Welcome to the CAREC "Road Safety Engineering" Workshop

- for professionals in Kazakhstan

Module 5

– ROAD SAFETY AUDIT – HOW, WHAT, WHEN, WHERE

Tuesday 26th October 2021

CAREC

Central Asia Regional Economic Cooperation Program

Successful completion of this workshop requires

- Participation in all six modules
- Attempted answers to the Poll Quiz questions
- Satisfactory preparation of a hazardous road location report with recommended treatments
- Satisfactory completion of a road safety audit report, with recommended treatments.

An introduction to road safety audit

How, what, when, where and why?

Road Safety Audit

My objectives are to:

- outline the road safety audit process,
- encourage the introduction of the audit process in your road authority,
- encourage you to undertake audits especially during the design stages of new road projects, and
- answer your questions about the audit process

What is road safety audit?

Why do we
need audit?

How do we do an audit?

Where?

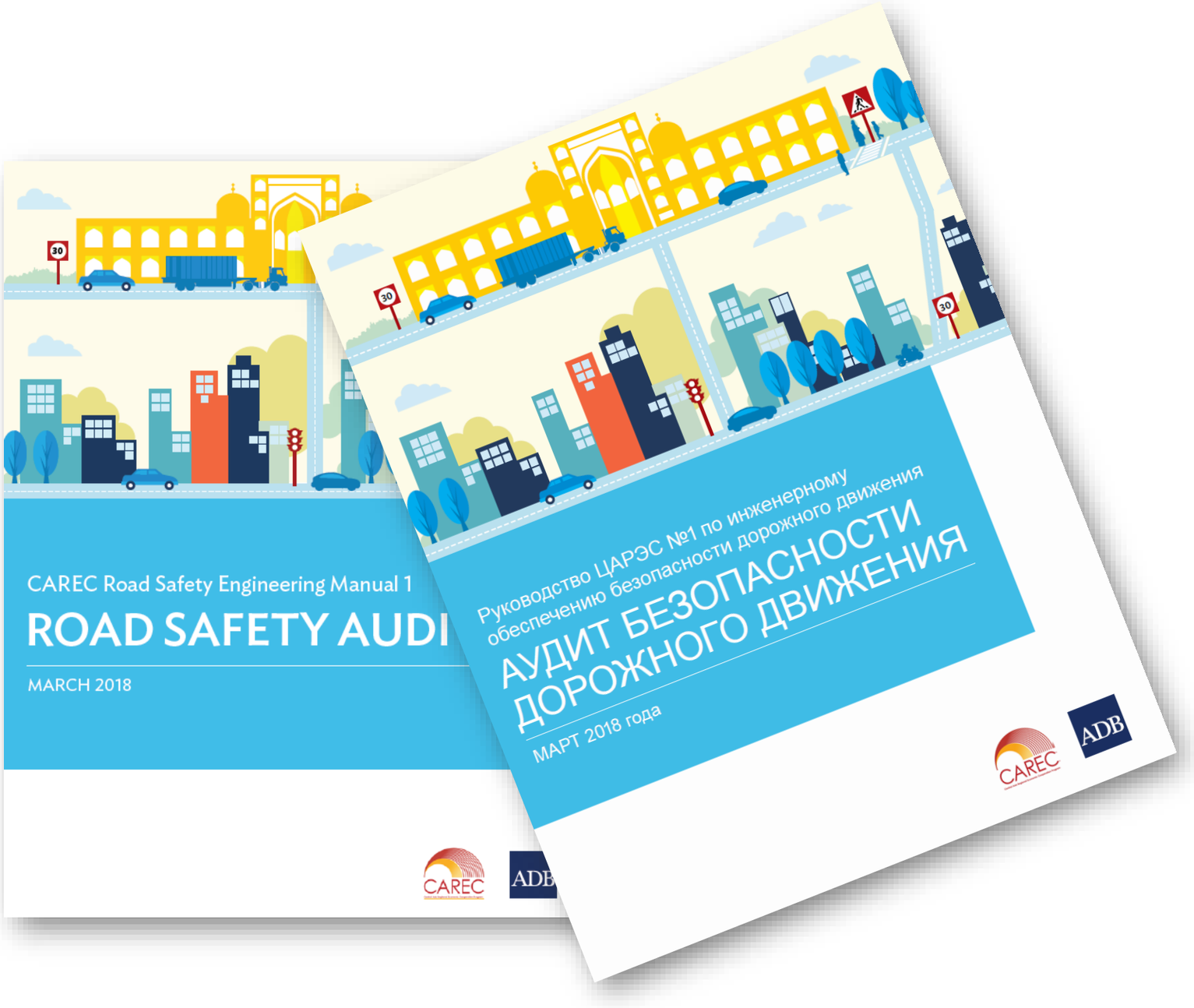
When?

Road Safety Audit

Prevention is better than cure

Road Safety Audit guidelines

Prevention is better than cure



A road safety audit is……
“a formal, systematic and detailed examination of a road project by an independent and qualified team of auditors that leads to a report listing the potential safety concerns in the project."

(CAREC 2018)

A road safety audit is……
“a formal, systematic and detailed examination of a road project by an independent and qualified team of auditors that leads to a report listing the potential safety concerns in the project."

(CAREC 2018)

An audit is:

- A formal process – not an informal check
- Carried out by people who are independent of the design
- Undertaken by people who have appropriate experience and training
- Restricted to road safety issues

Road Safety Audit is <u>NOT:</u>

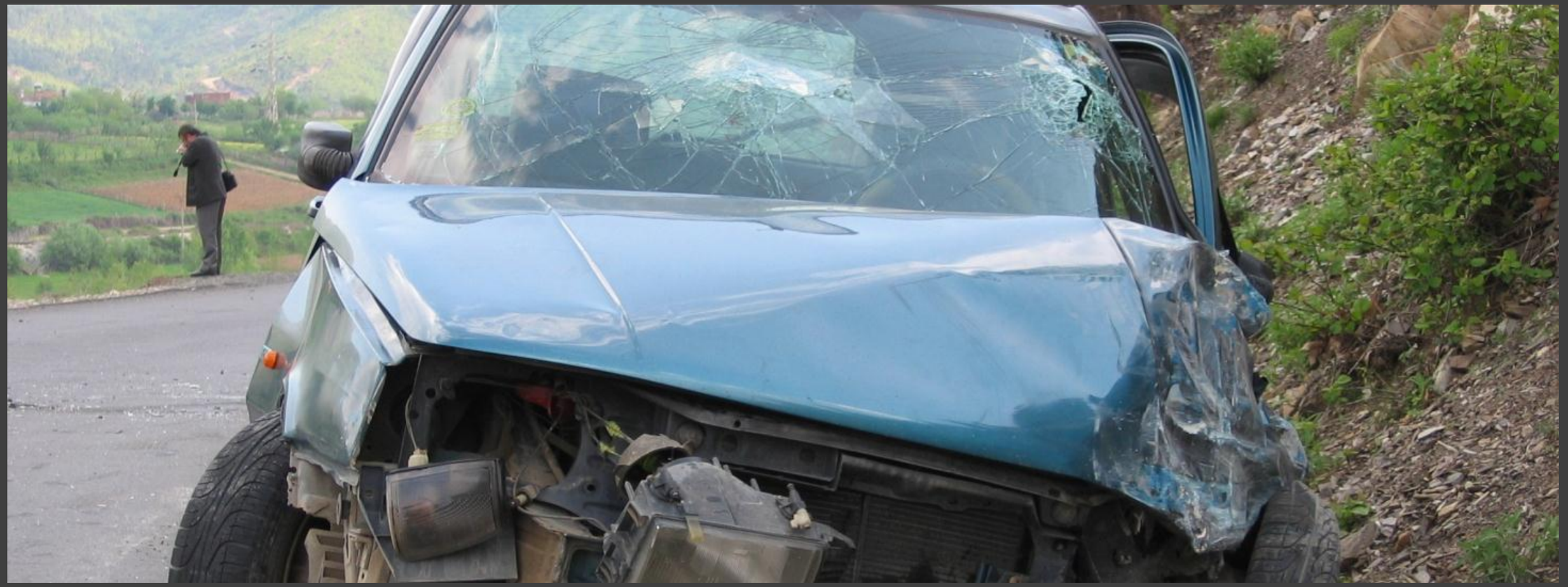
- another name for a blackspot investigation
- a substitute for a blackspot investigation
- an opportunity to redesign a scheme
- a design standards check, or a compliance check

Road Safety Audit

Prevention is better than cure

A road safety audit….

- requires professional judgment
- helps to inject safety into projects

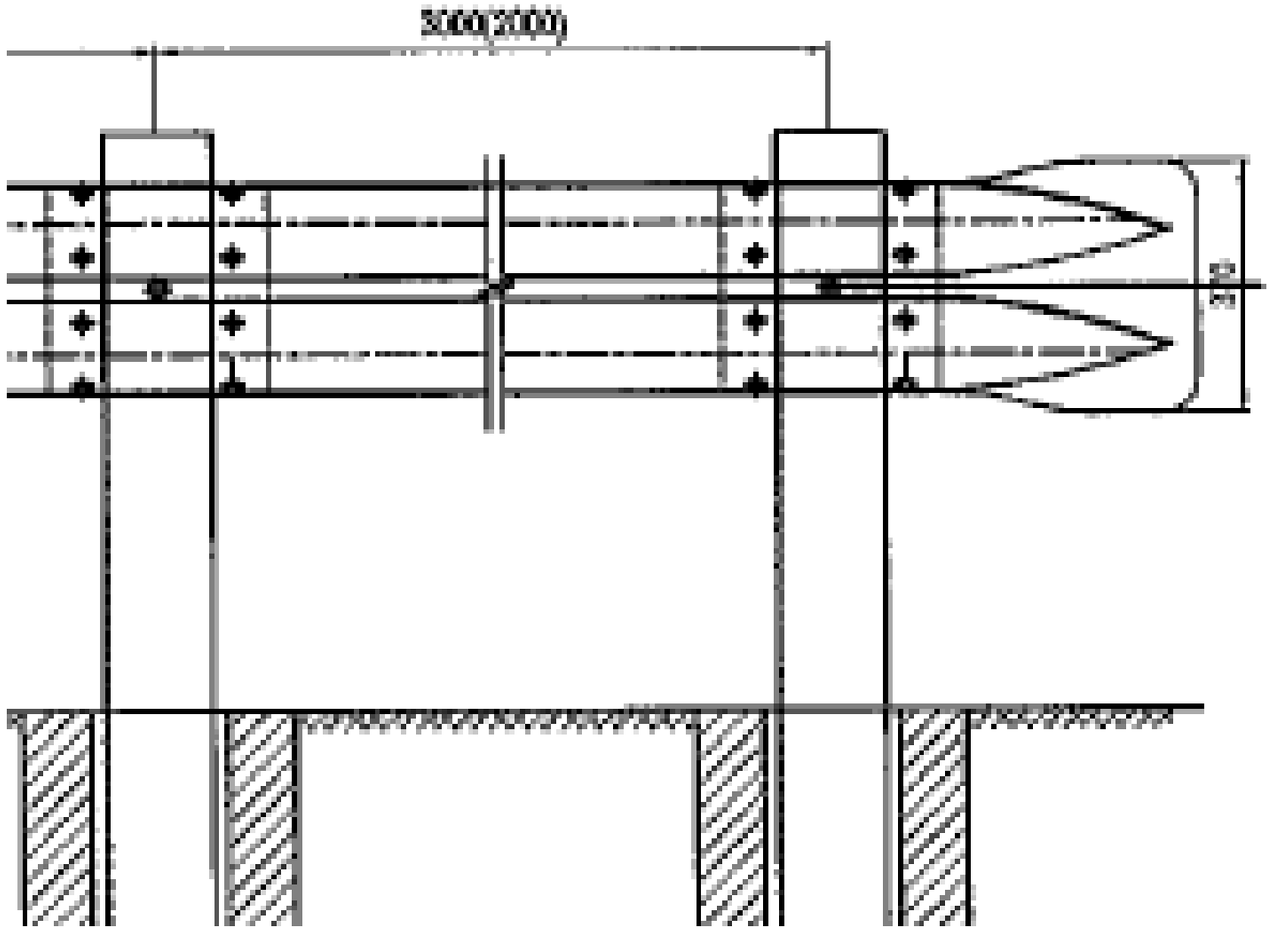


Remember that a road safety audit does *not* take over the responsibility for the project.

That remains with the Project Manager.

Road safety audit applies practical safety experience at the design stages of a project to ensure …

…..unsafe features are <u>not</u> introduced



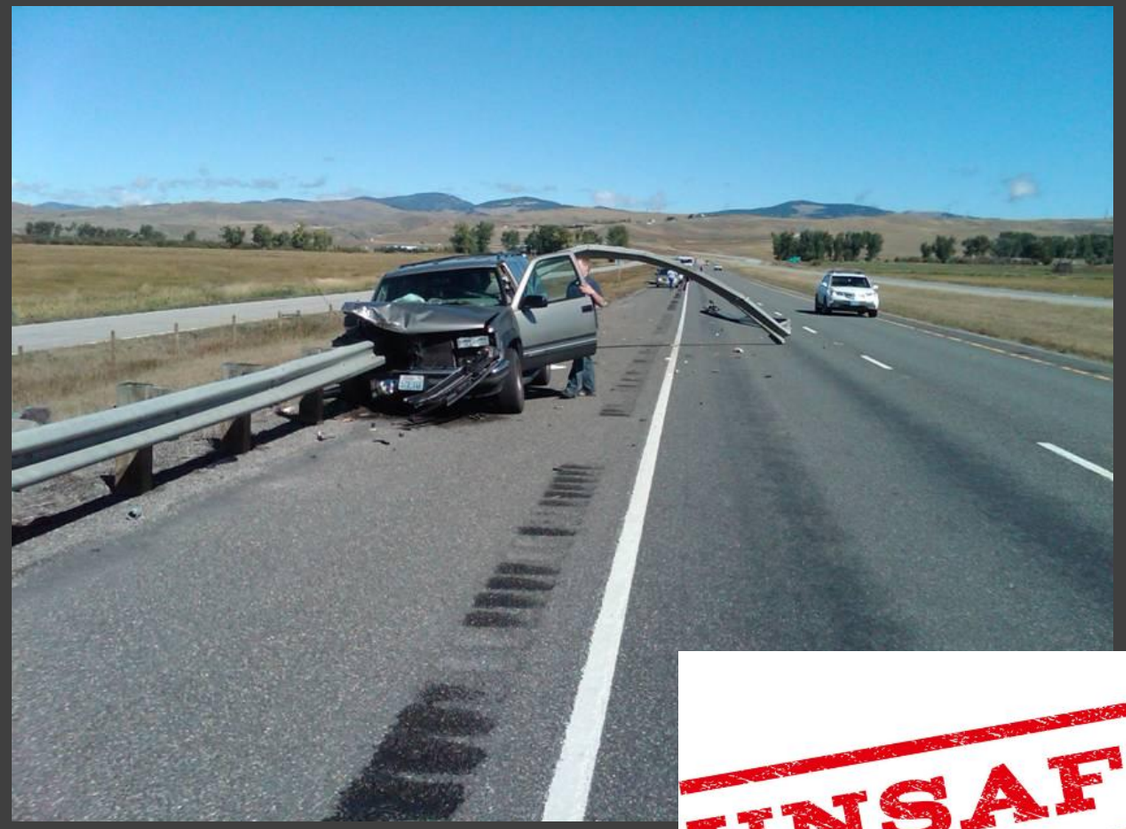
UNSAFE

Maybe “standard” –
but very UNSAFE

✗

Road safety audit applies practical safety experience at the design stages of a project to ensure …

….unsafe features are <u>not</u> introduced



Road safety audit applies practical safety experience at the design stages of a project to ensure …

…… safe features are introduced

✓

Blackspots, compared with audits.

What's the difference?

Blackspot investigations look at what *did* go wrong, why it went wrong, and suggests ways to reduce the risk of it from going wrong in future.

RSA investigates what might go wrong and suggests methods to prevent this.

Engineers are problem solvers

Auditors need to be problem finders!

Objectives of road safety audit

To minimise the risk of crashes occurring on a new road project, and to minimise the severity of the crashes that do occur;

To minimise the risk of crashes occurring on adjacent roads (that is, to avoid the possibility that the project creates crashes elsewhere on the network;

To recognise the importance of safety in road design (so that the needs and perceptions of all road users are met, and to achieve a balance where they may be in conflict);

To reduce the long-term costs of a new road project, bearing in mind that unsafe designs may be expensive (or even impossible) to correct at a later stage;

To improve the awareness of road safe engineering principles by all involved in the process of planning, design, construction and maintenance of roads.

Road safety audit

helps a project

Road safety audit is “safety insurance” for a new road

How do we do a road safety audit?

Decide

Select audit team

Pre-audit communication

Desktop audit

Inspect site

Table 1: Key Steps in the Road Safety Audit Process

Road Safety Audit Step	Responsibility
1. Determine if an audit is needed.	Project manager
2. Select an audit team leader, who then engages the audit team.	Project manager and road safety audit team leader
3. Draft the pre-audit communication to provide information (drawings and design reports) about the project to the team leader, outlining the project and discuss the audit ahead.	Designer (via project manager) and road safety audit team leader
4. Assess the drawings for safety issues (the "desktop" audit).	Audit team
5. Inspect the site both during daytime and nighttime.	Audit team
6. Write the audit report and send to the project manager.	Team leader with assistance from audit team
7. Discuss the key safety issues and clarify outstanding matters during post-audit communication.	Project manager (plus designer) and road safety audit team leader
8. Write a response report, referring to each audit recommendation.	Project manager
9. Follow up and implement agreed changes.	Project manager (and designer)

Write audit report

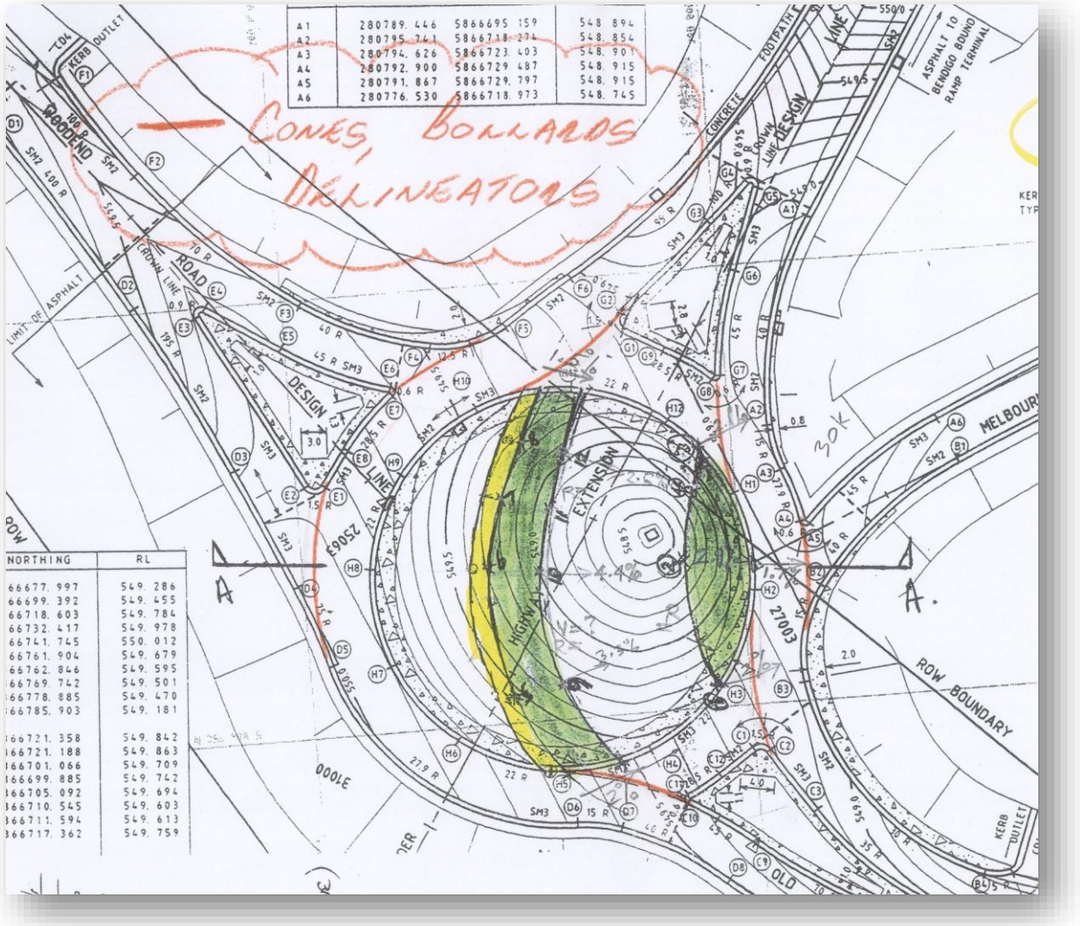
Post-audit communication

Respond to the report

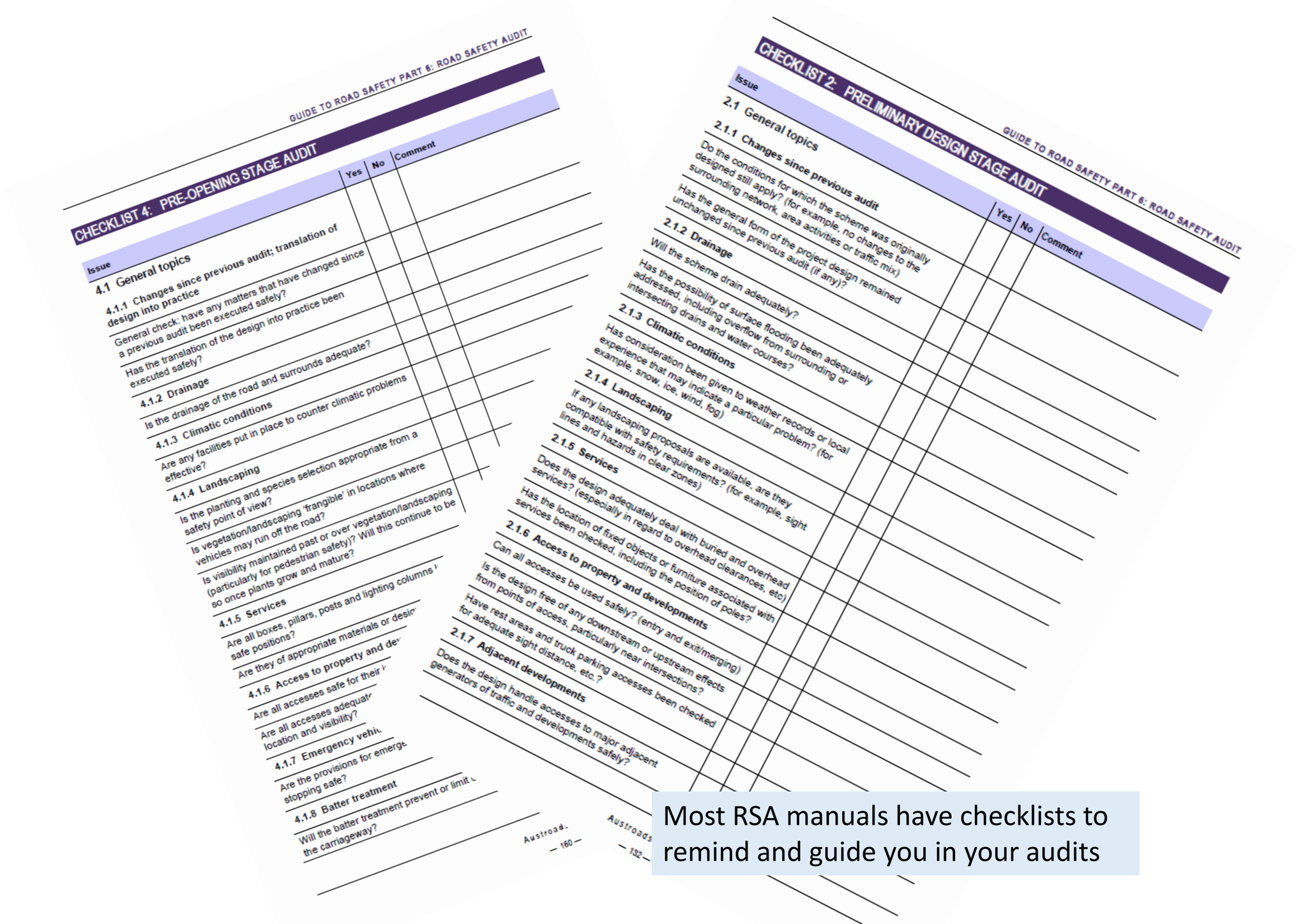
Implement

Key audit steps….

Closely review drawings



Use checklists



Most RSA manuals have checklists to remind and guide you in your audits

Key audit steps….

- inspect the site, day and night
- use checklists to prompt….

Key audit steps….

Respond to the audit report

Road safety audit reports on safety issues - only!

Road safety audit combines art with science - the art of assessing how the road users will use the road, and the science of proven road safety engineering principles.

What projects should be road safety audited?

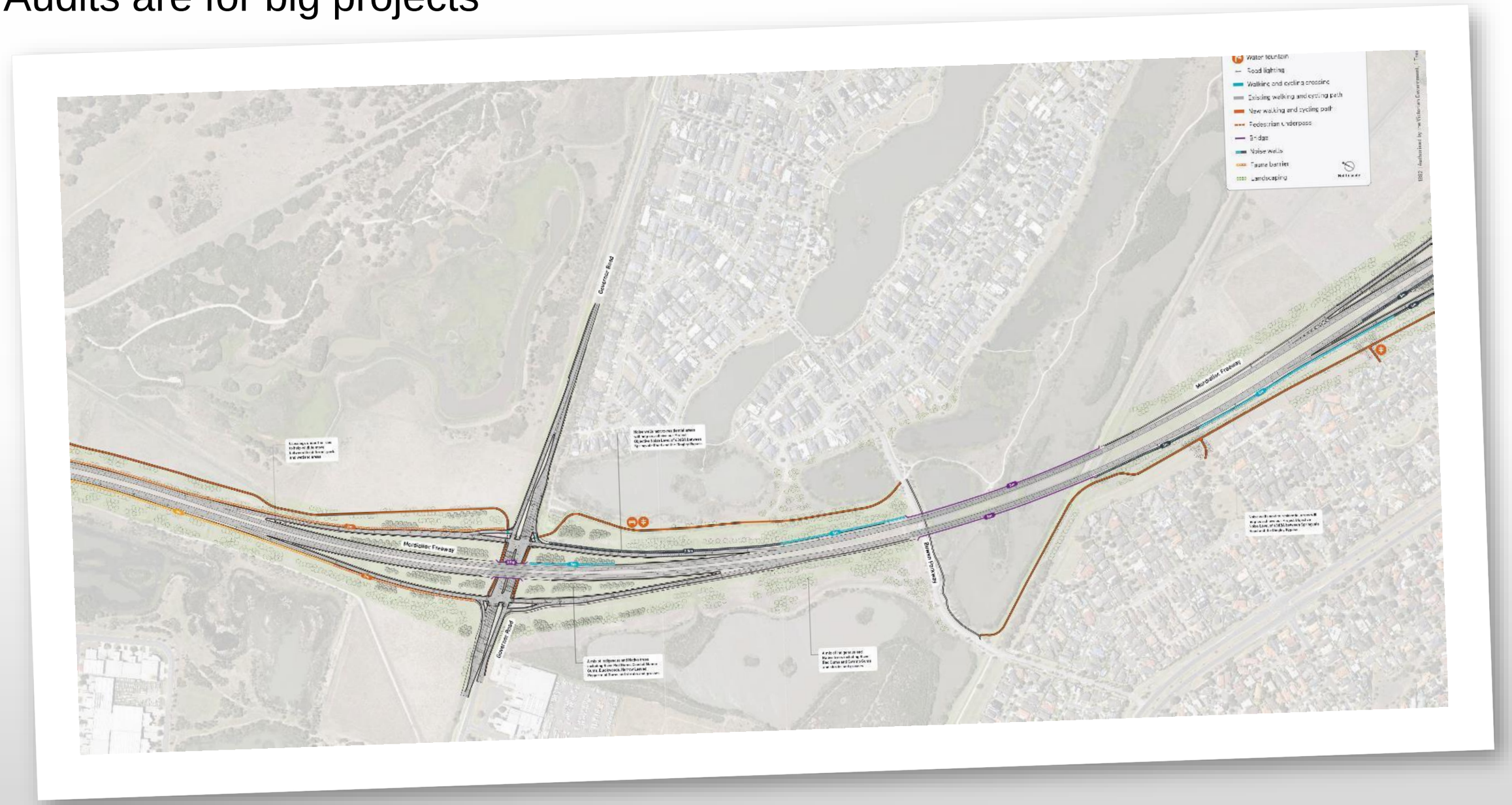
All road projects – big and small

What projects should we audit?

- Big road projects
- Small road projects
- Urban projects
- Rural projects
- Traffic management schemes
- Pedestrian projects
- Roadworks
- Any work that interacts with the road

Road safety audit is for big projects

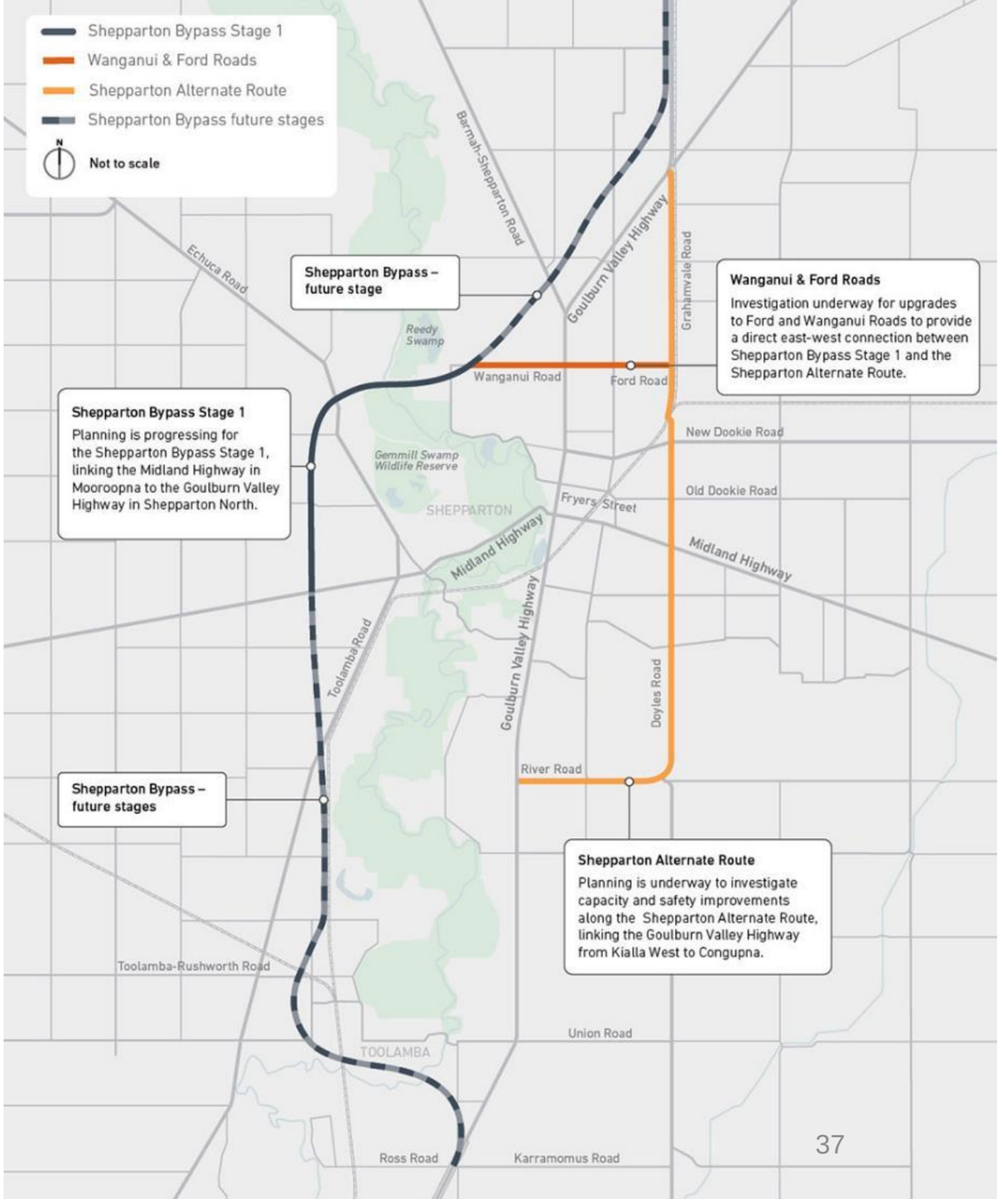
Audits are for big projects



Road safety audit is for small projects

Road Safety Audit

Road safety audit is for <u>rural</u> road projects – such as this proposed town by-pass



Road safety audit is for urban projects

Road Safety Audit

Road safety audit is for small projects, such as parklets and local street closures (during the COVID pandemic)


Road safety audits are for intersection improvements

Road Safety Audit

Road safety audit is for pedestrian projects

Road safety audit is for road works

Road Safety Audit

Road safety audit is for road works

Road safety audit is for bicycle projects

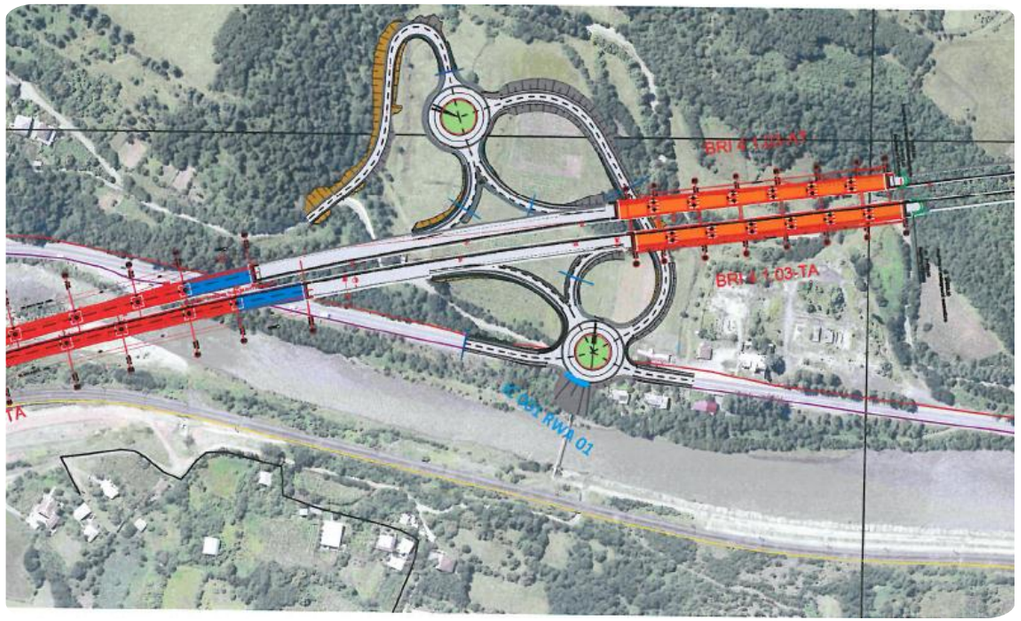
Road Safety Audit

Prevention is better than cure

When do we do road safety audits?

There are six agreed stages

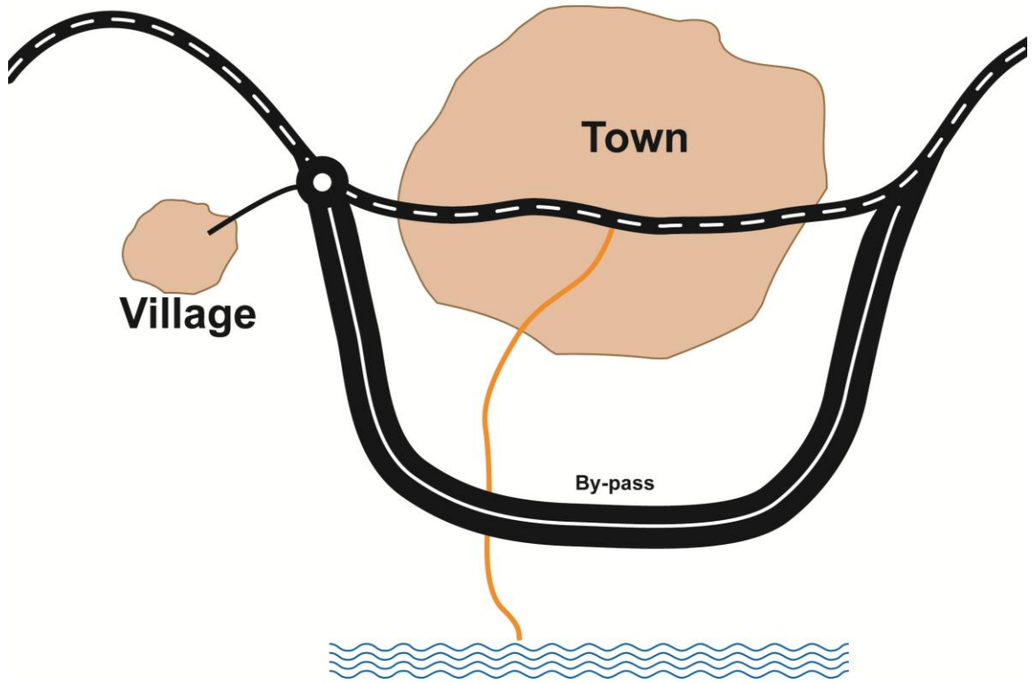
The 6 international stages of road safety audit



- Planning
- Preliminary design
- Detailed design
- Traffic management
- Pre-opening
- Existing road (called road safety inspections)

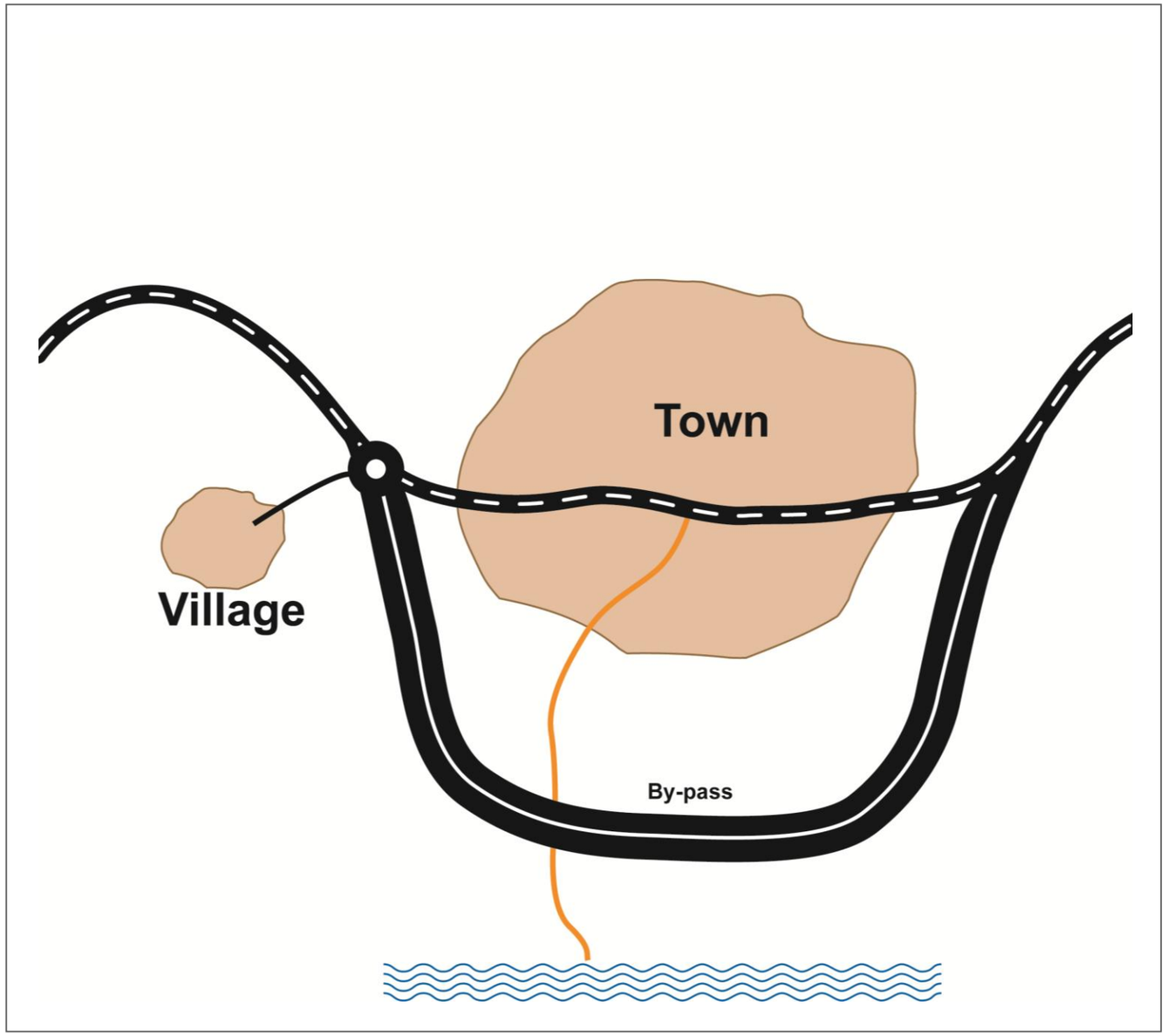
Existing road audits are called “inspections” – their overuse is not recommended as they…

- Lead to unfulfilled expectations if remedial work is not undertaken
- May cause misunderstandings with the benefits of design stage audits
- May cause confusion with crash investigations (blackspots)
- Should already be part of a good maintenance regime.



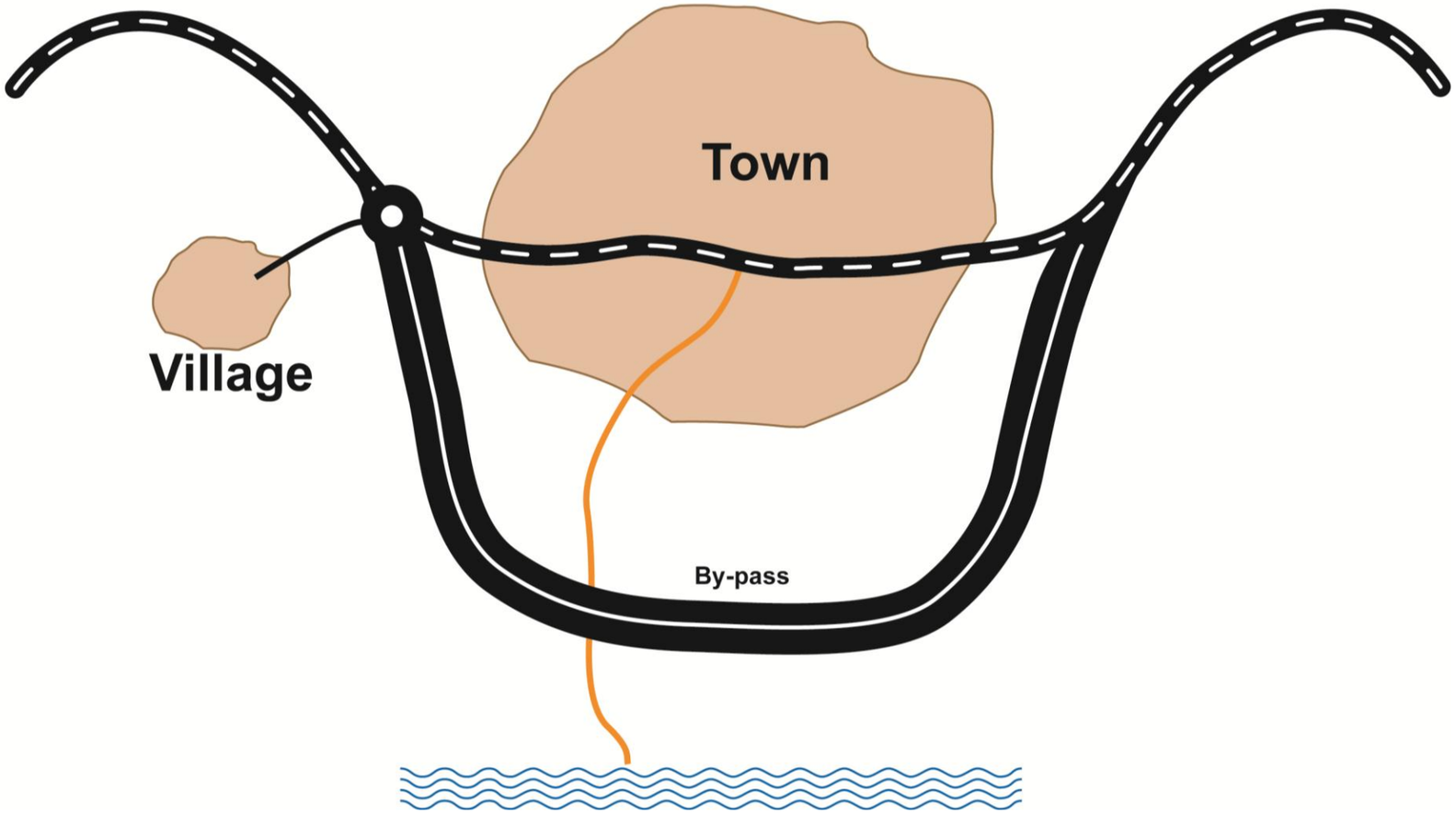
Planning stage audits consider…..

- route choice
- design standards
- impacts on the adjacent road network
- intersection types
- ….and much more

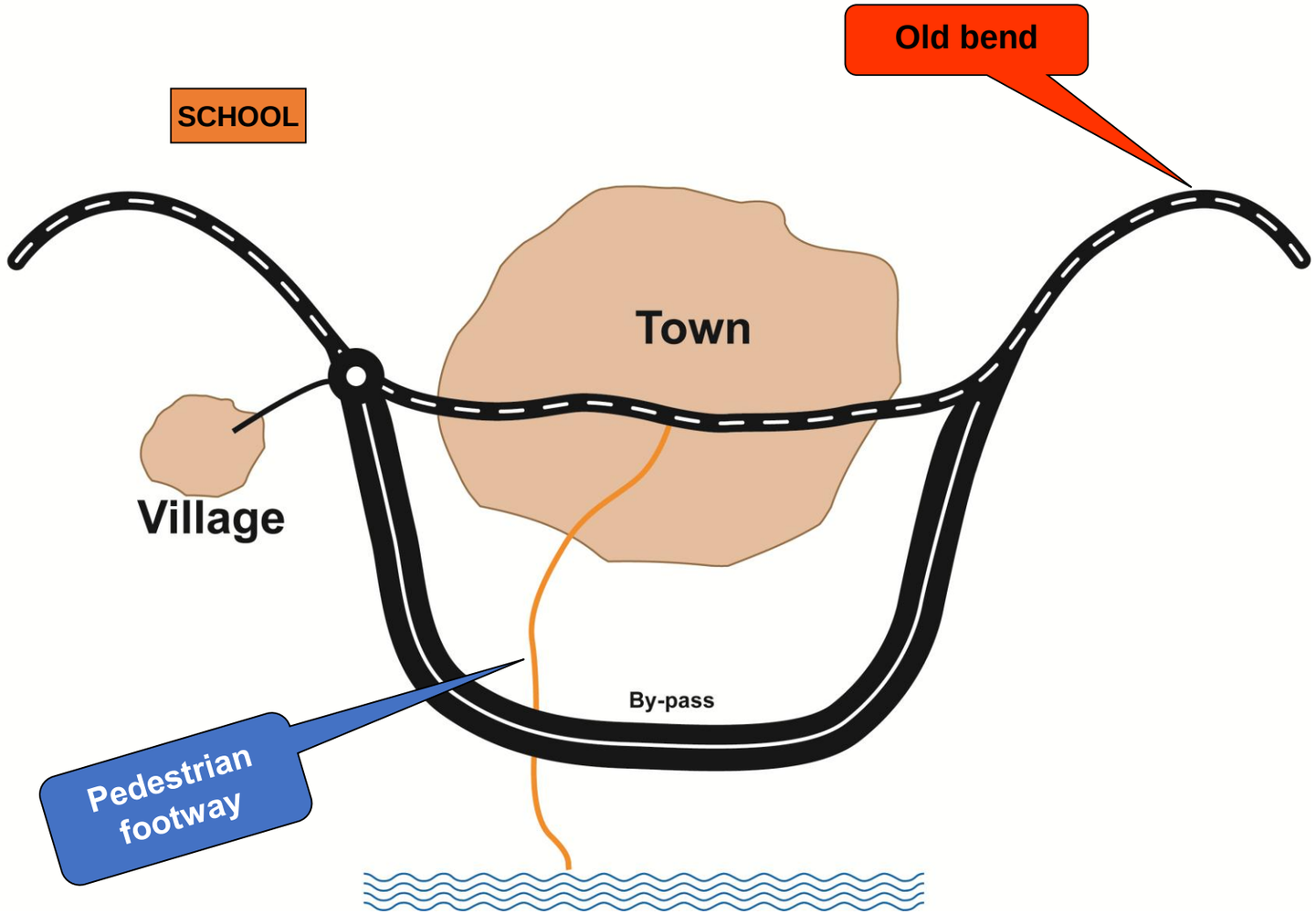


A town in the western part of the country has problems because of a busy highway. A By-Pass is proposed…….

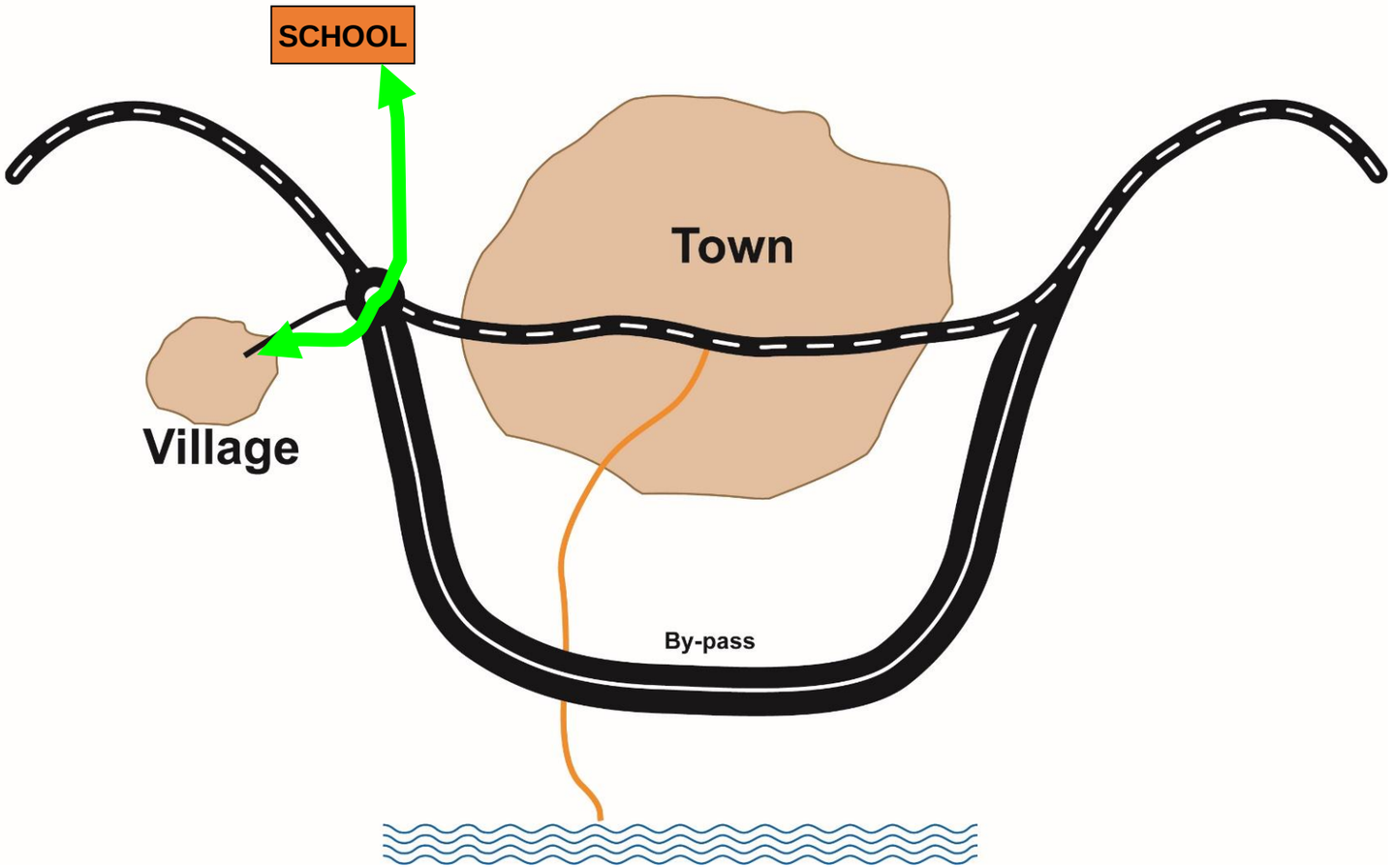
The By-Pass will take through traffic away from the highway and the development. Of course, it will be safer. Does it need to be audited?



An audit team looks at, and beyond, the proposed scheme

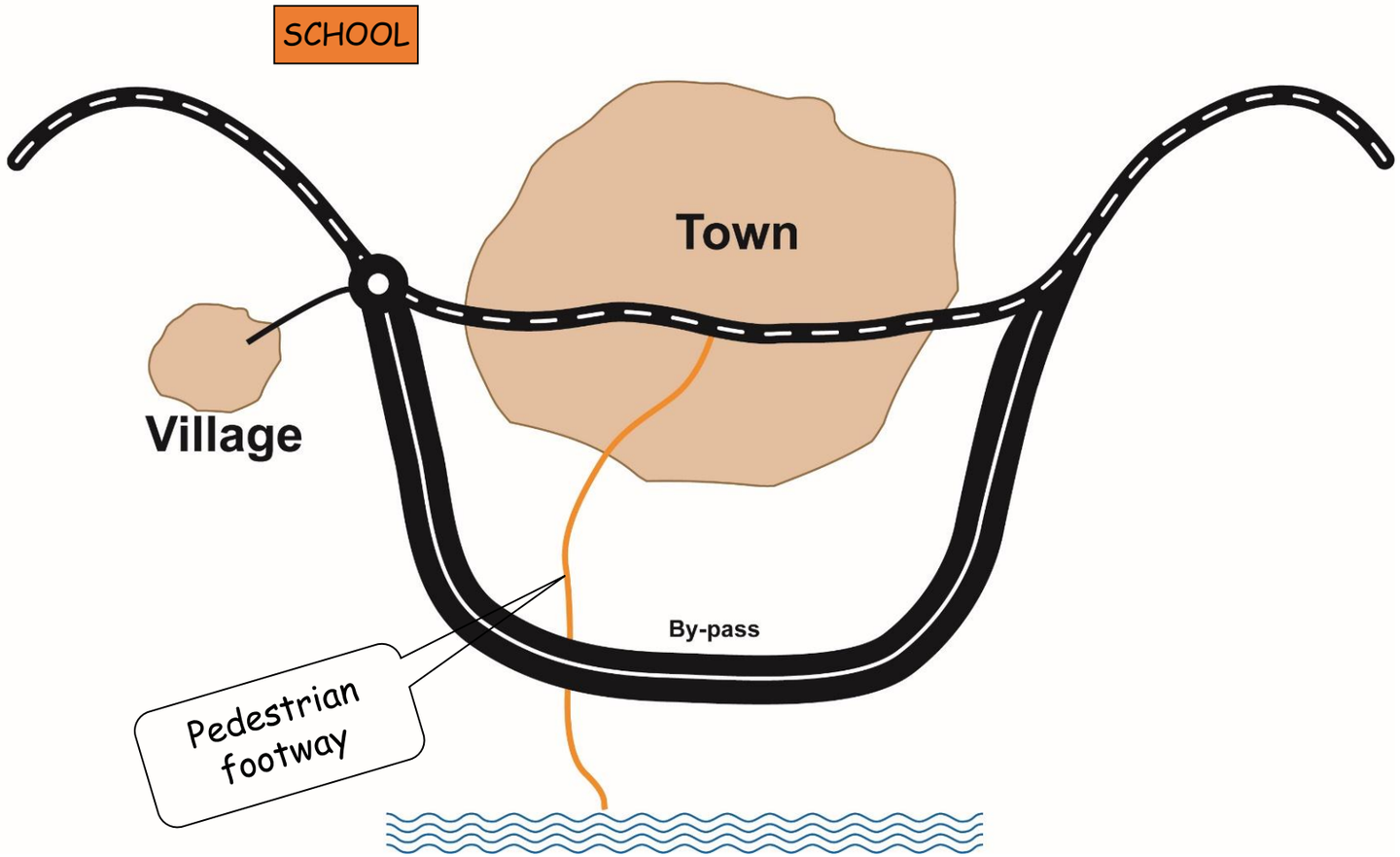


The audit team finds:



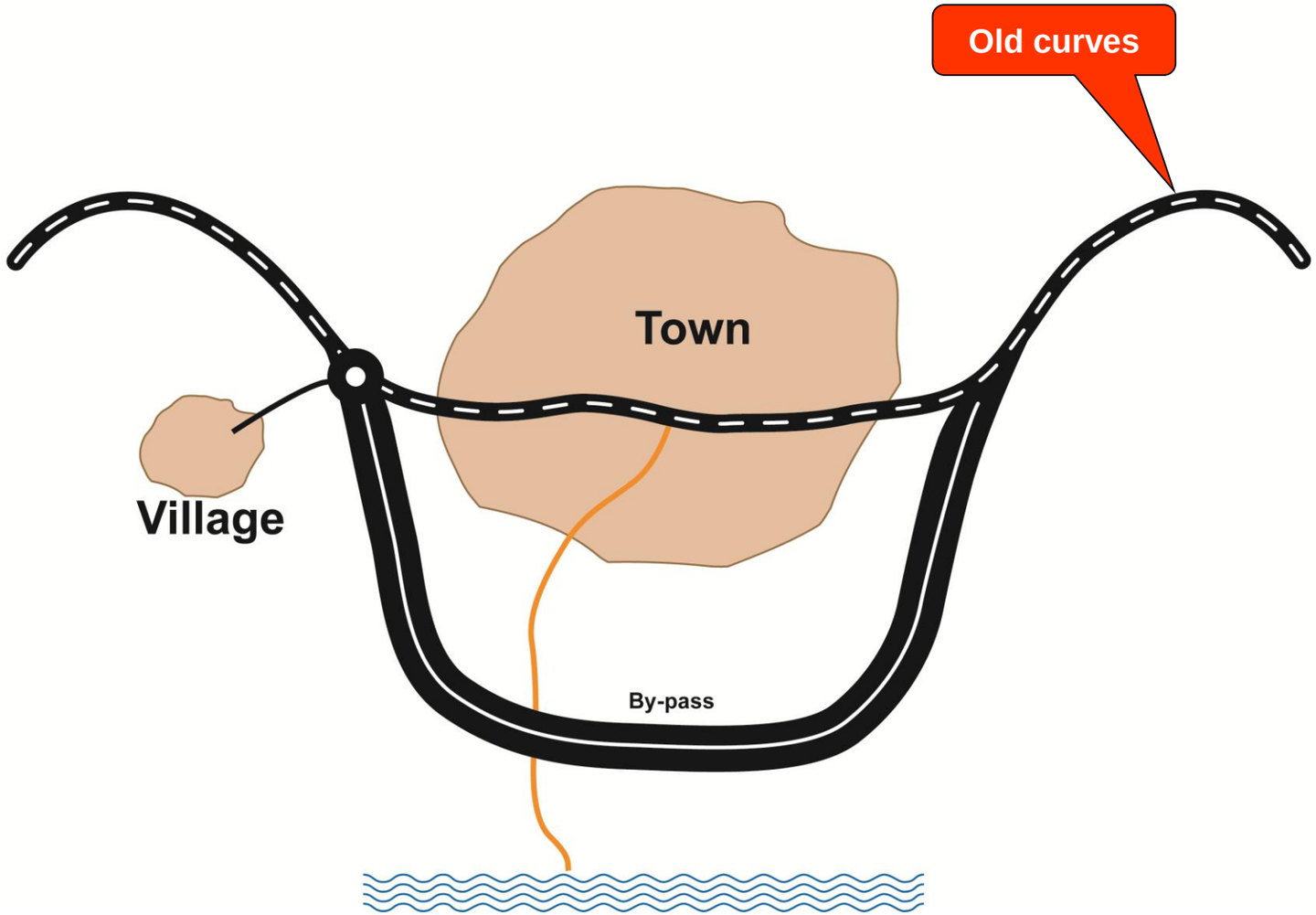
A similar roundabout exists nearby, in the same area – the proposed roundabout will look like this.

The audit team finds:




Prevention is better than cure

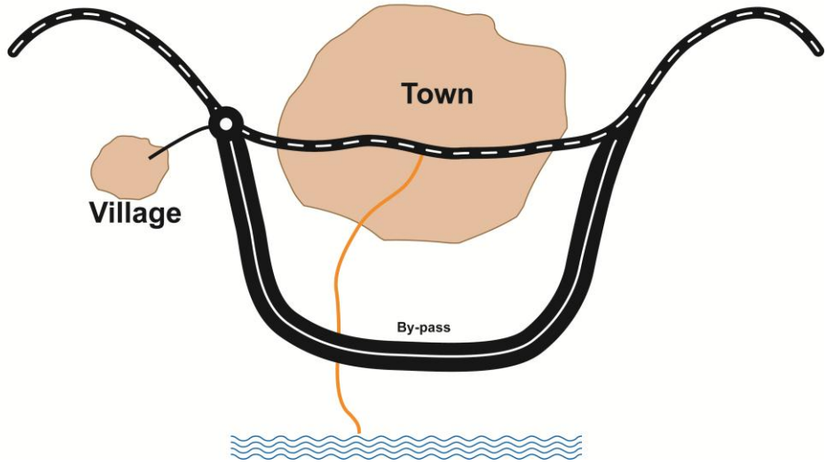
The audit team finds:



Old curves, just outside the project

The audit team reports on the possible safety concerns of…..

- Young pedestrians & cyclists at large roundabouts
- Pedestrians attempting to cross the new By-Pass
- Higher speeds entering the old curves



The Project Manager is now required to respond to these safety concerns and to follow up with necessary improvements.

The Project Manager decides:

Children at proposed roundabout

- Difficult issues
- Don’t give up on a roundabout if possible
- Give options to the design team
- A Stop/Give Way crossroad? But these have higher risk than roundabouts for other users.
- The designers are responsible for deciding and submitting new drawings to the Project Manager

The Project Manager decides:

Pedestrians crossing high speed road

- Difficult
- Offer options to the design team
- Overpass/underpass?
- Traffic signals?
- Break in median?
- Nothing!
- Not a zebra crossing!!!

The Project Manager decides:

Higher speeds entering the old bends – pave the shoulders and install chevron alignment markers

Some people think road safety audit is a compliance check with standards……

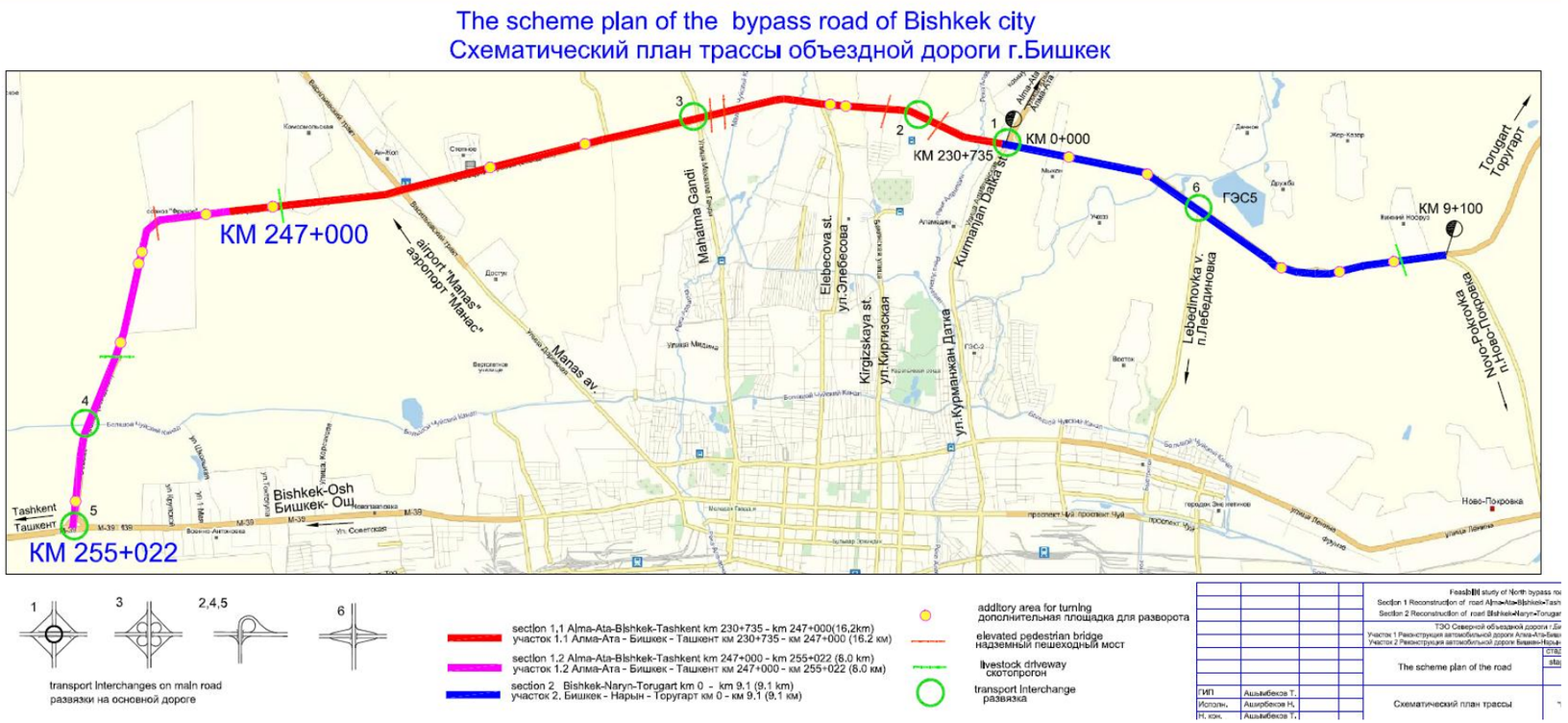
What standards are involved in this example?

There are none!

Road safety audit is <u>not</u> a compliance check against standards

Preliminary design stage audits consider…

- geometrics
- alignments
- intersection layouts
- cross sections
- vulnerable road users
- ……and more



Northern Bishkek By-Pass – preliminary design stage audit

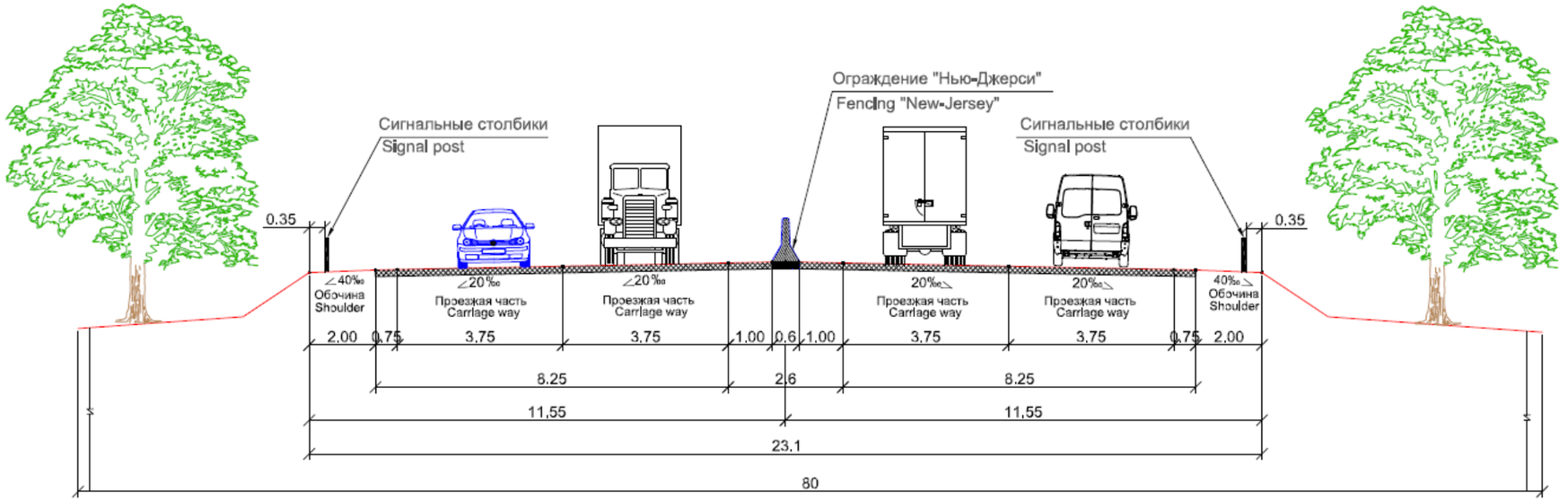
This preliminary design stage audit found safety issues with…

- Cross sections
- U-turn
- Interchange layouts
- Vulnerable road users
- .. and more

Тип 3 / Type 3 (на основной дороге / on main road)

Вне населенных пунктах с 4 полосами движения

Outside settlement with 4 traffic lanes



Примечание: На основании генерального плана г. Бишкек на период до 2025г. предусмотривается отвод земель под дорожную инфраструктуру шириной 80м в красных линиях на перспективу.
Письмо Государственного проектного института градостроительства и архитектуры ГААСиЖКХ при Правительстве Кыргызской Республики за №ЖА03/680 от 26.09.2019г.

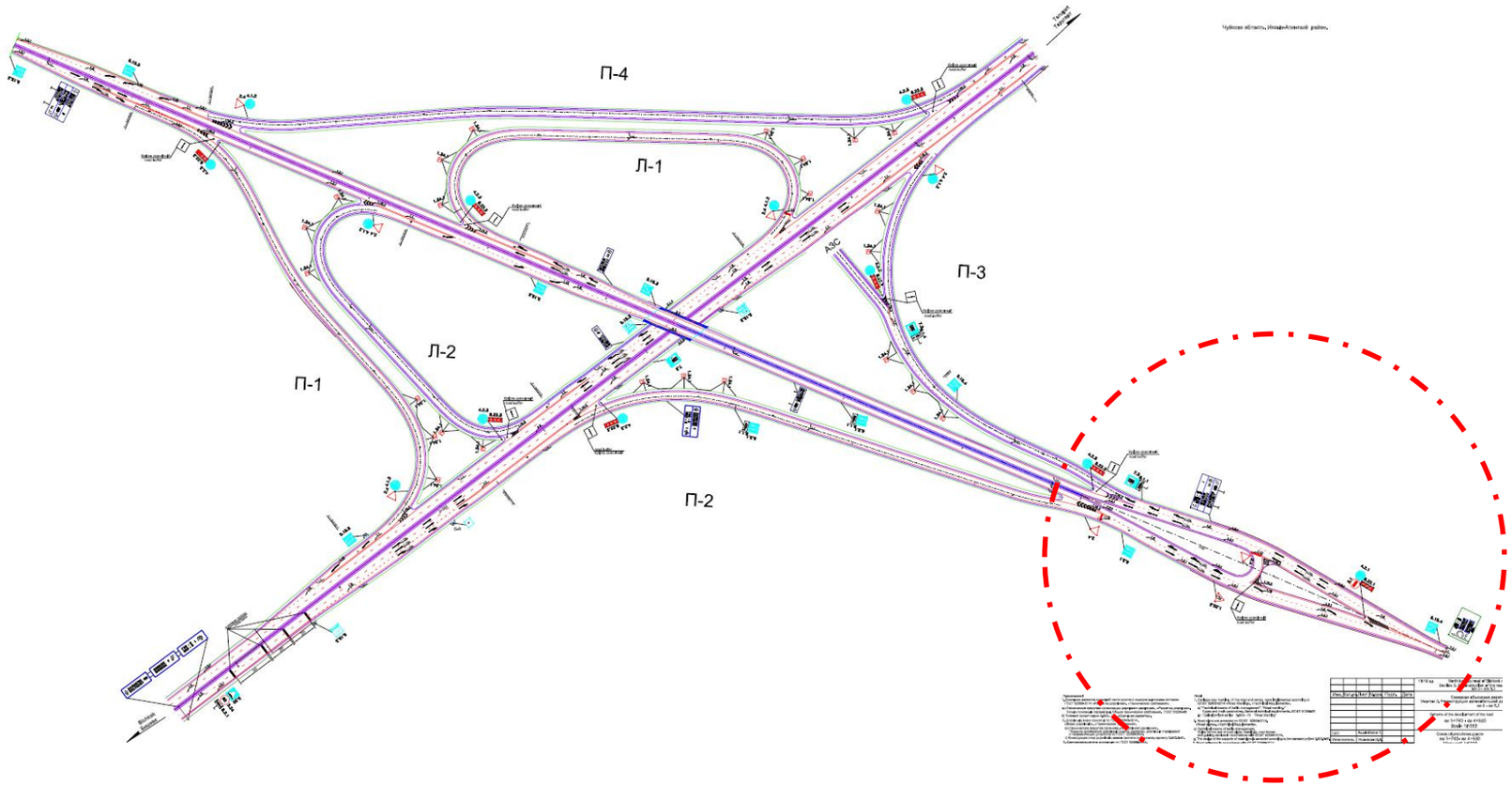
Note: On the base of the Ceneral Plan of Blshkek clty up to 2025, alloment of land for road lndustry wlth the wldth of 80m ln the red llnes for perspectlve ls provlded.
The letter of the State Design Institute of Urban Planning and Architecture under the goverment of the Kyrgyz Republic SAAC and HCS №ЖА03/680 от 26.09.2019г.

						19/18 ад	Northen bypass road of Blshkek clty Sectlon 1. Reconstructlon of the road Alma-Ata - Blshkek - Tashkent km 230+735-km 255+022
Изм.	Кол.уч.	Лист	№док.	Подп.	Дата		Северная объездная дорога г. Бишкек Участок 1. Реконструкция автомобильной дороги Алма-Ата-Бишкек-Ташкент км230+735-км255+022
						Typlcal cross sectlon	stage / стадия: ПД; page / лист: 4,2; pages / листов: 2
ГИП		Ашымбеков Т.				Типовые поперечные профили	ПИИ "Кыргыздортранспроект" г. Бишкек
Исполнитель		Исаев У.					
Н.контроль		Ашымбеков Т.					

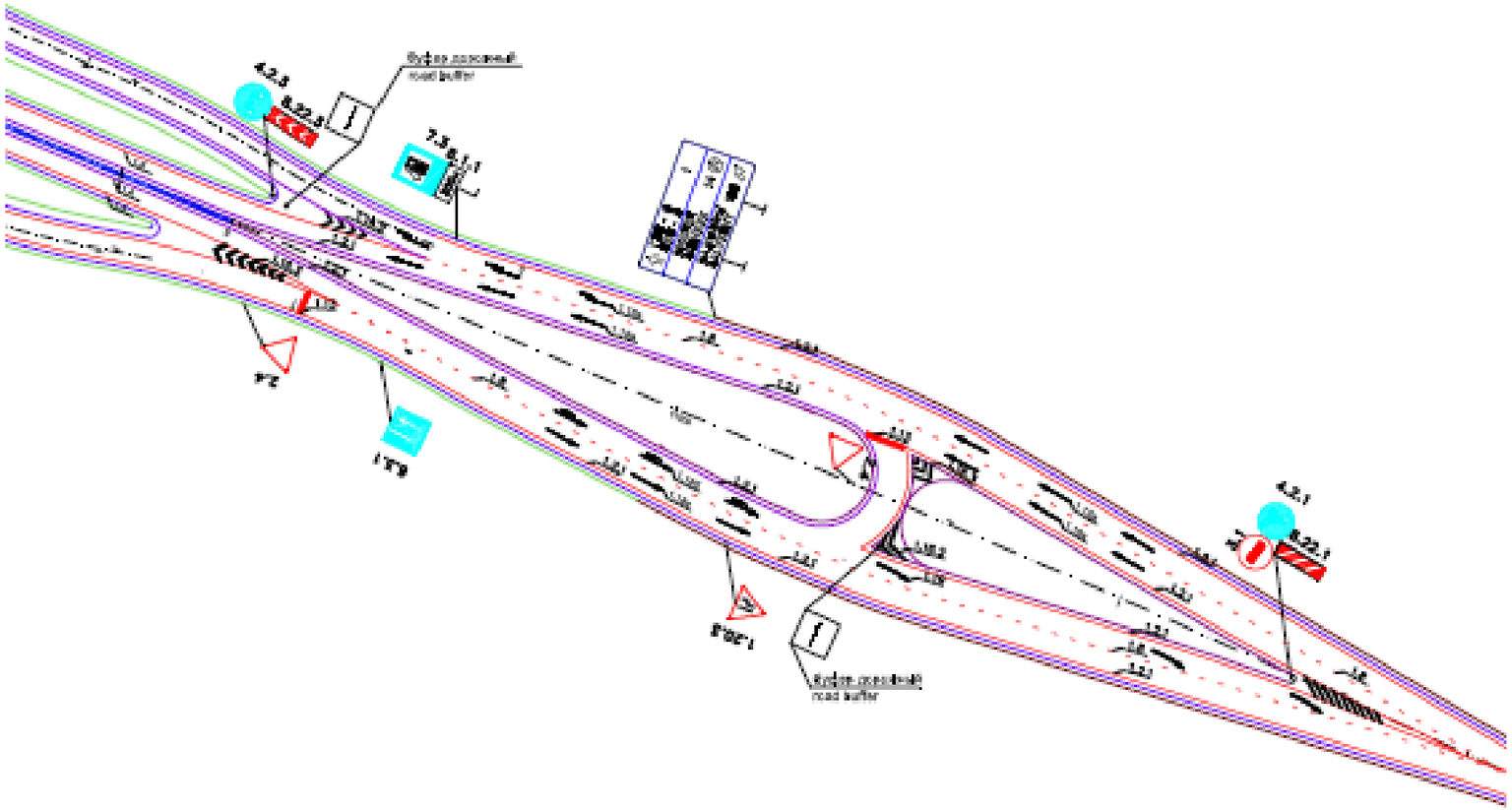
During the inspection, look to see who your customers are, and will be.

Existing 2-lane roundabout

Northern Bishkek By-Pass – preliminary design stage audit



Examining one part of one drawing




Low volumes
on N approach
Proposed
U-turn
© 2020 Google
Image © 2020 Maxar Technologies
Google Earth

Safety concerns…..

The preliminary design for the proposed interchange has several safety concerns:

- Wrong-way movements in the ramp could occur as vehicles leave the small road serving the service station.
- The proposed one-direction U-turn on the southern approach to this interchange will be located near an entry ramp where 2 lanes of traffic will be merging just as the U-turn opens; but the U-turn does not have a sheltered turn lane. On the other carriageway, U-turners will enter the road just before an exit ramp

Medium risk

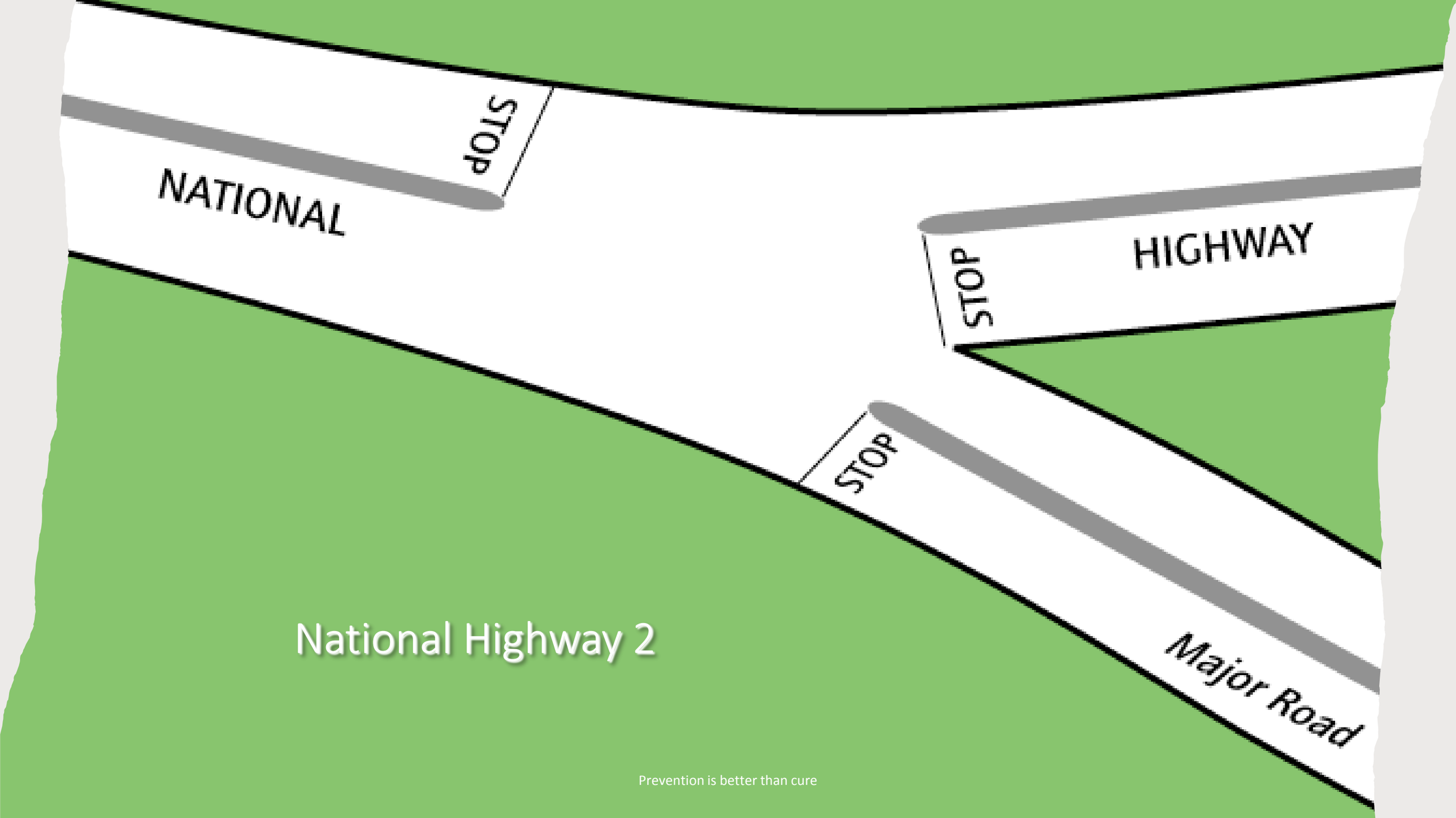
Recommendations…..

- Review the decision to construct this interchange.
- Consider improving and retaining the 2-lane roundabout. (It will not need a U-turn).

- If an interchange is built, consider adopting a conventional closed diamond interchange (serving all approaches – even the approach with low traffic volumes).
- Provide for all approaches to have access to/from the By-pass though the interchange.
- Then, remove the proposed U-turn from the design.

Detailed design stage audits consider…

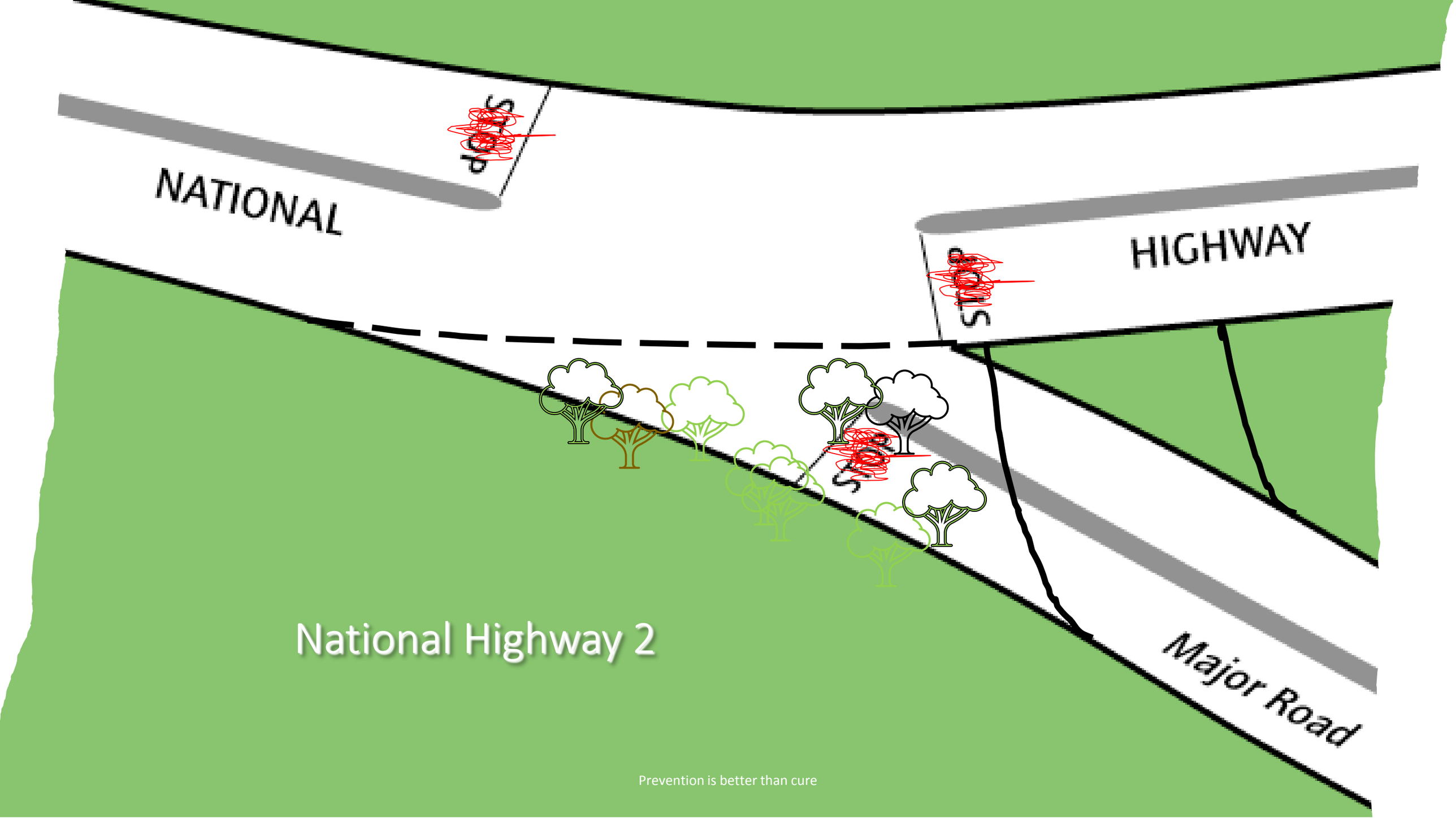
- clear zone issues
- signs/line marking
- crash protection
- traffic control
- geometric design
- lighting……..and more



National Highway 2

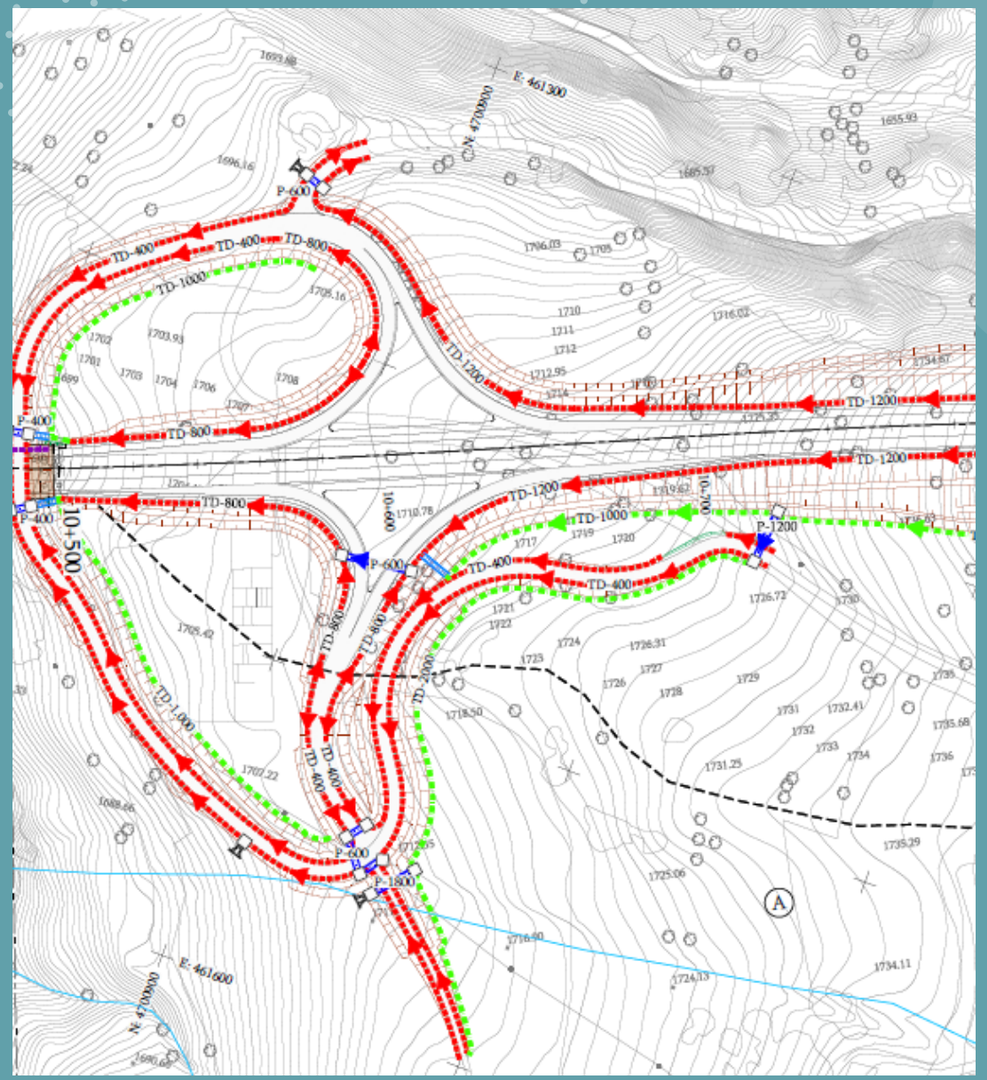
National Highway 2


OK
Telco
माँ का आशिर्वाद


NATIONAL
HIGHWAY
Major Road
National Highway 2

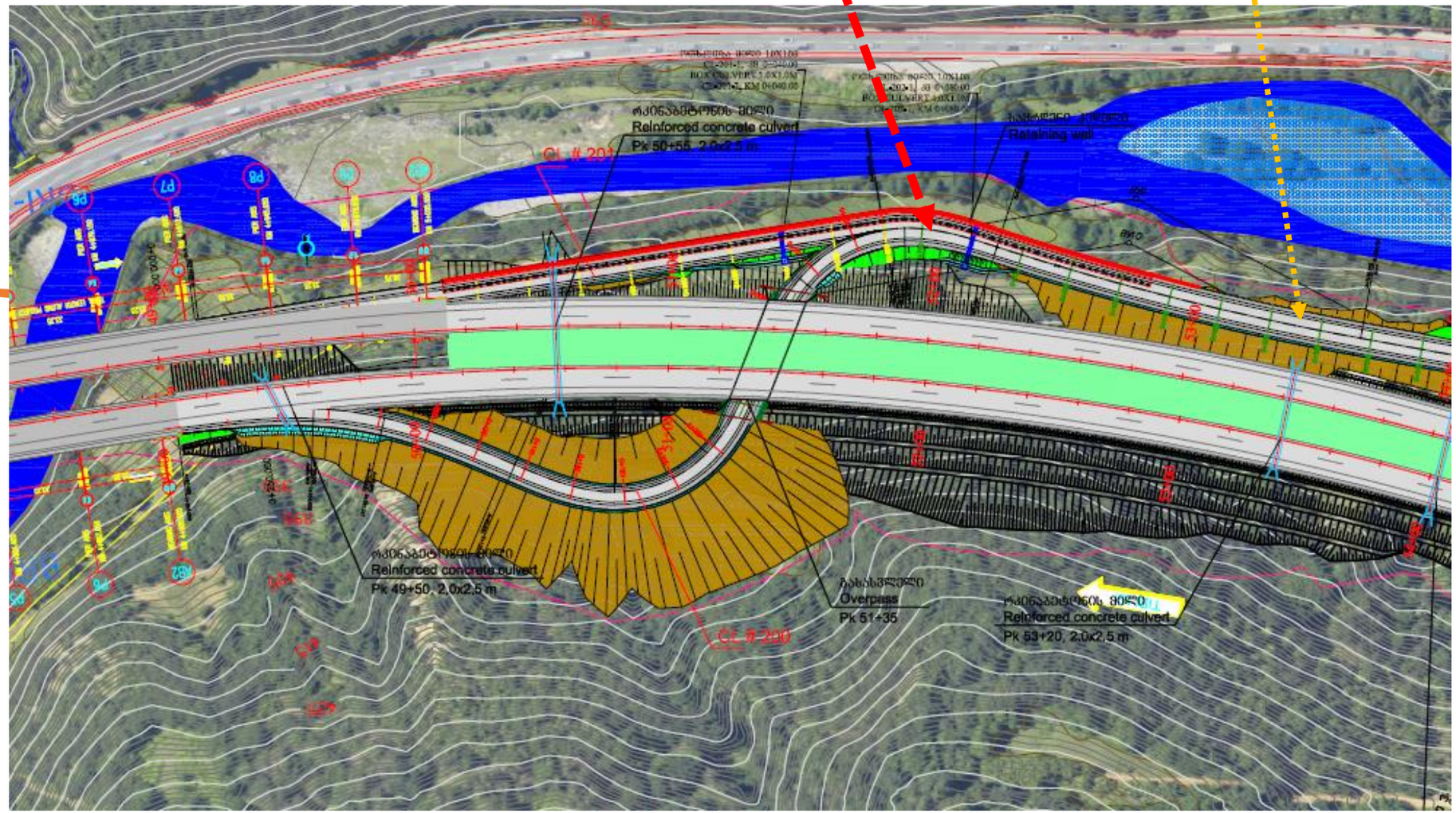
Detailed design stage audits consider…

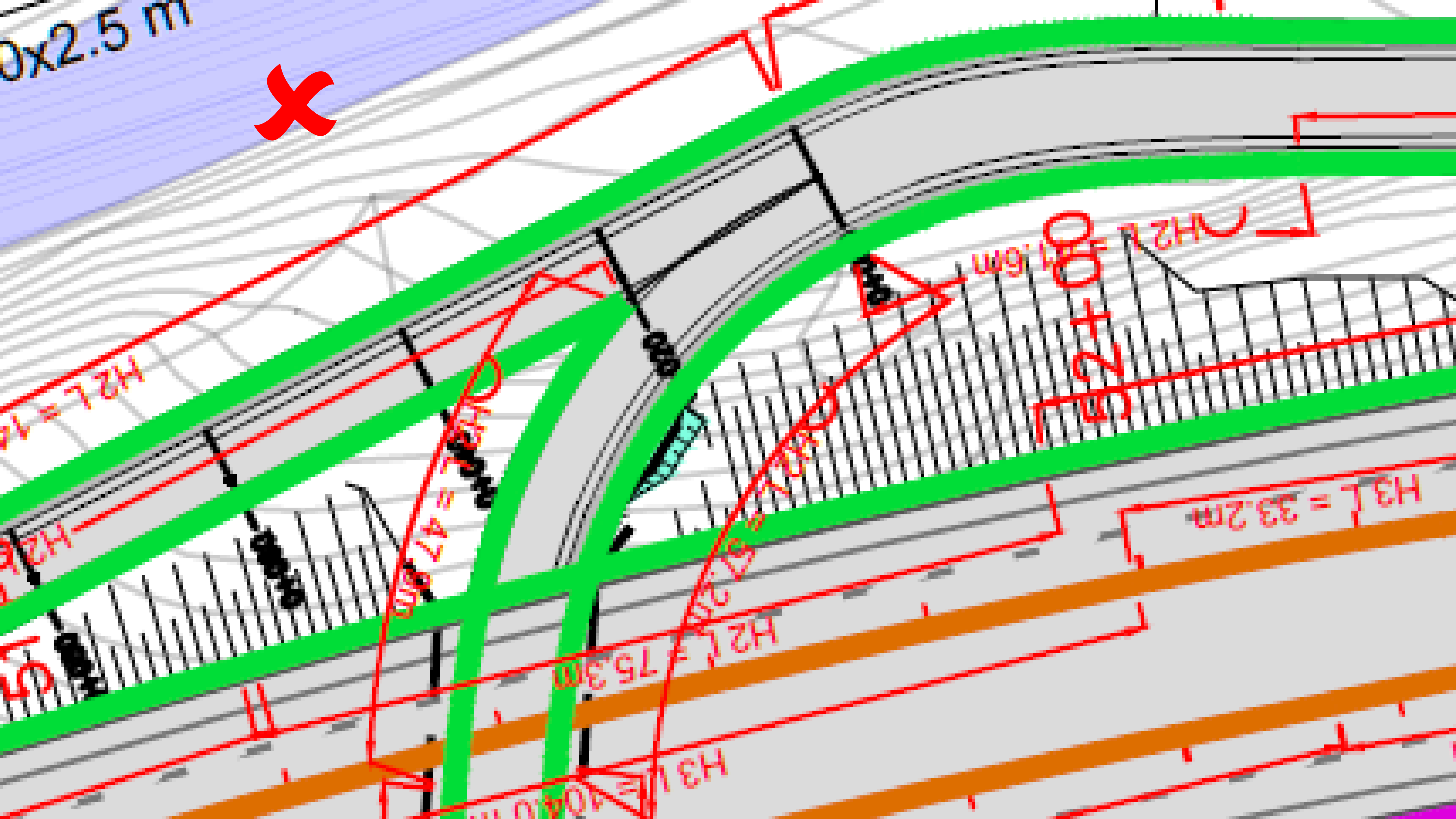
- roadside safety issues
- signs/line marking
- geometric issues
- traffic control
- pedestrian/bicycle issues
- lighting……..and more

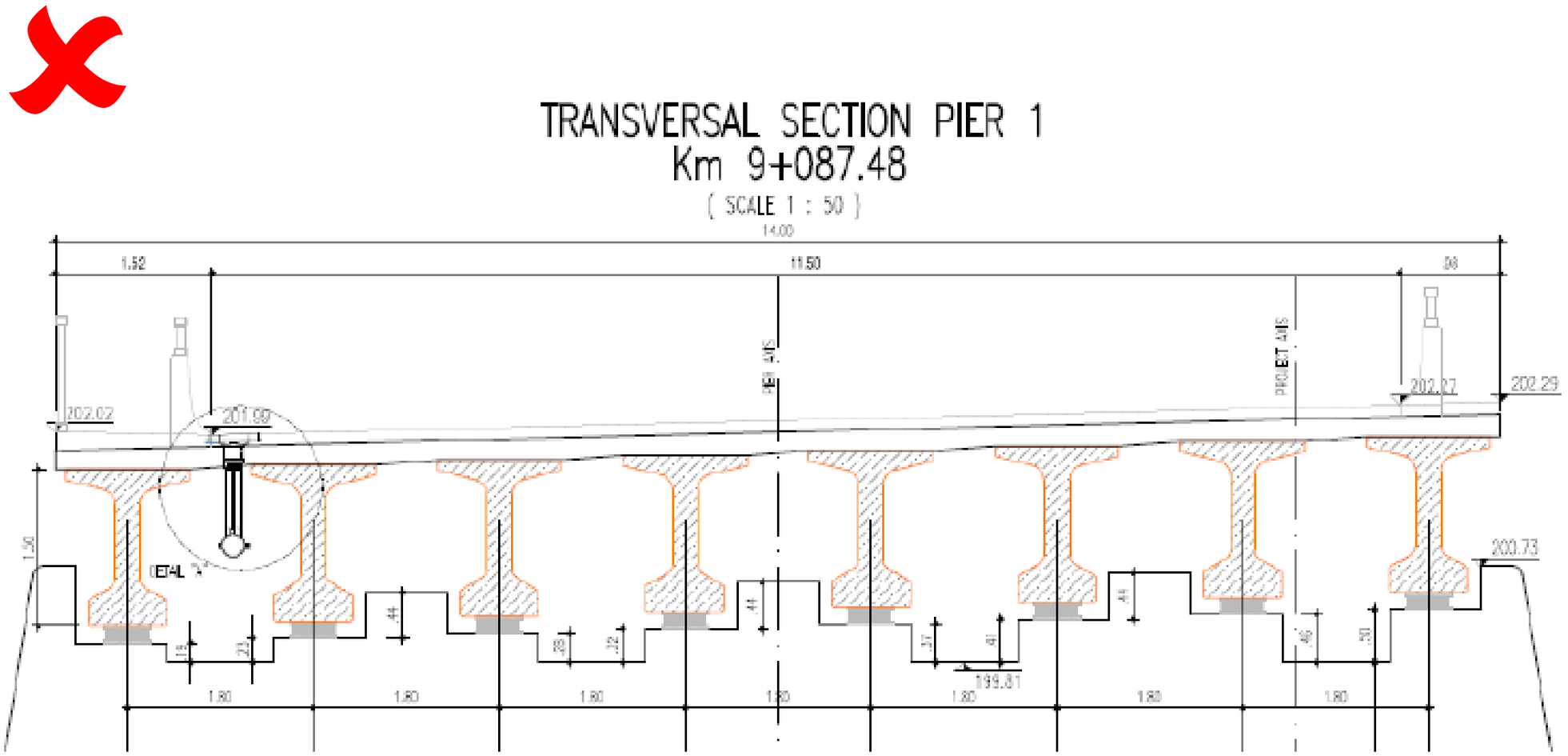


A detailed design stage audit in Georgia – a new expressway

High risk of wrong way movements




0x2.5 m
H3 L = 33.2m
H2 L = 75.3m



“Standard” but very unsafe

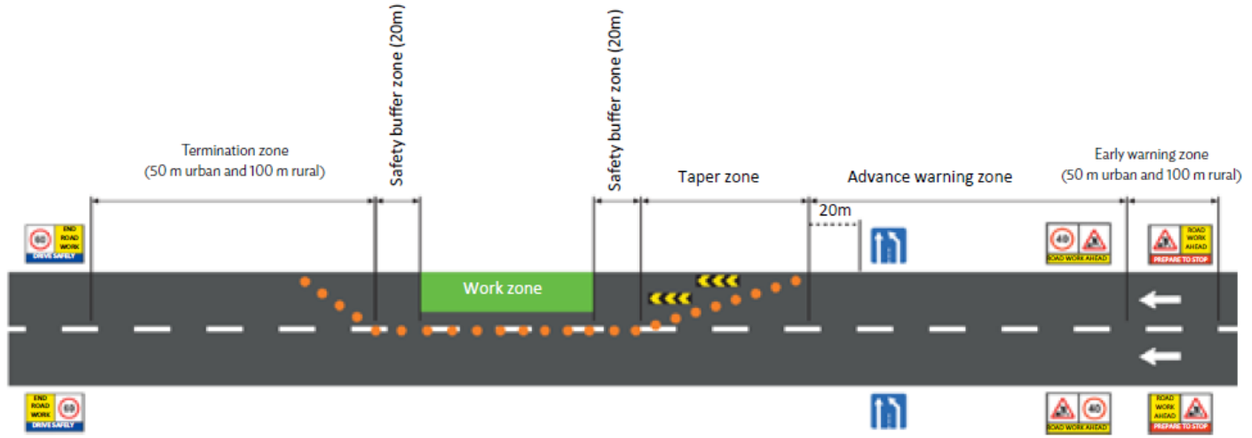

“Standard” but very unsafe

Audits of traffic management of road works consider….

- Crash protection at the work site
- Delineation
- Traffic control
- Traffic management
- Safety of workers
- Signs, lighting ……and more

Begin by auditing the Traffic Management Plan (TMP)

Figure 17: Closure of the Right-Hand Lane of a Multilane Carriageway



m = meter.

Note: The traffic management plan is for one direction of travel only.

Source: Asian Development Bank.


Not enough
advanced warning!

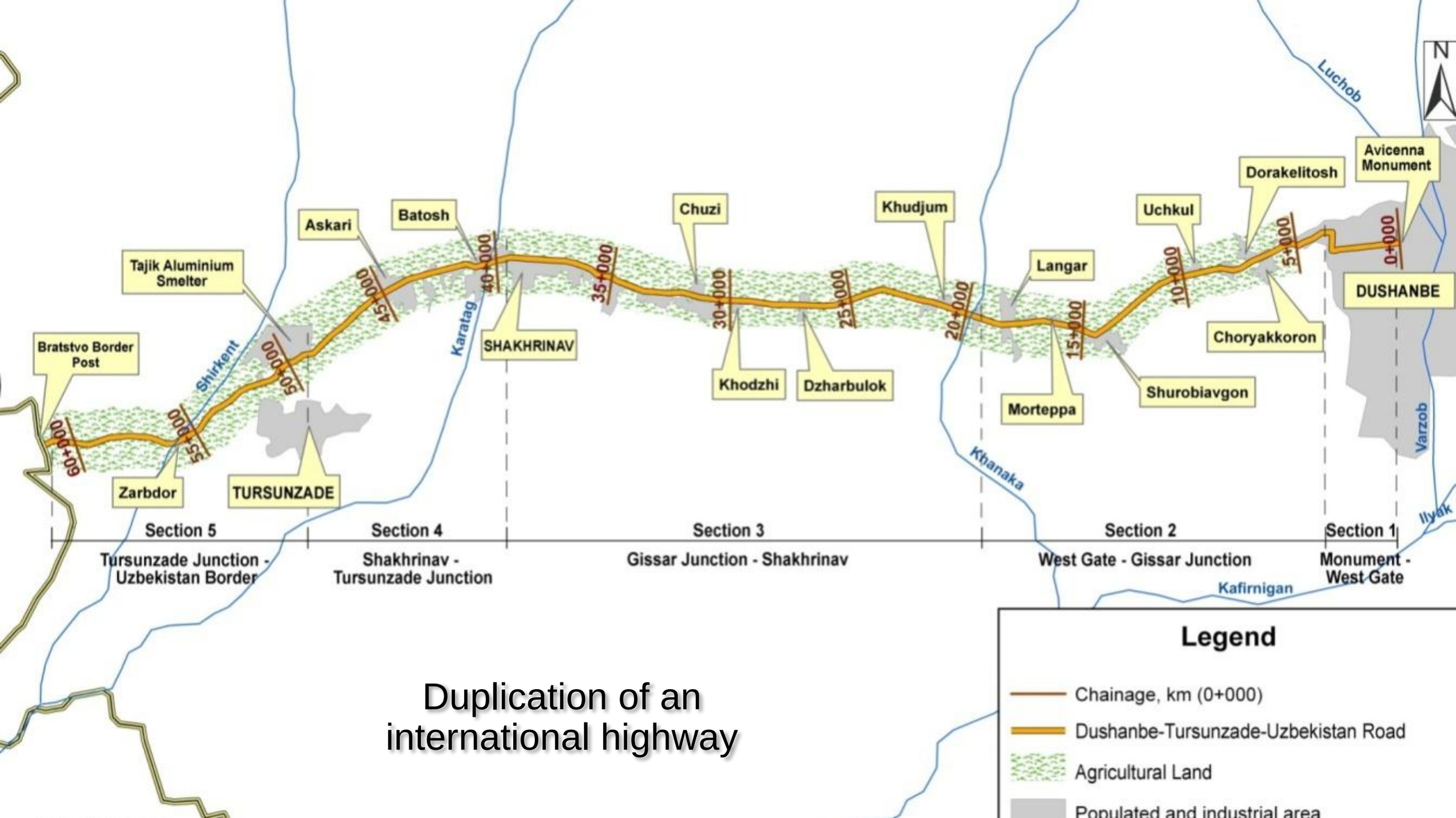

Think of this work site at night!

Traffic approaches at 130km/h.
Consider trucks at night!

Prevention is better than cure

Pre-opening audits consider…

- Previous audit issues – have they been adequately addressed
- Roadside hazards, including how these have been treated
- The correctness of signs and markings
- Facilities for pedestrians, bicyclists, and other specific groups
- Signal timings, phasing
- The road users' view ……and more



Duplication of an international highway

Pre/post- opening audit

57 km of newly duplicated highway.
Opened to traffic December 2015.

8 fatalities in first 6 months of 2016.
6 of these were pedestrians!

- High traffic speeds through villages (high risks for pedestrians).
- Geometric and traffic control issues (intersections and U-turns).
- Variations in cross sectional (particularly the width of paved shoulders).
- Roadside hazards (including barriers, concrete barricades, lighting columns, bridges, drains and culverts).

Pre/post-opening stage audit


Pre/post-opening stage audit
???
Image © 2016 DigitalGlobe
Google earth


Pre/post-opening stage audit


Pre/post-opening stage audit
АГРОТЕХСЕРВИС
ТАЪМИРИ ЧАРХҲО
ШИНОМАНТАЖ

Pre/post-opening stage audit

Pre/post-opening stage audit

Pre/post-opening stage audit

Pre/post-opening stage audit

Audits of existing roads (road safety inspections) consider all issues relevant to the crash potential of the road…

Prevention is better than cure

If an existing road audit identifies a *potential* safety issue, how can the road manager justify spending money to rectify it, while there are “black spots” (with proven crash records) waiting for funds ?

Prevention is better than cure - by Phillip Jordan

But audits of existing roads (road safety inspections) can….

… be useful in countries that do not have complete and accurate crash data

… guide engineers to high-risk locations

But remember, too many road safety inspections may…

- lead to unfulfilled expectations
- cause a misunderstanding of the benefits of design stage audits
- cause confusion with crash investigations

Road safety audit - the earlier, better - safer, cheaper


Road safety audit…may be the only time that road safety is explicitly considered in a project

The costs and the benefits of road safety audit

Road safety audits are a small part of the design cost…

- 1-2% of total design costs
- A fraction of 1% of total project costs (the bigger the project, the lower this percentage)

The costs and the benefits of road safety audit

UK Highways Agency

- TRL examined 22 audited sites on trunk roads
- The costs of implementing the audit recommendations were compared with the costs of rectifying the sites after the project was constructed
- Average saving per site of £11,373

Surrey County Council

- 19 audited sites were compared with 19 non-audited sites
- 2+ years of crash data were compared
- Audited sites had a casualty saving of 1.25 pa
- Non-audited sites had a casualty saving of just 0.25

The costs and the benefits of road safety audit

The costs and the benefits of road safety audit

Jordan

- 9 sites that had been constructed in the past decade (not audited) and had become safety problem sites
- It was assumed that, if the sites had been audited, they would not have required improvements later
- First year rate of return of 120%

The costs and the benefits of road safety audit

Denmark

- Assessed 13 schemes that had been audited during the design phase
- An evaluation panel conducted cost benefit analyses of these safety audits
- A general crash prediction method was used
- First year rate of return of 146%

The costs and the benefits of road safety audit

- AUSTROADS
  - Design audits had benefit cost ratios ranging from 3:1 to 242:1
  - Existing road audits had benefit cost ratios ranging from 2:1 to 84:1

One road crash fatality in your country costs?

The costs and benefits of road safety audit

- ✓ Audits are low cost
- ✓ Audits are high benefits


Road safety audit is a positive process

CONCLUSION

Road safety will benefit from road safety audit for several reasons……

- experience elsewhere has shown that the optimum road safety outcome is not achieved solely by compliance with standards
- road safety audit provides some “protection” against total reliance on standards
- road safety audit is a low-cost process, with demonstrated high benefits

CONCLUSION

It is a “transparent” process – open for all to see and ask questions about

It demonstrates professional responsibility in road safety engineering

It is attractive - bureaucratically as well as politically

CONCLUSION

There are growing concerns about road safety now

These will increase & grow

“Get it right the first time”

No one wants to build a blackspot!

What projects are to be audited in your country?

SUGGESTED RSA POLICY

“All road projects will be road safety audited at the following stages according to the class of road, in accordance with the procedures contained in the CAREC Road Safety Audit manual”

What road projects should be audited in your country? (A draft RSA policy!)

AUDIT	EXPRESSWAYS & INTERNATIONAL HIGHWAYS	NATIONAL HIGHWAYS	MAJOR ROADS (URBAN/RURAL)	LOCAL STREETS & VILLAGE ROADS
FEASIBILITY	√	Optional	Optional	N/A
PRELIMINARY DESIGN	√	Optional	Optional	N/A
DETAILED DESIGN	√	√	√	√
ROAD WORKS	√	Optional	Optional	Optional
PRE-OPENING	√	√	√	√
SAFETY REVIEWS OF EXISTING ROADS	ACCORDING TO LOCAL POLICY AND RESOURCES			
NO. OF AUDITS	5	Minimum 2	Minimum 2	Minimum 2

I wish you well for this important road safety process, and I look forward to your questions

Prevention is better than cure

Your homework
Detailed design stage road safety audit of the Dushanbe-Kurgonteppa Highway (Stage One)

Your audit homework 2 – a learning experience

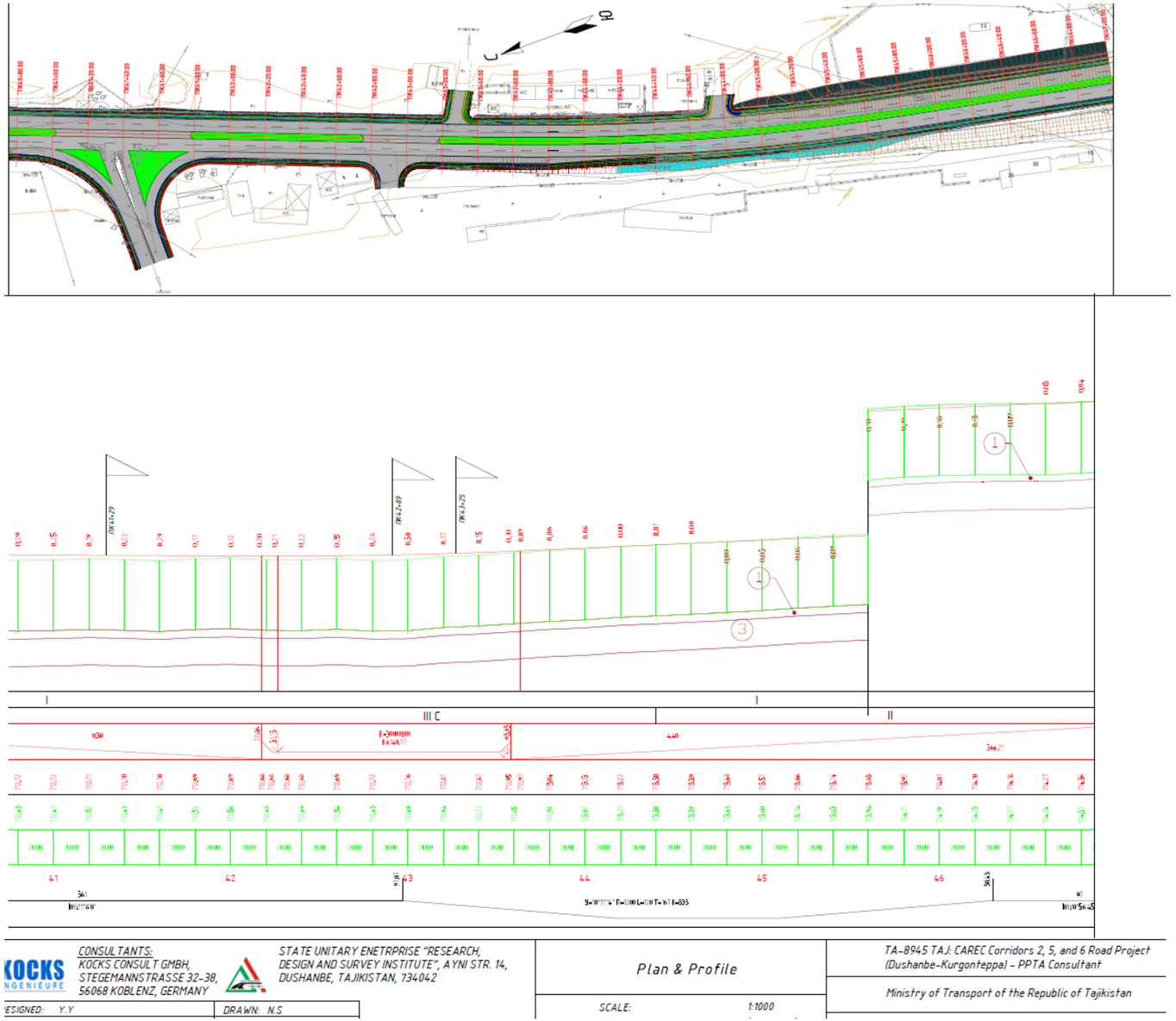
- ADB-funded project. Approval has been given to use it as a learning experience.

- This “real life” case study audit is for you to learn more about the audit process.
- Download the 2 sets of drawings for a major CAREC highway duplication project from the link.

- Audits take time. Audits require skills and judgement.
- Audits should be done by audit teams.

- Learning about the audit process is the reason for doing this homework.

A typical plan and profile drawing. For your audit



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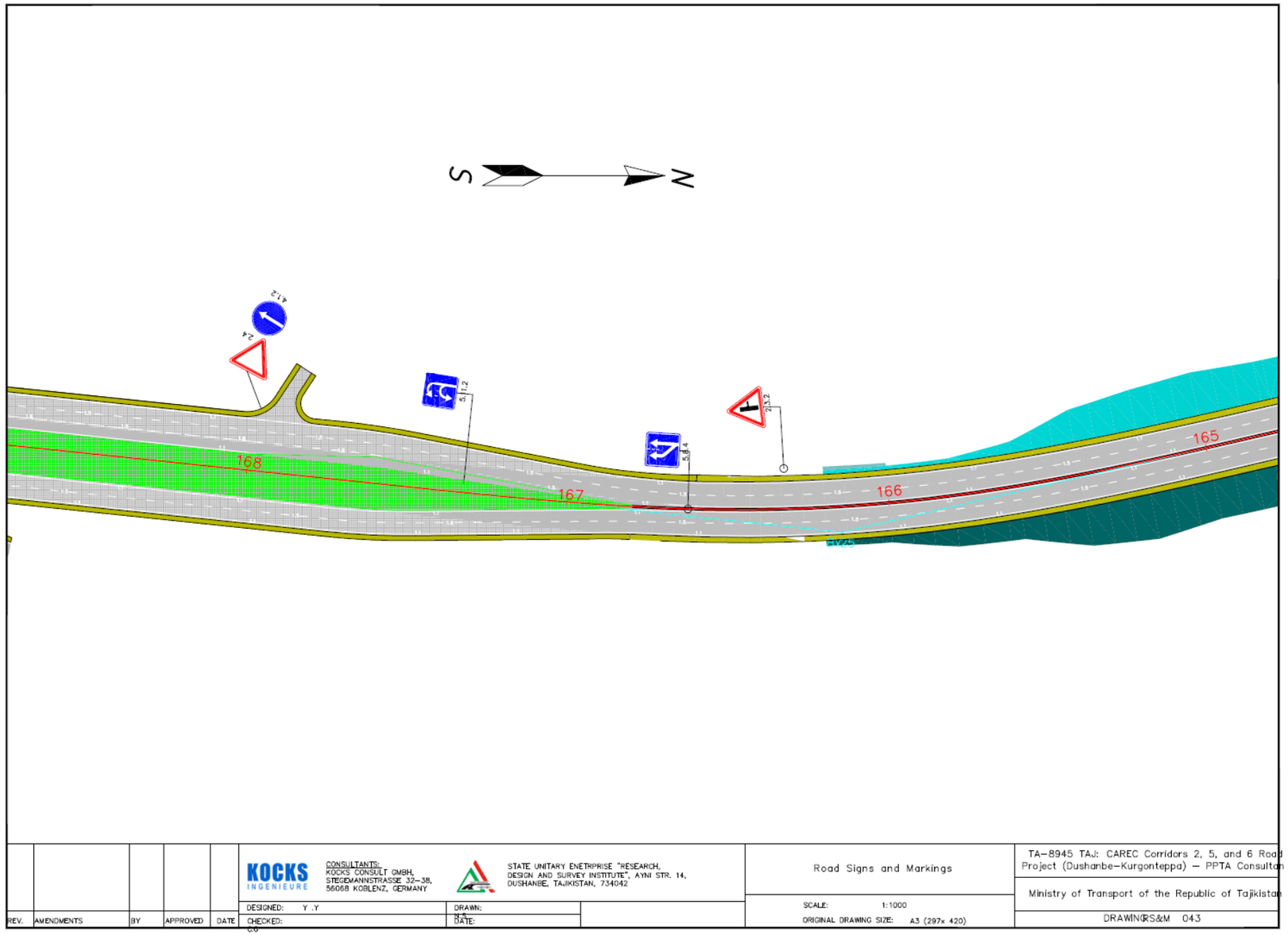
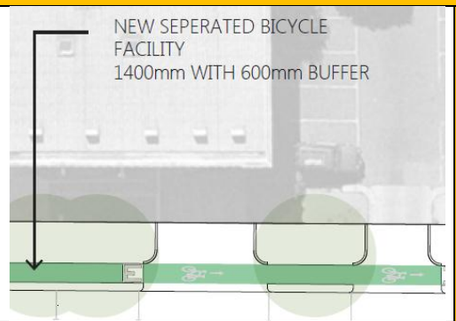
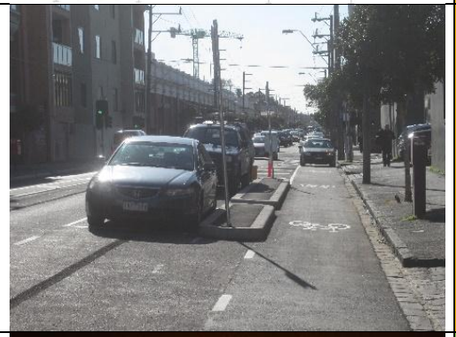


Your Homework 2

- Please examine the two sets drawings – or a few of each (this is a large project, and your time is limited)
- Use the audit checklists (from the CAREC RSA manual, or another manual) to assist and prompt you.
- Then prepare an audit report (with your recommendations) and upload it by tomorrow night! Maybe 1-2 pages.
- Quality, not quantity!
- Feedback will be given at the beginning of Module 6 on Thursday

A matrix of audit findings – you may wish to use such a table in your report

SHEET	SAFETY CONCERN	DRAWING/PHOTO	RISK	RECOMMENDATION	CLIENT RESPONSE
SAFETY CONCERNS WITH THE PROPOSED STREETSCAPE IMPROVEMENTS, PAISLEY STREET, FOOTSCRAY, CITY OF MARIBYRNONG					
General	The proposed bicycle lanes are shown in the drawings to be 1.4m wide. This is 400mm less than the AUSTROADS recommended minimum width. While this is likely to be adequate for a single line of cyclists travelling at a similar speed, it is likely to be too narrow to safely support passing manoeuvres (e.g, a faster rider overtaking a slower rider). This could lead to some "side swipe incidents"		**MED**	- As per Austroads Guide to Road Design Part 3, the minimum width for protected bicycle lanes is 1.8 m. Wider lanes of 2.0 m or greater will enable cyclists to pass one another. Physical separation from motor traffic should be provided by a raised traffic island or a safety strip that is desirably 1.0 m or greater wide (0.6 m minimum). - Consider providing a wider protected lane.	
General	The proposed 600mm buffer shown in the drawings is the minimum acceptable buffer width stated in VicRoads guidelines, but most car doors exceed this dimension. Passengers exiting a vehicle may open their door into the path of an approaching rider. Dooring is a serious bicyclist issue and providing a wider buffer is very desirable.		**MED**	- Increase the buffer (separator) to 1000mm wide. - If this is not possible, try to achieve a minimum 800mm width.	
General	During the evening site inspection, it was evident that several street lights were not working. This created some dark spots and has a direct impact on personal safety and could also increase the likelihood of tripping hazards. Although a lighting plan was not provided to the auditors (this is a Concept Stage audit and lighting plans would not be expected until a later stage) it is desirable to consider lighting and maintenance of lighting as early as possible.		**LOW**	- Ensure that a lighting review/upgrade is included as part of the project. - Ask Councils maintenance group to inspect and repair any street lights that are not working.	

Your Homework 2

- We cannot do a site inspection!
- The following photographs are your “substitute” site inspection.
- Please DO NOT make comments about the safety issues in the existing highway (*you will see many in these photographs*). The photos show the road users, the topography and why the highway is soon to be duplicated.
- This is a detailed design stage audit. The highway is going to change greatly.
- Your job is to audit the detailed design stage drawings - ONLY.
- Your time is limited.

HERE IS YOUR SITE VISIT!

This is the existing road. Do NOT comment on these photos – audit only the drawings

Generally moving along the chainage from near 0+00 towards 33+00


This is the existing road. Do NOT comment on the photos – audit only the drawings
Generally moving along the chainage from near 0+00 towards 33+00


This is the existing road. Do NOT comment on the photos – audit only the drawings
Generally moving along the chainage from near 0+00 towards 33+00


This is the existing road. Do NOT comment on the photos – audit only the drawings
Village of Ovi Shivu
Km 6.5

This is the existing road. Do NOT comment on the photos – audit only the drawings

Village of Ovi Shivu

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This is the existing road. Do NOT comment on the photos – audit only the drawings
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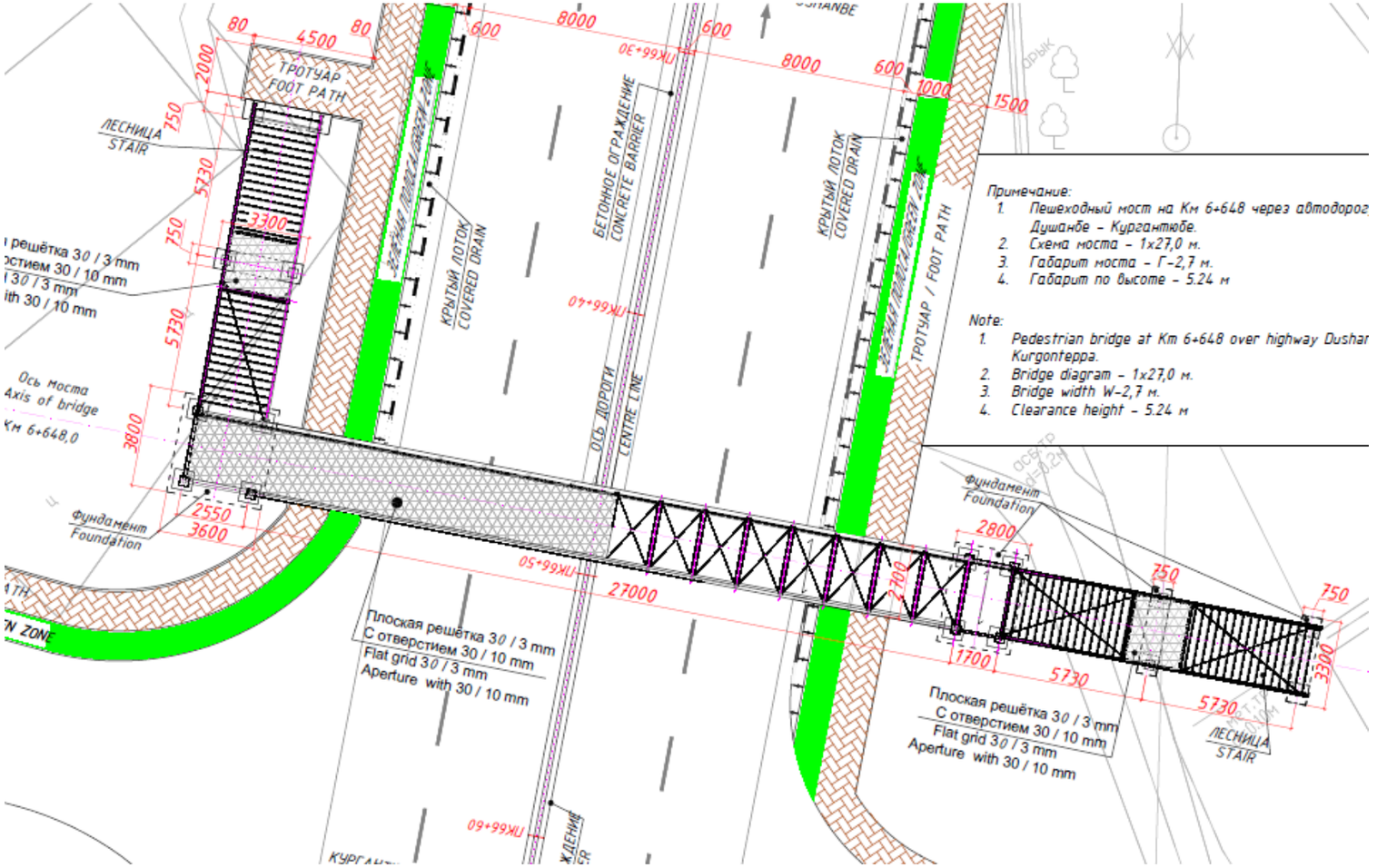
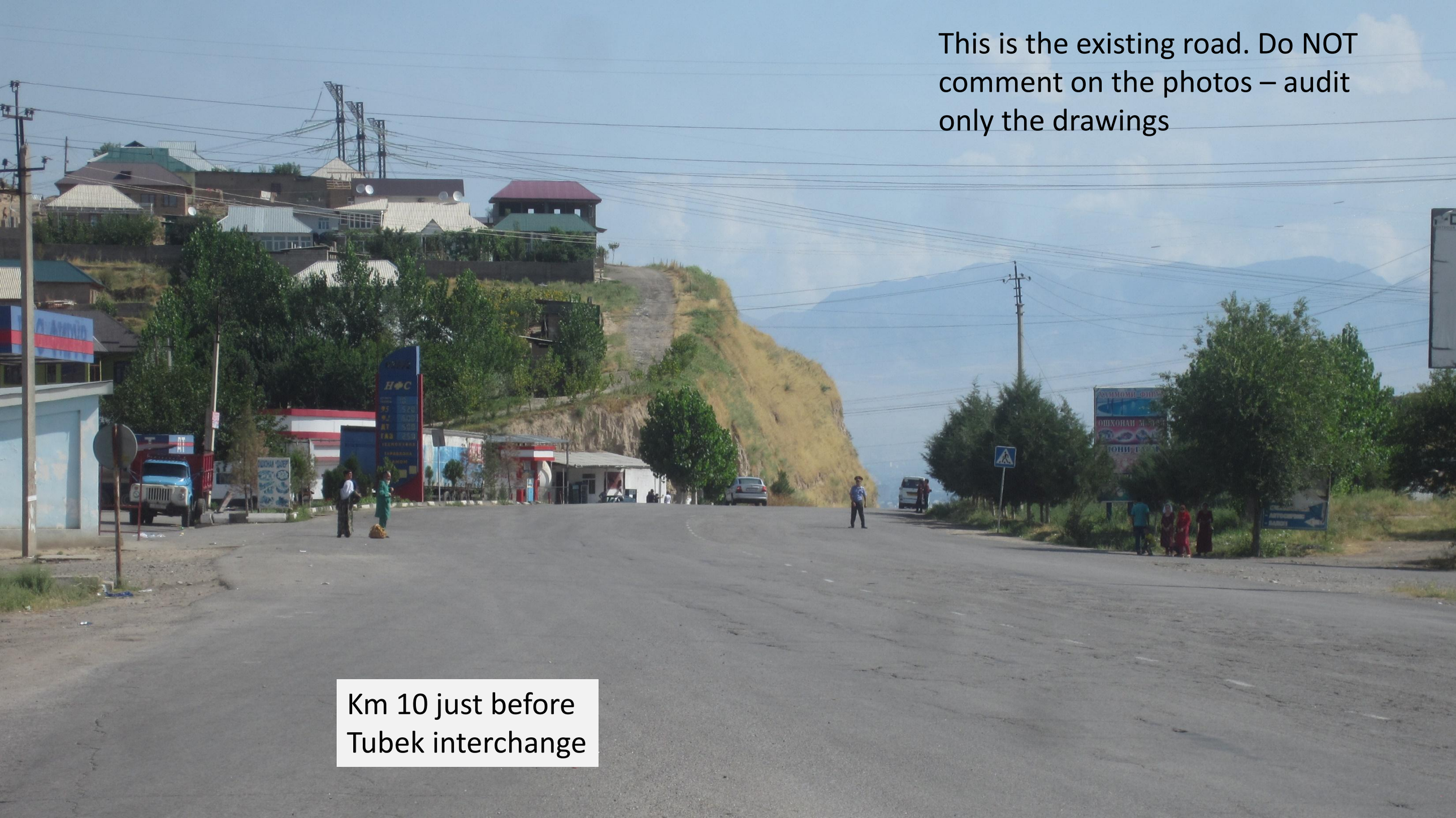


There is a proposed pedestrian overpass in Ovi Shivu. Auditors need to ask if will it offer service to the pedestrians of the village.
It is located to serve school children. It will have 32 steps up and 32 steps down.
Think of the disabled, or those pedestrians with loads!

Km 6.5


This is the existing road. Do NOT comment on the photos – audit only the drawings
Km 9 – 1500m before Tubek interchange


This is the existing road. Do NOT comment on the photos – audit only the drawings
Km 10 just before Tubek interchange


This is the existing road. Do NOT comment on the photos – audit only the drawings
Tubek interchange


This is the existing road. Do NOT comment on the photos – audit only the drawings
Tubek interchange

This is the existing road. Do NOT comment on the photos – audit only the drawings

Tubek interchange


This is the existing road. Do NOT comment on the photos – audit only the drawings
Near Km 18-19


This is the existing road. Do NOT comment on the photos – audit only the drawings
Near Km 23

This is the existing road. Do NOT comment on the photos – audit only the drawings

Bridge at southern end of Stage 1 (Km 33+475)

This is the existing road. Do NOT comment on the photos – audit only the drawings

Beyond Stage 1 – outside the scheme near Km 36

Your Homework 2 – a possible template

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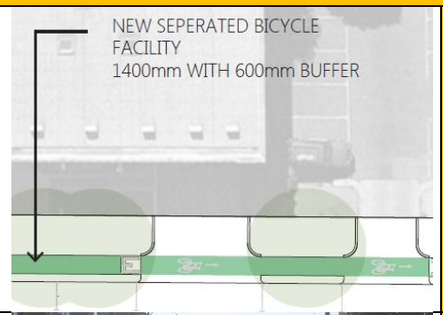
General	The proposed bicycle lanes are shown in the drawings to be 1.4m wide. This is 400mm less than the AUSTROADS recommended minimum width. While this is likely to be adequate for a single line of cyclists travelling at a similar speed, it is likely to be too narrow to safely support passing manoeuvres (e.g, a faster rider overtaking a slower rider). This could lead to some "side swipe incidents"		**MED**	- As per Austroads Guide to Road Design Part 3, the minimum width for protected bicycle lanes is 1.8 m. Wider lanes of 2.0 m or greater will enable cyclists to pass one another. Physical separation from motor traffic should be provided by a raised traffic island or a safety strip that is desirably 1.0 m or greater wide (0.6 m minimum). - Consider providing a wider protected lane.	
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Your Homework 2 - RSA

- DO NOT comment about the safety issues you see in the photographs. That is the existing highway. Only look at the topography, and the types of road users. Its your site inspection.

- Your job is to audit the detailed design stage drawings for the proposed highway duplication - ONLY.

YOUR ROAD SAFETY AUDIT HOMEWORK

- Examine a few drawings (time is short).
- Look for safety concerns in them.
- Prepare a one/two-page RSA report.
- Write the safety concerns clearly and accurately.
- Give a risk for each.
- Give a recommendation for each.
- Upload your report (in English) by tomorrow night.
- Feedback at the start of Module 6 on Thursday.
- Questions?
- Good luck!