Appendix 3 – Fundamentals and Inspection Assessments Site Summary

- **Summary of Assessment Process**
- **Sample Assessment**
- **Intervention Programme Example**
- **Marking schedule**

Fundamentals and Inspection Assessments Site Summary:

Location - _____ (reference station, GPS position, road names)

Inspector name_____ **Signature**_____ **Date of inspection**_____

1. **Establish the design envelope/lateral extent of the area of concern** (AGRD6: Section 3.2)
2. **Hazard(s) identification** – primary and secondary
3. **Site layout** – sketch
   a) ***Length of need*** (Length $_{ADVANCE}$ + Length $_{HAZARD}$ + Length $_{OPPOSING}$) - wheel or tape
   b) ***Photos*** - many
4. **Design review**
   a) ***System identification*** – flexible, semi-rigid or rigid and which product?
   b) ***Selection assessment*** – is the chosen system appropriate and compliant?
   c) ***Terminal identification and compliance*** – NZTA: M23A e.g. MSKT, SoftStop, MAX-Tension, crash cushion, WRSB terminal etc.
   d) ***Gating clear area*** - 6 m x 18.5 m
   e) ***Shy-line*** – AGRD6: Table 5.4 (e.g. L_S = 2.8 m for 110 km/h)
   f) ***Flare rate*** – AGRD6: Table 5.5
   (e.g. 110 km/h for semi-rigid: within shy-line = 30:1, outside shy-line = 15:1)
   g) ***Approximate length of need*** (leading *and* opposing, if applicable) – @ approx. 10^o departure angle (i.e. 5:1 - measure distance perpendicular from edgeline to back of hazard and then multiply by 5)
   h) ***Runout length to back of hazard*** – (does the barrier intercept the runout path?)
   - AGRD6: Table 5.8 (e.g. L_R = 88 m for 1000 to 5000 AADT @ 110 km/h)
5. **Installation review**
   a) ***Site Grading*** – according to supplier or standard plan (i.e. max 10:1 on approach, max 6:1 in clear area)
   b) ***Terminal*** (system specific checklists *and* the list below)
      i. Flare
      ii. Delineation
      iii. Anchorage
      iv. Bolting, washers, pattern
      v. Breakaway posts
      vi. Blockouts
      vii. Post condition
      viii. Height
      ix. Damage
   c) ***System*** (system specific checklists *and* the list below)
      i. Height
      ii. Bolting
      iii. Post condition
      iv. Missing posts, additional posts, nesting
      v. Transitions
      vi. Tension bays
      vii. Rail damage
      viii. Grading
      ix. Delineation
6. **Develop intervention program** – prioritise based on risk (frequency x severity) and effort/cost

Table 5.8: Run-out lengths for barrier design

Design speed (km/h)	Run-out length L_R (m) for AADT range			
	> 10 000	5 000–10 000	1 000–5 000	< 1 000
110	110	101	88	76
100	91	76	64	61
90	80	67	56	54
80	70	58	49	46
70	60	49	42	38
60	49	40	34	30
50	34	27	24	21

Table 5.5: Flare rates

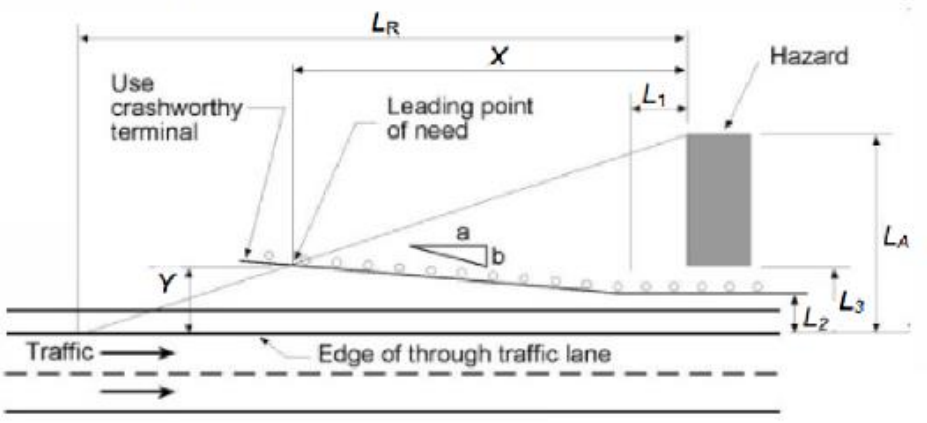
Design speed (km/h)	Flare rate for barrier within the shy-line offset (d:1)	Flare rate for *rigid* barrier outside the shy-line offset (d:1)	Flare rate for *non-rigid* barrier outside the shy-line offset (d:1)
50	13:1	8:1	7:1
60	16:1	10:1	8:1
70	18:1	12:1	10:1
80	21:1	14:1	11:1
90	24:1	16:1	12:1
100	26:1	18:1	14:1
110	30:1	20:1	15:1

Notes:
- *Non-rigid is equivalent to semi-rigid or flexible.*
- *Flare rate applies to approach flare only.*

Table 5.4: Shy-line offset values

Design speed (km/h)	Shy-line offset (m)
50	1.1
60	1.4
70	1.7
80	2
90	2.2
100	2.4
110	2.8
120	3.2
130	3.7

Figure 5.22: Run-out length method of determining length of need



(a) Establishing leading point of need

Notes:
- *L_R is the run-out length for the barrier.*
- *L_A is the lateral extent of the hazard (edge of traffic lane to rear of hazard).*
- *L_1 is the tangent length of the barrier upstream from the area of concern.*
- *L_2 is the barrier's lateral distance from the edge of the traffic lane.*
- *L_3 denotes the distance from the edge of the traffic lane to the nearest point on the hazard.*
- *L_S is the shy-line offset.*

EXAMPLE OF A

Fundatmentals and Inspection

SITE SUMMARY

Your Details:

- Name
- Company
- Contact Information (phone, email)
- Course name and date

Email your completed Site Summary to:

barrier.workshops@nzta.govt.nz

Fundamentals and Inspection Assessments Site Summary 18th March 20124

Location:

State Highway 1, RS 273 RP 0.000, Maungakaramea Rd intersection

The assessment for this site is in relation to the state highway.

Hazard Identification:

The state highway has a 100 km/h posted speed and carries between 13,000 and 14,000 vehicles per day (13869 AADT 10.26% HCV 2009).

Referring to table 4.1 of Part 6 of the AUSTROADS Guide to Road Design (Pt 6 AGRD), we see that the clear zone requirements for fill slopes range from 10.0m to 13.5m, depending on the batter slope. Batter slopes 3h.1v and steeper are considered non-traversable and no clearzone is provided. On this site the batter slope at best is 3h:1v and therefore reliance on a clear zone is not recommended.

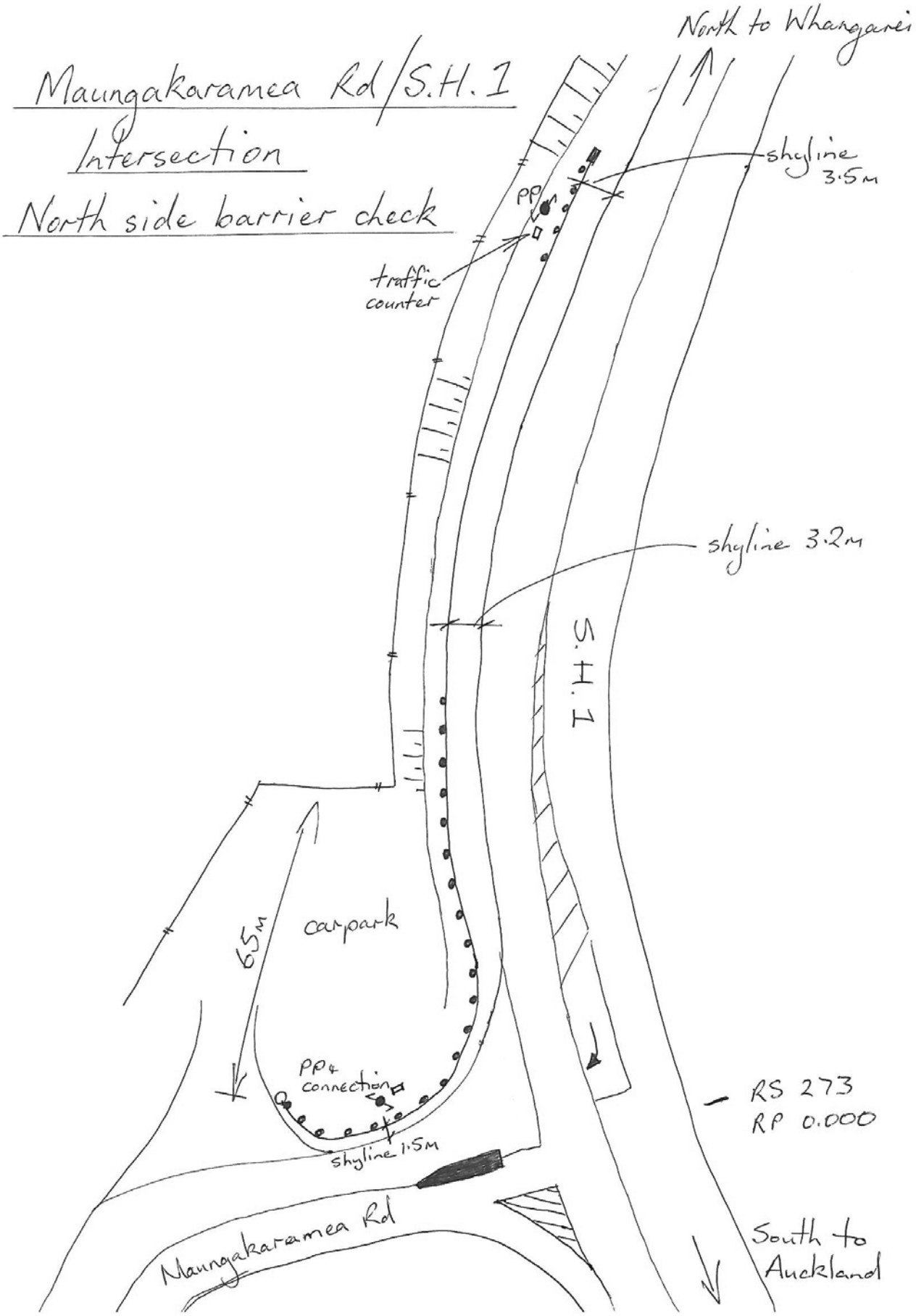
There are 3 hazards identified: car park (photo 1), traffic counter (permanent) and power pole (photo 2), steep batters up to 3m (photo 3). Based on the batter slope and height, figure 4.6 from Pt 6 AGRD suggests a barrier is warranted over much of the site.

Photo 1

Photo 2

Photo 3

Site Layout Sketch:



Sketch 1

- The length is 209m (measuring wheel)

Site photos:

Side Rd approach - Maungakaramea Rd

Curved Rail - looking north

X-350 Terminal end - looking south

Curved Rail and Trailing End Terminal

Design Review:

- The system is a *semi-rigid strong post timber*. It is a tangential barrier primarily.
- There are two types of end terminal selected; an X-350 and a curved trailing end; both of which comply with NZTA: M23A.
- Referring to Table 6.4 in Pt 6 AGRD, the shyline required is 2.4m from the near side traffic. This installation is compliant for highway traffic.
- A ‘gating clear area’ is required for each terminal end. This is not available to the X-350 due to the close proximity of the batter. It is also not available to the trailing end/curve section as it is compromised by the light pole and control box.

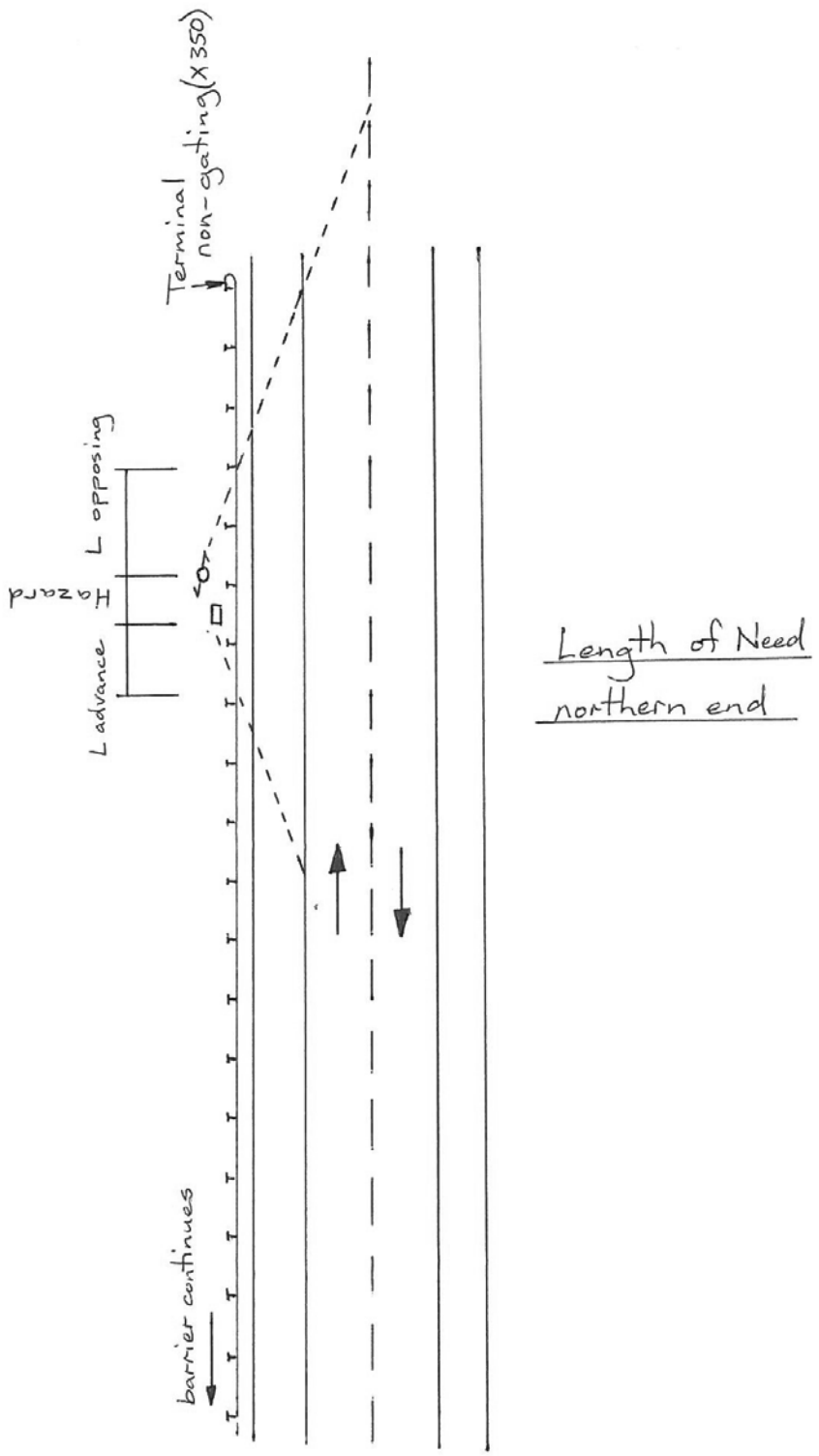
Trailing end/curve gating area compromised

No clear gating area for X-350

- A run out length to the hazard of 120m is required in this location. There is no run out length available on the north end (X-350) and only 65m available on the south end (car park).
- Length of Need (LoN) requirements is set out in Section 6 of Pt 6 AGRD. As stated above there are 3 hazards identified. The car park has the required LoN from errant vehicles because of the curved rail installation. The traffic counter also has the required LoN in both directions; it is 1m behind the rail (refer to sketch 2). The steep batter hazard is unprotected at the northern end from both directions.

Car park protected from errant vehicles

North end steep batter unprotected


Terminal
non-gating (X350)
L opposing
Hazard
L advance
barrier continues
Length of Need
northern end

Sketch 2

Installation Review:

- Recommended Flare rates are detailed in Table 6.5 of Pt6 AGRD. For this installation the barrier is 3.0m from the edge line and tangential and therefore flare rates are ok; the installation complies.
- Site grading to be 1/10 on approach, max 1/4 in clear area. This site complies with the approach grading, and where appropriate the clear area grading (car park only).

Terminals:

- Refer to checklists.
- Post condition is good on both terminals and there is no damage on either terminal.

INSTALLATION CHECKLIST FOR GUARDRAIL & TERMINIAL ENDS

X-350 Fully Redirective Terminal End (System Length 11.4m)

	Y/N	NA
• END(first) Rail is bolted to post **#1** and all others except post **3**	Y	
• Post #1, steel breakaway, up right way and bolted at base.	Y	
• Steel or Timber breakaway posts installed from Post 2 through 6.	Y	
• Rail is set at 550mm to centre of rail.	Y	
• Locking Bar is turned fully and bolted in place.	Y	
• Nuts are fitted on traffic face of rail at impact head.	Y	
• Correct nosing is fitted to impact head. (inside out)	N	
• Ground strut lays flush with ground. Ground Anchor **should be lower** than post #1.	Y	
• Ground anchor does not protrude more than 100mm above the ground.	Y	
• The entire Terminal End (11.4m rail) is installed straight with flare as per design (offset between 0 mm to 400 mm)	Y	
• Slider is connected to end of first rail. All 4 outer holes bolted with nuts on traffic face.	Y	
• Slider bracket and angle bar are attached correctly. Angle bar closest to impact head end.	Y	
• Guardrail for terminal end (i.e. 3 lengths) must be 2.7mm highway rail.	Y	
• Yellow Shear Bolts correctly installed at post 5 (washer only between nut and rail.	Y	
• Cables are not drooping excessively.	N	

Trailing End Terminal

Assembly and installation is to be generally in accordance with AS/NZS 3845:1999, TNZ M23 and CSP Pacific drawing FX335, FX348-2 & FX348-4

	Check	
• The rail height (top) is in accordance with the plans (706mm above the edge of the shoulder or the ground line)	X	430 - 460 to rail ℄
• The steel tubes/posts do not protrude more than 100mm above the ground line (measured by the AASHTO 1.5m cord method, site grading may be necessary to meet this requirement.	X	110mm
• The bolts at the top of the steel tubes are not over tightened and the walls of the steel tubes are not collapsed/distorted.	X	distorted
• The 200mm x 200mm bearing plate at post 1 is correctly positioned and the anchor cable is taut and correctly installed (it should be rechecked after installation to be sure it hasn't relaxed.)	X	both counts
• Blockouts have been toe nailed to the posts.	✓	
• The backfill material around the posts is properly compacted.	✓	
• The rail panel is not attached to the post at post No. 2 the rail sits on the shelf angle only	X	bolted through

- rail not bolted to no. 1 post
- no shelf angles anywhere
- X350 shear bolts used for rail anchor fitting

on checklist

Post 1 – not bolted

Rail anchor bolts

Bearing plate slipped around

System:

- Height of rail is good at 550mm to centre over the majority of length. The presence of detritus lets the remaining length down but if removed it would comply.

Detritus build up

- Bolting is sound on the straight sections but on the curved portion there is no unbolted rail sitting on shelf angles. This curve should have at least 1 shelf angle.

- Post condition is good.
- Blockouts have been toe nailed against rotation.
- Nesting of rail has not been required in this installation.
- Rail damage is minor and consists of 1 slightly dented rail.

Rail damage

- Grading is good between road and barrier.

Intervention Programme:

Intervention is required in the form of:

Short Term - Serious/Significant = 0 to 3 months

- Change the bolting pattern on the curved section so that correctly selected posts have rails sitting on shelf angles only
- Remove all detritus that compromises rail height
- Attach hazard and width markers
- Tighten X-350 cables
- Replace Trailing End Terminal anchor bolts with correct ones, install shelf angle and bolt at Post 1.

Medium Term - Significant = < 3 years

- Consider removing the car parking spaces behind the curved rail to establish a Gating Clear Area.
- Install a compliant trailing end terminal
- Investigate changing the light pole behind the curved rail from a concrete pole to a frangible pole.

Road Safety Barrier Fundamentals and Inspection Inspections: Examples for Developing an Intervention Program

Note that these are *examples* only. The timing of your interventions can vary depending on opportunities to advance their repair or resolution of the issues identified. An example would be to combine the correction of a curved rail incorrect apex/missing anchors and loose/missing splice bolts. Hazard risk (hazard severity + traffic exposure) will be specific to your site can bring forward or delay the necessary interventions.

	Minor	**Significant**	**Serious**
Within 3 months	Loose/missing splice bolts	Significant system hardware damage	Energy head installed such that it can't work
Within 12 months	Debris build-up affecting system height Minor system hardware damage	Missing delineation Hazards within CZ that can be easily removed Trailing energy head incorrect lapping Deficient end terminal grading plan Curved rail incorrect apex/missing anchors	Inadequate LoN Incorrect/dangerous transition
Within 3 years	Incorrect delineation	Not accepted leading end terminal Unprotected utility poles < 3m of edgeline Inadequate LoN + run-out length	Inadequate run-out length

Draft: 22 August 2015

FOUNDATIONS AND INSPECTION MARKING GUIDE (70% = PASS)

Name_____ Date submitted_____

No.	Item	Remarks	Mark
1.	**Basic Details** • Name of student (1) • Location of guardrail system (4) • Hazard(s) Identification (5)	Important to ID position and author to allow consultation during follow-up List the hazard(s)	10
2.	**Site Layout** • Sketch (10) • Measurements (5) • Photos (5)	Sketch should be comprehensive and accurate, showing key measurements. The photos should be relevant to overall layout, important details and faults	20
3.	**Design Review** • System ID (5) • Terminal ID/Compliance (5) • Gating Clear Area (5) • Runout Length to hazard (5) • Estimated LON (5) • Shy Line (5)	Check accuracy of this information, all should be able to be worked out. Compliance (see M23)	30
4	**Installation Review** • Site grading (5) • **Terminal:** (flare, bolting pattern, CRT Posts, post condition, anchorage, height, damage, and delineation) (10) • **System:** (height, bolting, post condition, blockouts, nesting, rail damage, grading road to barrier, delineation) (10)	Normally where the installation is not correct this will be noted and accompanied by a photograph	25
5.	**Develop an Intervention Programme** • Use minor significant and serious, does the rating suit the risk?	Check have they correctly sorted faults into minor, significant and serious – and applied a realistic time frame for correction	15