level, hilly, or rolling ground.

(4) Security: Indicate the type of security required for the water point.

c. The water reconnaissance report is used to keep track of the data gathered on the water recon by the unit leader. It also shows what the different types of water sources can provide and what the requirements are for development. The water reconnaissance report contains all the following information:

(1) Heading: The heading is where all the information such as; who, what, where, when, etc. is annotated.

(a) Date: The date the water reconnaissance was performed.

(b) Time of reconnaissance: Must be given for accurate records to be kept.

(c) Reported by: This block should contain the name of the person performing the reconnaissance.

(d) Forwarded to: This is who the report is being sent to.

(e) Map Coordinates: The six-digit grid coordinates of the location should be given.

(2) Quality/Quantity:

(a) Type of source: Indicate if the source is a stream, river, pond, lake, ocean, or natural well.

(b) TDS: The measure of total dissolved solids present in the source.

(c) Temperature: The temperature of the water in ^{0}F.

(d) Turbidity: The muddy or unclear condition of the water

caused by suspended material which has to be removed to make the water potable. Turbidity is put into three categories:

1 Light

2 Medium

3 Heavy

(e) pH test: Note the measure of acidity or alkalinity in the water.

(f) Chlorine test: Note the measure of chlorine in water.

(g) Quantity: Indicate the yield of the source in gallons per minute or as an infinite source.

(3) Site Conditions:

(a) Security: Indicate the type of security required for the water point.

(b) Drainage/soil type: List if natural run-off is provided or if drainage must be dug. Also indicate if the soil type is frozen, stable, rocky, or clay.

(c) Terrain: Give general description such as flat, level, hilly, or rolling ground.

(d) Bivouac: Identify the size of the area available for bivouac. It should be located 100 yards away and 100 feet downstream from the source.

(e) Distance to consumer: In most cases this should not exceed a radius of ten miles.

(f) Roads: Description of roads in and out of the water point, such as dirt, gravel, or paved.

(4) Sketch of the area: Made during the ground reconnaissance and keyed to a map. Detailed information gathered on potential sites can be invaluable and is of great importance. Ensure the direction of north is placed on all sketches by using the north indicator symbol.

REFERENCES:

FM 10-52-1
TM-09241B-12&P