WisDOT Structure Inspection - Underwater Inspections and Assessments

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Welcome to the Structure Inspection Refresher Training Series.
This module details information on underwater inspections and assessments.
This training module includes slides with audio as well as slides with clickable interactive features. When you finish a slide, click next.
There is a short quiz at the end of the training.
Please start the training by clicking next.

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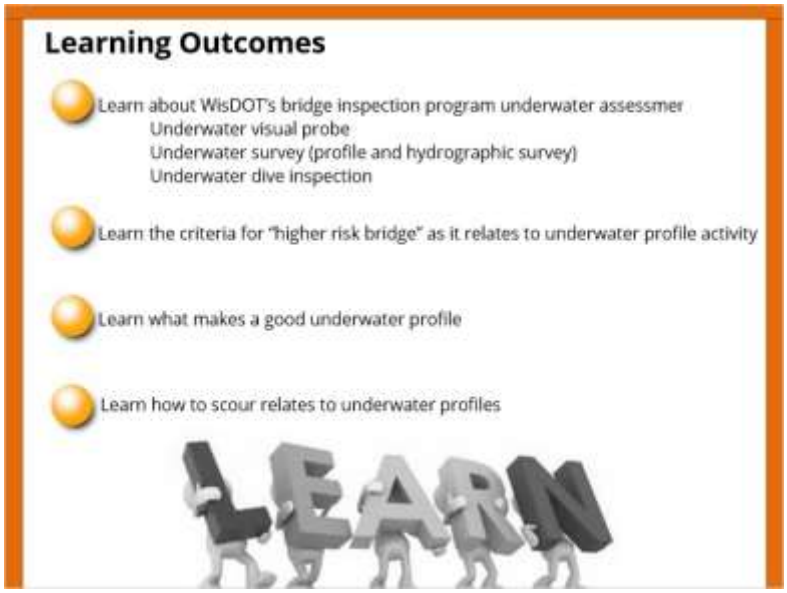

The learning outcomes from this session:
- Learn about WisDOT's bridge inspection program underwater assessments which include:
  - Underwater visual probe
  - Underwater survey (profile and hydrographic survey); and
  - Underwater dive inspection
- Learn the criteria for "higher risk bridge" as it relates to underwater profile activity
- Learn what makes a good underwater profile
- Learn how scour relates to underwater profiles

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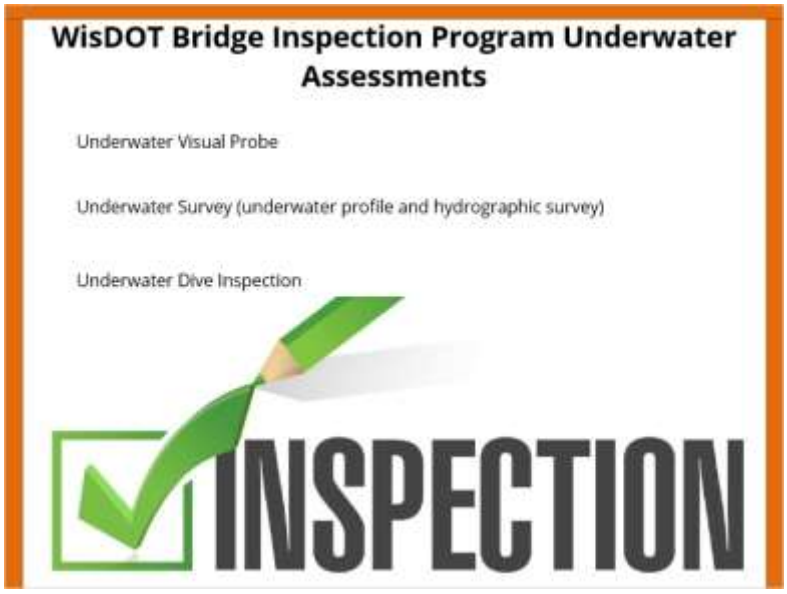

The WisDOT Bridge Inspection Program requires underwater assessments of the bridge elements, streambed, and channel location. There are three main underwater assessments. These are underwater visual probe, underwater profile activity, and underwater (dive) inspection.

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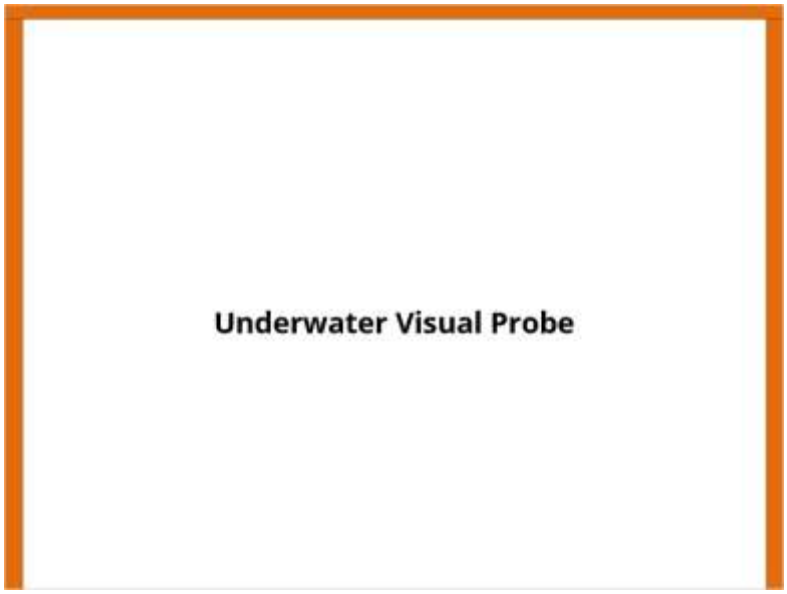

The underwater visual probe activity generally involves wading or probing with a rod and/or feet to assess the element and streambed condition. Under certain conditions, a visual condition assessment is acceptable.

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This activity is required for all substructure units located in water 4' or less in depth and under safe conditions for the inspector. A visual condition assessment is acceptable if the water level is low, the water is clear, and the inspector can assess the condition with a high level of certainty. If a substructure unit is dry, the inspector should indicate that on the inspection form for the unit in question. It is preferred this activity occurs during the Routine Inspection, but if stream conditions (high water, high velocity, ice, etc.), safety concerns, or scheduling prohibit it, then an underwater probe must be scheduled separately to ensure the proper frequency isn't exceeded. For culvert type bridges, a probe is also required at the ends to assess element condition and check for potential scour. On bridges meeting the requirements of both an UW dive inspection and a probing/visual activity, the probing/visual activity will be made as part of the UW dive inspection on the same inspection interval as the UW dive inspection.

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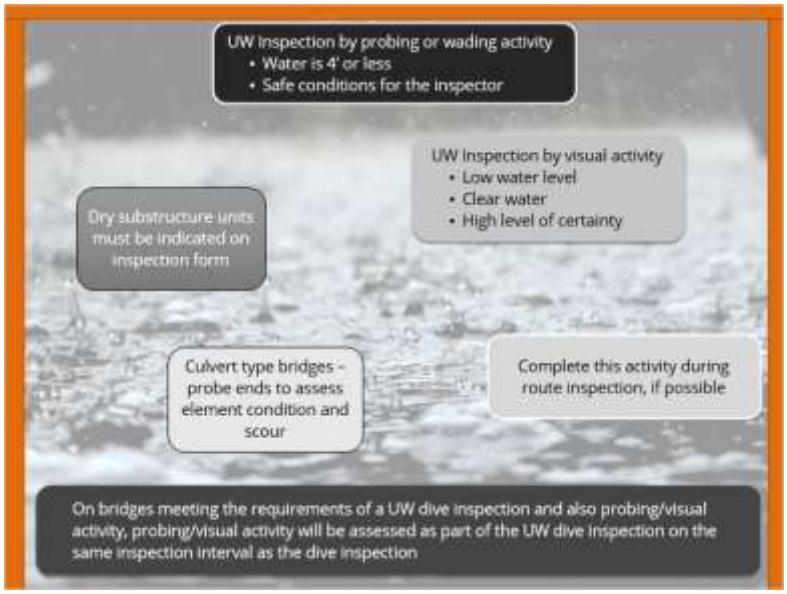

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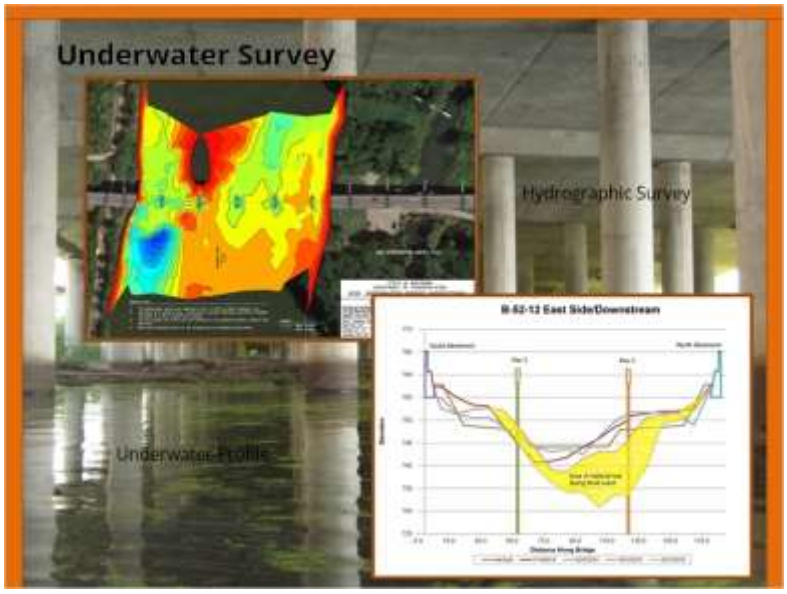

Underwater Survey: This activity involves gathering streambed elevations and alignment information used to assess streambed conditions and monitor channel movement at bridges over waterways. The data gathered is compared to as-built information and past profiles. The survey is in the form of an underwater profile and a hydrographic survey. The underwater profile consists of cross-sections of the streambed taken parallel to the bridge. The ability to capture the true picture of the underwater landscape with a underwater profile is limited. A hydrographic survey is performed in conjunction with the underwater dive inspection using sonar equipment on select bridges generally on bridges over larger bodies of water where the water stretches across the full span or multiple spans.

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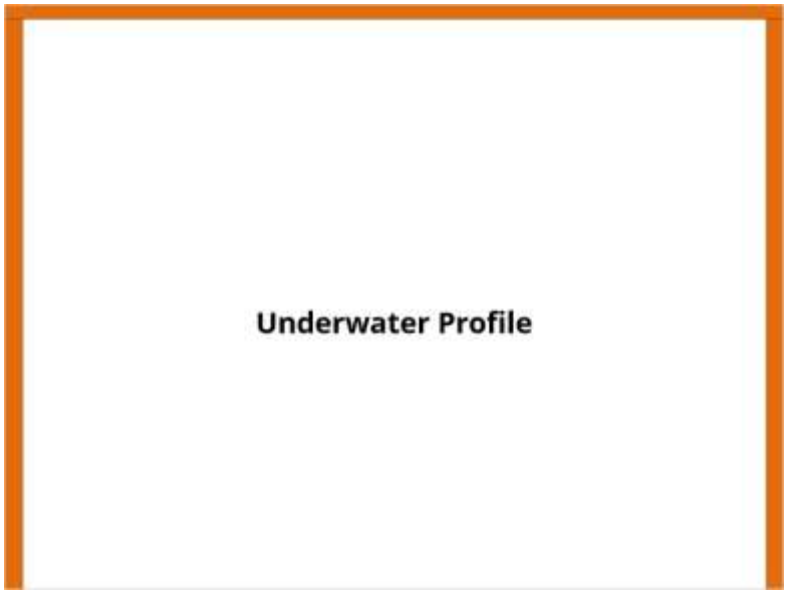

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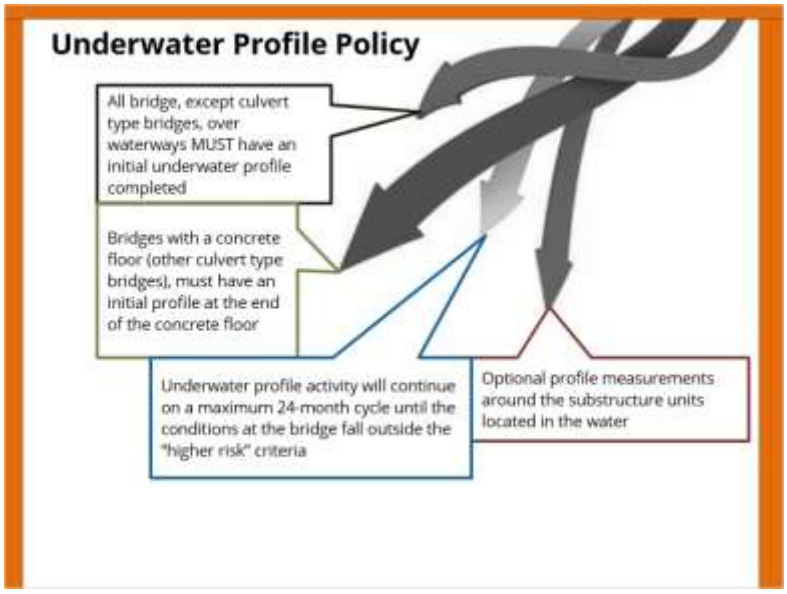

WisDOT's underwater profile policy is as follows:
All bridges over waterways, except culverts type bridges, must have an initial underwater profile completed.

Bridges with a concrete floor (other than culvert type bridges) must have an initial profile at the end of the concrete floor.

Profile measurements around the substructure units located in the water are optional.

Underwater profile activity will continue on a maximum 24-month cycle until the conditions at the bridge fall outside the “higher risk” criteria. “Higher risk” criteria defined later in module.

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The underwater profile must continue on bridges considered as “higher risk”.
Higher risk bridges are defined as those classified as Scour Critical - these are bridges determine by evaluation or observation to be vulnerable to scour; those with an NBI Channel (Item 61) coded at 5 or below; those with a Scour Defect #6000 in condition state 3 or 4; and those identified by the program manager.

Bridges meeting the higher risk bridge criteria must have the underwater profile completed at a maximum frequency of 24 months on both the upstream and downstream fascia. The team leader or program manager must compare the new profile data with historical data to ascertain potential movement of the channel and risk of substructure undermining. The information must be documented in the Highway Structures Information System.

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Structures over water that experience a significant flooding event must have a post flood profile evaluation to ensure the channel hasn't significantly shifted to affect the structural integrity of the bridge.

A significant flood event is defined as one that causes the stream to flow beyond its banks (unless defined within a Plan of Action (or POA)).

Review the (POA) for bridges classified as Scour Critical. Contact the program manager.

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Since underwater profile activity is essentially a surveying task, the individuals gathering the profile data do not need to be a certified bridge inspector. The individual gathering the profile data must be competent in the task of collecting and recording the information. The profile results must be reviewed and compared to previous profile results by the Inspection Team Leader (TL) or the Program Manager (PM).

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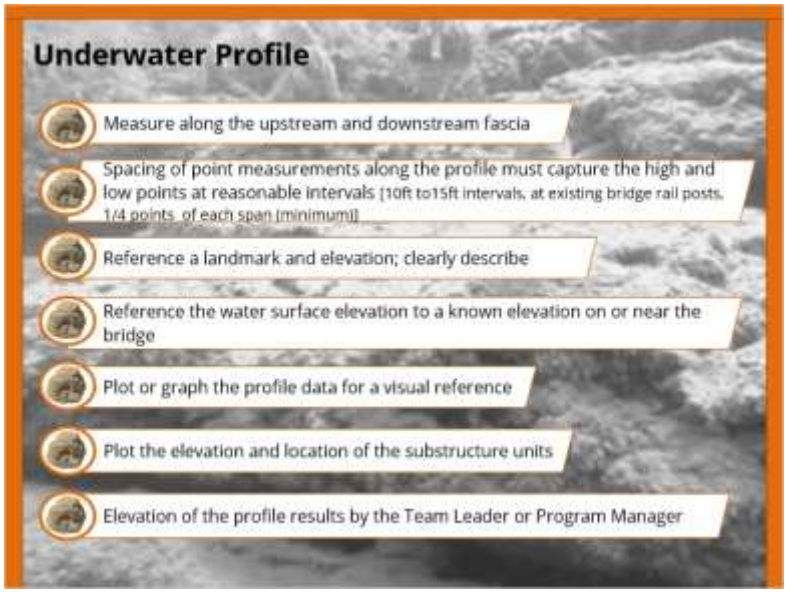

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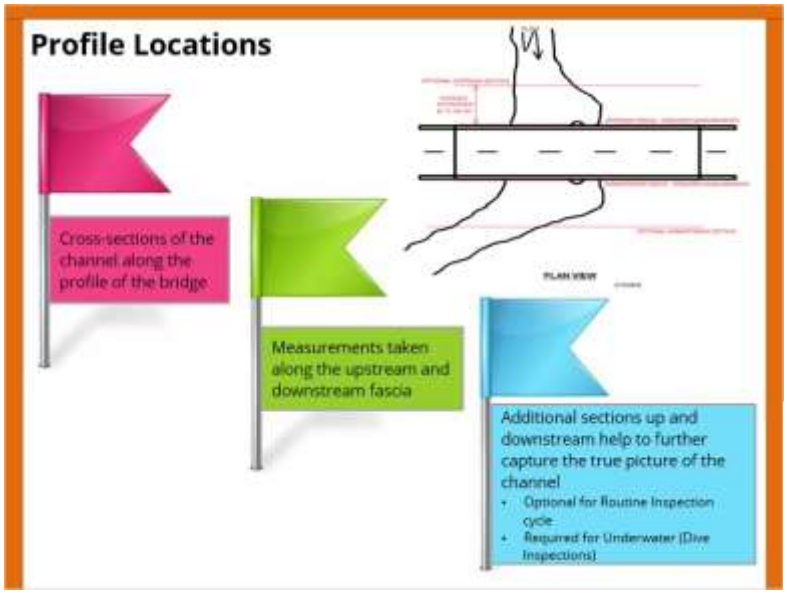

A good underwater profile will include the following:

The profile measurements taken along the upstream and downstream fascia. Additional sections up and downstream may be taken to help capture the true picture of the channel.

The spacing of the point measurements along the profiles must capture the high and low points (the breakpoints) at reasonable intervals. The typical spacing is 10 to 15' intervals. Other simple visual references such as the bridge rail post, provide a good location for point measurements. The spacing can be the ¼ points of each span when the profile is completed in conjunction with an underwater dive inspection.

Clearly reference a landmark with an elevation - this can be derived off the existing plan or it can be an arbitrary location and elevation. Subsequent profiles must use the same landmark and elevation (e.g. North Abutment - Upstream Fascia at beam seat). When using an arbitrary elevation, a constant elevation along the length of the structure may be assumed, even if it is located on a vertical profile. This is acceptable because the profile is a comparative tool. So long as the subsequent inspections replicate this arbitrary elevation and the locations at which measurements are taken, the data will indicate whether there have been any changes to channel alignment or elevation.

Reference the water surface elevation to a known elevation on or near the bridge.

Plot or graph the profile data for a visual reference. Spreadsheet programs such as Excel offer a good method of storing data for future reference and modification.

Plot the elevation and location of the substructure units. This information is essential in determining if any changes will affect the bridge,

The inspection team leader or program manager must evaluate the underwater profile results.

The underwater profiles are cross sections of the channel along the profile of the bridge. The profile measurements are taken along the upstream and downstream fascia, parallel to the bridge. Additional sections up and downstream help to further capture the true picture of the channel. Additional sections are optional when the underwater profile activity is part of a Routine Inspection cycle and required for regular Underwater Dive Inspections.

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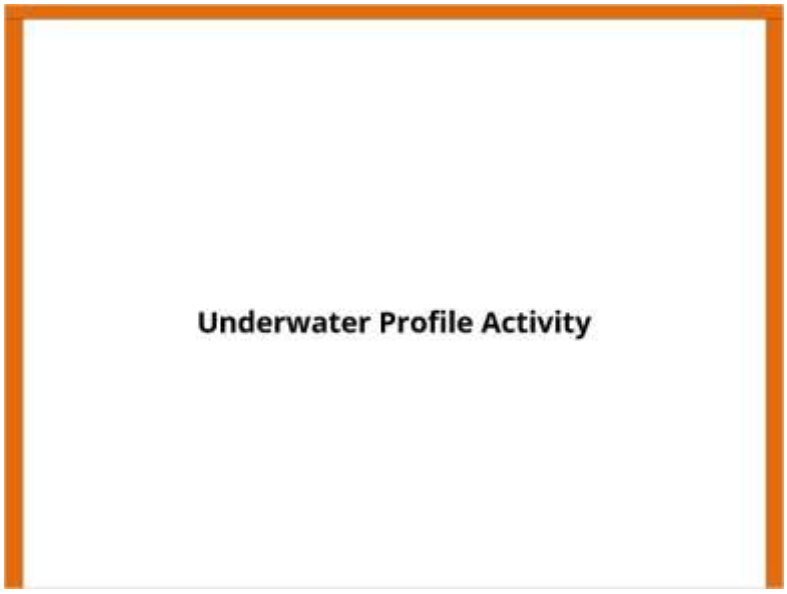

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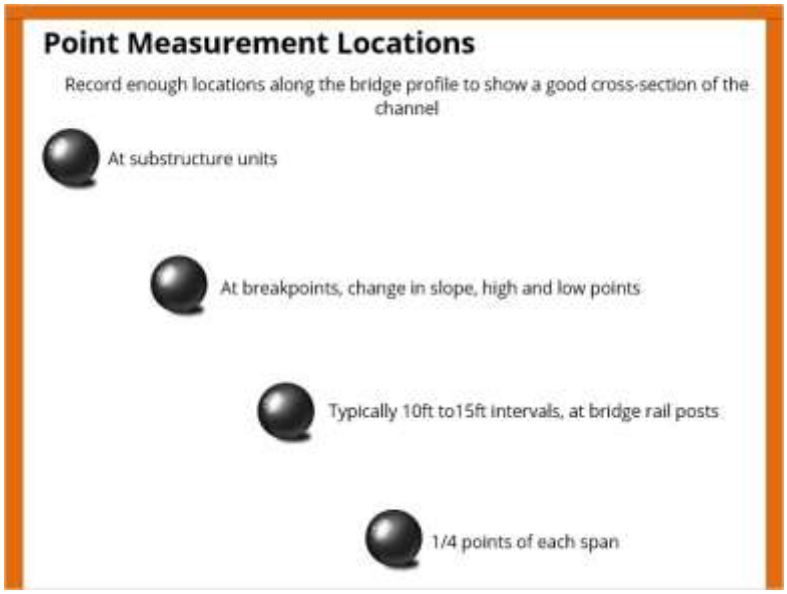

There must be enough point locations along the bridge profile to show a good cross-section of the channel. The point measurements along the bridge profile must capture the high and low points at reasonable intervals. The point measurements must be taken at the substructure units, at breakpoints (changes in slope/high & low points) between the substructure units, and at spacing typically of 10' to 15' intervals or ¼ points of each span or at the bridge rail posts.

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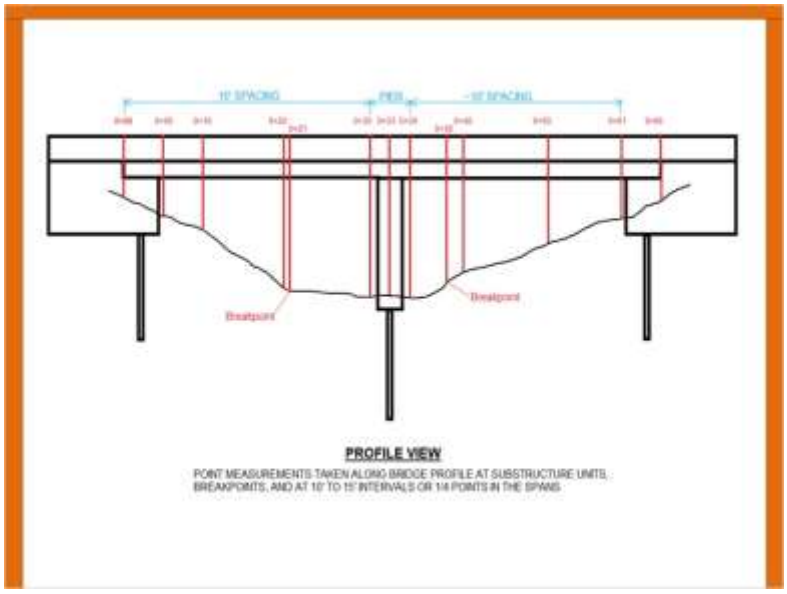

This drawing shows example locations of point measurements along the bridge profile: at substructure units, at breakpoints, at spacing of 10' along the bridge.

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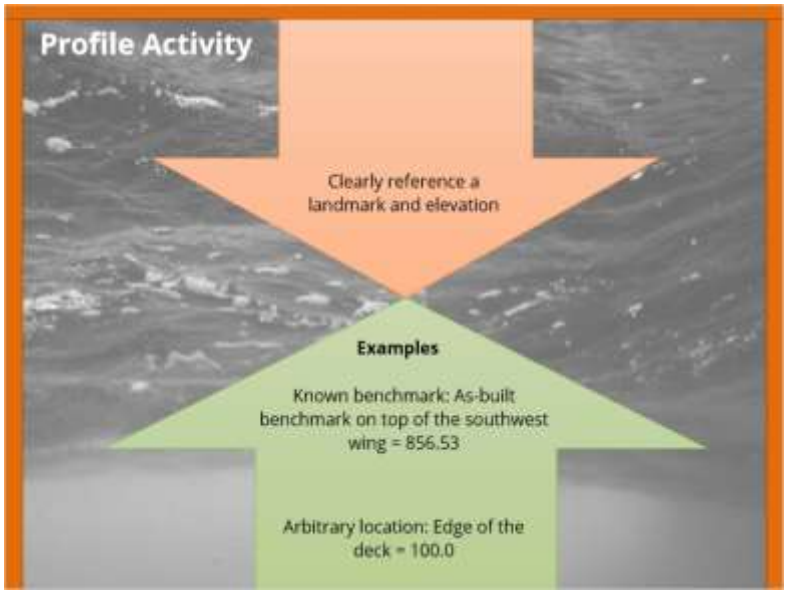

Reference a landmark and elevation from an existing plan or an arbitrary location and clearly describe on the profile documentation. Subsequent profiles must use the same landmark and elevation (e.g. North Abutment - Upstream Fascia at beam seat). When using an arbitrary elevation, a constant elevation along the length of the structure may be assumed, even if it is located on a vertical profile. This is acceptable because the profile is a comparative tool. So long as the subsequent inspections replicate this arbitrary elevation and the locations at which measurements are taken, the data will indicate whether there have been any changes to channel alignment or elevation.

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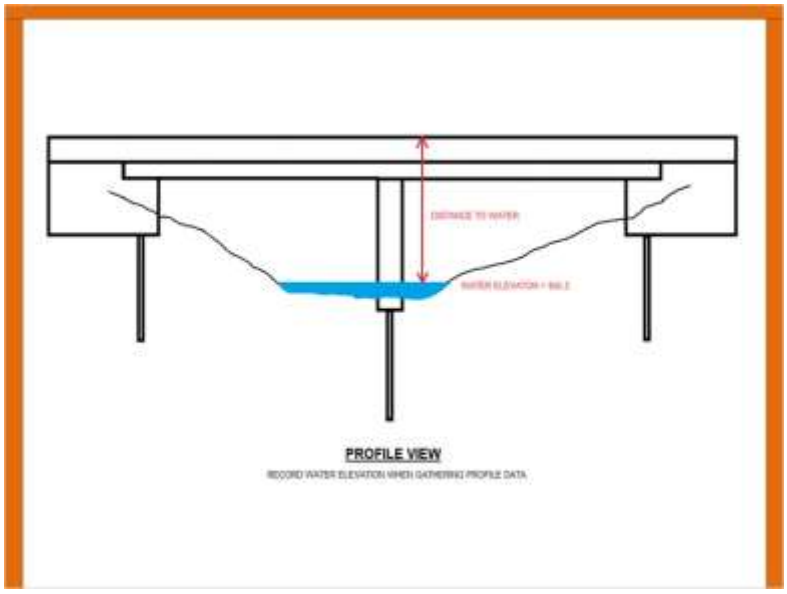

Reference the water surface elevation to a known elevation on or near the bridge.

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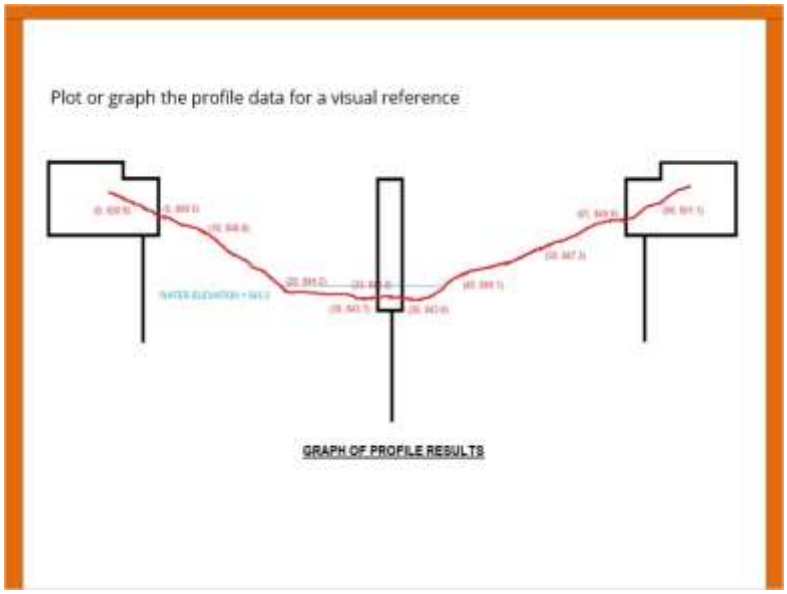

Plot or graph the profile data for a visual reference. Spreadsheet programs such as Excel offer a good method of storing data for future reference and modification.

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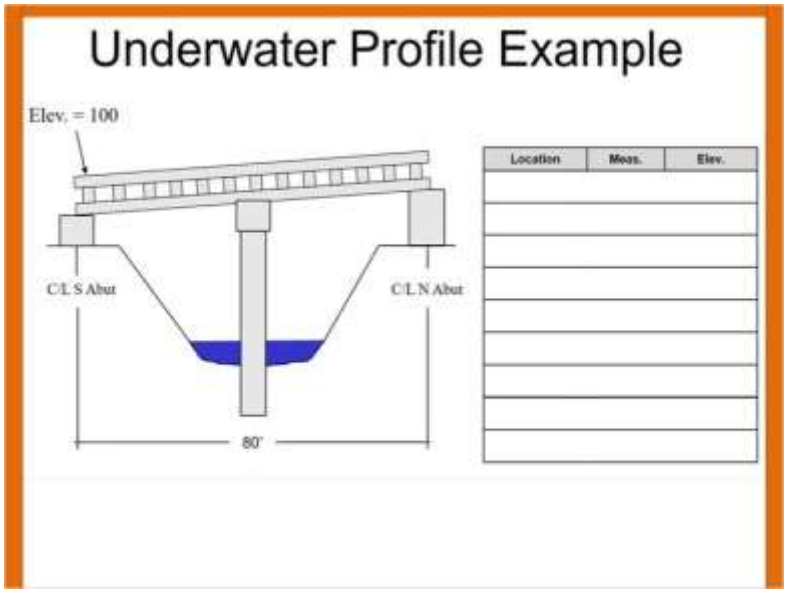

The intent of the underwater profile is to have a repeatable procedure for future comparisons. It is not necessary for the inspector to determine the true elevation of the stream bed or water elevation so long as the same methods are repeated from the same locations at every inspection.

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The inspection team leader or program manager must evaluate the underwater profile results and review the historic profile measurements to determine the potential movement of the channel and the risk of substructure undermining.

The inspector should look for exposed footings or piling and determine if a structural evaluation is necessary.

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Underwater dive inspections: The purpose of an underwater dive inspection is to assess the condition of the underwater elements and to asses the conditions around the underwater elements. An underwater dive inspection is required if water conditions exist at the structure that prohibit access to all portions of an element by visual or tactical means during a Routine Inspection - generally when the water depth is consistently over 4' at the substructure unit or conditions at the substructure unit make it difficult or dangerous to inspect by conventional methods - swift current, soft streambed, etc. Underwater profiles and hydrographic surveys are completed in conjunction with the underwater dive inspection.

Generally, underwater dive inspections are required on an interval not to exceed 60-months. For bridges classified as Scour Critical, the interval must not exceed 24-months.

The inspection is conducted by evaluating the substructure units and the waterway by using a probe rod or sounding pole. The inspector wearing boots or waders walks around the substructure, probing the units and channel bottom with the rod and with his/her feet, while visually inspecting the areas above and directly below the waterline where visibility permits. Limitations of the wading inspection are deep water, poor water visibility, excessively soft or irregular streambed conditions, and swift currents that make movement difficult or dangerous.

The results of the probe are entered into the HSI system under the Tab titled Underwater. This tab lists all substructure units on the bridge. If the substructure unit is dry at the time of the probing, the inspector shall note that on the form for the unit in question.

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Generally, underwater dive inspections are required on an interval not to exceed 60-months. For bridges classified as Scour Critical, the interval must not exceed 24-months.

The underwater dive inspections must be completed by a certified bridge inspector and a certified diver.

Bridges not meeting the dive inspection requirements must have each substructure unit in water probed for undermining at an interval not to exceed the required frequency of the Routine Inspection. It is preferred this activity occur during the Routine Inspection, but if stream conditions (high water, ice, etc.), safety concerns, or scheduling prohibit it, then a UW-Probe must be scheduled separately to ensure the proper frequency isn't exceeded. If a substructure unit is dry, the inspector should indicate that on the inspection form for the unit in question. For culvert type bridges, a probe is also required at the ends to assess potential scour.

The inspection is conducted by evaluating the substructure units and the waterway by using a probe rod or sounding pole. The inspector wearing boots or waders walks around the substructure, probing the units and channel bottom with the rod and with his/her feet, while visually inspecting the areas above and directly below the waterline where visibility permits. Limitations of the wading inspection are deep water, poor water visibility, excessively soft or irregular streambed conditions, and swift currents that make movement difficult or dangerous.

The results of the probe are entered into the HSI system under the Tab titled Underwater. This tab lists all substructure units on the bridge. If the substructure unit is dry at the time of the probing, the inspector shall note that on the form for the unit in question.

During the dive inspection, the inspectors shall make note of what substructure units are dry, which ones can be accessed by wading, and which units require diving. This information shall be recorded in the Highway Structures Information System (HSI). All units shall be assessed during the dive inspection. Dry units can be documented as “dry” without additional detail need for evaluation. Units that can be probed shall be and notes shall be taken on the condition of the streambed and substructure unit. And units that require diving shall be inspected according to guidelines in the Wisconsin Structures Inspection Manual.

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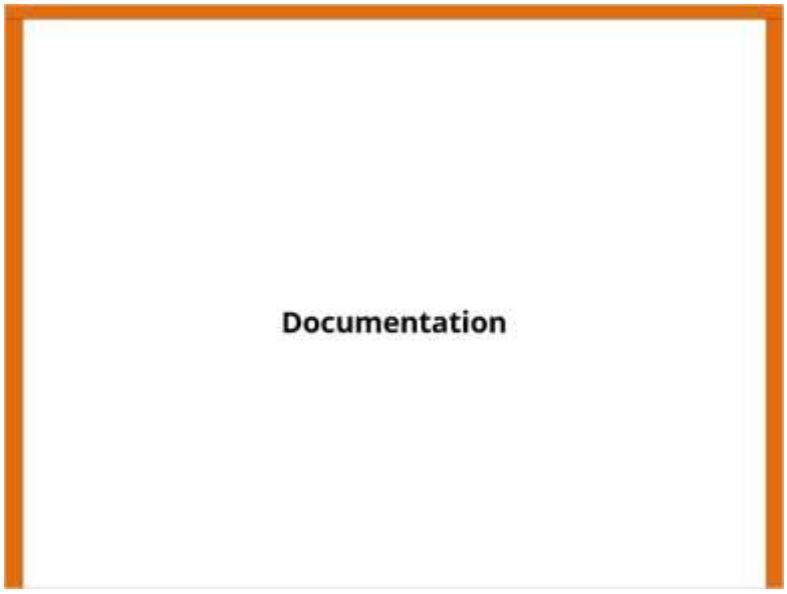

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As with all inspection activities, good documentation is key. Underwater probing and profiles must be documented in the Highway Structures Information system (or HSI).

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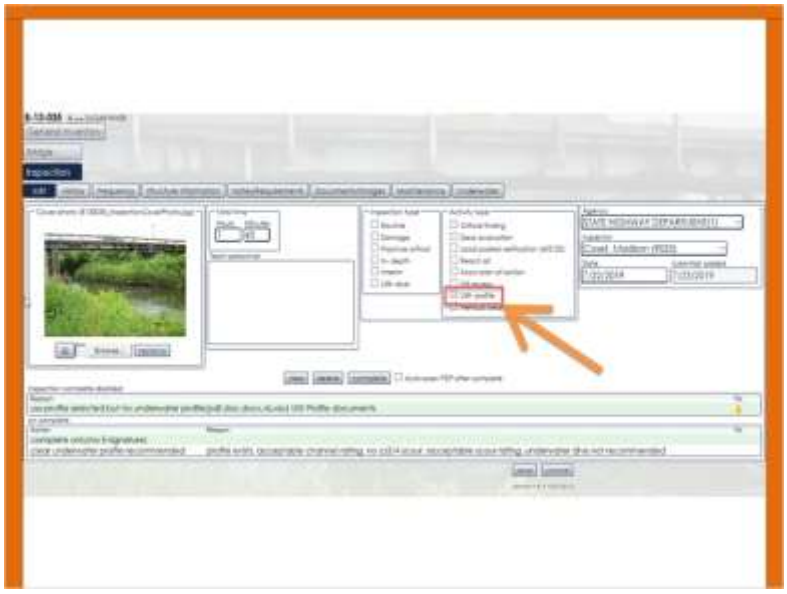

To document an underwater profile, the first step is to check the activity type titled UW-Profile on the create tab. This button must be selected in order for the system to properly document the profile.

Profiles can be entered along with the routine inspection, or they can be entered as a stand-alone activity.

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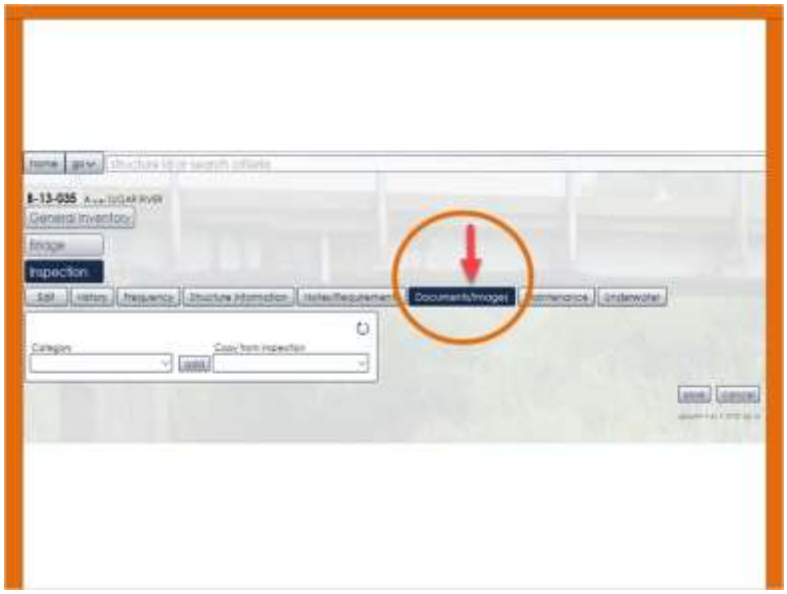

Once the inspector has the profile activity selected, they'll need to click on the documents/images tab.

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On this tab, select UW-Profile from the category dropdown and click Add.

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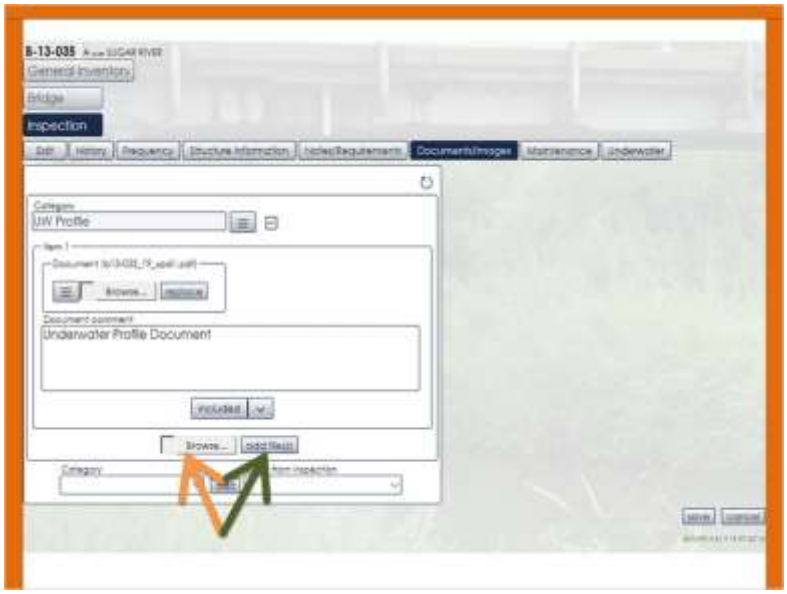

Browse for the files to be uploaded and click add files.

At a minimum, the cross sections at both the upstream and downstream sides of the bridge need to be uploaded.

These cross sections should not simply be for the current profile, but instead should have all the historical profile measurements included on one graphic.

Common practice is to upload an Excel document that contains all the various years of data, but a PDF of the cross sections can also be loaded.

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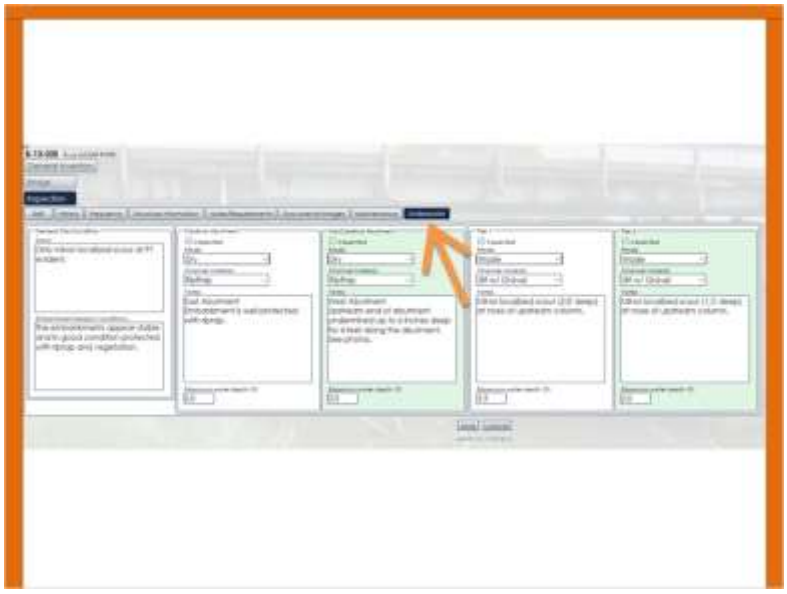

In addition to document uploads, inspectors need to document underwater probing results on the Underwater tab.

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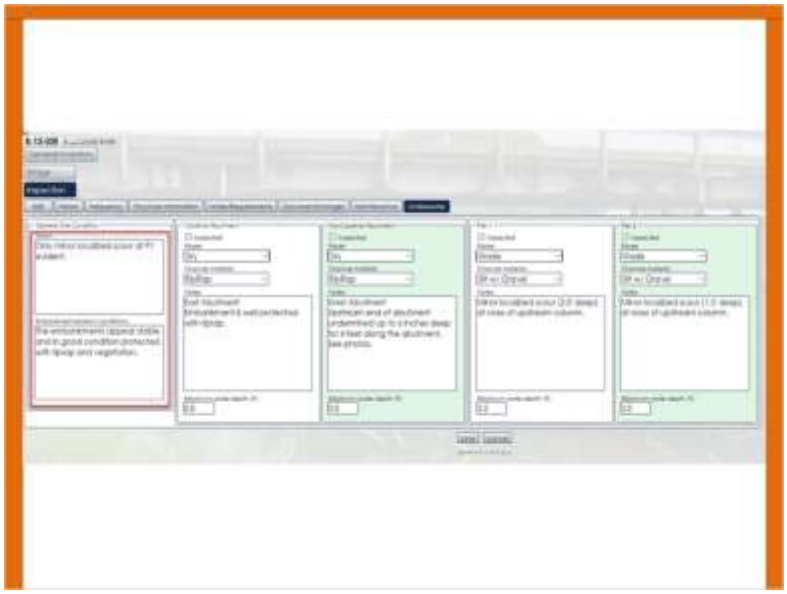

The underwater tab includes spaces for notes on general site conditions such as scour and embankment conditions.

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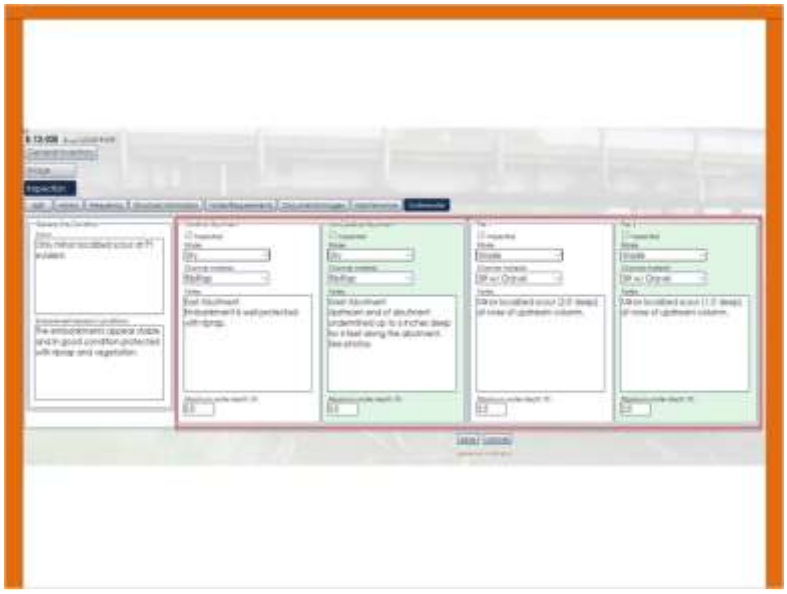

In addition, it allows for each substructure unit to have separate and distinct notes.

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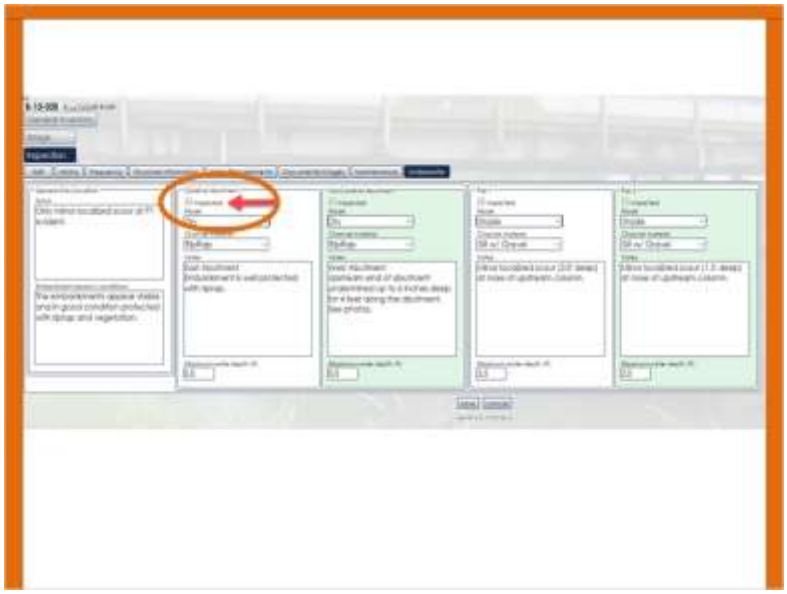

For each unit, there is a checkbox to indicate if that unit was probed during the inspection.

The HSI system defaults to checked. If you did not inspect a particular unit, uncheck the box.

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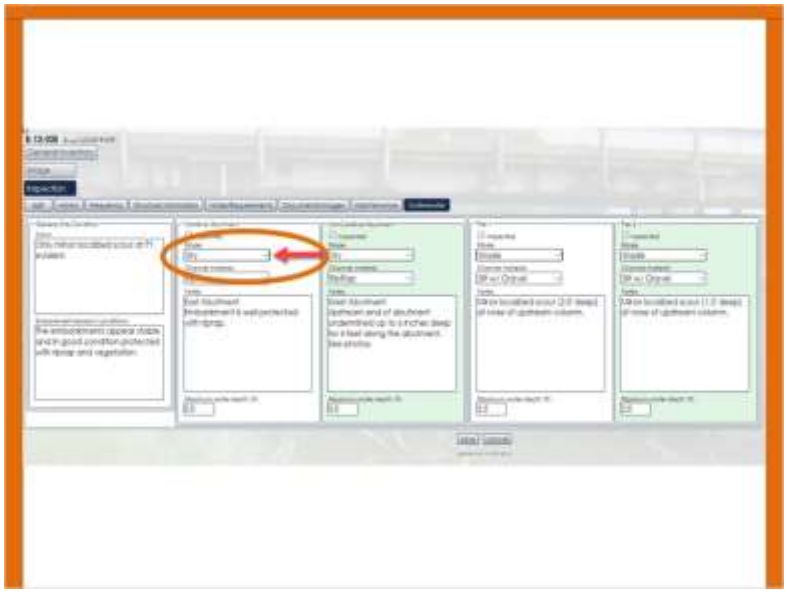

The next section asks if the unit was Dry during the inspection, or if the inspector had to wade in water to inspect.

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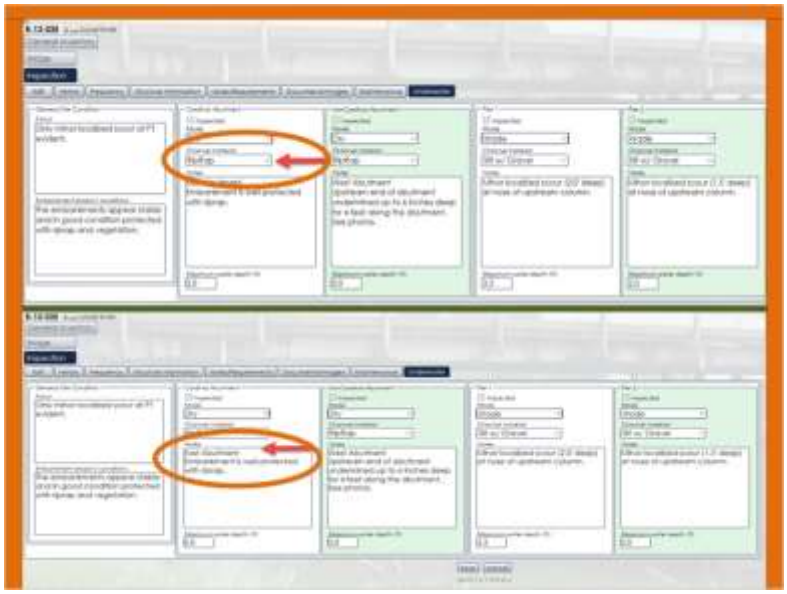

After that, the inspector should document the general type of channel material found adjacent to the unit. In this example, there was heavy riprap at both abutments while the piers had silt with some gravel.

Each unit also has a notes field. Notes should give a general indication of the conditions of the channel around the unit, as well as any issues with the unit underwater. Also include any localized scour observed during the inspection.

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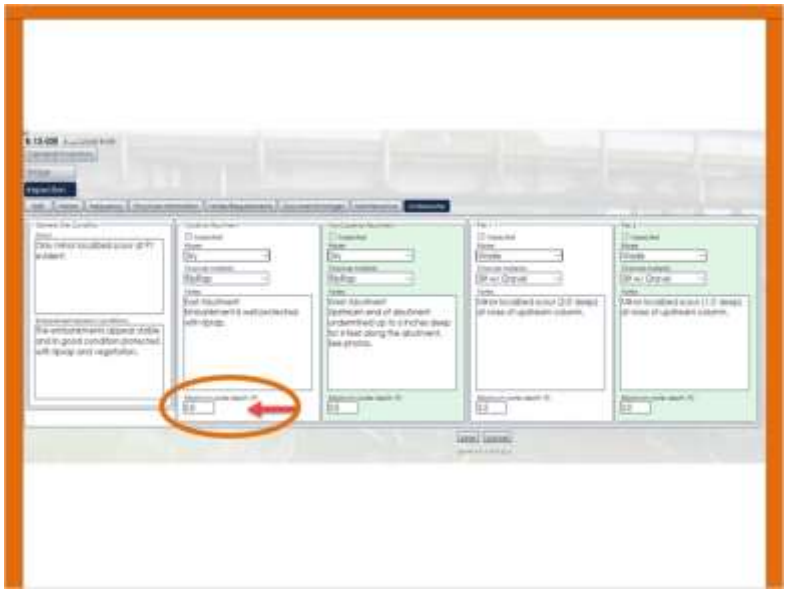

Finally, an estimate of the maximum depth observed while probing the unit should be recorded.
Any maintenance needs should be documented as well before the inspection is signed and completed in the system.

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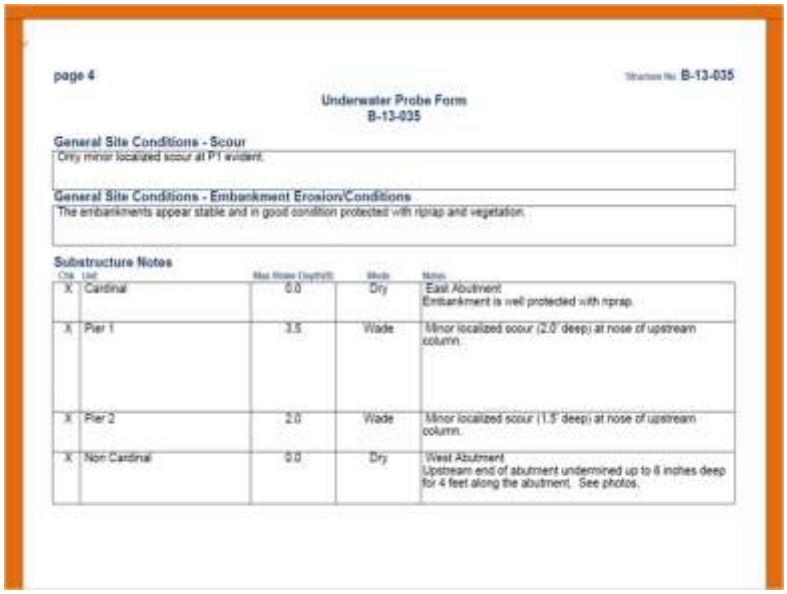

page 4

Structure No. B-13-035

Underwater Probe Form
B-13-035

General Site Conditions - Scour
Only minor localized scour at P1 evident.

General Site Conditions - Embankment Erosion/Conditions
The embankments appear stable and in good condition protected with riprap and vegetation.

Substructure Notes

Crit	Unit	Max Noise Depth(ft)	Mode	Notes
X	Cardinal	0.0	Dry	East Abutment Embankment is well protected with riprap.
X	Pier 1	3.5	Wade	Minor localized scour (2.0' deep) at nose of upstream column.
X	Pier 2	2.0	Wade	Minor localized scour (1.5' deep) at nose of upstream column.
X	Non Cardinal	0.0	Dry	West Abutment Upstream end of abutment undermined up to 8 inches deep for 4 feet along the abutment. See photos.

The information contained on the underwater tab will be compiled and added to the inspection report along with any cross-sections saved as a PDF document.

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