# Safe System Assessment

## Princes Highway, Slyvania – Fall prevention

Version: 01
Date: 28 July 2021

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# Executive Summary

A Safe System Assessment has been conducted on design work completed to improve road safety along Princes Highway, Sylvania. The existing conditions and two design options were. The SSA Matrix scores are shown in the table below.

| Option | Score |
|---|---|
| Existing conditions | 248 / 448 |
| Safety Improvements | 127 / 448 |

With the vehicle volumes levels on Princes Highway, the exposure ratings are high through most of the scorings. Having history of run off road and head on crash types the project aims to implement measures to reduce the likelihood and severity of crashes in line with the safe systems approach.

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# 1. Introduction to the Safe System

## 1.1. Safe System Pillars

The Safe System approach seeks to ensure that no road user is subjected to kinetic energy exchange in a crash that will result in death or serious injury. There is a shared responsibility for safe travel outcomes between system designers (road authorities, vehicle manufactures, road designers etc.) and road users. There are four Safe System pillars: safer vehicles, safer speeds, safer roads and safer road users. Post-crash response is another element that is often recognised as the fifth pillar. All parts of the system must be considered and strengthened so that road safety outcomes are maximised and to ensure that road users are adequately protected even if one part fails.

Safe System Assessment (SSA) is concerned mainly with the safer roads and safer speeds pillars. A SSA is used to examine road project proposals and aims to identify infrastructure and speed related factors that are likely to contribute to a higher risk of fatal and serious injury (FSI) crashes. It also seeks to identify design or scope changes that will improve the alignment of the project with Safe System principles.

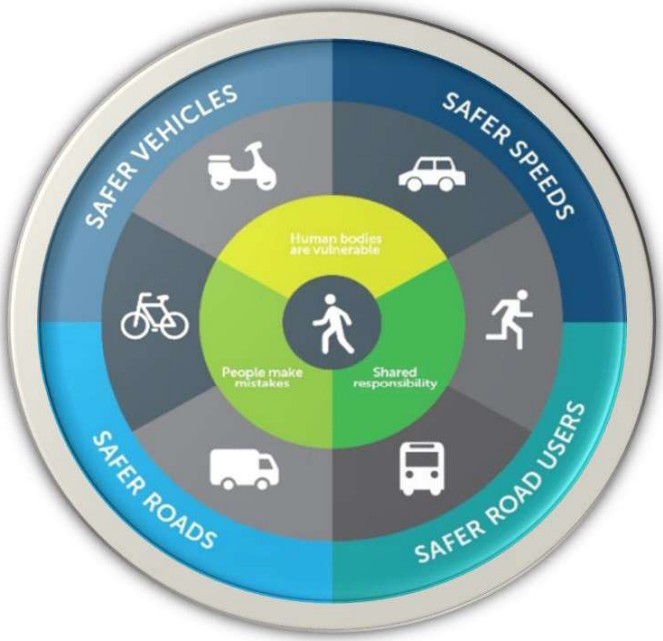



**Figure 1: Safe System Pillars**

## 1.2. Safe System Impact Speeds

The impact speed in a collision is a significant factor that affects the probability of a person being killed or seriously injured in a crash. Safe System impact speeds are speeds below which the chances of survival are high and the likelihood of serious injury is low.

Figure 2 is a guide to Safe System impact speeds for common crash types. It should be noted that the angle of impact of a collision is also a factor that affects the severity of a crash. As far as is practically possible, infrastructure should be designed and travel speeds managed so that the impact speeds when a crash occurs are below the thresholds show in Figure 2.


**Figure 2: Safe System Impact Speeds**

# 2. Safe System Assessment Process

The Safe System Assessment process is based on Austroads Safe System Assessment Framework (Austroads 2016, Research Report AP-R509-16, *Safe System Assessment Framework*)

Steps in the process include:

- Deciding on the type of assessment (full or rapid)
- Selecting an appropriate team to conduct the assessment
- Understanding the project background, context and objectives
- Collation of information and data for both existing and future conditions
- Inspection of the site
- Conducting the assessment of existing conditions and each project design option using the SSA Matrix
- Consideration of the additional Safe System components; road users, vehicles and post-cash care
- Review of the SSA Matrix scores and development of suggested changes to improve alignment with Safe System principles
- Reporting
- Review of suggested design and scope changes
- Amendment of project scope and design to incorporate the accepted changes.

# 3. Assessment Details

## 3.1. Type of Assessment

Transport for NSW Network and Safety team based on the advice of the Centre for Road Safety conducted a Safe System Assessment to support a funding application under the Safer Roads Program. This is also supported by the Safer Roads Program Guidelines.

## 3.2. Assessment Team

Boyd Johns – Traffic Engineering Officer

Kristian Calcagno – Network and Safety Officer

Kshitij Shah - Network and Safety Services Manager

Nicolas Kocoski - Senior Manager Network & Safety Services

### 3.3. Meetings and Site Inspections

Preliminary Meetings where conducted with the Network and Safety team and Design Review to discuss the need, treatment and priority of this location.

# 4. Project Description

### 4.1. Project Background and Objective

The Princes Highway is a major arterial road along the east coast of Australia, extending from New South Wales through Victoria and into South Australia. It is an important corridor supporting local communities, and industry.

At Sylvania, the Princes Highway is separated dual carriageway with 3 lanes in each direction. The 2021 Average Daily Traffic Count (ADTC) at this location is over 40,000 vehicles (Traffic Volume Viewer, station ID: 40041)

At the existing site there is an approximately 1.5m vertical drop on the north side of the Princes

Highway to the local side street that runs parallel with the highway. There is no protection at this location with only SA kerb and gutter and superseded pedestrian fencing which is a spearing hazard for errant vehicles.

**Figure 1: Project Extents**

| Prompts | Comments |
|---|---|
| What is the reason for the **project**? Is there specific crash type risk? Is it addressing specific issues such as poor speed limit compliance, road access, congestion, future traffic growth, freight movement, amenity concerns from the community, maintenance/asset renewal, etc. | This project aims to decrease the risk and severity of off left crashes eastbound by providing physical protection for vehicles on the Princes Highway. The alignment and formation of the road is good at this location, however with vehicle volumes about 40,000 ADTC, this project is seen as a priority |

| | |
|---|---|
| What is the **function** of the road? Consider location, roadside land use, area type, speed limit, intersection type, presence of parking, public transport services and vehicle flows. What traffic features exist nearby (e.g. upstream and downstream)? What alternative routes exist? | The Princes Highway is a major link between the southern suburbs of Sydney and the CBD. There are No Stopping and Clearway provisions on both sides of the Princes Highway. There are two intersections either side of the proposal Princes Highway and Florida Street (left in left out only) and Princes Highway and un-named local assess street |
| What is the **speed** environment? What is the current speed limit? Has it changed recently? Is it similar to other roads of this type? How does it compare to Safe System speeds? What is the acceptability of lowering the speed limit at this location? | 70km/h is supported by suitable design standards and community needs. Reduction in speed unlikely to be accepted |
| What **road users** are present? Consider the presence of elderly pedestrians, school children and cyclists. Also note what facilities are available to vulnerable road users (e.g. signalised crossings, bicycle lanes, school speed limits, etc.) | Low amounts of vulnerable road users. No pedestrian access across road. |
| motorcyclists and other vehicles using the roadway. | 2021 Average Daily Traffic Count at this location is over 40,000 vehicles. 10% heavy vehicles |

**Table 2: Project Background, conditions and context**

## 4.2. Proposed Works

Providing a physical barrier to protect errant eastbound vehicles on the Princes Highway falling into the adjacent side street through the use of NSW High Profile Redirective Kerb (HPRK) – cross section shown below. This kerb has been tested and redirects a sedan vehicle and 2.27t Utility vehicle at 70km/h at an impact angle of 10°. Upgrade existing pedestrian fencing to Transport for NSW compliant pedestrian fencing.

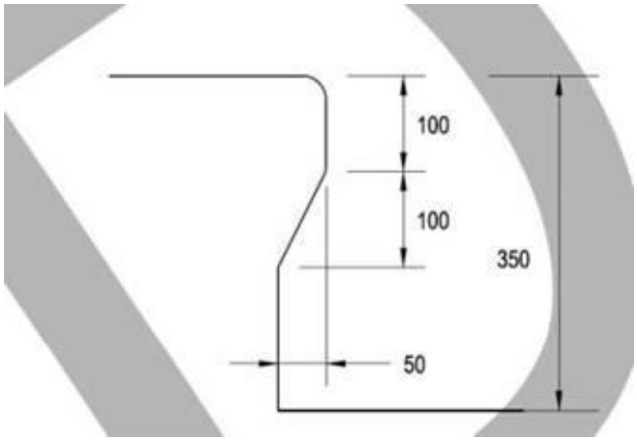



**Figure 2: NSW High Profile Redirective Kerb (HPRK) profile**

# 5. Assessment of Project Design Options

## 5.1. Assessment Summary

The Safe System Assessment Matrix scores for the existing conditions and the proposed design options are shown in Table 3. The scores for each crash type are shown in Figure 3. The detailed assessments are presented in Section 5.2.

**Table 3: SSA Matrix Scores for the Project**

| | |
|---|---|
| Existing conditions | 248 / 448 |
| Safety Improvements | 127 / 448 |

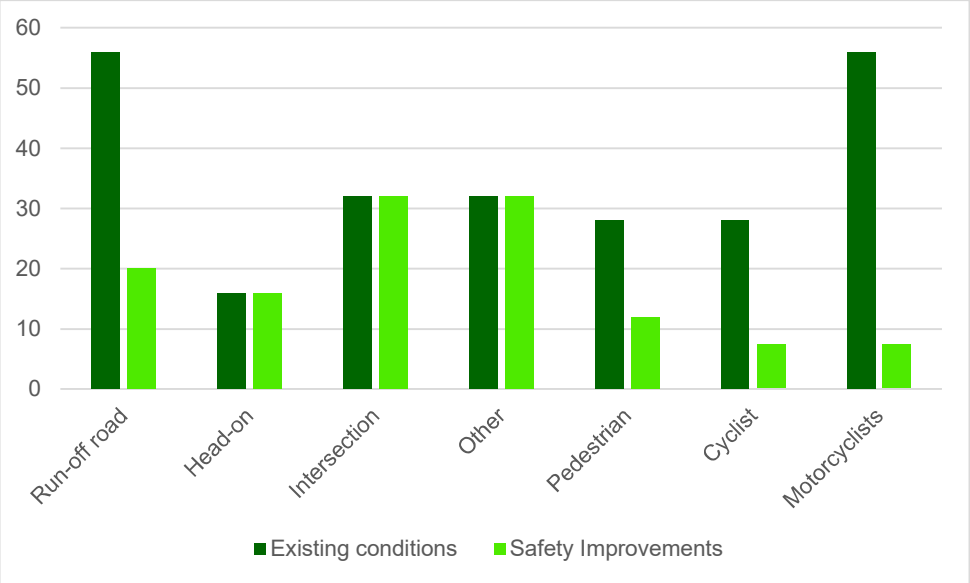



**Figure 3: SSA Scores for Crash Types**

## 5.2. Safe System Assessment Matrices

Table 4: SSA Matrix – Existing Conditions

| | Run-off road | Head-on | Intersection | Other | Pedestrian | Cyclist | Motorcyclists |
|---|---|---|---|---|---|---|---|
| **Exposure Comments:** | • > 40,000 vehicles | • > 40,000 vehicles | • > 40,000 vehicles | • > 40,000 vehicles | • <50 | • <100 | • >1,000 |
| **Exposure Score:** | 4/4 | 4/4 | 4/4 | 4/4 | 2/4 | 2/4 | 4/4 |
| **Likelihood Comments:** | Factors that increase the likelihood include:<br>• No shoulder<br>• Unprotected vertical drop of 1.5m only 1m away from carriageway<br>• No deceleration / acceleration lane into side streets<br>• Pedestrian fencing that represents spearing hazard<br>Factors that decrease the likelihood include:<br>• Pavement condition appears to be satisfactory. | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>• 10% heavy vehicles.<br>• No shoulders<br>• Illegal overtaking<br>Factors that decrease the likelihood include:<br>• Separation by raised median | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>• High percentage of heavy vehicles<br>Factors that decrease the likelihood include:<br>• Road alignment.<br>• Line marking.<br>• Signposting | Factors that increase the likelihood include:<br>• No shoulder<br>Factors that decrease the likelihood include:<br>• Pavement condition appears to be satisfactory. | Factors that increase the likelihood include:<br>• No deceleration / acceleration lane into side streets<br>• Superseded pedestrian fencing with large gaps<br>• Resident houses adjacent to roadway<br>Factors that decrease the likelihood include:<br>• Pavement condition appears to be satisfactory<br>• Pedestrian fencing | Factors that increase the likelihood include:<br>• Unprotected vertical drop of 1.5m only 1m away from carriageway<br>Factors that decrease the likelihood include:<br>• Good sight distance | Factors that increase the likelihood include:<br>• Pedestrian fencing that represents spearing hazard<br>• Unprotected vertical drop of 1.5m only 1m away from carriageway<br>Factors that decrease the likelihood include:<br>• Line marking<br>• Signposting. |
| **Likelihood Score:** | 3.5/4 | 1/4 | 2/4 | 2/4 | 3.5/4 | 3.5/4 | 3.5/4 |
| **Severity Comments:** | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>• Light poles in clear zone<br>• Launching and Roll-over risk with vertical drop<br>Factors that decrease the likelihood include:<br>• None | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• None | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• None | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• None | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• None | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• None | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• None |
| **Severity Score:** | 4/4 | 4/4 | 4/4 | 4/4 | 4/4 | 4/4 | 4/4 |
| **Product** (multiply scores above for crash type) | **56/64** | **16/64** | **32/64** | **32/64** | **28/64** | **28/64** | **56/64** |
| | | | | | | **TOTAL** | **248/448** |

**Table 5: SSA Matrix – NSW High Profile Redirective Kerb and compliant pedestrian fencing**

| | Run-off road | Head-on | Intersection | Other | Pedestrian | Cyclist | Motorcyclists |
|---|---|---|---|---|---|---|---|
| **Exposure Comments:** | • > 40,000 vehicles | • > 40,000 vehicles | • > 40,000 vehicles | • > 40,000 vehicles | • <50 | • <100 | • >1,000 |
| **Exposure Score:** | 4/4 | 4/4 | 4/4 | 4/4 | 2/4 | 2/4 | 4/4 |
| **Likelihood Comments:** | Factors that increase the likelihood include:<br>• No shoulder<br>• ~~Unprotected vertical drop of 1.5m only 1m away from carriageway~~<br>• No deceleration / acceleration lane into side streets<br>• ~~Pedestrian fencing that represents spearing hazard~~<br>Factors that decrease the likelihood include:<br>• Pavement condition appears to be satisfactory.<br>• Replace SA kerb with NSW High Profile Redirective Kerb<br>• Install compliant pedestrian fencing | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>• 10% heavy vehicles.<br>• No shoulders<br>• Illegal overtaking<br>Factors that decrease the likelihood include:<br>• Separation by raised median | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>• High percentage of heavy vehicles<br>Factors that decrease the likelihood include:<br>• Road alignment.<br>• Line marking.<br>• Signposting | Factors that increase the likelihood include:<br>• No shoulder<br>Factors that decrease the likelihood include:<br>• Pavement condition appears to be satisfactory. | Factors that increase the likelihood include:<br>• No deceleration / acceleration lane into side streets<br>• ~~Superseded pedestrian fencing with large gaps~~<br>• Resident houses adjacent to roadway<br>Factors that decrease the likelihood include:<br>• Pavement condition appears to be satisfactory<br>• ~~Superseded pedestrian fencing~~<br>• Replace SA kerb with NSW High Profile Redirective Kerb<br>• Install compliant pedestrian fencing | Factors that increase the likelihood include:<br>• ~~Unprotected vertical drop of 1.5m only 1m away from carriageway~~<br>Factors that decrease the likelihood include:<br>• Good sight distance<br>• Replace SA kerb with NSW High Profile Redirective Kerb<br>• Install compliant pedestrian fencing | Factors that increase the likelihood include:<br>• ~~Pedestrian fencing that represents spearing hazard~~<br>• ~~Unprotected vertical drop of 1.5m only 1m away from carriageway~~<br>Factors that decrease the likelihood include:<br>• Line marking<br>• Signposting.<br>• Replace SA kerb with NSW High Profile Redirective Kerb<br>• Install compliant pedestrian fencing |
| **Likelihood Score:** | ~~3.5~~ 2/4 | 1/4 | 2/4 | 2/4 | ~~3.5~~ 1.5/4 | ~~3.5~~ 1.5/4 | ~~3.5~~ 1.5/4 |
| **Severity Comments:** | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>• Light poles in clear zone<br>• ~~Launching and Roll-over risk with vertical drop~~<br>Factors that decrease the likelihood include:<br>• Install NSW High Profile Redirective Kerb and compliant pedestrian fencing along roadway | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• None | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• None | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• None | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• None | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• Install NSW High Profile Redirective Kerb and compliant pedestrian fencing along roadway | Factors that increase the likelihood include:<br>• 70km/h speed limit<br>Factors that decrease the likelihood include:<br>• Install NSW High Profile Redirective Kerb and compliant pedestrian fencing along roadway |
| **Severity Score:** | ~~4~~ 2.5/4 | 4/4 | 4/4 | 4/4 | 4/4 | 4 2.5/4 | 4 2.5/4 |
| **Product** (multiply scores above for crash type) | **20/64** | **16/64** | **32/64** | **32/64** | **12/64** | **7.5/64** | **7.5/64** |
| | | | | | | **TOTAL** | **127/448** |

# 6. Treatments to Improve Safe System Alignment

Table 5 and Table 6 list treatments that will improve the Safe System alignment of the project.

**Primary treatments** are those measures that have the potential to eliminate or come close to eliminating the risk of fatal and serious injury (FSI) crashes.

**Supporting treatments** are effective in reducing the risk of FSI crashes but not to the extent of a primary treatment (i.e. there is a residual moderate or significant FSI crash risk). Implementation of a primary treatment should be given priority over a supporting treatment that may be targeting a similar crash risk.

**Table 5: Primary Treatments**

| Treatments for consideration | Project response |
|---|---|
| Speed Zone Reduction | Current speed limit of 70km/h is supported by suitable design standards and community needs. Reduction in speed would reduce severity of crashes. However, this is unlikely to be accepted by the community |
| Create batter slope | This treatment would eliminate the fall hazard for vehicles and pedestrians, however the service road below would need to be acquired for the batter footprint. This would remove access to 12 residential properties. This is unlikely to be accepted by the community |
| Compliant Transport for NSW pedestrian fencing | This was a seen as a priority for the Transport for NSW project team. The current fencing is highly dangerous to errant vehicles and it is highly likely on impact to spear a vehicle |

**Table 6: Supporting Treatments**

| Treatments for consideration | Project response |
|---|---|
| Concrete barrier | This treatment was considered, however the narrow width between the Princes Highway and the access road would make it difficult to contain the profile of Type F concrete barrier.<br><br>Additionally, light poles are installed next to the roadway which would require relocation if Type F concrete barrier was installed. Alternatively, the concrete barrier could be installed behind the light poles however this would increase the risk of vehicles impacting the light poles as when the concrete barriers were impacted they would direct vehicles into the light poles. |
| NSW High Profile Redirective Kerb (HPRK) | This treatment was preferred by the project team as the profile is smaller than concrete barrier and would not require the removal of existing light poles. The kerb system has been tested and redirects a sedan vehicle and 2.27t Utility vehicle at 70km/h at an impact angle of 10°. This system would protect light vehicles and motorcyclists from the fall hazard |

# 7. Additional Safe System Components

As part of this SSA, consideration has been given to other components that comprise the Safe System i.e. road users, vehicles and post-crash care. Issues identified as relevant to this project are listed in Table 7.

**Table 7: Other Safe System Components**

| Pillar | Prompts | Comments / Issues |
|---|---|---|
| **Road user** | Are road users likely to be alert and compliant? Are there factors that might influence this?<br>What are the expected compliance and enforcement levels (alcohol / drugs, speed, road rules and driving hours)? What is the likelihood of driver fatigue? Can enforcement activities be conducted safely?<br>Are there special road users (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism) or risk-taking behaviours? | Drivers likely to be alert.<br>Slight downhill grade may cause speeding eastbound<br>Enforcement would be difficult at this location due to having no shoulders and no stopping / clearways |
| **Vehicle** | What level of alignment is there with the ideal of safer vehicles?<br>Are there factors that may attract large numbers of unsafe vehicles? Is the percentage of heavy vehicles too high for the proposed / existing road design? Is this route used by recreational motorcyclists?<br>Are there resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement activities be undertaken safely?<br>Has vehicle breakdown been catered for? | Moderate percentage of heavy vehicles.<br>No enforcement |
| **Post-crash care** | Are there issues that might influence safe and efficient post-crash care in the event of a severe injury (e.g. congestion, access, stopping space)?<br>Do emergency and medical services operate as efficiently as possible?<br>Are other road users and emergency response teams protected during a crash event? Are drivers provided the correct information to address travelling speeds on the approach and adjacent to the incident? Is there reliable information available via radio, VMS etc?<br>Is there provision for e-safety (i.e. safety systems based on modern information and communication technologies, C-ITS)? | No shoulder to pull over<br>VMS facing eastbound traffic that can warn of congestion / crash<br>Speed limit signage on approach. Curve advisory speed sign in project extents |

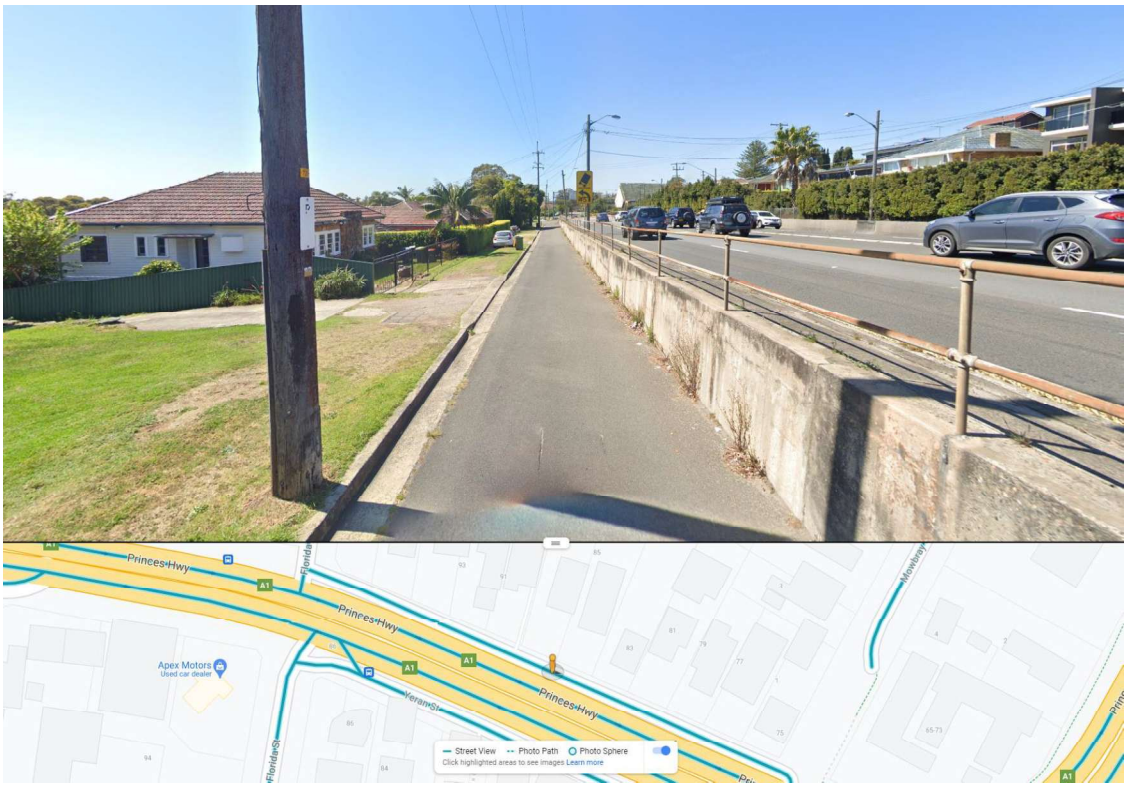
# Appendix A

**Aerial image from Nearmap taken on 17/06/2021**

# Appendix B

### Google street view – Princes Highway Eastbound


### Google street view – Local access road Eastbound



# Appendix C

## C1. Recent crash May 2021


Excerpt from The Leader, May 10 2021 (https://www.theleader.com.au/story/7245587/three-children-hurt-in-crash/ )

***"Three children hurt in crash when car flips at Sylvania***

*Three children under the age of 10 were taken to St George Hospital after the car they were a passenger in was involved in a collision with two parked cars before landing on its roof at Sylvania over the weekend.*

*NSW Police said emergency services were called to Princes Highway, Sylvania, near Mowbray Street, at about 12.45am on Saturday, May 8, following reports of a collision involving three vehicles.*

*Officers from Sutherland Police Area Command arrived at the scene and were told a silver Audi sedan was travelling north before it was allegedly involved in a collision with two parked cars, flipped and landed on its roof.*

*The driver, a man, 42, was treated at the scene by NSW Ambulance paramedics for pelvic injuries before being taken to St George Hospital in a stable condition.*

*His passengers, three children aged under 10, suffered minor injuries and were taken to St George Hospital as a precaution."*


Screenshot from 9 News Australia Youtube Channel, May 8 2021
(https://www.youtube.com/watch?v=85V-z6YZNAg )