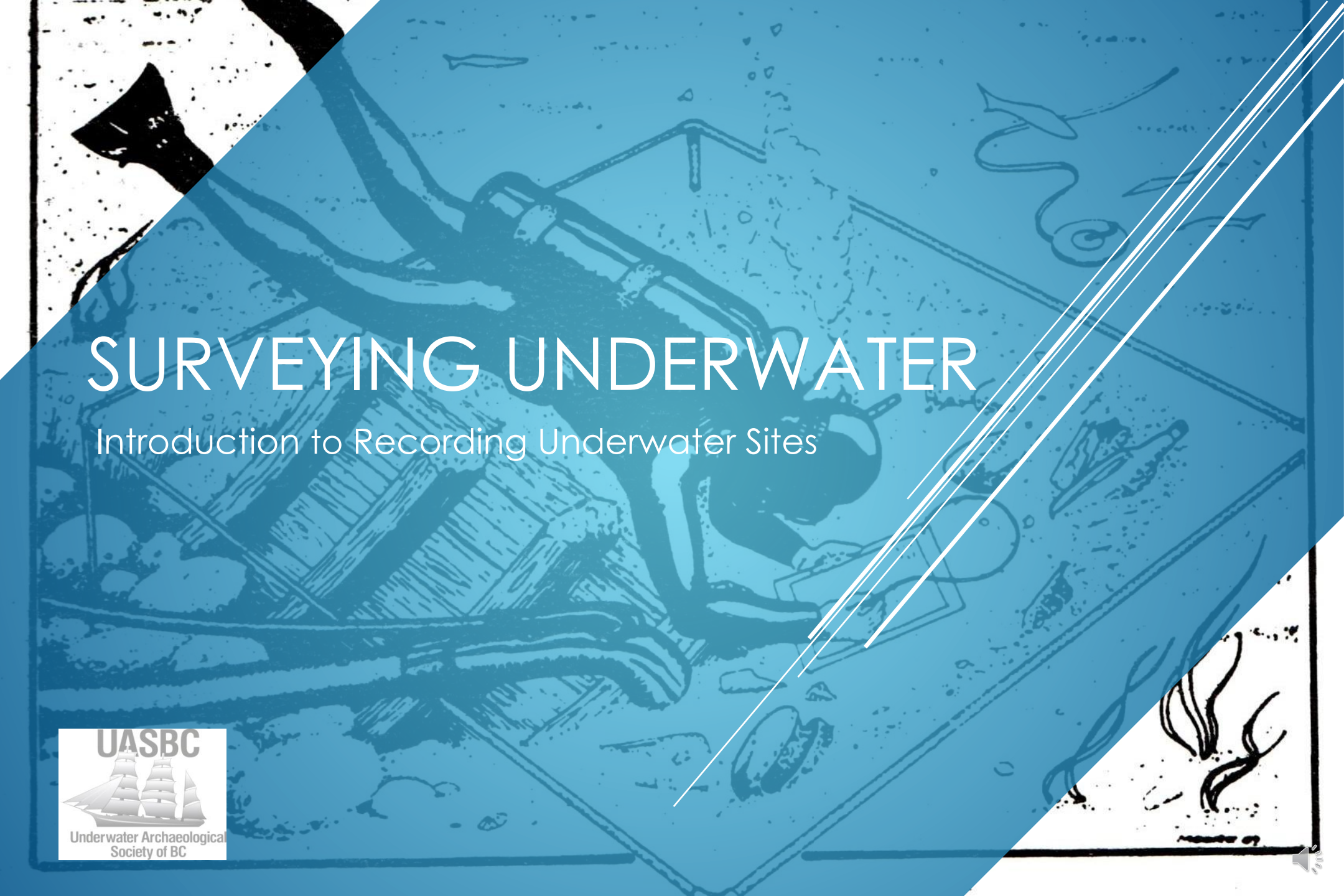


SURVEYING UNDERWATER

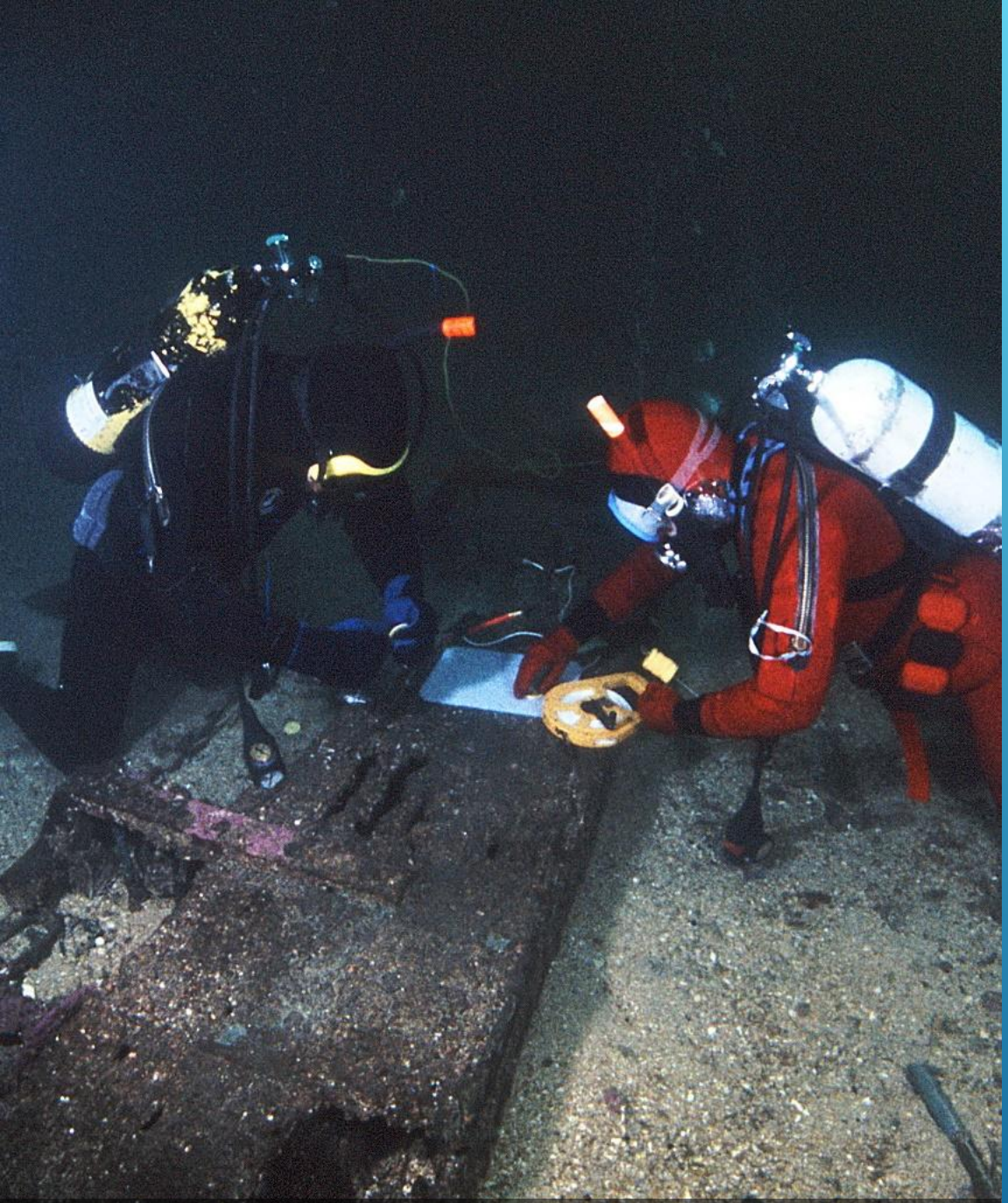
Introduction to Recording Underwater Sites

UASBC
Underwater Archaeological Society of BC

SURVEYING UNDERWATER

By the end of this module you will understand:

- How to establish **survey objectives**.
- A **3-step procedure** for completing surveys.
- Basic & Advanced **survey methods**.



Divers mapping the ____ (Photo: Neil McDaniel)

SURVEY OBJECTIVES

Once a site has been located, surveying it in detail is the logical next step.

Underwater surveying is particularly challenging, so clearly defining the objectives of a survey ensures **project success** and **diver safety**.

Underwater survey involves collecting information about the position and orientation of objects in a site – in other words, creating a 2D **site map** or 3D **model**.

SURVEY OBJECTIVES

There are many potential objectives for an underwater survey project.

- To document the **arrangement of artifacts** relative to one another.
- To monitor how a **site changes over time**.
- To develop an understanding of the site in **advance of excavation** work.
- To document **unique artefacts** that may warrant recovery and conservation.
- To create an **educational resource**.

SURVEY PROCEDURES

Step 1

Planning

Step 2

Site Recording

Step 3

Processing Data

STEP 1: SURVEY PLANNING

Before starting, know what it is you want to achieve.

The **level of detail and accuracy** needed will determine the survey equipment and method.

The **type of site**, and **environmental considerations** such as current, surge and waves will limit some choices.

Equipment availability, **diver experience** and **budget** will also influence the final plan.

STEP 2:
SITE RECORDING

Site recording is carried out **efficiently** by diver teams who are well-briefed & adequately trained.

Each dive team **focuses on a particular task**, location or artifact.

Each dive team **records their observations** on a dive slate or wetnotes.

Each dive team is **de-briefed**: dive profiles and description of accomplishments and difficulties are documented in detail.

Original underwater notes and debriefing notes are collected and archived.

STEP 3: PROCESSING DATA

After dives are completed, the collected raw data is **transferred to a permanent record**.

Site mapping info is **plotted** on a master site map.

Photographs, including those collected for 3D modelling are transferred to a permanent **storage device** before being processed.

Data must be processed in the **correct order**. Artifact locations cannot be mapped before a site datum is plotted. Scale 3D models cannot be generated prior to measurement data being added.

BASIC SURVEY EQUIPMENT

Most underwater survey methods use the same basic tools:

- Dive slate or wetnotes
- Measuring tape
- Compass
- Marker buoys
- Plastic tags
- Drawing frame

SITE DATUM & BASELINE

Archaeologists take all measurements from a fixed site datum, measuring "**from the known to the unknown**". The first step in setting up an underwater survey is establishing a site datum and if necessary, laying out a baseline.

A **site datum** can be established on a permanent, unmoving feature or on a temporary marker installed by the survey team.

A **baseline** is a straight lines running across a site between two fixed datum points, such as the length of a shipwreck.

ASSIGNING TEAMS

Dive teams should be organized based on divers' **abilities** and **experience**. There are many survey tasks that can be accomplished by an inexperienced diver when they are paired with an experienced diver. Little can be accomplished by pairs of inexperienced divers.

Dive teams should be given **a particular task** to accomplish. Generally, it is prudent to have each dive team focus on **a specific part of a site** to avoid interfering with other teams' surveying tasks.

SURVEY METHODS

The most appropriate survey method is the one that results in the **most accurate survey results** and the **safe return of all divers** and equipment.

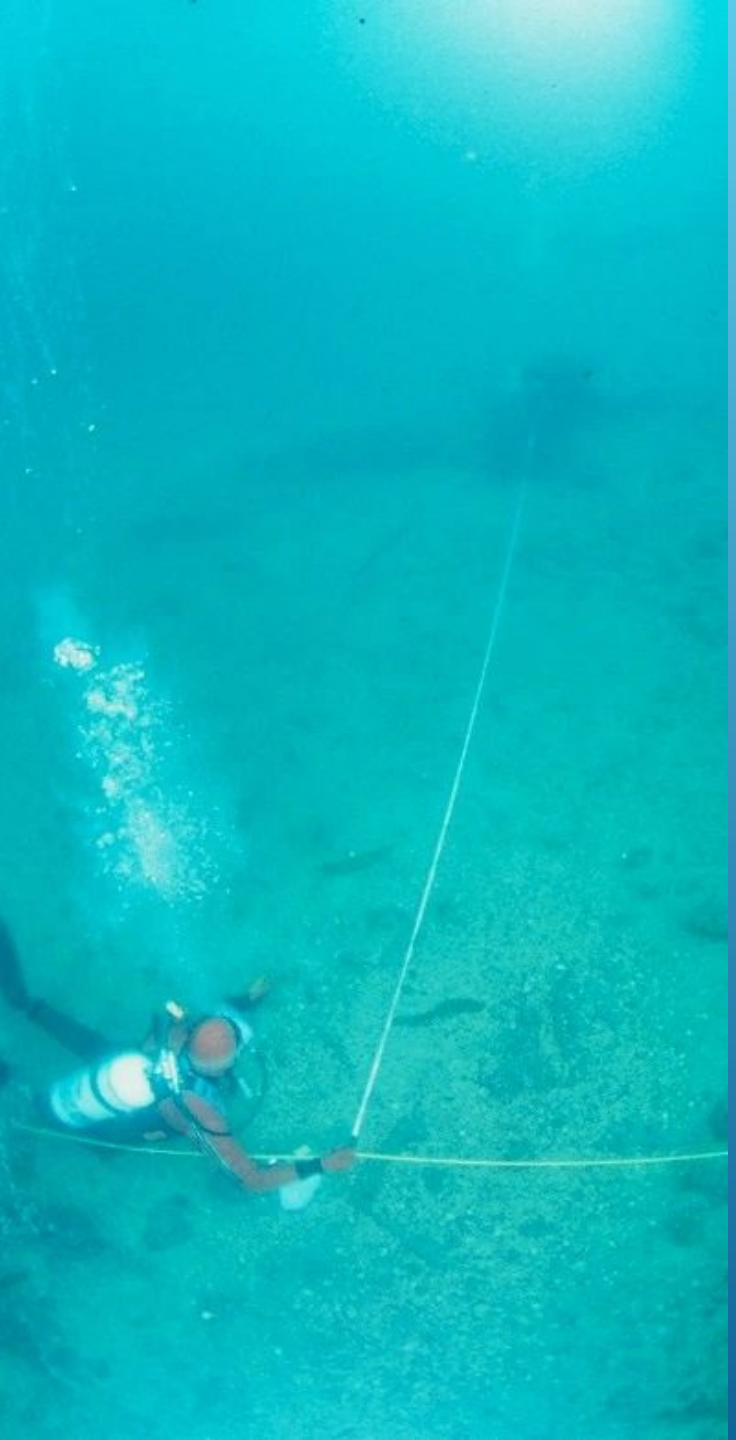
Site conditions, including sloping bottom, visibility, current and marine growth all influence measurement accuracy.

Diver training and experience, site depth and planned bottom times all affect a diver's ability to **complete assigned tasks without rush**ing. Dives must be planned to allow divers sufficient time to take careful measurements.

SURVEY METHODS

This course covers 5 **basic survey methods**:

- Baseline offset
- Trilateration
- Radial Survey
- Traverse
- Drawing frame

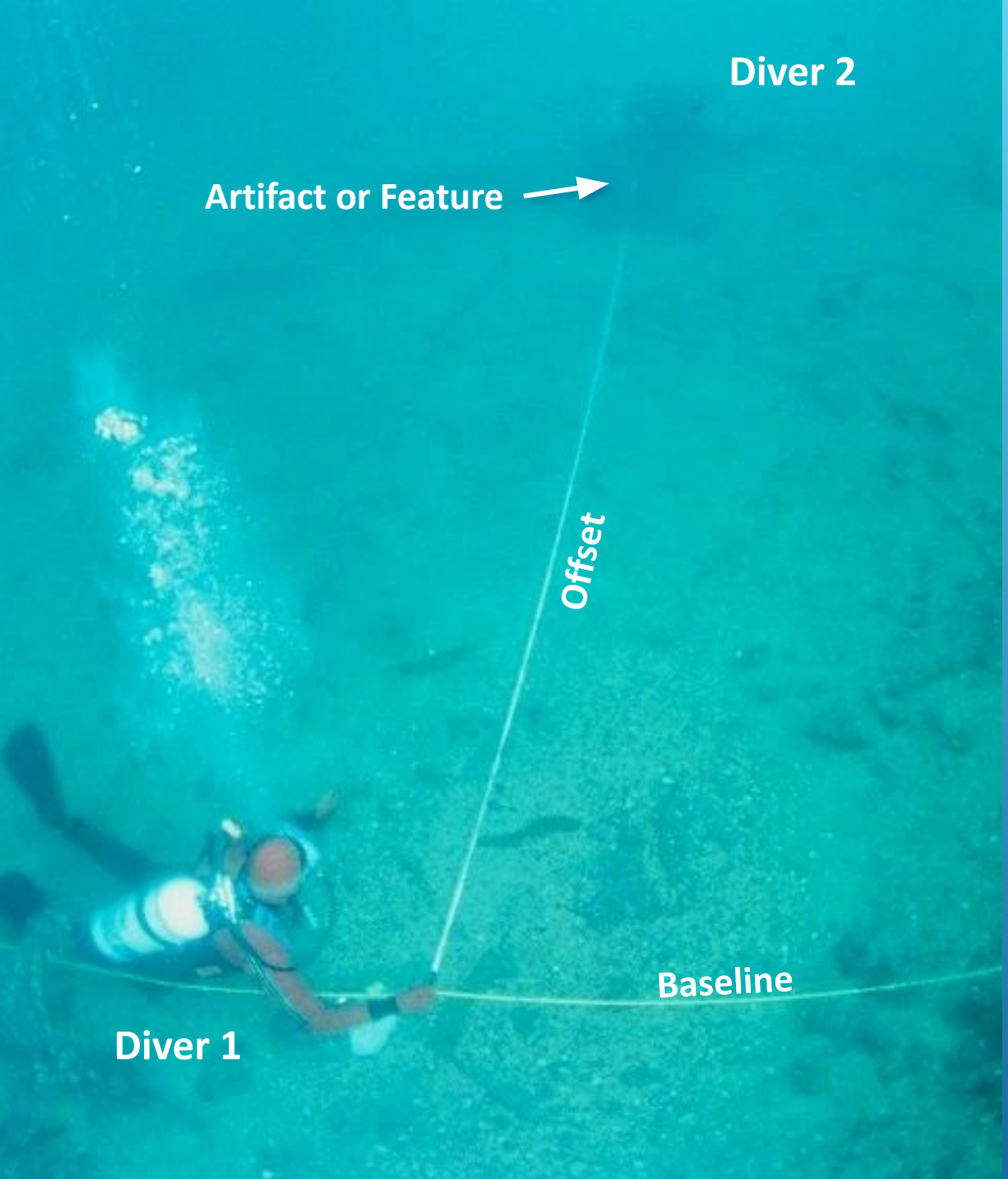


BASELINE OFFSET

A baseline – typically a long measuring tape – is laid through the middle of the site.

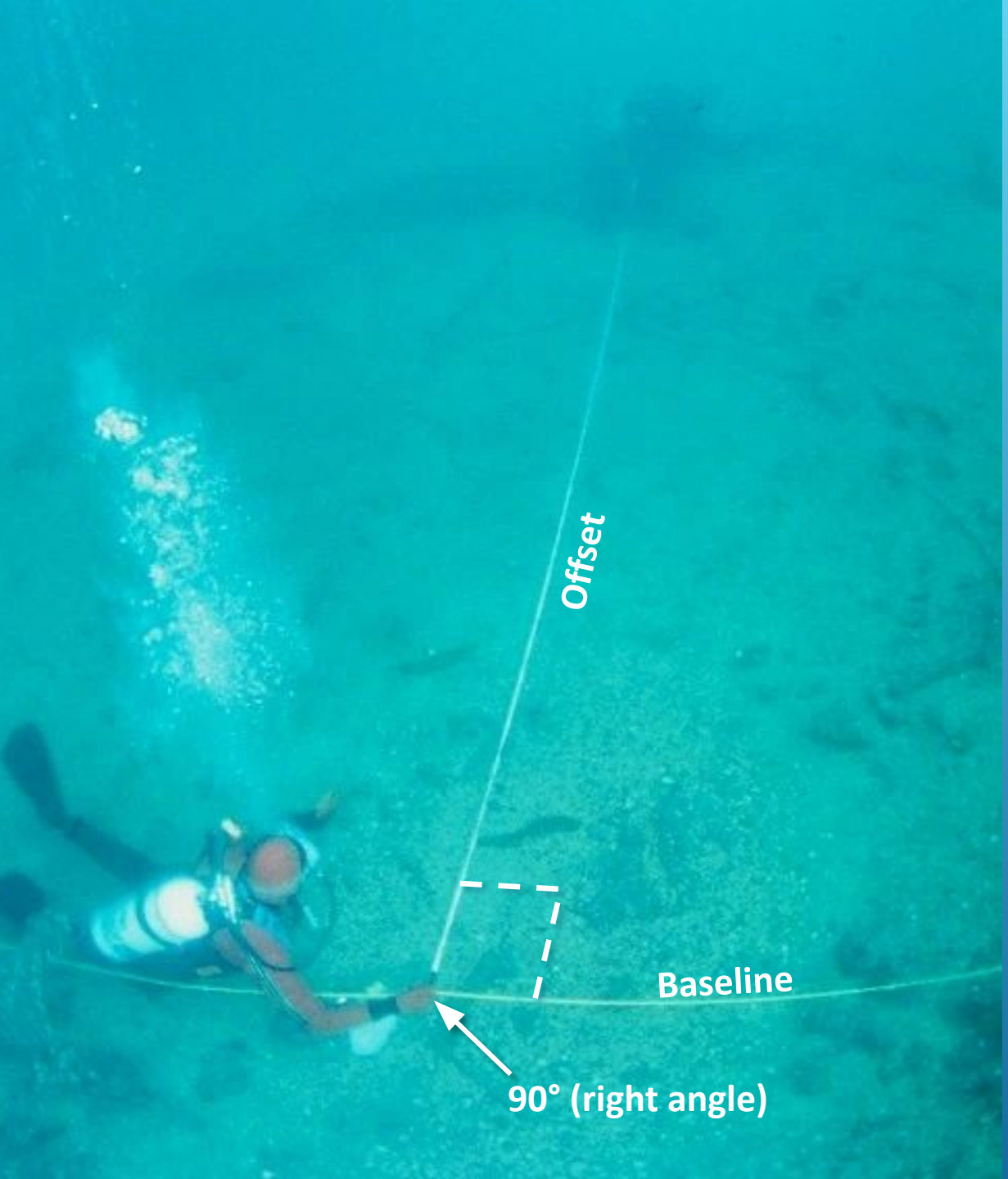
All measurements to artifacts on the wreck site are made at right angle “offsets” from this baseline.

Much work can be done in a short period of time and participants require little survey training or experience.



BASELINE OFFSET

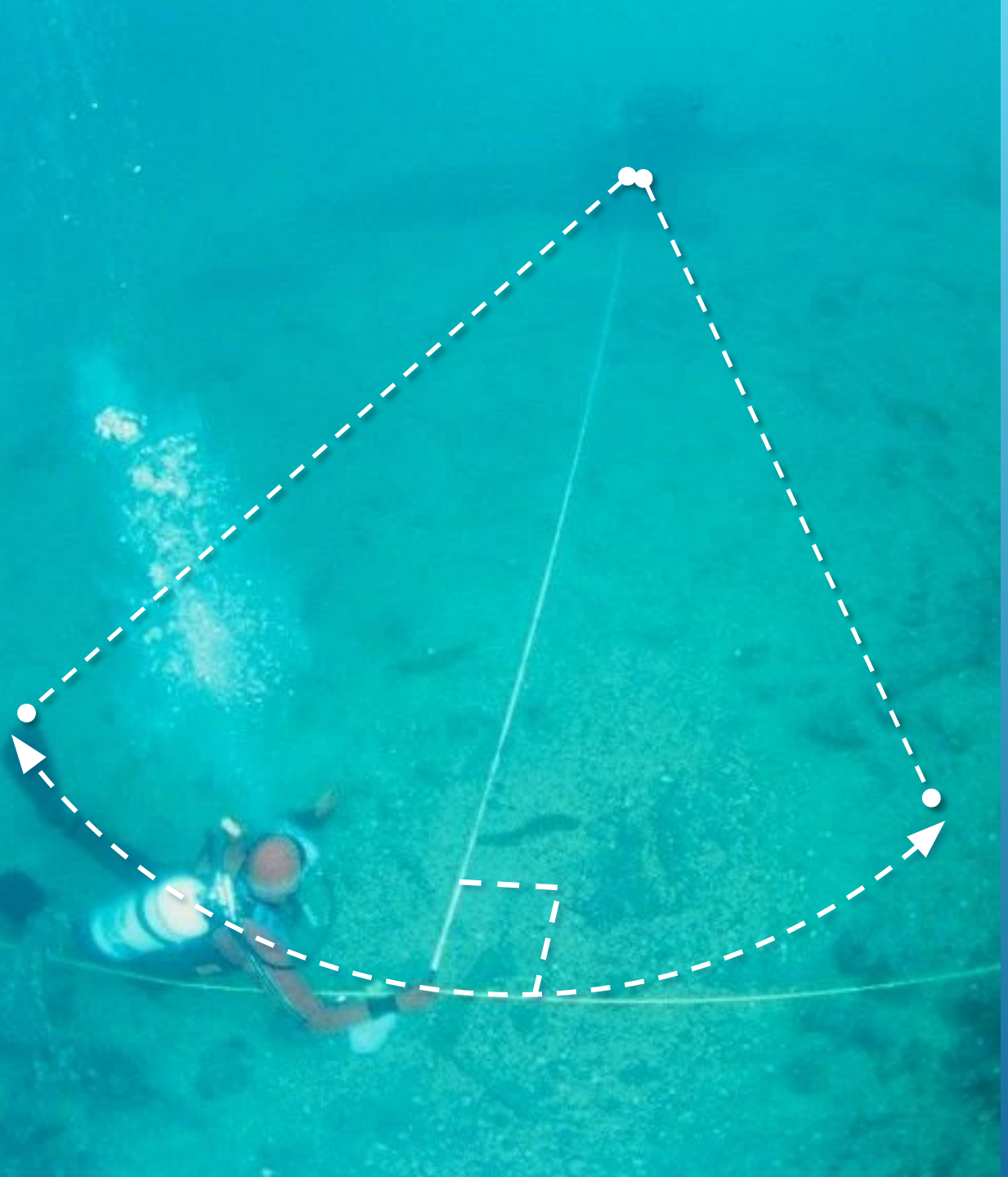
1. Diver 1 positions themselves on the baseline with a measuring tape.
2. Diver 2 holds the “zero” end of the measuring tape on the object being mapped.
3. Diver 1 records the distance along the baseline and the offset – establishing coordinates (x,y) for the object.



BASELINE OFFSET

Measurements **must** be made at **right angles**.

Diver 1 is responsible for establishing a 90° (right angle) intersection between the two measuring tapes before reading the distances on the two tapes.



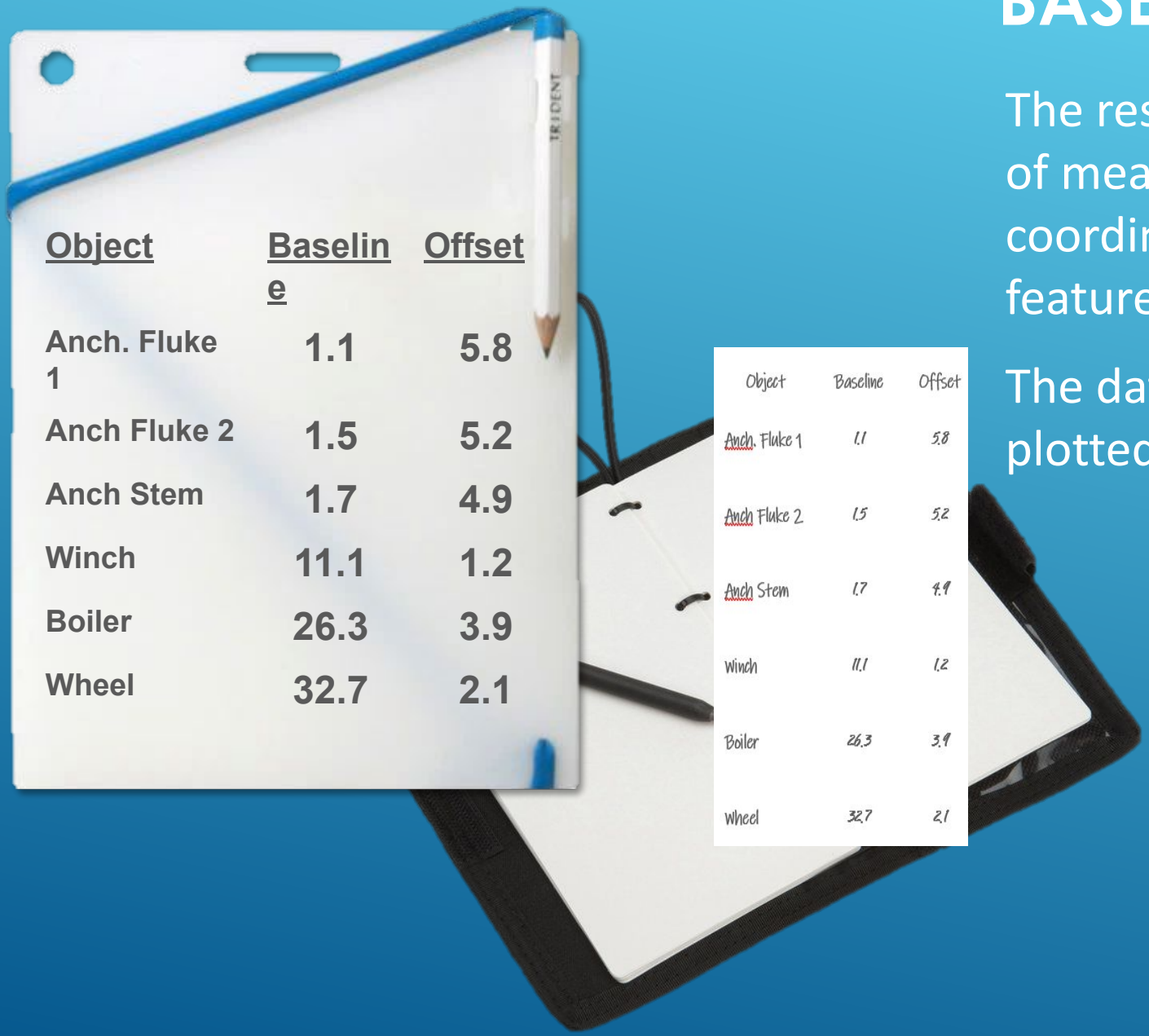
BASELINE OFFSET

A right angle is the **shortest distance** from the object to the baseline.

Diver 1 determines the shortest distance by moving the tape in a **pendulum motion** along the baseline.

If Diver 1 is using a large dive slate, it can also be used to check the angle.

BASELINE OFFSET



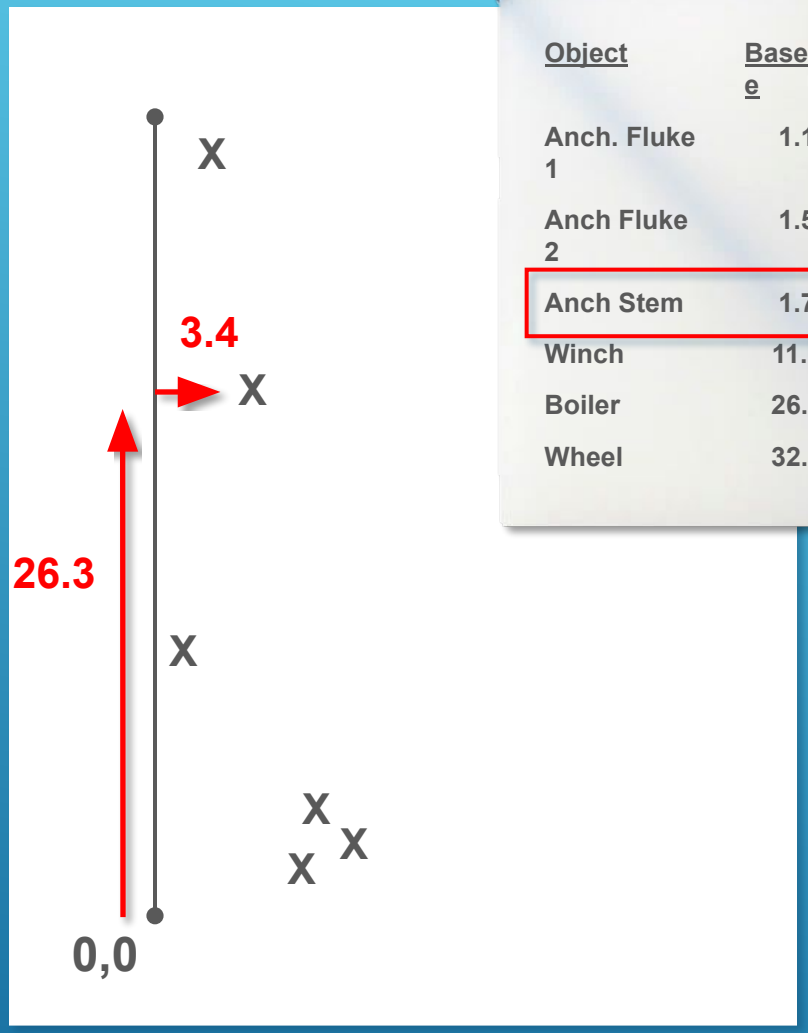
The result is a list of pairs of measurements - X,Y coordinates for objects or features at the site.

The data now needs to be plotted on a site map.

BASELINE OFFSET
PLOTTING DATA

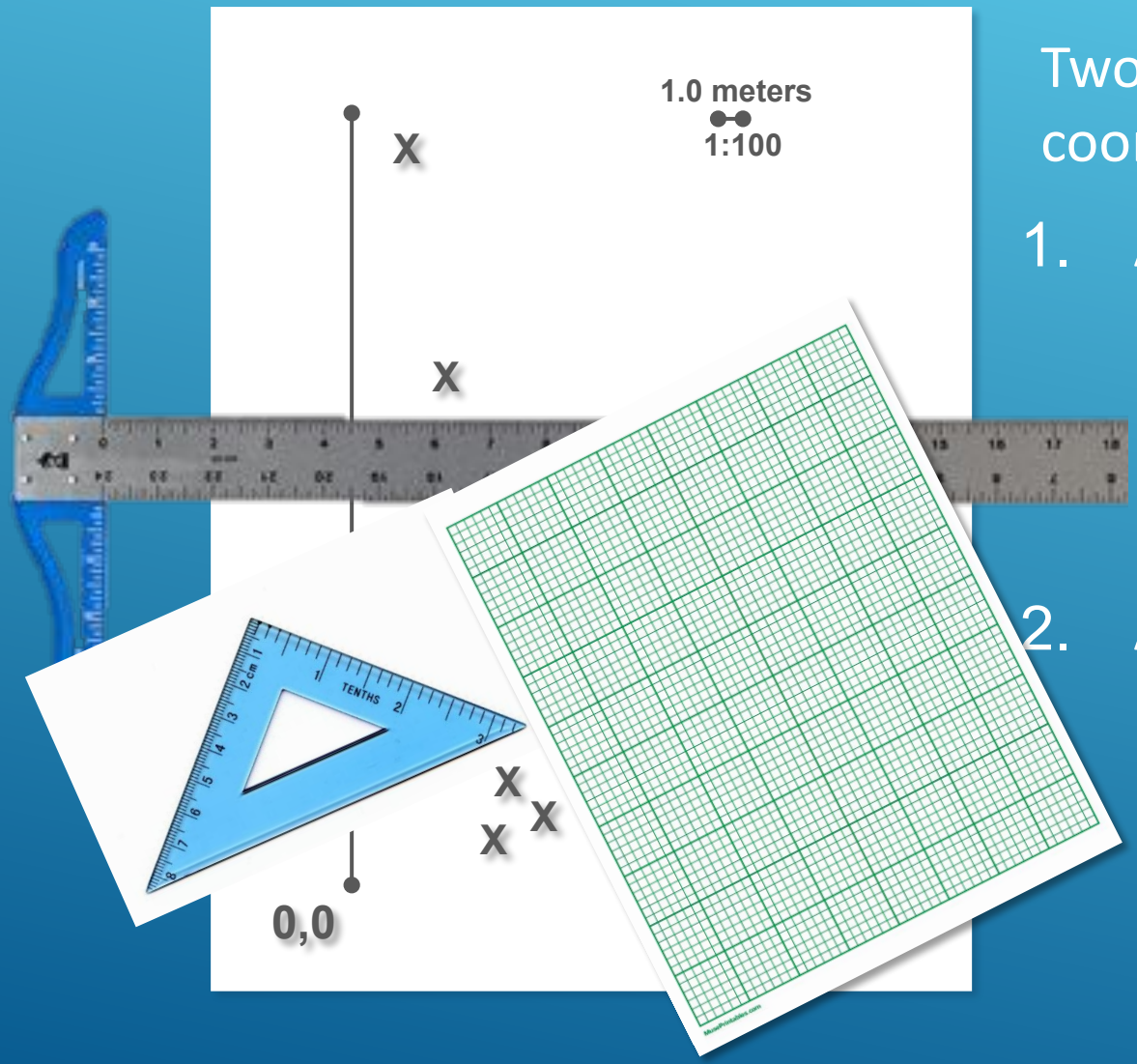
To plot baseline offsets, the baseline needs to be plotted first and the “zero” end labeled.

Each pair of coordinates is plotted as a single point by measuring along the baseline, then measuring out from the baseline at a right angle (offset).



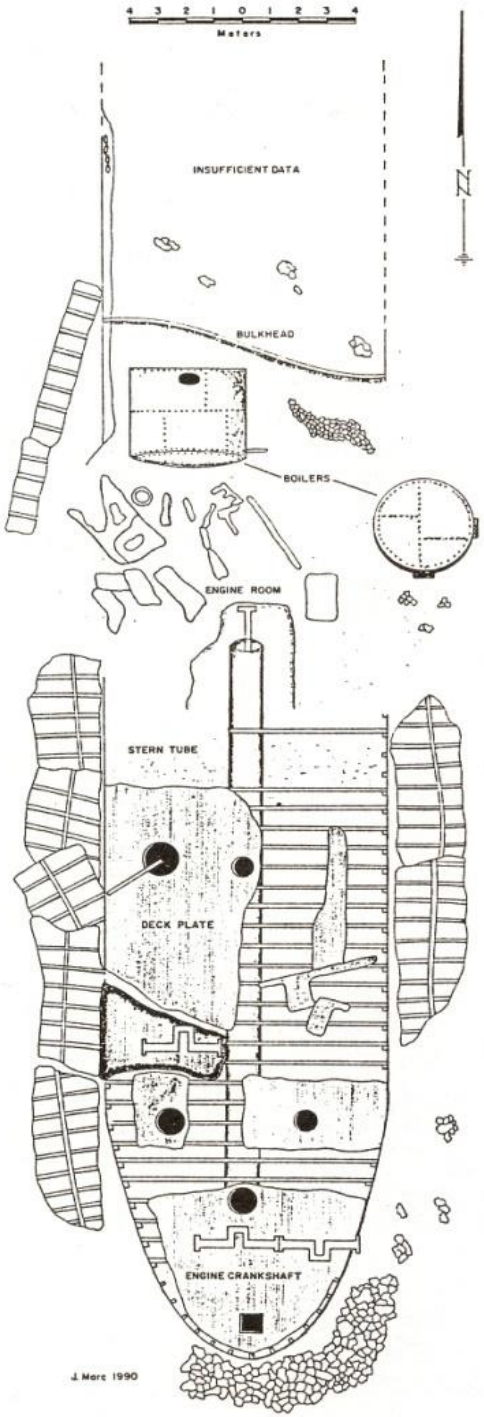
Object	Baseline	Offset
Anch. Fluke 1	1.1	4.4
Anch Fluke 2	1.5	5.6
Anch Stem	1.7	4.9
Winch	11.1	1.2
Boiler	26.3	3.9
Wheel	32.7	2.1

BASELINE OFFSET
PLOTTING DATA



Two things are necessary for plotting coordinate data:

1. A map **scale**
   - Even scales are easy to use (e.g., 1 m = 1 cm or 1:100).
   - Scale choice based on size of site and level of detail to be mapped.
2. A tool for measuring **right angles**
   1. T-square
   2. Set Square
   3. Graph Paper



BASELINE OFFSET

Requirements

- 2 Divers
- Basic survey skills
- Accurate right angles
- Set Baseline
- Objects close to baseline

Advantages

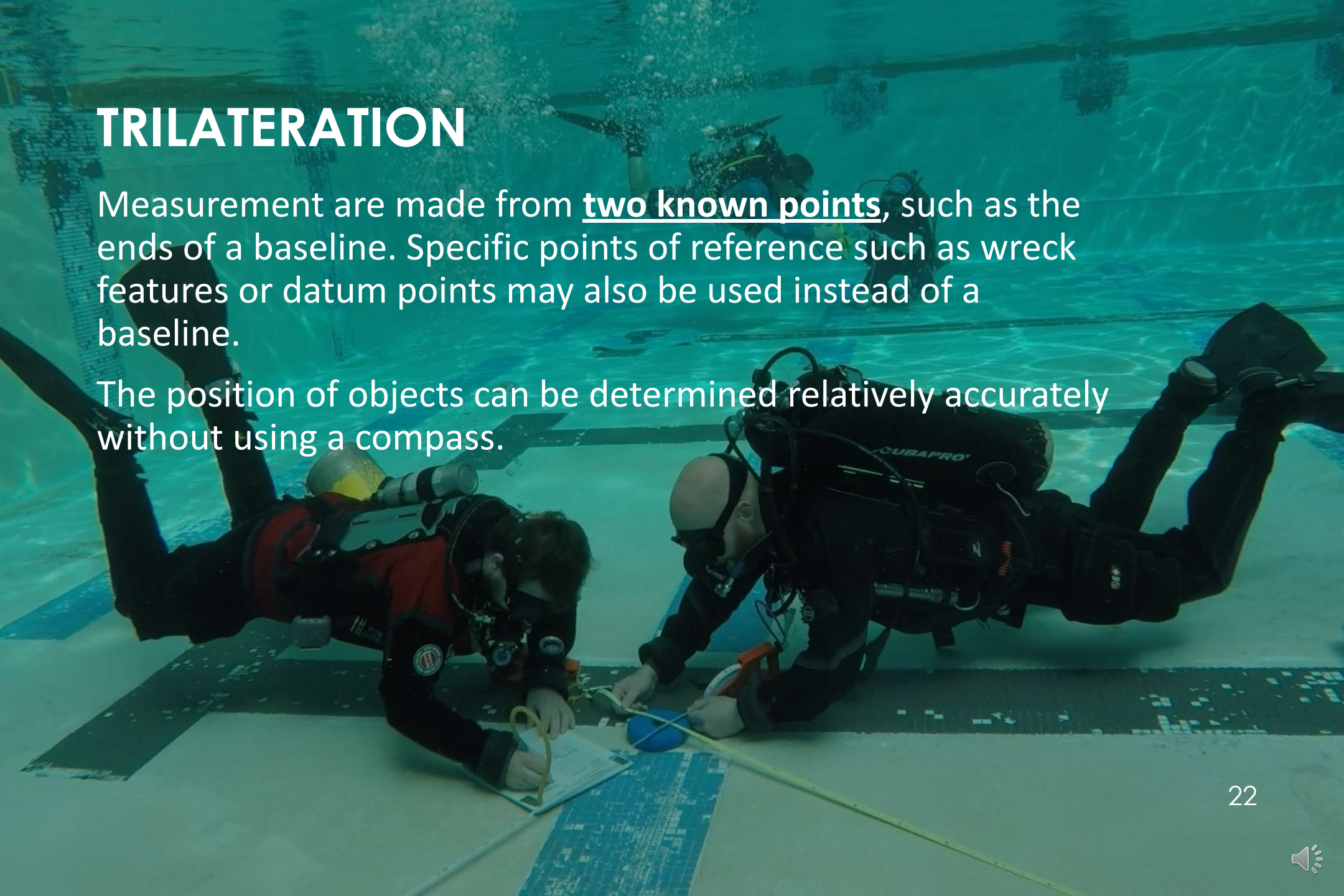
- Fast and effective on flat sites
- Easy to plot data

The *Barnard Castle* site plan was produced using the Baseline Offset method.

TRILATERATION

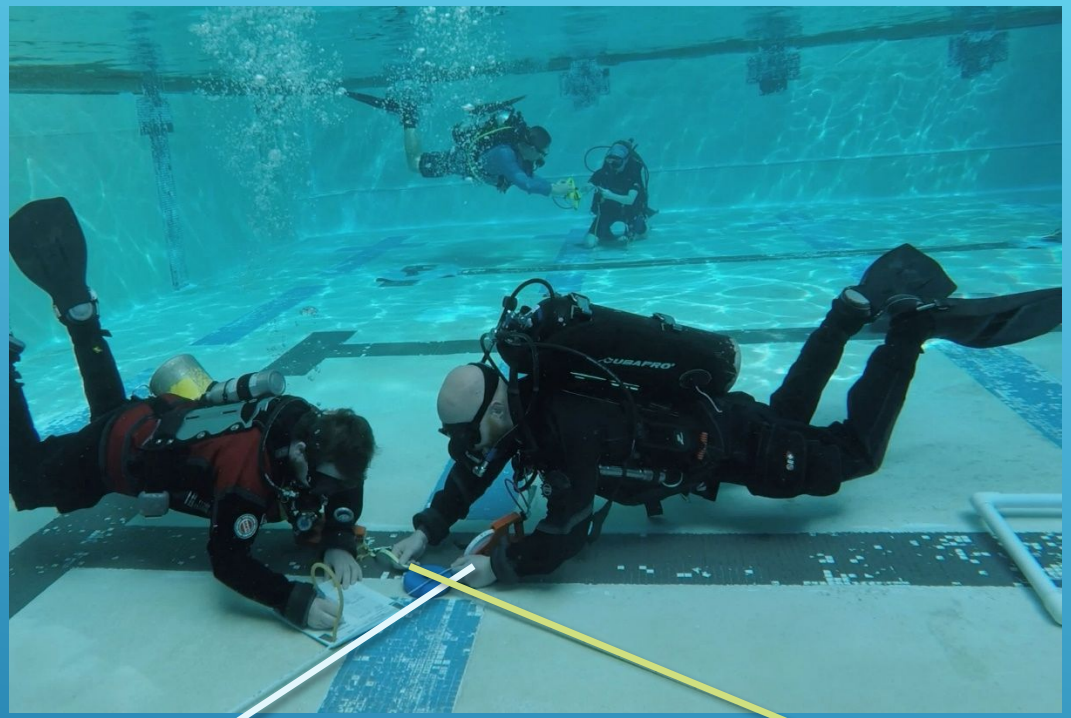
Measurement are made from **two known points**, such as the ends of a baseline. Specific points of reference such as wreck features or datum points may also be used instead of a baseline.

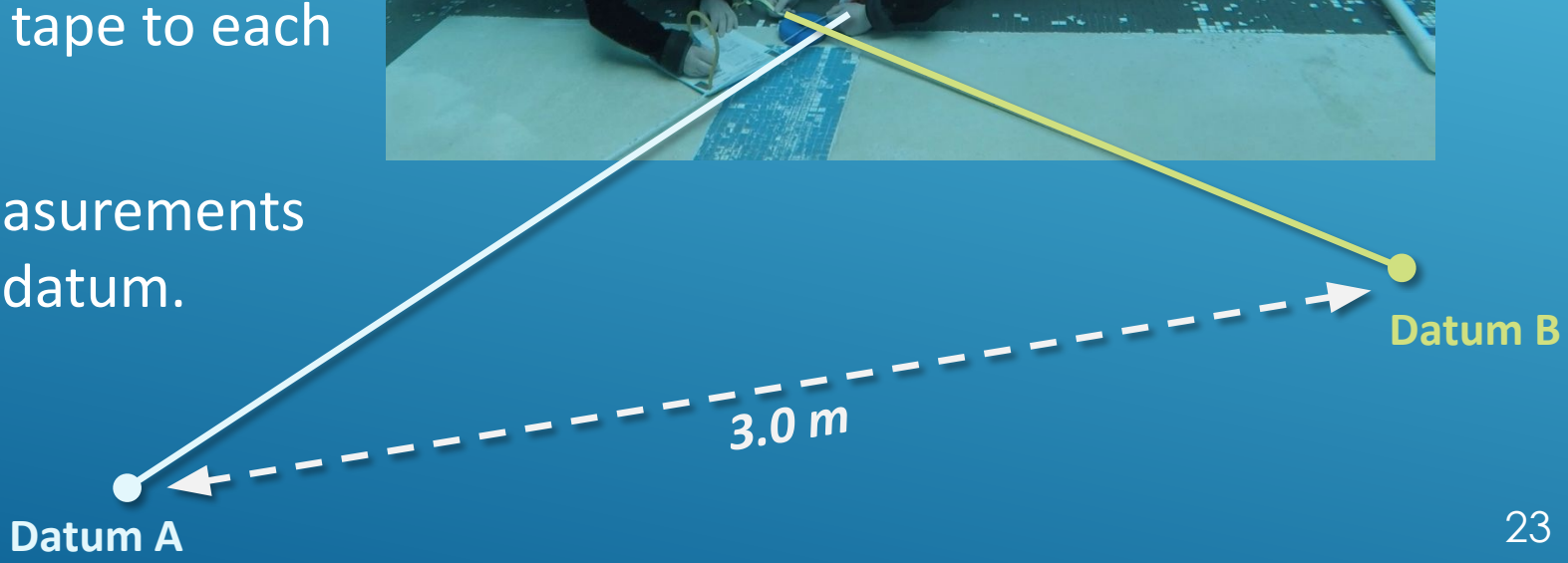
The position of objects can be determined relatively accurately without using a compass.



TRILATERATION

1. Establish Datum A and Datum B and measure the distance between them.
2. Fix the “zero” end of a measuring tape to each datum
3. Record measurements from each datum.

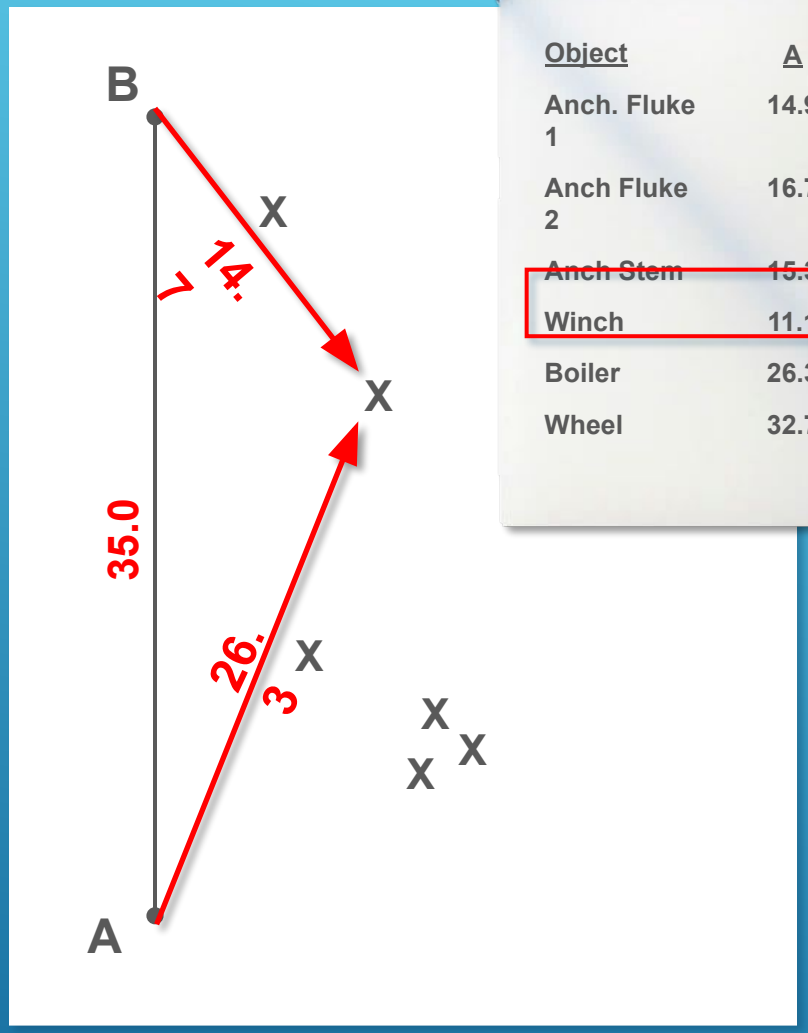




TRILATERATION
PLOTTING DATA

To plot triangulation points, the baseline needs to be plotted first and both datums labeled.

Each pair of coordinates is plotted as a single point by measuring from each datum.



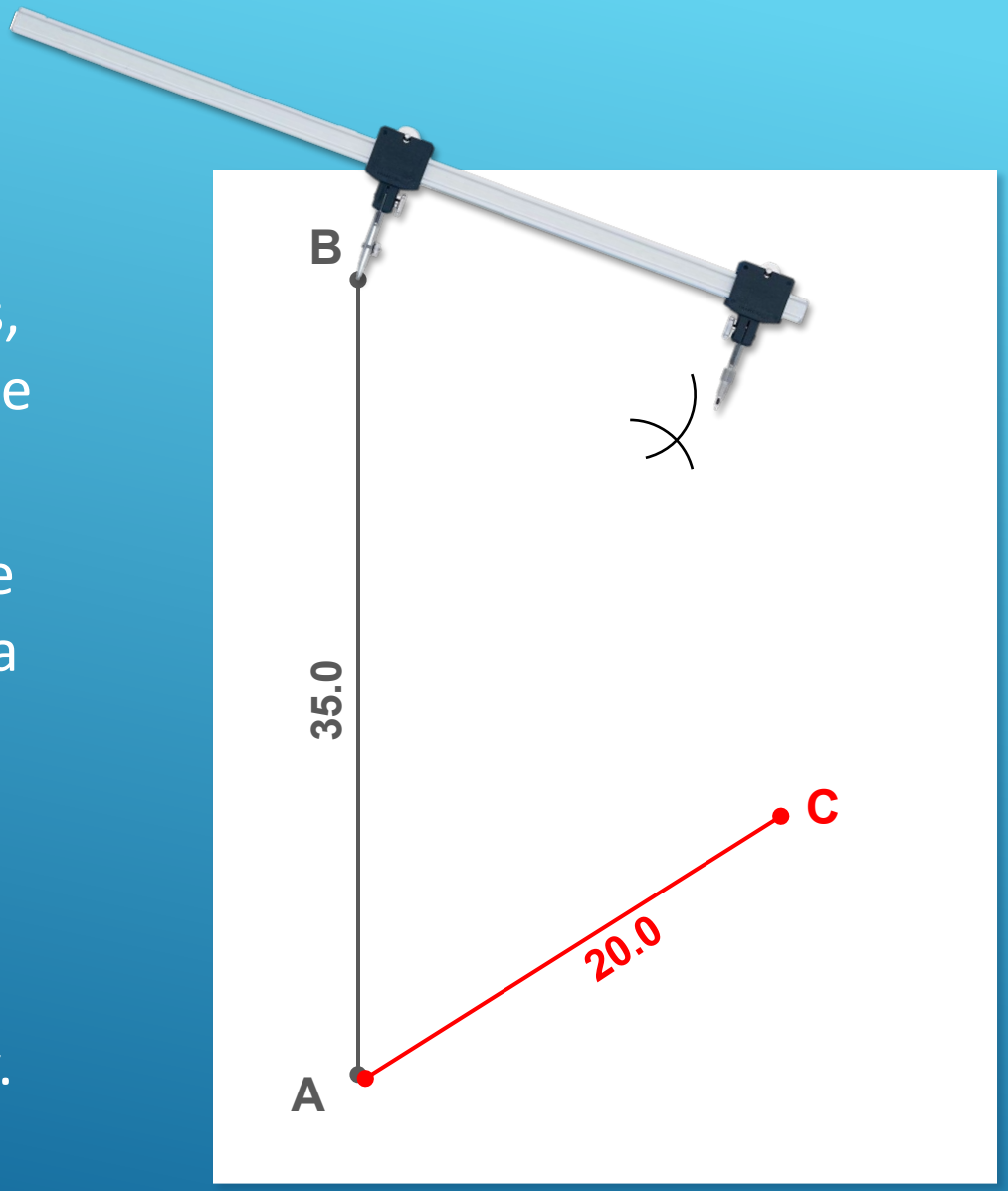
Object	A	B
Anch. Fluke 1	14.9	30.7
Anch Fluke 2	16.7	28.6
Anch Stem	15.3	28.1
Winch	11.1	22.9
Boiler	26.3	14.7
Wheel	32.7	3.2

TRILATERATION
PLOTTING DATA

Like plotting Baseline Offsets, choosing an appropriate scale is needed before starting.

Set a drafting compass to the Datum A distance and draw a small arc. Repeat for Datum B. Arcs should cross at right angles.

Measurements from a 3rd datum will improve accuracy.



TRILATERATION

Requirements

- 1 or 2 Divers
- Basic survey skills
- Set Baseline or multiple datums
- Takes more time than Baseline Offsets

Advantages

- Fast and effective on flat sites
- Better accuracy over large distances than Baseline Offset
- Accuracy can be improved with additional datums
- Easy to plot data

TRAVERSE

The **relative position of two objects** can be mapped by swimming a traverse between them.

Traverses **must start at an established datum**.

The bearing and distance between two objects is recorded using a compass and measuring tape or knotted line.

This technique is useful for relating large objects to each other on a relatively flat, large site.

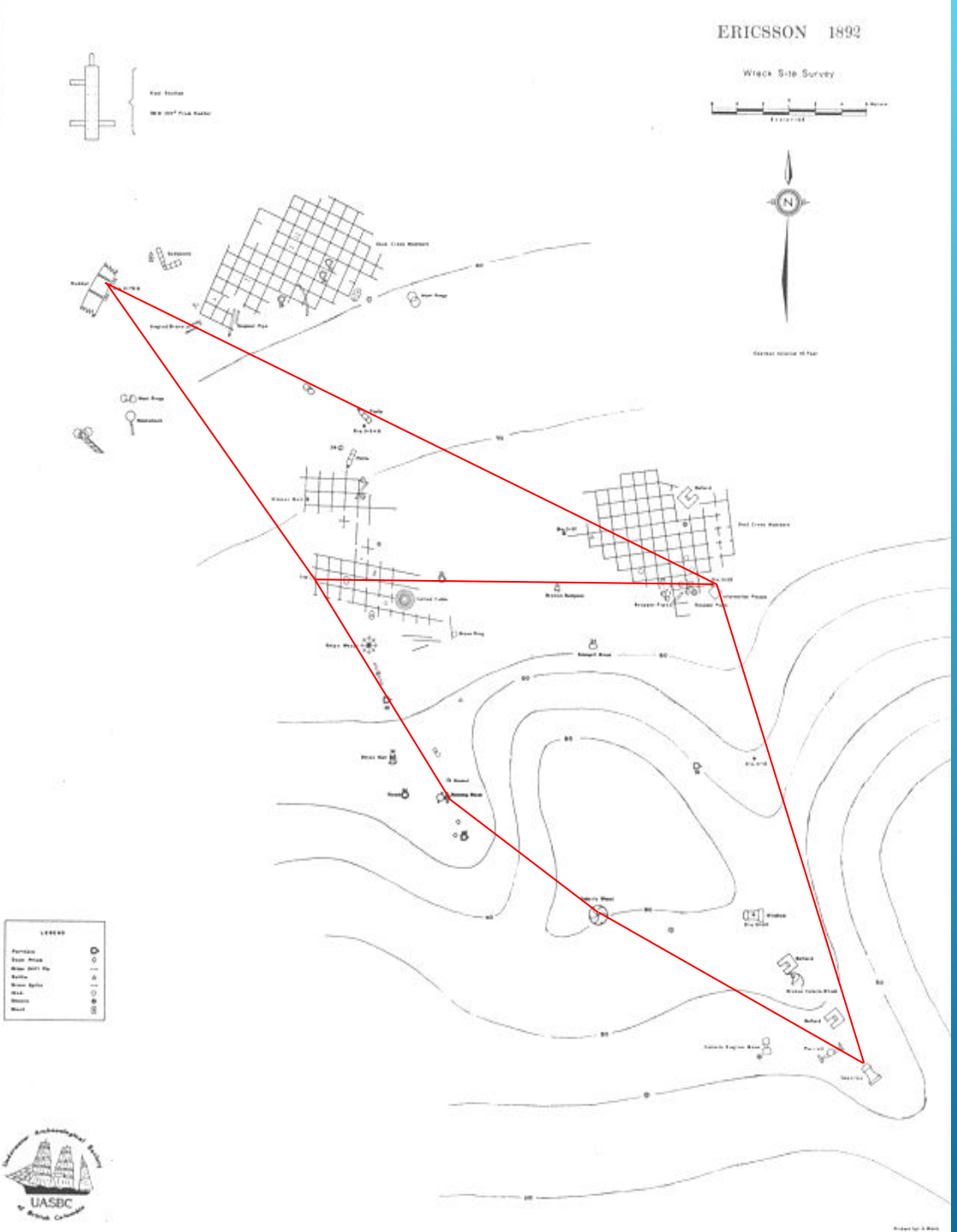
An **accurate compass**, and the **skill** to use it, are critical.

TRAVERSE

Traverse **distance** and compass **bearing** is recorded consecutively as the diver swims from one object to the next.

Dive slates or wetnotes can be set-up with **recording tables** or forms in advance of diving.

Additional information about each object, such as **depth**, can also be recorded.



TRAVERSE

Traverses are plotted using a ruler and protractor.

Each traverse must be plotted in the order it was recorded, starting from the site datum.

The *Ericsson*, sunk in Barkley Sound, B.C., was documented using the Traverse method.

TRAVERSE

Requirements

- 1 or 2 Divers
- Good compass skills
- Plotting takes time

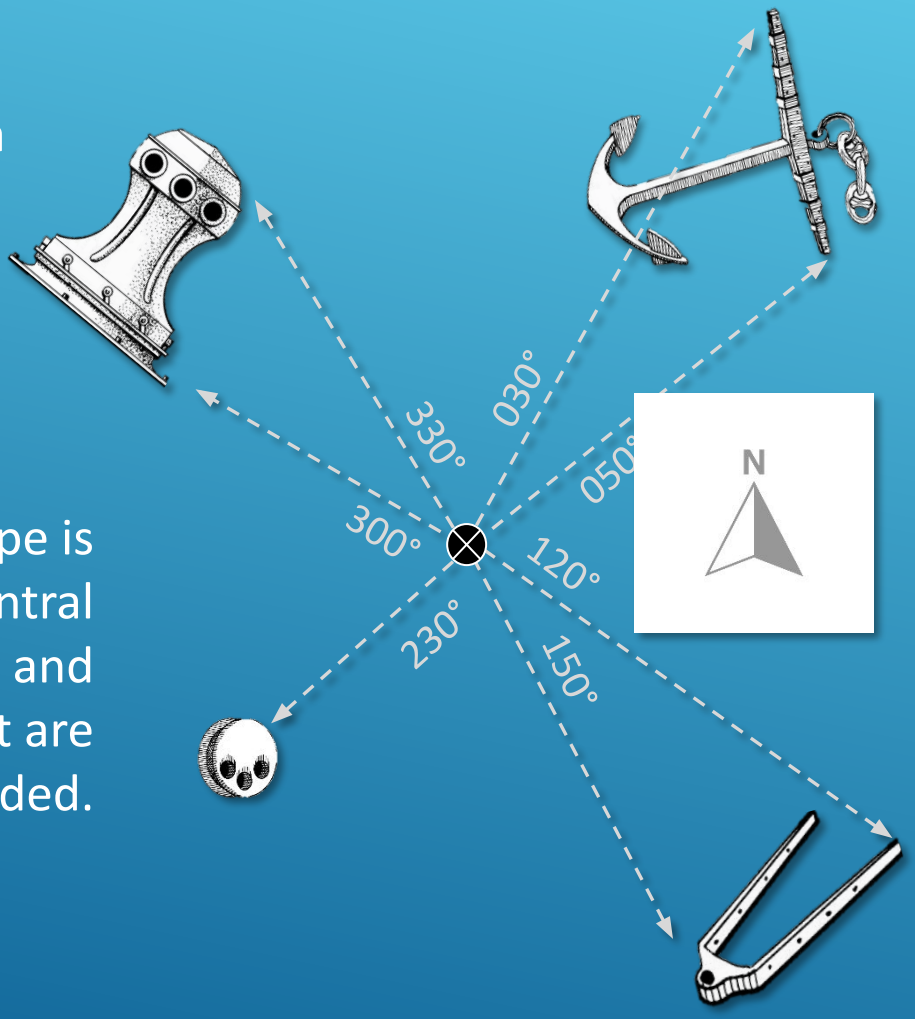
Advantages

- Works on sloping sites
- Requires only a single datum

RADIAL SURVEY

A simple and accurate mapping technique for a single diver. Radial survey works best in a small, level area.

1. The zero end of the tape is attached to the central datum and distance and bearing to each artifact are recorded.



3. Each bearing is marked from the centre of the map using a protractor.

4. Distances along each bearing are measured with a ruler and marked.

5. Lastly, each object is drawn to scale.

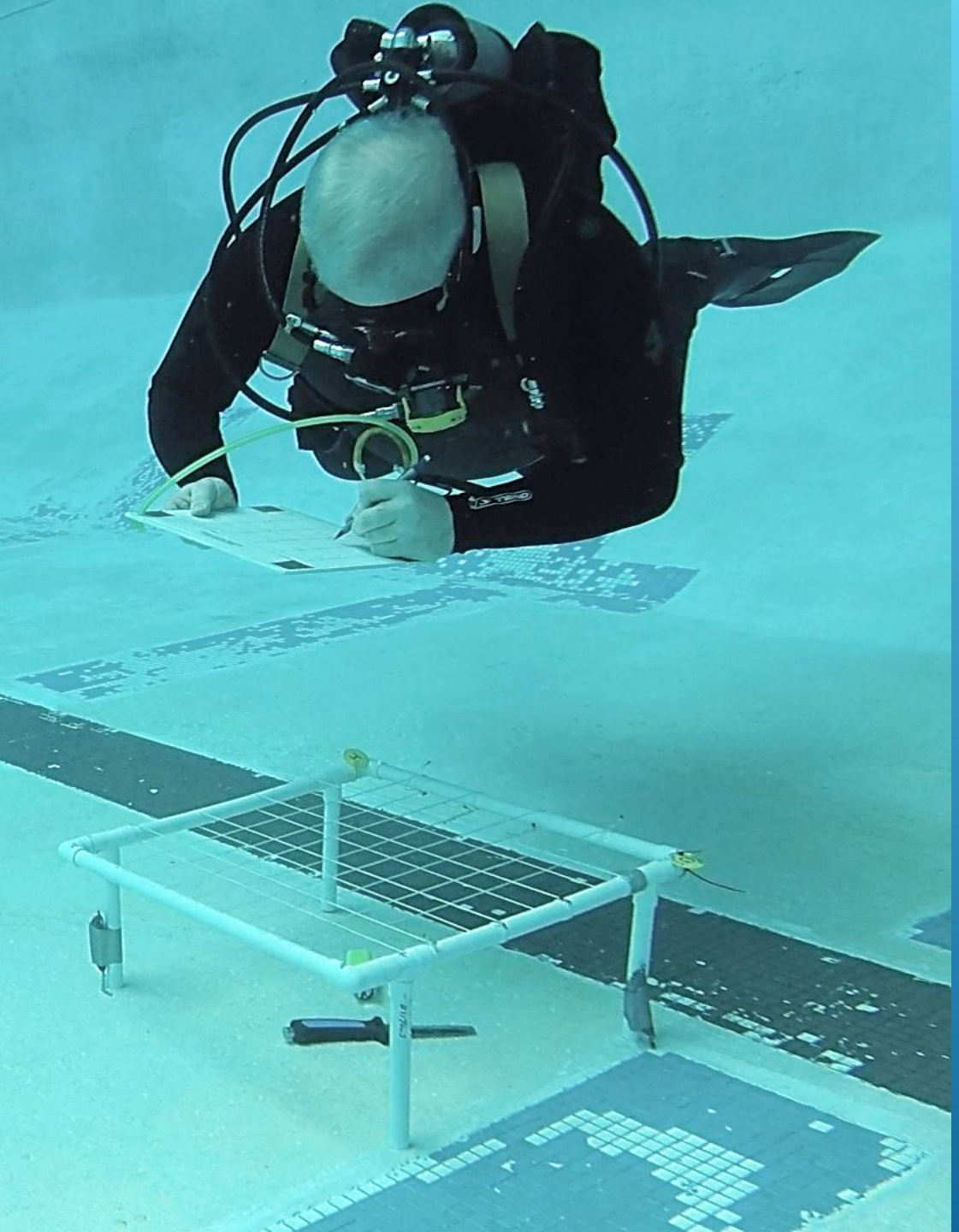
RADIAL SURVEY

REQUIREMENTS

- 1 Diver
- Limited area
- Level site area

ADVANTAGES

- Very fast
- Requires only a single datum
- Very easy to plot



DRAWING FRAME

A drawing frame is useful for mapping **small areas or objects in detail**.

A typical drawing frame is free standing, **1 meter square**, divided into 10 or 20 cm squares.

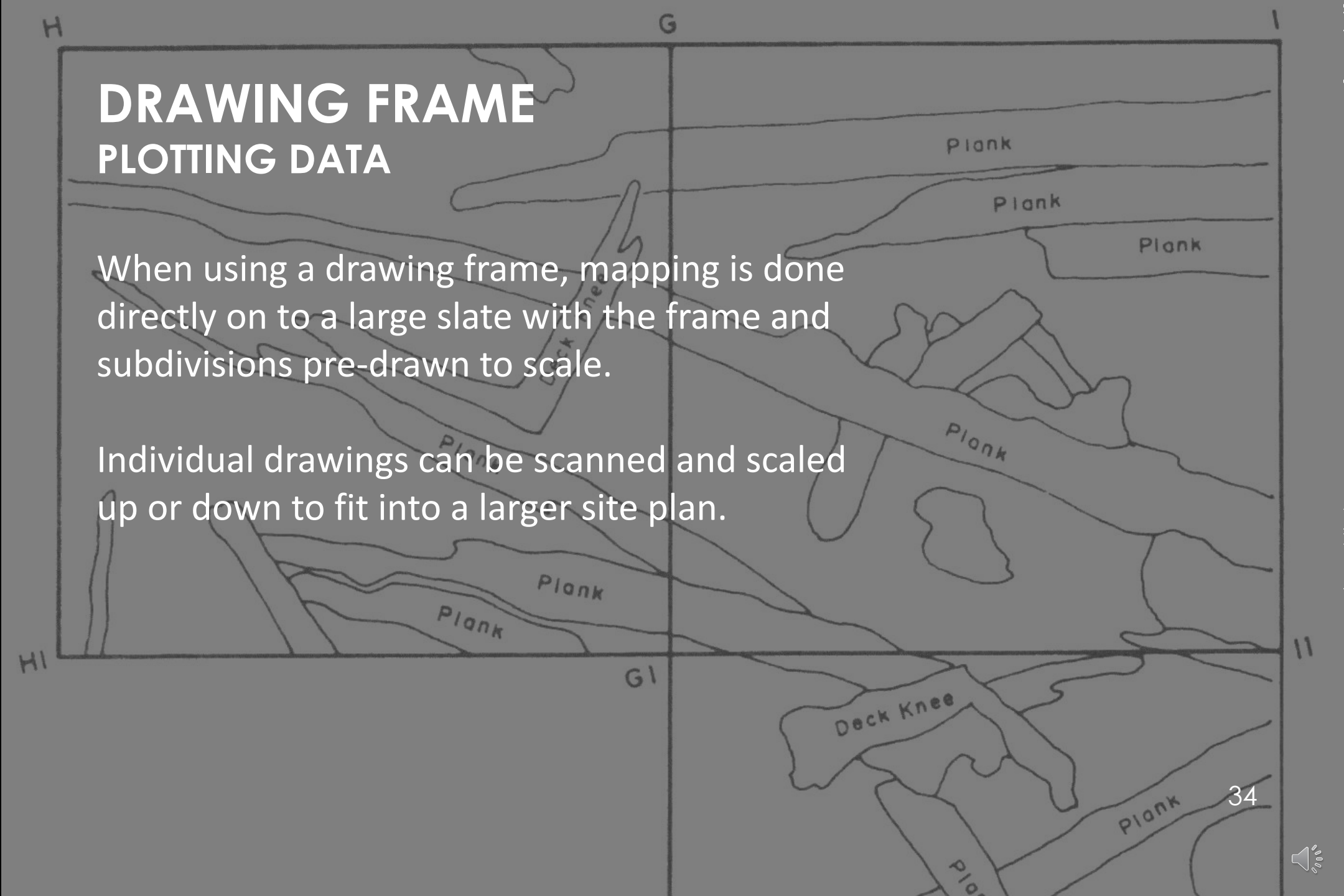
To map objects a diver must hover **directly over** the drawing frame and draw what is in each square.

To ensure the diver is position directly over top of the frame, most frames use double strings.

DRAWING FRAME
PLOTTING DATA

When using a drawing frame, mapping is done directly on to a large slate with the frame and subdivisions pre-drawn to scale.

Individual drawings can be scanned and scaled up or down to fit into a larger site plan.



DRAWING FRAME

Requirements

- 1 Diver
- Very small, level area
- Parallax guides
- Diver drawing skill and attention

Advantages

- Very detailed mapping
- Maximum coverage of specific area.
- Easy to plot

QUIZ

- What is the objective of a site survey?
- Why do we do site surveys?
- What are the 3 steps to completing a site survey?
- Name 4 survey methods.
- What is a datum point?
- How is a site survey set up?