7.0 CHAPTER 7 – VERTICAL CLEARANCE MEASUREMENTS (VCL2)

7.1 INTRODUCTION

The vertical clearance of a bridge is of concern when vehicles are required to pass under structural components. This is the case with grade separations, where traffic passes under the bridge, or with through trusses where vehicles pass under the portal bracing members. When a vehicle strikes either a portal bracing member or the underside of a bridge, it can damage both the vehicle and the structural components of the bridge. Such damages can put the safety of the travelling public at risk.

The vertical clearance of a bridge is posted on the structure itself. The vertical clearance is also posted in advance of the bridge structure in order to allow vehicles with loads higher than the vertical clearance time to stop or detour before making contact with the overhead members. Large vehicles with high loads are warned of any height restrictions on their permitted routes so they can plan a safe trip.

When a Level 1 inspection notes evidence of a recent reduction in the vertical clearance, such as a new asphalt overlay or gravel buildup, the Bridge Manager is notified. A Level 2 inspection is required to confirm the vertical clearance using the VCL2 Level 2 Inspection form.

7.2 GENERAL VERTICAL CLEARANCE INFORMATION

The current legal vehicle height without permit in the Province of Alberta is 4.15 metres. New grade separation structures are designed to provide a minimum of 5.35 metres of clearance. All bridge structures have their vertical clearance posted on the structure at the midway point over the driving lanes, with one sign for each direction of travel. In situations where there are multiple structures, or a series of structures without access roads between them, the minimum vertical clearance of these structures is posted. The approaching clearance restriction is posted in advance of the structure for both directions of travel.

Vertical clearance information is required for the following structure usage types:

- Grade Separation (GS)
- Pedestrian Grade Separation (PS)
- Through Truss Span (TH)
- Railroad Underpass - roadway goes under railway (RU)

The value that is posted on the vertical clearance sign is the minimum measured height between the lowest point of the structure and the surface of the clear roadway, less 0.1 m tolerance, and rounded down to the nearest 0.1 m.

7.2.1 POSTING REQUIREMENTS

For **undivided highways**, the minimum measured vertical clearance of all the roadway components shall be used in calculating the posted clearance for all directions of travel.

For **divided highways**, the minimum measured vertical clearance for all roadway components over the same direction of travel shall be used in calculating the posted clearance. Thus, westbound highway lanes and westbound collector or distributor lanes would be posted with the same value: the minimum vertical clearance of those roadway components. The eastbound roadway components could have a different minimum vertical clearance posted.

If there are several vertical clearance restrictions on one roadway without any means to enter or exit the roadway between structures, the minimum vertical clearance of all the structures shall be posted in advance of the structures, and the same minimum clearance shall be posted on all the structures. If a particular structure is significantly higher than the minimum vertical clearance, that structure will not be posted.

7.3 MEASURING THE VERTICAL CLEARANCE

Vertical clearance measurements are to be taken on all roadway components that have a vertical clearance restriction.

7.3.1 ROADWAY COMPONENTS

A **roadway component** is considered to be all the roadway elements that are not separated by a concrete, natural or other type of median. Some examples follow to help clarify this definition:

- Undivided highways are considered to be one roadway component
- Divided highways are considered to be two roadway components
- Highway lanes and a merge lane that are not separated by a median are considered to be a single roadway component.
- Highway lanes and a merge lane that are separated by a median, whether concrete, natural or other means, are considered to be two separate roadway components.
- A structure over northbound and southbound highway lanes with a separate northbound or southbound collector/distributor road has three roadway components.

7.3.2 LOCATION OF VERTICAL CLEARANCE MEASUREMENTS

Vertical clearance measurements are taken from the top of the roadway surface to the lowest point on the superstructure. They are generally measured with a digital measuring rod or an electronic measuring device.

The inspector should not disturb the traffic flow when taking the vertical clearance measurements without approved traffic control in place. Main routes may have to be measured at night, non-peak hours or in conjunction with scheduled maintenance activities in order to avoid high traffic volumes.

Vertical clearance measurements shall be taken on roadway components at the following locations:

- The edge of the roadway, pavement or the gutter line if a curb is present
- Shoulder lines
- Lane lines painted on the roadway, including centrelines on undivided highways
- Single lane roadway component shall have an additional measurement taken at the mid-point of the roadway
- Additional measurements can be taken in the centre of lanes, but are not generally necessary for multi-lane roadway components
- If a minimum vertical clearance occurs at any other location other than those listed above, additional measurements are to be taken at those locations

Note that grade separation structures require measurements to be taken on both sides of the structure to ensure that the lowest clearance is recorded. Through truss structures require measurements at portal bracing members, unless a minimum vertical clearance is noted elsewhere.

During the inspection, the inspector shall look for evidence of reduced vertical clearance due to a new asphalt overlay, asphalt patching, gravel build-up, or excessive sagging of bridge elements. Ensure measurements are taken at the areas of lowest clearance if they are different than the measurement locations outlined above. Measurements are in metres and are recorded to three decimal places.

Refer to Figure 7.5 for additional information regarding the location of vertical clearance measurements.

7.4 INVENTORY INFORMATION

The inventory information found at the top of the Level 2 Vertical Clearance Measurement form (VCL2) contains the same inventory data found on the typical Level 1 and other Level 2 bridge and culvert inspection forms. Descriptions of these fields may be found in Section 1.3.2 of the Level 2 Inspection Manual or Section 4 of the Level 1 BIM Inspection Manual.

Ensure the date of the Level 2 inspection is recorded in the header information on the first page. This date will be echoed onto the last page of the VCL2 form.

7.4.1 ADDITIONAL STRUCTURE INVENTORY INFORMATION

In addition to the inventory data in the header of the form, the VCL2 form provides additional information about the bridge structure. This section is located immediately below the header information on page one of the VCL2 form and is shown in Figure 7.1. Refer to Section 1.4 for a complete description of the Structure Information fields.

```
STRUCTURE INFORMATION:

No. of spans: ..    Span Types: .../...  Substructure Types: .../...
Span Lengths: .....-.....-.....-.....-.....m    Total Length: .....m
```

Figure 7.1 – VCL2, Additional Structure Information

The VCL2 form also provides additional information about the current posted vertical clearance signs. It is located immediately below the header information on page one of the VCL2 form. This information is taken from the last Level 1 inspection that was entered into the BIM system.

```
LEVEL 1 VERTICAL CLEARANCE INFORMATION:

 Posted Vertical Clearance:Y/N ___  On Bridge __B Lane ___ m; __B Lane ___ m;
 Posted : In Advance  __B Lane Y/N ___;  __B Lane Y/N __
 Remarks _____________________________________________________________________
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Figure 7.2 – VCL2, Level 1 Vertical Clearance Information

7.4.2 POSTED VERTICAL CLEARANCE (Y/N)

This is a 'yes' or 'no' field (Y/N) that describes whether there was a posted vertical clearance at the time of the last Level 1 inspection.

7.4.3 DESCRIPTION OF VERTICAL CLEARANCE SIGNS ON BRIDGE

These fields describe the direction of traffic flow for which the bridge-mounted clearance signs are intended. The vertical clearances posted on these signs are also provided. Up to two different signs can be posted on a bridge, one for each direction of traffic. An example of this completed field would be 'On Bridge NB Lane 4.2 m; SB Lane 4.2 m'.

7.4.4 POSTED SIGNS IN ADVANCE (Y/N)

If vertical clearance signs have been posted in advance of the structure, it will be noted in this 'Posted:' line.

7.4.5 REMARKS

Any special remarks that the Level 1 inspector made regarding the vertical clearance will be brought forward on these lines.

7.5 LEVEL 2 VERTICAL CLEARANCE SUMMARY INFORMATION – PAGE 1

After the Level 2 inspection is completed, the inspector summarizes the results of the vertical clearance measurements on page one of the VCL2 form. The results from the previous Level 2 measurements are also provided in this area if they exist in the BIM system.

The following measurements and data are summarized in this section of the form: the vertical clearance measurements, the calculated posting clearance, and the existing postings on the bridge and in advance of the structure. Figure 7.3 shows the Level 2 Vertical Clearance Summary Information section of the form.

LEVEL 2 VERTICAL CLEARANCE SUMMARY INFORMATION:

	_BL O/U _		_ BL O/U _		_ BL O/U _		_ BL O/U _	
	LAST (m)	NOW (m)	LAST (m)	NOW (m)	LAST (m)	NOW (m)	LAST (m)	NOW (m)
Minimum measured clearance								
Calculated posting clearance								
Existing posting on bridge								
Existing posting in advance								
Revise posting	Y/N ___		Y/N ___		Y/N ___		Y/N ___	
Comments:								

Figure 7.3 – VCL2, Vertical Clearance Summary Information

7.5.1 ROADWAY COMPONENTS (___BL)

This field describes the roadway component that will be shown in the column below. The blank field is to be completed by the inspector if it has not already been brought forward from a previous Level 2 inspection. It represents the direction of travel approaching the restricted vertical clearance, and the 'BL' represents '-bound lanes'.

Accepted values for the blank field are N, S, E, W for the directions of the travel; north, south, east, and west. If the roadway component is also a collector or distributor, place a 'C' in front of the direction of travel. An 'X' is entered for undivided highways.

For example:

NBL – indicates northbound highway lanes
CNBL – indicates northbound collector or distributor lanes
XBL – indicates undivided highway lanes

Up to four roadway components can be recorded on the VCL2 form.

7.5.2 CLEARANCE RESTRICTIONS OVER OR UNDER THE BRIDGE STRUCTURE (O/U __)

This field describes whether the vertical clearance restriction is over or under the bridge structure. If the information in this field has not already been brought forward from a previous Level 2 inspection, the inspector should complete this field. The letter 'O' is used for vertical clearance restrictions that are over the deck of the structure, such as a through truss. The letter 'U' is used for vertical clearance restrictions that are under the bridge structure, such as a roadway under a grade separation.

7.5.3 LAST AND NOW COLUMNS

These columns allow the inspector to compare the previous and current data. All of the values that appear in these columns will be given in meters. The 'Last' column is data that has been entered into the BIM system from the previous Level 2 measurements, while the 'Now' column summarizes the current Level 2 inspection data. If no previous Level 2 measurements have been entered into the BIM system, the 'Last' column will appear blank.

7.5.4 MINIMUM MEASURED CLEARANCE

This is the smallest vertical distance between the bottom of the structure and the top surface of the roadway component. The inspector shall enter the minimum vertical clearance measurement for each roadway component in meters to three decimal places.

7.5.5 CALCULATED POSTING CLEARANCE

The calculated posting clearance value is the value that would be posted on the vertical clearance sign for that roadway component. It is calculated as the minimum measured clearance, less a 0.1 metre tolerance, and is then rounded down to the nearest 0.1 metre.

7.5.6 EXISTING POSTING ON BRIDGE

Record in this field the existing posted vertical clearance (in metres) on the bridge structure for each roadway component.

7.5.7 EXISTING POSTING IN ADVANCE

In this field, the inspector is to record the existing posted vertical clearance in metres that is in advance of the bridge structure for each roadway component.

7.5.8 REVISE POSTING (Y/N __)

This is a 'yes' or 'no' field (Y or N) indicating whether a revised vertical clearance posting is required for the roadway element. The inspector shall enter a 'Y if the vertical clearance posting requires revision. An 'N' is entered if the existing vertical clearance posting does not require revision.

7.5.9 COMMENT LINES

Four lines are provided for the inspector to make any additional comments that relate to the inspection.

7.6 INSPECTION DATA WORKSHEET – PAGE 2

The second page of the VCL2 form is the worksheet where the inspector records detailed vertical clearance measurements for each roadway component. This Inspection Data Worksheet is shown in Figure 7.4. There can be a maximum of four roadway components per worksheet. Further, measurements can be recorded for up to 40 different locations for each roadway component per page. Additional pages can be used if required.

INSPECTION DATA:

SPAN ID	_ BL O/U _			_ BL O/U _			_ BL O/U _			_ BL O/U _		
	LOC.	LAST (m)	NOW (m)	LOC.	LAST (m)	NOW (m)	LOC.	LAST (m)	NOW (m)	LOC.	LAST (m)	NOW (m)
					ROWS REPEAT							
MIN.	*****			*****			*****			*****		
Comments:												

Figure 7.4 – VCL2, Inspection Data Worksheet

7.6.1 SPAN IDENTIFICATION (SPAN ID)

This field is for the inspector to identify the span on which the vertical clearance measurements were taken.

For grade separation structures, the span number and the side of the bridge being measured are recorded in this field. The span number is represented by the letter 'S' followed by a number. The spans are numbered in the direction of increasing chainage from west to east or from south to north. The span number is then followed by another letter such as 'N' for North, or 'S' for South to describe the side of the bridge where the measurement was taken. The location could also be described by 'E' for East or 'W' for West. An example of a span identification number would be 'S2N', where the measurement was taken from Span 2 on the north side of the bridge.

For through trusses, the top chord panel points are also identified in this field. These top chord panel points are labeled using the letter 'U' followed by a number. The numbering increases from left to right while facing downstream. For example, 'U1' would represent the left most top chord panel point when facing downstream.

7.6.2 ROADWAY COMPONENTS (___BL)

This field describes the roadway component on which vertical measurements will be taken.

The B in this field stands for Bound, and may be described by entering a direction such as 'N' for North, 'S' for South, 'E' for East or 'W' for West. For example, 'NB' means the roadway component is Northbound. If the roadway component is also a collector or distributor, place a 'C' in front of the direction of travel. An 'X' is entered for undivided highways.

For example:

N BL – indicates northbound highway lanes
CN BL – indicates northbound collector or distributor lanes
X BL – indicates undivided highway lanes

7.6.3 CLEARANCE RESTRICTIONS OVER OR UNDER THE BRIDGE STRUCTURE (O/U __)

This field describes whether the vertical clearance restriction is over or under the bridge structure. The letter 'O' is for vertical clearance restrictions that are over the deck of the structure, such as for a through truss. The letter 'U' is for vertical clearance restrictions that are under the bridge structure, such as under a grade separation.

7.6.4 LOCATION (LOC.)

This field describes the location of the vertical clearance measurement on the side of the span.

There are two parts to the location code. The first part consists of a 'L' for Left or a 'R' for 'right'. The inspector determines this first part when facing the direction of increasing chainage. The second part of the location code represents the edge of the road, the gutter line, the shoulder, or a lane line.

The following abbreviations are used to describe the measurement location code:

LE - Left edge of road
RE - Right edge of road
LG - Left gutter line
RG - Right gutter line
LS - Left shoulder of road
RS - Right shoulder of road
L# - Lane line, measured from left to right (e.g. L1, L2, etc.)

If a measurement is taken between any of the above locations, it shall be labeled with a letter following the abbreviation. Therefore, a measurement that is taken between L1 and L2 would be represented by the abbreviation L1A.

Refer to Figure 7.5 for additional examples.

The inspector may also use the comment section at the bottom of the page to clarify any measurement locations that are not as described above. For example, a clarifying comment might be 'L1A located 2.0 m to the right of L1'.

7.6.5 LAST AND NOW COLUMNS

These columns allow the inspector to record the current measurement data and compare it to any previous Level 2 measurements.

The inspector is to record the current inspection measurements in the 'Now' column. The 'Last' column is data that has been entered into the BIM system from the previous Level 2 measurements. The values in these columns will be in metres and measured and recorded to three decimal places. If there has not been any previous Level 2 measurements entered into the BIM system, the 'Last' column will appear blank.

7.6.6 MINIMUM (MIN.)

The minimum vertical clearance measurement for each column (each direction) is recorded in the 'Min.' field under the 'Now' heading. The previous minimum value will appear in the 'Last' column. Minimum vertical clearance measurements are recorded in metres to three decimal places.

7.6.7 COMMENT LINES

Four lines are provided for the inspector to clarify any measurement locations or make any additional comments that relate to the inspection.

7.7 OTHER VCL2 ITEMS – LAST PAGE

Refer to Section 1.5 for instructions on completing the last page of the VCL2 form. The last page shares a common format with the other Level 2 forms.

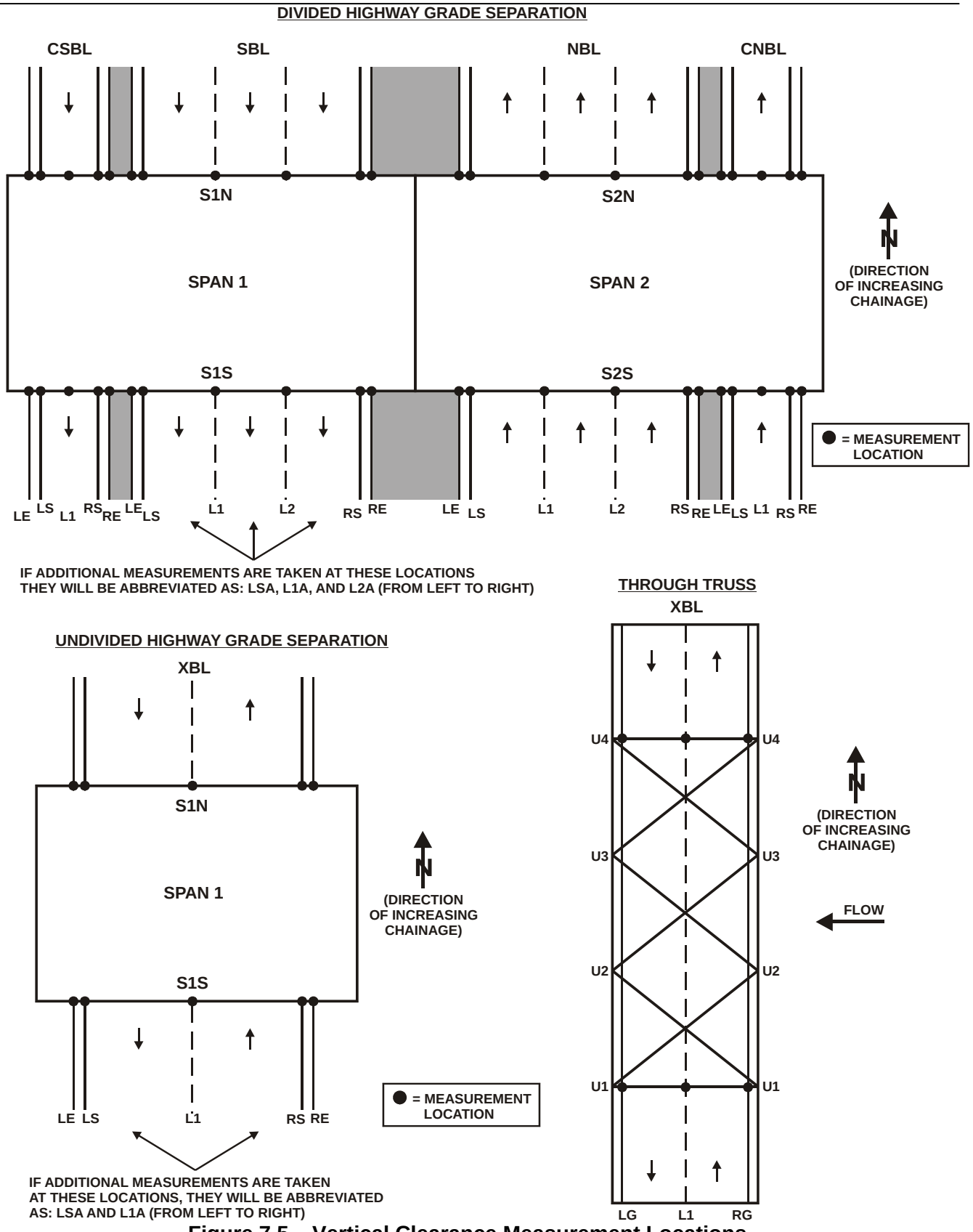

Figure 7.5 – Vertical Clearance Measurement Locations

Bridge File Number : ....
Legal Land Location: ...-..-...-..-.
Latitude/Longitude : ...../.....
Road Auth./Region : .../R.
Bridge or Town Name: .....
Stream Name : .....
Highway #:Cntrl Sec: ....:...
Road Classification: .....-...
AADT/Year : .-...../..
Detour Length : ...km

Structure Usage : ..
Year Built : ../..
Clear Roadway/Skew: ....m/...Deg

Prev. Insp. Date : ____/__/__ (YMD)
Insp. Req'd Date : ____/__/__ (YMD)
(based on _____)

Current Insp. Date: ____/__/__ (YMD)
Inspector's Code : ____

STRUCTURE INFORMATION:
No. of Spans: .. Span Types: .../... Substructure Types: .../...
Span Lengths: .....-.....-.....-.....-.....m Total Length: .....m

LEVEL 1 VERTICAL CLEARANCE INFORMATION:

Posted Vertical Clearance: Y/N ___ On Bridge __B Lane ___ m; __B Lane ___ m;
Posted : In Advance __B Lane Y/N ___; __B Lane Y/N __
Remarks _____

LEVEL 2 VERTICAL CLEARANCE SUMMARY INFORMATION:

	_ BL O/U _		_ BL O/U _		_ BL O/U _		_ BL O/U _	
	LAST (m)	NOW (m)	LAST (m)	NOW (m)	LAST (m)	NOW (m)	LAST (m)	NOW (m)
Minimum measured clearance								
Calculated posting clearance								
Existing posting on bridge								
Existing posting in advance								
Revise posting	Y/N ___		Y/N ___		Y/N ___		Y/N ___	
Comments:								

INSPECTION DATA:

SPAN ID	_ BL O/U _			_ BL O/U _			_ BL O/U _			_ BL O/U _		
	LOC.	LAST (m)	NOW (m)	LOC.	LAST (m)	NOW (m)	LOC.	LAST (m)	NOW (m)	LOC.	LAST (m)	NOW (m)
MIN.	*****			*****			*****			*****		

Comments:

LEVEL 1 INSPECTION (INFORMATION ONLY) Level 1 date: ____/__/__

Structural Condition Rating: __% Sufficiency Rating: __%
Estimated Remaining Life of Structure: __ years

Special Comments for Next Inspection:

Next Scheduled Level 1 inspection: ____/__/__ Current Cycle: __months

ITEMS REQUIRING IMMEDIATE ATTENTION:

LEVEL 2 INSPECTION SPECIAL REQUIREMENTS:

Y => Snooper: __ Lift: __ Traffic control: __ Boat: __ Ladder: __
Other: _____

INSPECTOR:

Recommended Cycle __ months OR Next Insp. Date ____/__/__ (blank for default)
Recommended Additional Cycles: _ (blank for default, 0 for discontinue)

Inspector's Code: ___	Inspector's Name: _____	Class: _
Assistant's Code: ___	Assistant's Name: _____	Class: _
Assistant's Code: ___	Assistant's Name: _____	Class: _

Comments: _____
_____

REVIEWER: Review Date: ____/__/__

Approved Cycle __ months OR Next Insp. Date ____/__/__ (blank for default)
Approved Additional Cycle: _ (blank for default, 0 for discontinue)\

Reviewer's Code: ___	Reviewer's Name:_____	Class: _

Comments: _____
_____

Default No. of Inspections: _	Number completed to date: __
Default Cycle: __ months	Next Inspection Required Date ____/__/__