

# Road Safety Audit Applications for US 30



Nick Fortey, P.E.

January 24, 2011

Federal Highway Administration, Oregon Division

[nick.fortey@fhwa.dot.gov](mailto:nick.fortey@fhwa.dot.gov) 503-587-4721



# Road Safety Audits\*

*\* Assessments, Reviews, etc.*

# Background

- Road Safety Audits/Assessments (RSAs) are a valuable tool used to evaluate road safety issues and to identify opportunities for improvement
- Road Safety Audits have been widely used around the world
- Road Safety Audits are applicable throughout the highway design and performance cycle.

# Road Safety Audits (RSAs)

4

- Formal safety performance examination
- Existing or Future Road Segment or Intersection
- Independent, multidisciplinary team



# What is an RSA?

- A formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team.

<i>RSAs <u>are</u>:</i>	<i>RSAs <u>are not</u>:</i>
<ul style="list-style-type: none"><li>✓ <b>Focused on road safety.</b></li><li>✓ <b>A formal examination.</b></li><li>✓ <b>Proactive in nature.</b></li><li>✓ <b>Conducted by a multidisciplinary team.</b></li><li>✓ <b>Conducted by a team that is independent of the operations, design, or ownership of the facility.</b></li><li>✓ <b>Conducted by a qualified team.</b></li><li>✓ <b>Broad enough to consider the safety of all road users of the facility.</b></li><li>✓ <b>Qualitative in nature.</b></li></ul>	<ul style="list-style-type: none"><li>X A means to evaluate the design of a facility.</li><li>X A check of compliance with standards.</li><li>X A means of ranking or justifying one project over another.</li><li>X A means of rating one design option over another.</li><li>X A redesign of a project.</li><li>X A crash investigation (although the crash history of an existing facility is reviewed by an RSA team).</li><li>X A safety review.</li></ul>

# Why RSAs?

- Use of RSAs continues to grow
- Success has led to FHWA adopting process as one of its nine “proven safety countermeasures”
- RSAs
  - ▣ Will help save lives and reduce injuries
  - ▣ Examine conditions in detail that may pose safety hazards to all road users
  - ▣ Consider safety from a human factors point of view
  - ▣ Do not require large investment in time or money



# Traditional Road Safety Review *versus* Road Safety Audit

## Traditional Road Safety Review

- **reactive**
- **in-house team**
- **field review?**
- **standards compliance**

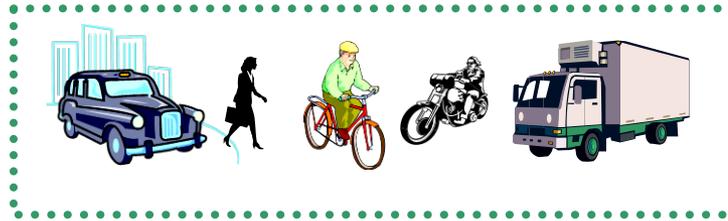
## Road Safety Audit

- **proactive**
- **independent team**
- **field reviews**
- **comprehensive, with  
human factors**

# An RSA also...

8

- Considers safety of all road users



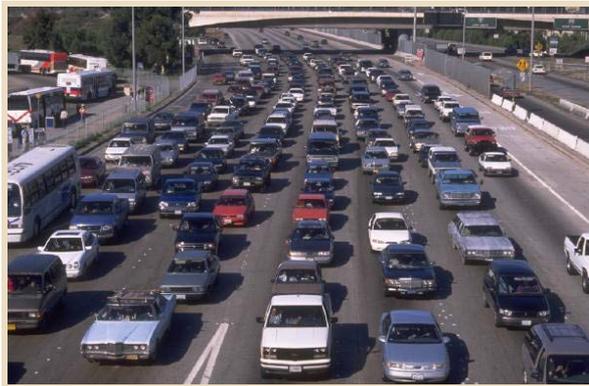
- Considers interactions at the borders or limits of the project
- Examines the interaction of project elements
- Proactively considers mitigation measures

# Systems Approach: Crashes Caused by Various Factors

Roadway 34%



Vehicle 12%



Driver 80%

Human is weakest link in this system, so we must design around human needs.

# Prioritize Safety Concerns

## Qualitative Estimate of Risk

RISK CATEGORY		SEVERITY			
		Low	Moderate	High	Extreme
Crash Frequency Category	Frequent	C	D	E	F
	Occasional	B	C	D	E
	Infrequent	A	B	C	D
	Rare	A	A	B	C

# When do we conduct RSAs?

11

## □ Early Stages

- Planning / scoping / feasibility
- Preliminary (draft) design
- Detailed design



## □ Construction

- Work zones
- Pre-opening



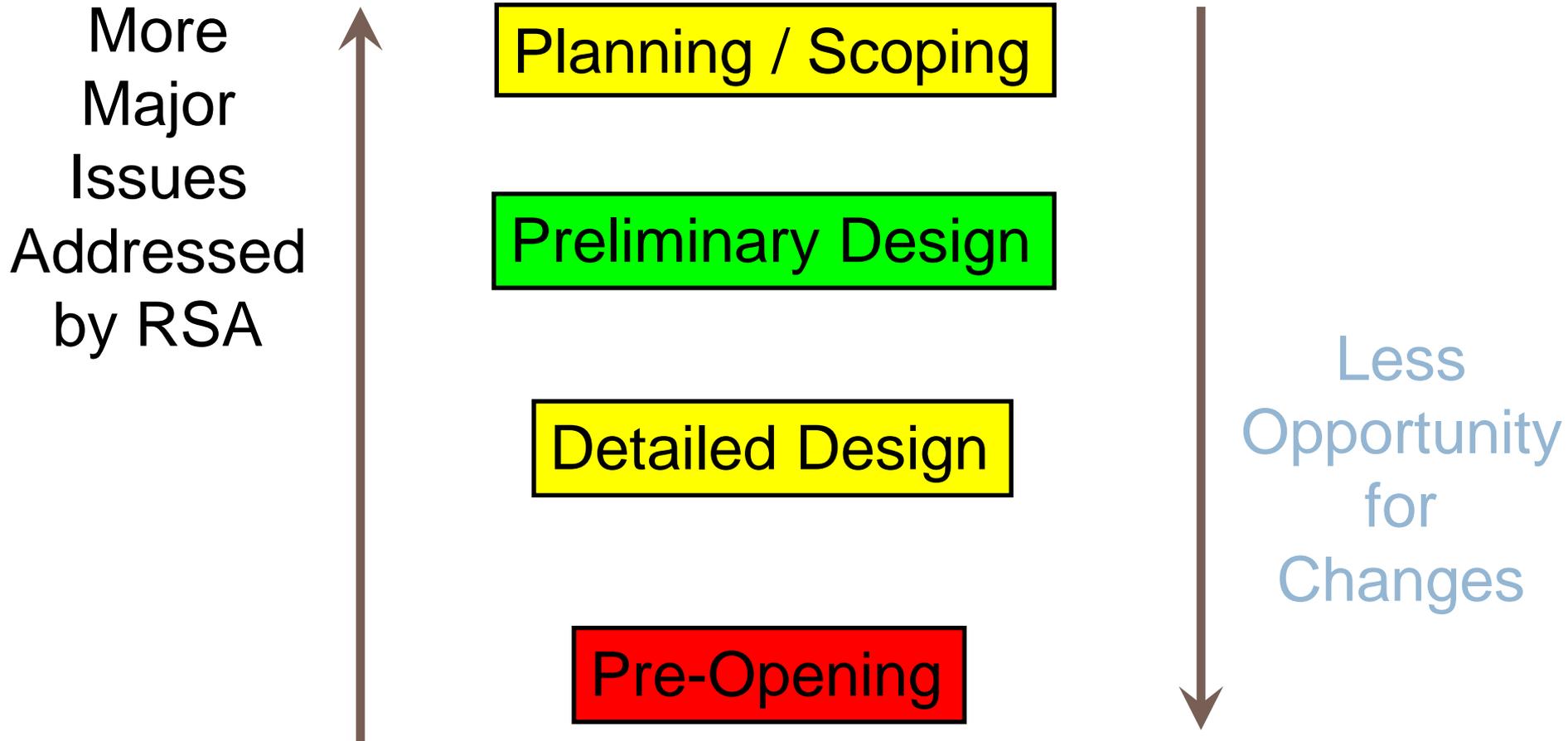
## □ Post-construction

- Existing roads



# RSAs & Project Stages

12



# RSA Benefits

- ❑ Reduce the number and severity of crashes
- ❑ Promote awareness of safe practices
- ❑ Process to identify and address problems
- ❑ Considers human factors and multimodal issues
- ❑ Low cost



# RSA PROCEDURES

The 8-step Process



# RSA Procedure

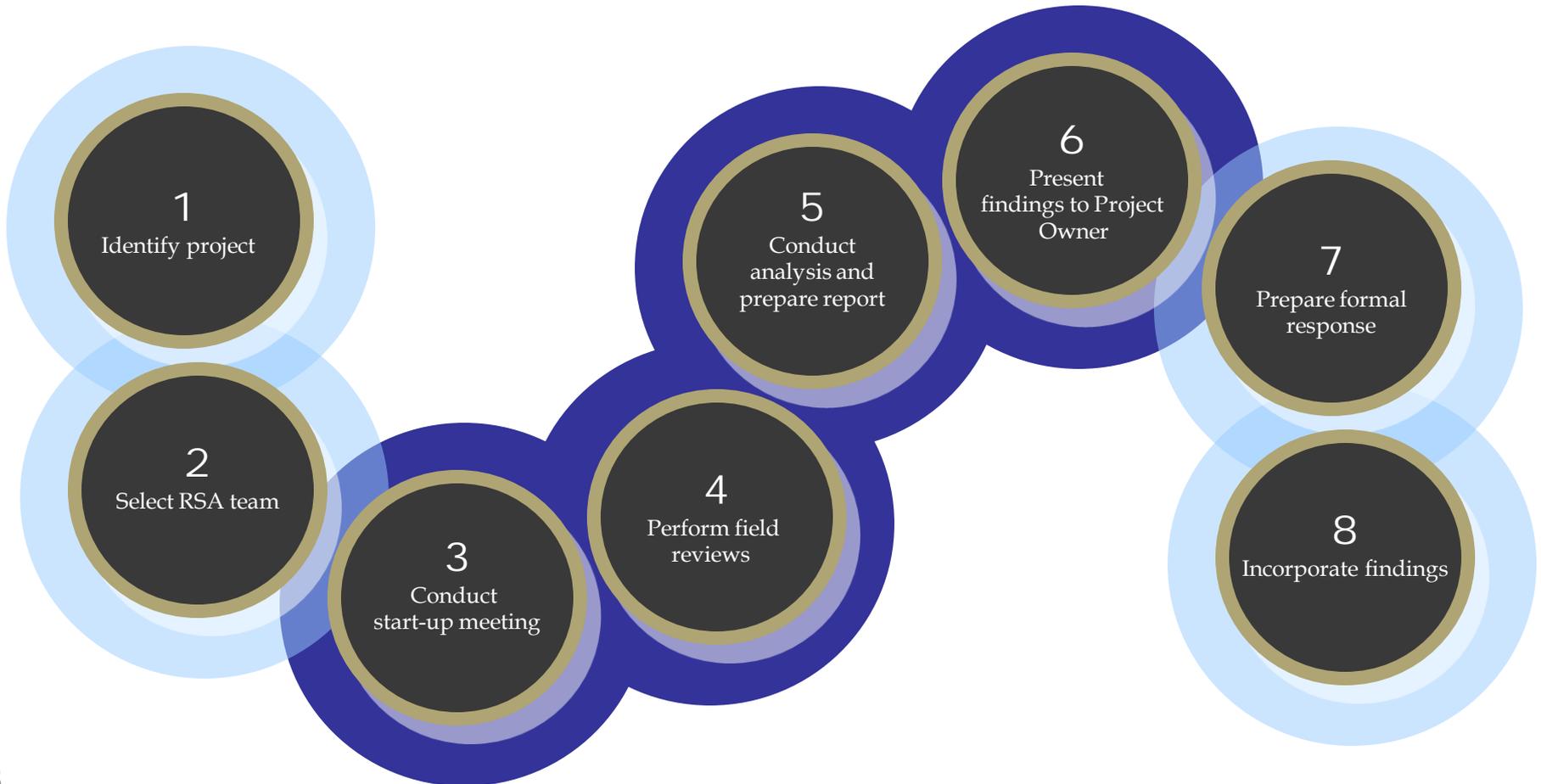
## Responsibilities



RSA Team



Road Owner



# RSA Procedure

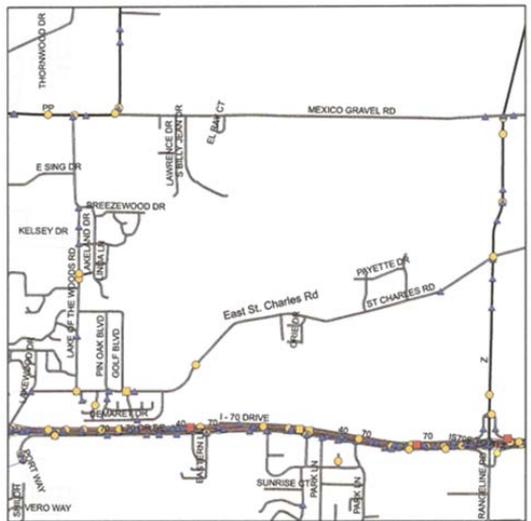
## Responsibilities

- RSA Team
- Road Owner

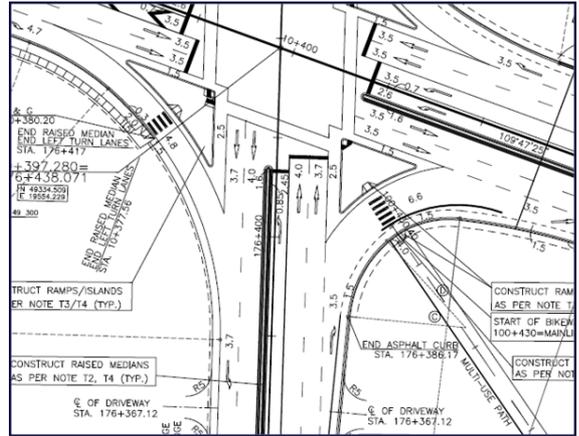


# Identify the Project

## Planning/Scoping Stage



## Design Stage



## Existing Roadway



# RSA Procedure

## Responsibilities

- RSA Team
- Road Owner



## Select RSA Team



1. Independent
2. Experienced
3. Multi-disciplinary

# Select RSA Team: Core Skills

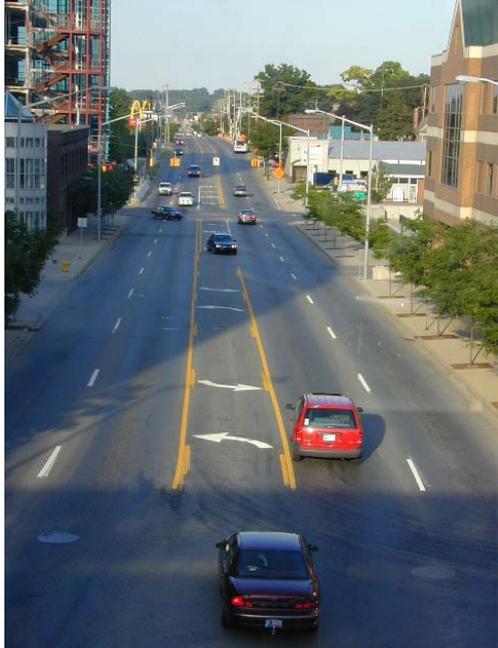
Traffic operations



Planning



Geometric design



Road users/human factors



## Select RSA Team: Supplementary Skills

- Human Factors Specialists
- Law Enforcement
- Maintenance



# RSA Procedure

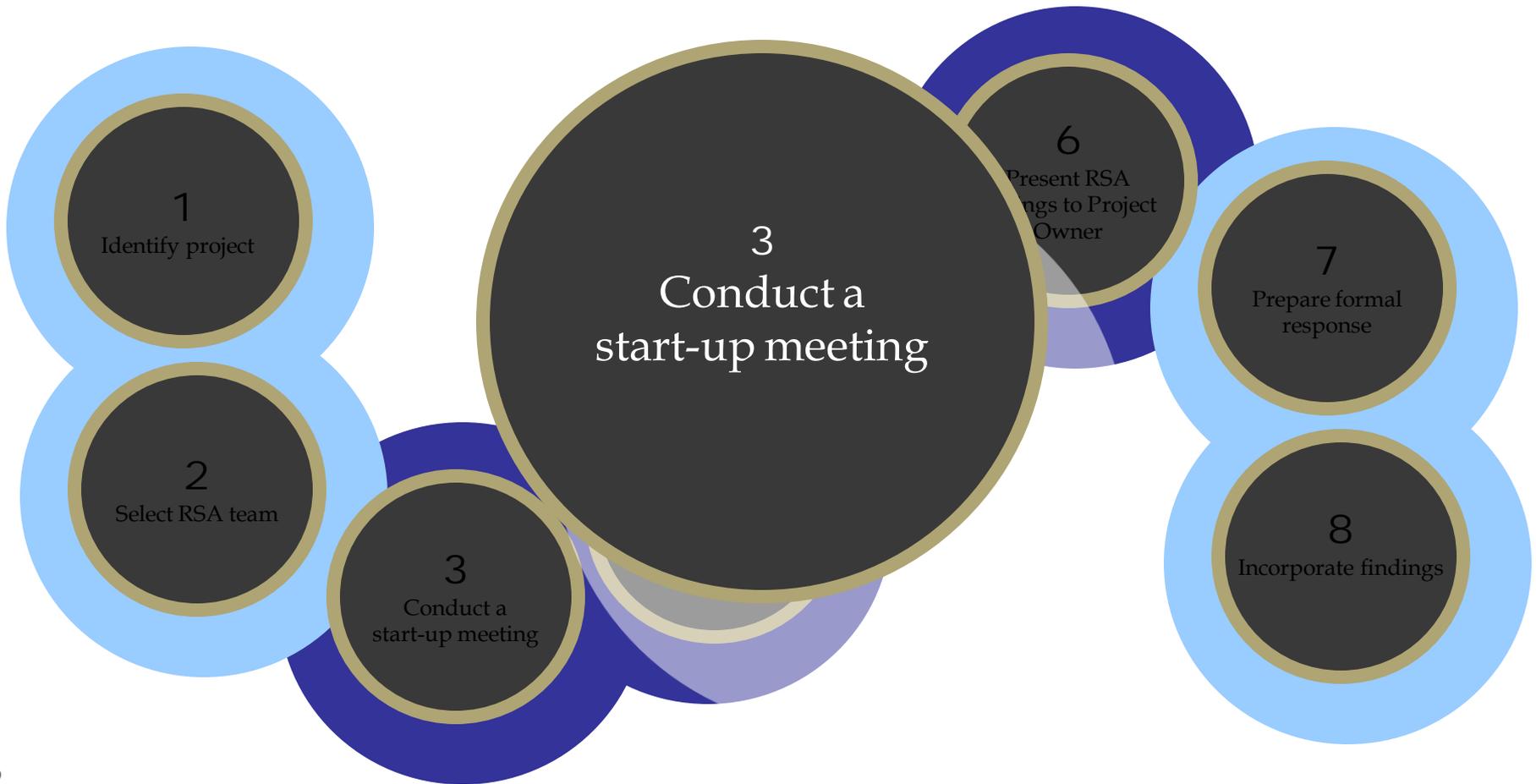
## Responsibilities



RSA Team



Road Owner



## Start-up Meeting

- Identify individual roles
- Communicate information
- Communicate RSA process
- Discuss constraints and limitations



Start-up Meeting:  
Provide Project Information



- Crash history
- Traffic volume
- Design drawings
- As-built drawings
- Corridor studies
- Transportation Plans
- Design criteria

# RSA Procedure

## Responsibilities



RSA Team



Road Owner



# Field Review: Observations

- ❑ Road user types
- ❑ Driver behavior
- ❑ Surrounding land uses
- ❑ Link to adjacent network



# Field Reviews: Common Items

- Sight distance obstructions
- Pedestrian and cyclist conflicts
- Visual clutter



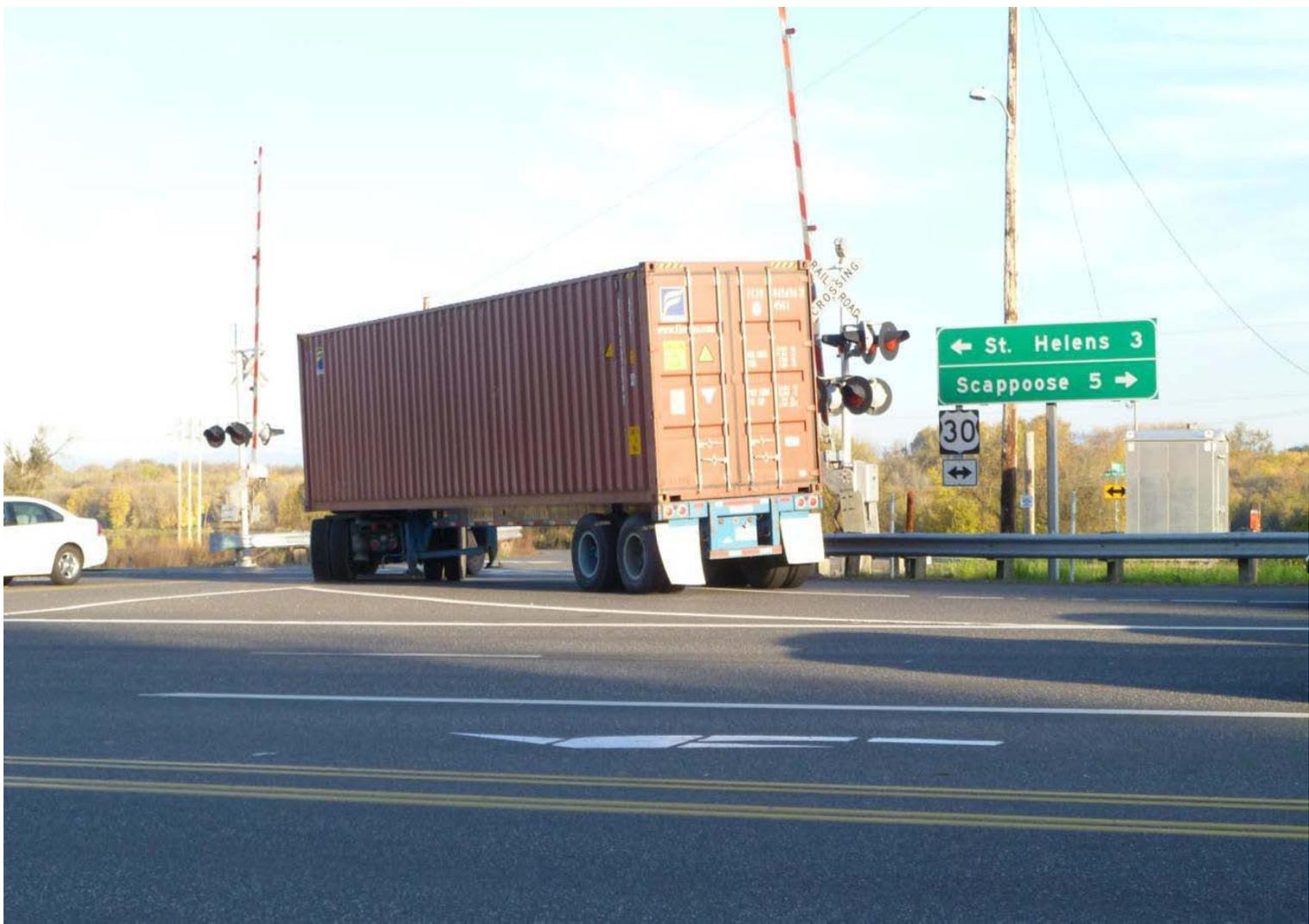
Field Reviews:  
Variable Conditions to Observe

- Peak and off-peak traffic periods
- Dry and wet weather conditions
- Day and night conditions



Field Reviews:  
Variable Conditions to Observe

- Interactions



Field Reviews:  
Variable Conditions to Observe

- Facility
- Corridor
- Network



## Field Reviews: Up Close and Personal



Walk and drive the site!

# RSA Procedure

## Responsibilities



RSA Team

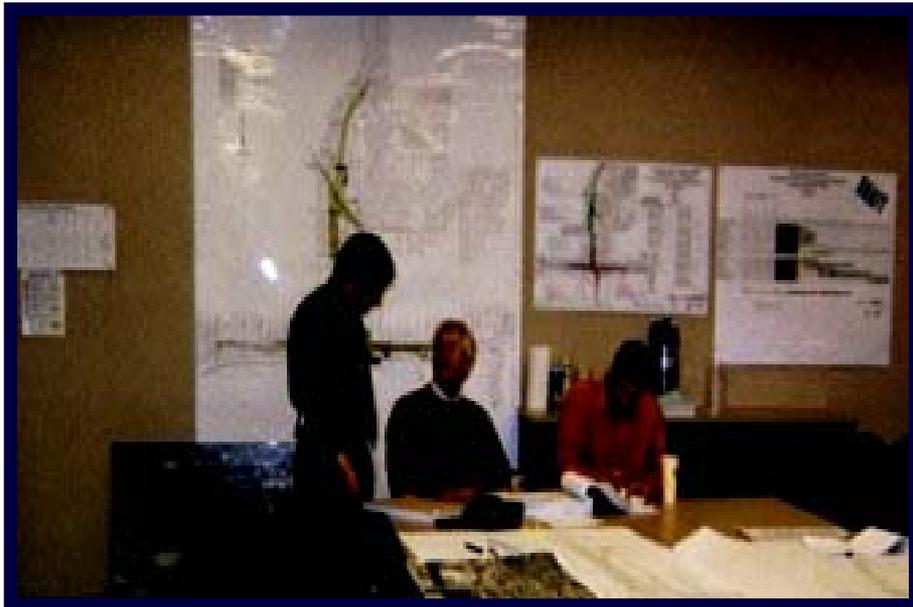


Road Owner



## Conduct RSA Analysis

- Identify and prioritize safety concerns
- Develop suggestions for reducing the degree of risk
- Compose presentation of early findings.



# Risks to be considered

**Drop  
Offs**



# Risks to be considered



# Prioritize Safety Concerns

## Qualitative Estimate of Risk

RISK CATEGORY		SEVERITY			
		Low	Moderate	High	Extreme
Crash Frequency Category	Frequent	C	D	E	F
	Occasional	B	C	D	E
	Infrequent	A	B	C	D
	Rare	A	A	B	C

## Mitigate Safety Concerns: Short and Long Term Solutions

- **Short Term Solutions**
  - Maintenance
  - Vegetation
  - Signing & Pavement Markings
- **Long Term Solutions**
  - Curve Flattening
  - Modify Vertical Alignment

Mitigate Safety Concerns:  
Short and Long Term Solutions

- *Road Management:*

- Role of highway in overall regional network
- Clarification of the road's function is needed to identify future directions for:
  - design (geometry, signing, markings)
  - maintenance
- *Interim safety issues* have been identified that are independent of management direction.

Mitigate Safety Concerns:  
Short and Long Term Solutions  
Other Factors

- unfamiliar drivers
- mix of traffic types and vehicle types
- in-vehicle navigation systems and internet maps
- no cell phone coverage

# RSA Procedure

## Responsibilities



RSA Team



Road Owner



## RSA Findings Presentation

- Discuss safety concerns
- Clarify findings and suggestions
- Assist project owner in making best choices



# RSA Findings: Formal Report

**Sample Road Safety Audit**  
Issue 1: Closely-spaced Sample Street Intersections

**Safety Issues:** During peak periods, left-turn queues may extend into or past adjacent closely-spaced intersections on Sample Street.

**Safety Issue Description:** Opposing through and right turn traffic volumes can be expected to cause peak-period delays to traffic turning left at two intersections:

- Sample Street and the northbound entrance to I-XX, which has limited (70-foot) left-turn storage lane,
- Sample Street and Example Street, which has no left-turn lane.



If left-turn movements experience a long delay, queued left-turn traffic may obstruct through traffic on Sample Street. Queued or obstructed traffic may queue back and affect operations at upstream intersections, increasing the risk of all types of intersection collisions.

---

**Expected Crash Types:** intersection (left-turn, rear-end, and crossing)  
**Expected Frequency:** occasional  
**Expected Severity:** medium  
**Risk Rating:** D (moderate-high risk level)

---

**Suggestions:** If micro simulation modelling or post construction observations show congestion related to left turn queues, the following measures may be considered:

- Signalize the ramp intersection, and coordinate the ramp signal with those at Sample Street and Example Street to clear traffic when queues approach the adjacent upstream intersection.

Safety concern

Description

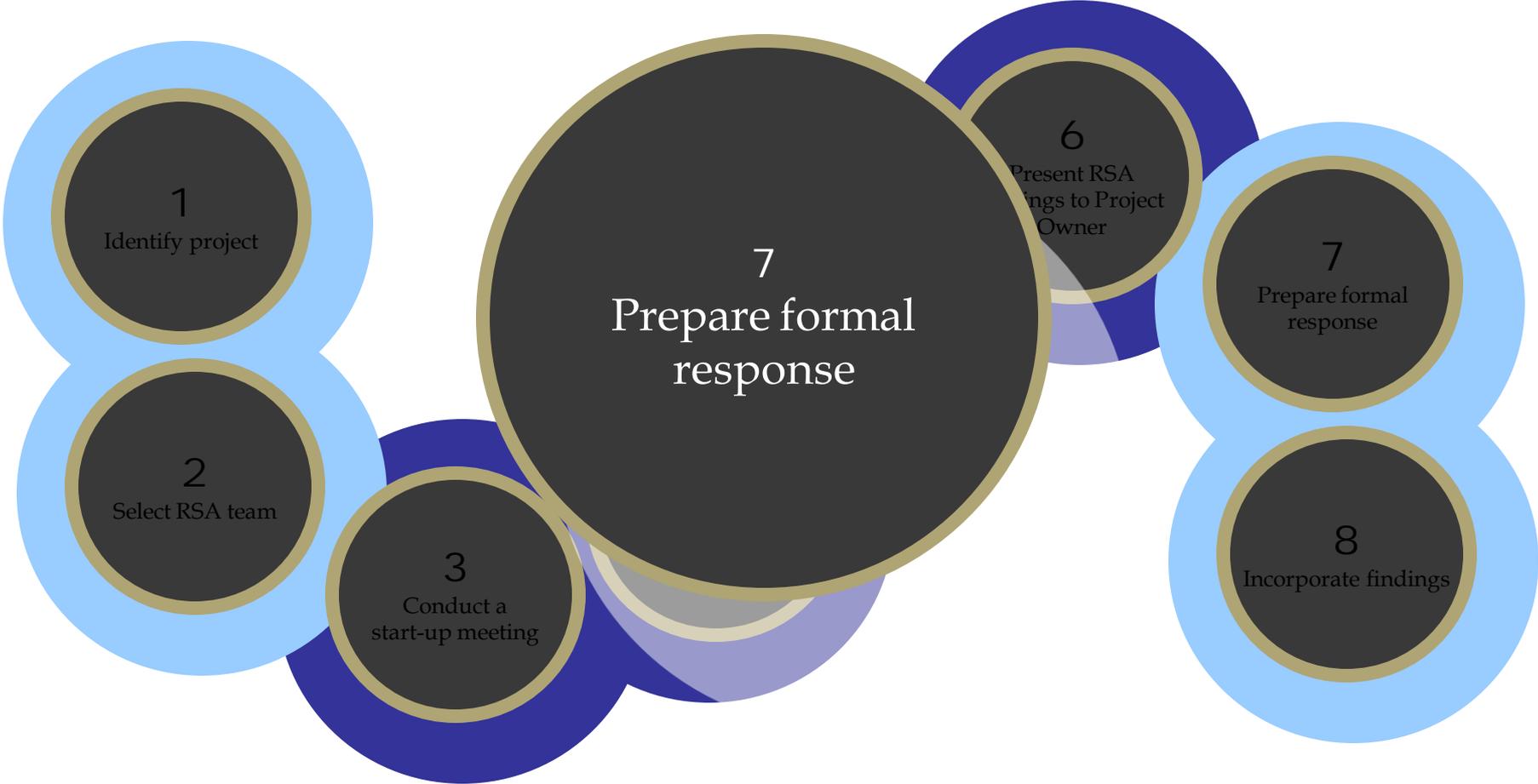
Prioritization (optional)

Suggestions (optional)

# RSA Procedure

## Responsibilities

- RSA Team
- Road Owner



## Response Letter

**Action taken**

*Suggestion 1: Consider sidewalks along the project route to accommodate future pedestrian activity.*

*Planning Division will recommend sidewalks be included within the scope of this project when submitted to Design Division.*

**Reason for not taking action**

*Suggestion 2: If R/W is available, add an acceleration on US 60 in the westbound direction for RT turning from Bowring Rd.*

*This is not feasible for the following reasons: Any changes to the top of cut/toe of slope would affect the utility relocation which is currently under way. Also, the drive at Sta. 551+20 may conflict with accelerating vehicles.*

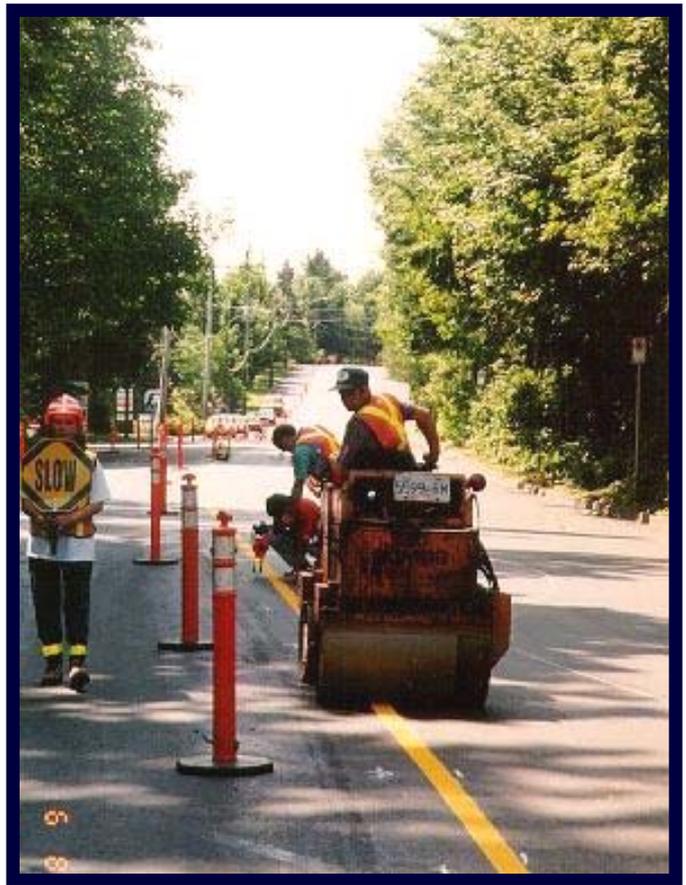
# RSA Procedure

## Responsibilities

- RSA Team
- Road Owner



## Implementation of Improvements



Implementation may depend on policy, manpower, and/or funding. Implementation may also be considered a process.

# What are common safety issues and potential countermeasures?

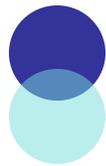
Topic Area	General Issues	Example Observations	Example Countermeasures
Cross-section	Limited pavement width	Narrow or no paved shoulders	Improve/stabilize unpaved shoulders Install safety edge
	Pavement edge drops	Vertical pavement edge drops greater than two inches	Install new paved shoulders or widen existing paved shoulders Install centerline or edgeline rumble strips or rumble stripes
Horizontal curves	Sharp curves	Limited sight distance	Install advance curve warning (with/without advisory speed)
		Inadequate superelevation	Install centerline and edgeline pavement markings Improve delineation (e.g., chevrons, post-mounted delineators)
	Various levels of delineation	Inconsistent and old signing	Upgrade existing signs (size, retroreflectivity, location)
		Faded pavement markings; no edgelines	Improve skid resistance with high-friction treatment (e.g., NovaChip, microsurfacing, etc.)
Roadside hazards	Common roadside hazards located in close proximity to the roadway	Trees, rocks, utility poles, guide wires	The order of preference for treating roadside hazards (from most preferred to least preferred) <sup>1</sup> is to:
		Steep embankments	1. Remove the obstacle.
		Drainage features (inlets, headwalls, culverts)	2. Redesign the obstacle so it can be safely traversed.
		Large bodies of water	3. Relocate the obstacle to a point where it is less likely to be struck.
Walls and barriers	4. Reduce impact severity by using an appropriate breakaway device.		
			5. Shield the obstacle with a longitudinal traffic barrier designed for redirection or use a crash cushion.
			6. Delineate the obstacle if the above alternatives are not appropriate.

# Presentation of Issues & Recommendations

## Primary Issue: Animals on the Roadway

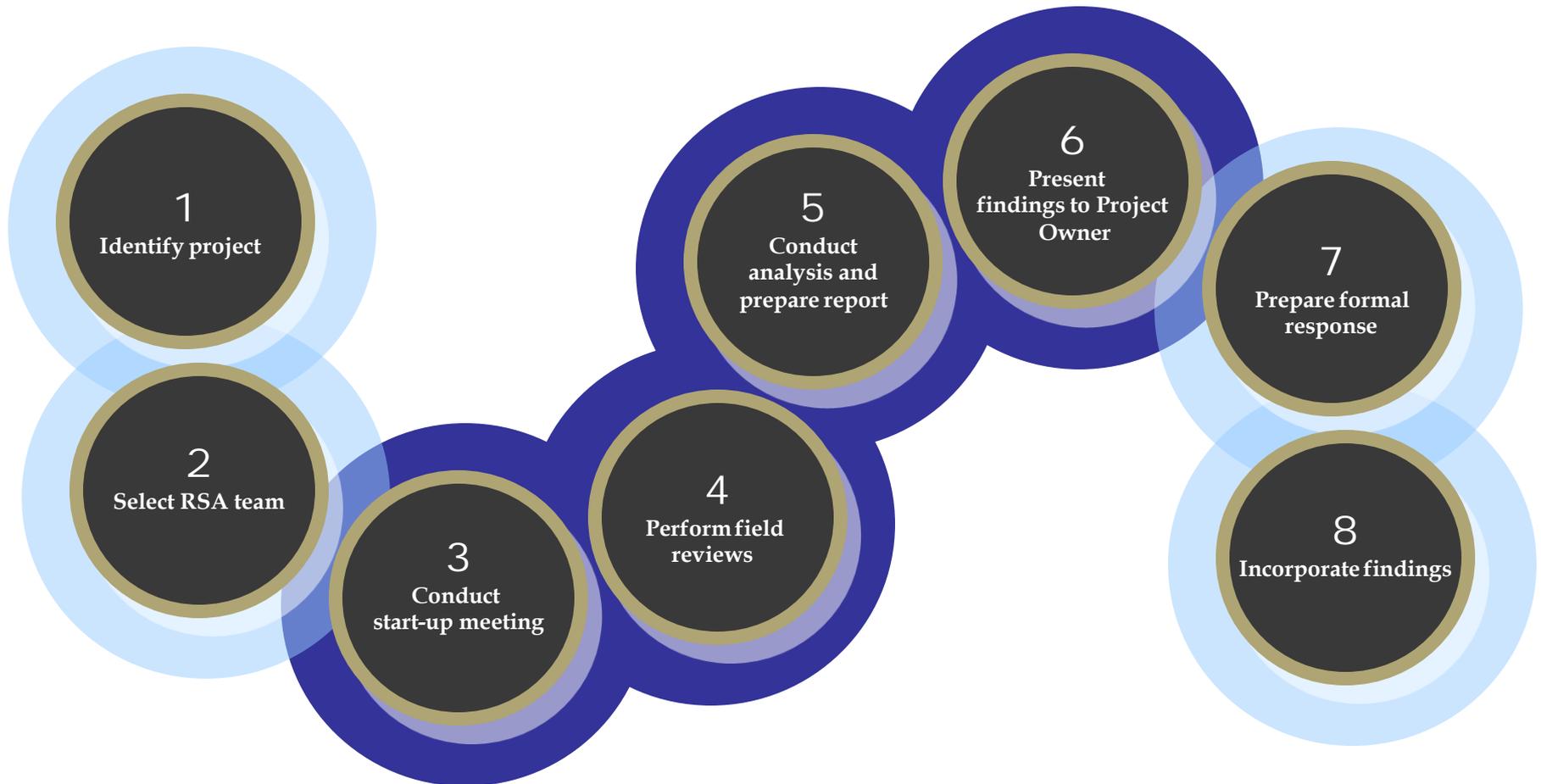
Specific Safety Concern	Suggested Improvements	Example of Issue
<p><b>Animals</b>—the roadside throughout the study area is open range.</p> <p>Horses, cows, and sheep were observed crossing and grazing along the roadway during daytime and nighttime conditions. Animal-related crashes represented approximately 25% of all crashes along the corridor.</p>	<p><i>Short-Term</i> – Utilize reflective ear tags, branding, or other strategies to increase the conspicuity of animals at night.</p> <p><i>Intermediate</i> – Consider installing an animal fence along the corridor. This may be a challenge as the County does not provide any right of way fencing on county roads This may require lobbying the grazing official to support the effort.</p> <p><i>Long-Term</i></p> <ul style="list-style-type: none"> <li>• Engage animal owners regarding economic loss and better control of animals.</li> <li>• Consider lobbying for legislation to prohibit open range grazing and couple this with local enforcement. The enforcement component is critical because legislation alone will have limited effectiveness without actual consequences.</li> </ul>	 <p>View of the corridor within the study area. Photo shows a horse crossing the road, which was a common observation during the RSA.</p>

# Responsibilities



**RSA Team**

**Design Team / Project Owner**



# Questions?

