



TETRA TECH

Savary Island Slope Hazard Study

Presented to: qathet Regional District

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Slope Hazard Study Purpose

- Develop criteria for evaluating the location of potential hazardous slopes on Savary Island.
- Determine the extents of potentially hazardous slopes and provide recommended a set-back distance from these slopes to identify potentially hazardous areas.
- Recommendations include engaging a qualified professional for a project-specific assessment prior to development within potentially hazardous areas.
- The results of the study are meant to provide information to the qathet Regional District and Savary Island property owners.

- Savary Island Dune and Shoreline Study (Thurber, 2003)
- qathet Regional District Coastal Flood Mapping: Phase 1 - Mainland (Tetra Tech, 2021)
- qathet Regional District Coastal Flood Mapping: Phase 2 – Islands (Tetra Tech, 2022)
- *Sea Dike Guidelines, Climate Change Adaption Guidelines for Sea Dikes and Coastal Flood Hazard Land Use, BC Ministry of Environment, 2011.*
- *Flood Hazard Area Land Use Management Guidelines, Ministry of Forests, Lands, Natural Resource Operations and Rural Development, 2018.*

Sea Dike Guidelines, Climate Change Adaption Guidelines for Sea Dikes and Coastal Flood Hazard Land Use, BC Ministry of Environment, 2011

- Provides guidelines for the design of sea dikes to protect low lying lands that are exposed to coastal flood hazards arising from their exposure to the sea and to expected sea level rise due to climate change.
- Presents design standards at a conceptual stage. Assumes qualified professionals are involved in the detailed design stage for projects.

Flood Hazard Area Land Use Management Guidelines, Ministry of Forests, Lands, Natural Resource Operations and Rural Development, 2018

- Intended to help local governments, land-use managers and approving officers develop and implement land-use management plans and make subdivision approval decisions for flood hazard areas.
- The goals of the provincial Guidelines are to reduce or prevent injury, human trauma and loss of life, and to minimize property damage during flooding events.
- Provides a projection of sea level rise for BC, storm event characteristics for design and setback distances for safe construction of buildings.

Savary Island Dune and Shoreline Study (Thurber, 2003)

- Purpose of the study:
 - Establish hazard setback lines for the entire perimeter of the Island to ensure building locations are safe from erosion hazards for 50 and 200-year horizons.
 - Confirm the location, extent and sensitivity of the dune area on the Island.
 - Refine draft development guidelines for a Savary Island Official Community Plan.
- The Study determined the erosion rates for Savary Island averaged 0.41 m/year and 0.25 m/year for the south and north shores, respectively.
- Cited previous studies by Klohn-Crippen (1993) and Golder Associates (1999) that also recommended set-backs distances for safe construction of permanent buildings.
- **Conclusions: “Savary Island will continue to be reduced in width from south to north by natural erosion forces. Soil erosion, including landslide activity is a constraint to residential development along south island bluffs... If global warming causes a significant rise in sea level, erosion rates will almost certainly increase from those of the past.”**

qathet Regional District Coastal Flood Mapping

Phase 1 – Mainland (Tetra Tech, 2021)

- Tetra Tech orthophoto review of 2006 and 2017 images indicated erosion rates between 0 m and 0.4 m per year. This correlated well with the Thurber (2003) study.
- Conducted geological mapping of the shoreline to identify material types and developed the erosion potential ranking system used in the Slope Hazard Study for Savary Island.

Phase 2 – Islands (Tetra Tech, 2022)

- Conducted geological mapping of the Islands to identify material types and determined the erosion potential for each type.
- Utilized coastal water levels, including predicted sea level rise, and wave run-up distances from the MoE Climate Change Adaption Guidelines for Sea Dikes and Coastal Flood Hazard Land Use (2011).

Surficial Geology of Savary Island and Erosion Potential

Material Type	Relative Erosion Potential
Marine	High
Eolian	High
Glaciomarine	Moderate
Glaciofluvial	Moderate
Till	Low to Moderate
Bedrock	Negligible for This Study

Material types mapped using: Terrain Classification System for British Columbia; Version 2; A System for the Classification of Surficial Materials, Landforms and Geological Processes of British Columbia. Ministry of Environment, Lands and Parks.

Erosion Potential Ranking System

Variable and Rating Criteria Descriptions	Ranking Score	Variable and Rating Criteria Descriptions	Ranking Score
Shoreline Type		Vegetation Cover of Back Beach	
Mud and Sand	10	Bare Soil	10
Sand and Gravel	10	Grassed	8
Gravel to Cobbles	8	Bushes	5
Gravel to Boulders	6	Forested	0
Anthropogenic	N/A	Storm Exposure - Maximum Modelled Wave Height (m) within 250 m of Shore	
Rock - Total Score nominally fixed at		>4 m	40
Geology Back Beach Type		3 - 4 m	30
Eolian	15	2 - 3 m	20
Recent Fluvial	10	1 - 2 m	10
Recent Marine	10	0 - 1 m	5
Glaciofluvial	8	Field Observation Modifiers	
Glaciomarine	8	Major slope instability (20+ m slope)	40
Till	5	Minor slope instability (<20 m slope)	10
Anthropogenic	N/A	Thurber 2003 Erosion Rate > -0.3 m change	10
Slope Angle		Thurber 2003 Erosion Rate -0.1 to -0.3 m change	5
> 40°	15	Small river delta observed (> 250 m wide)	-5
15° - 40°	5	Large river delta observed (< 250 m wide)	-10
0° - 15°	0	No relevant observation	0

- Erosion Potential Ranking System from qathet Regional District Coastal Flood Mapping: Phase 2 – Islands (Tetra Tech, 2022)

Erosion Potential Ranking System

Ranking Description	Ranking Score
Very Low	0 - 20
Low	20 - 45
Moderate	45 - 70
High	70 - 130
Unranked	NA

- Erosion Potential Ranking System from qathet Regional District Coastal Flood Mapping: Phase 2 - Islands (Tetra Tech, 2022)

Erosion Potential Ranking System Example

Variable and Rating Criteria Descriptions	Ranking Score
Shoreline Type	
Mud and Sand	10
Sand and Gravel	10
Gravel to Cobbles	8
Gravel to Boulders	6
Anthropogenic	N/A
Rock - Total Score nominally fixed at	
Geology Back Beach Type	
Eolian	15
Recent Fluvial	10
Recent Marine	10
Glaciofluvial	8
Glaciomarine	8
Till	5
Anthropogenic	N/A
Slope Angle	
> 40°	15
15° - 40°	5
0° - 15°	0

Variable and Rating Criteria Descriptions	Ranking Score
Vegetation Cover of Back Beach	
Bare Soil	10
Grassed	8
Bushes	5
Forested	0
Storm Exposure - Maximum Modelled Wave Height (m) within 250 m of Shore	
>4 m	40
3 - 4 m	30
2 - 3 m	20
1 - 2 m	10
0 - 1 m	5
Field Observation Modifiers	
Major slope instability (20+ m slope)	40
Minor slope instability (<20 m slope)	10
Thurber 2003 Erosion Rate > -0.3 m change	10
Thurber 2003 Erosion Rate -0.1 to -0.3 m change	5
Small river delta observed (> 250 m wide)	-5
Large river delta observed (< 250 m wide)	-10
No relevant observation	0

Total
Score:
46

- Erosion Potential Ranking System from qathet Regional District Coastal Flood Mapping: Phase 2 – Islands (Tetra Tech, 2022)

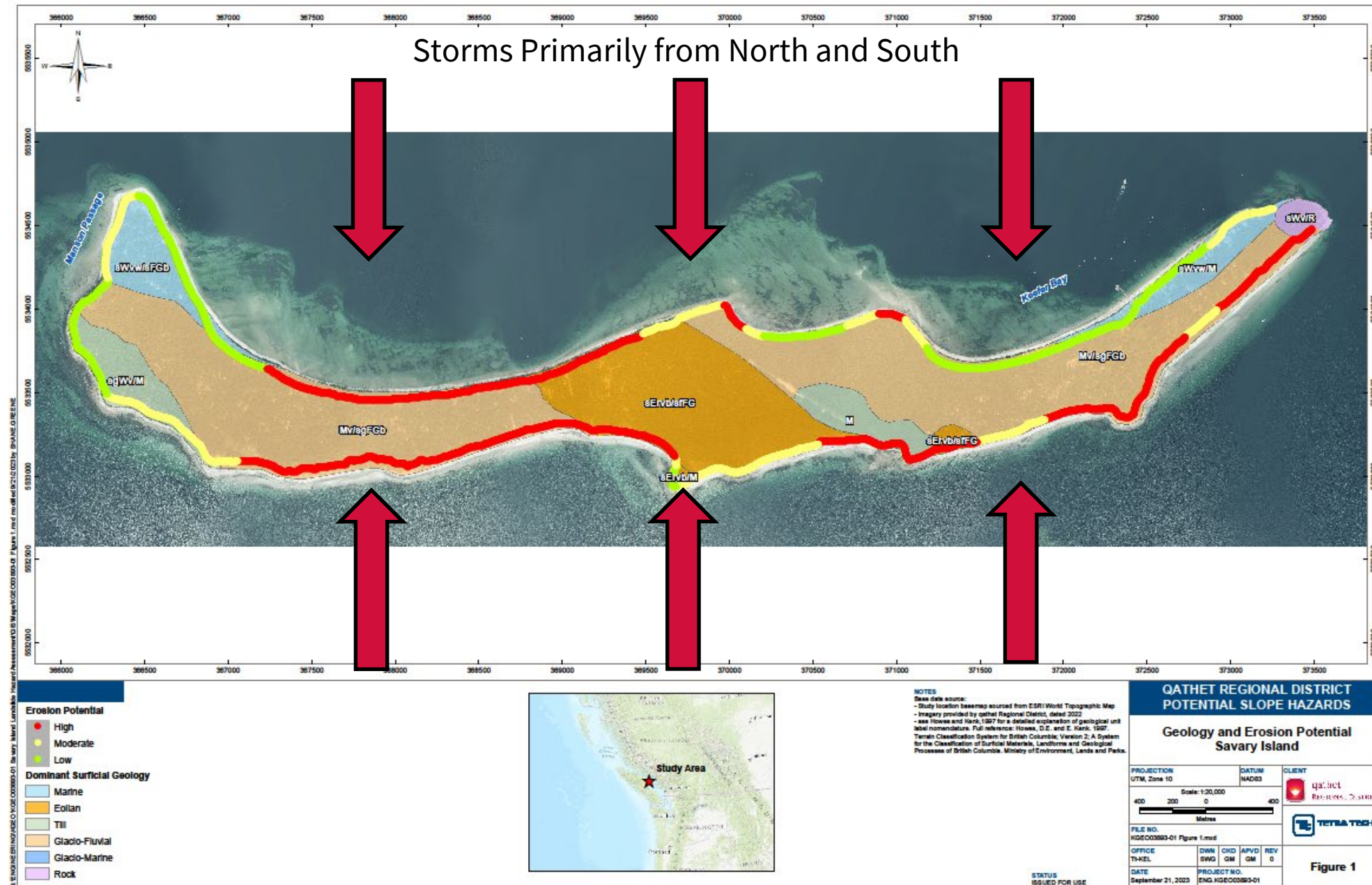
Erosion Potential Ranking System Example

Ranking Description	Ranking Score
Very Low	0 - 20
Low	20 - 45
Moderate	45 - 70
High	70 - 125
Unranked	NA

Total
Score:
46

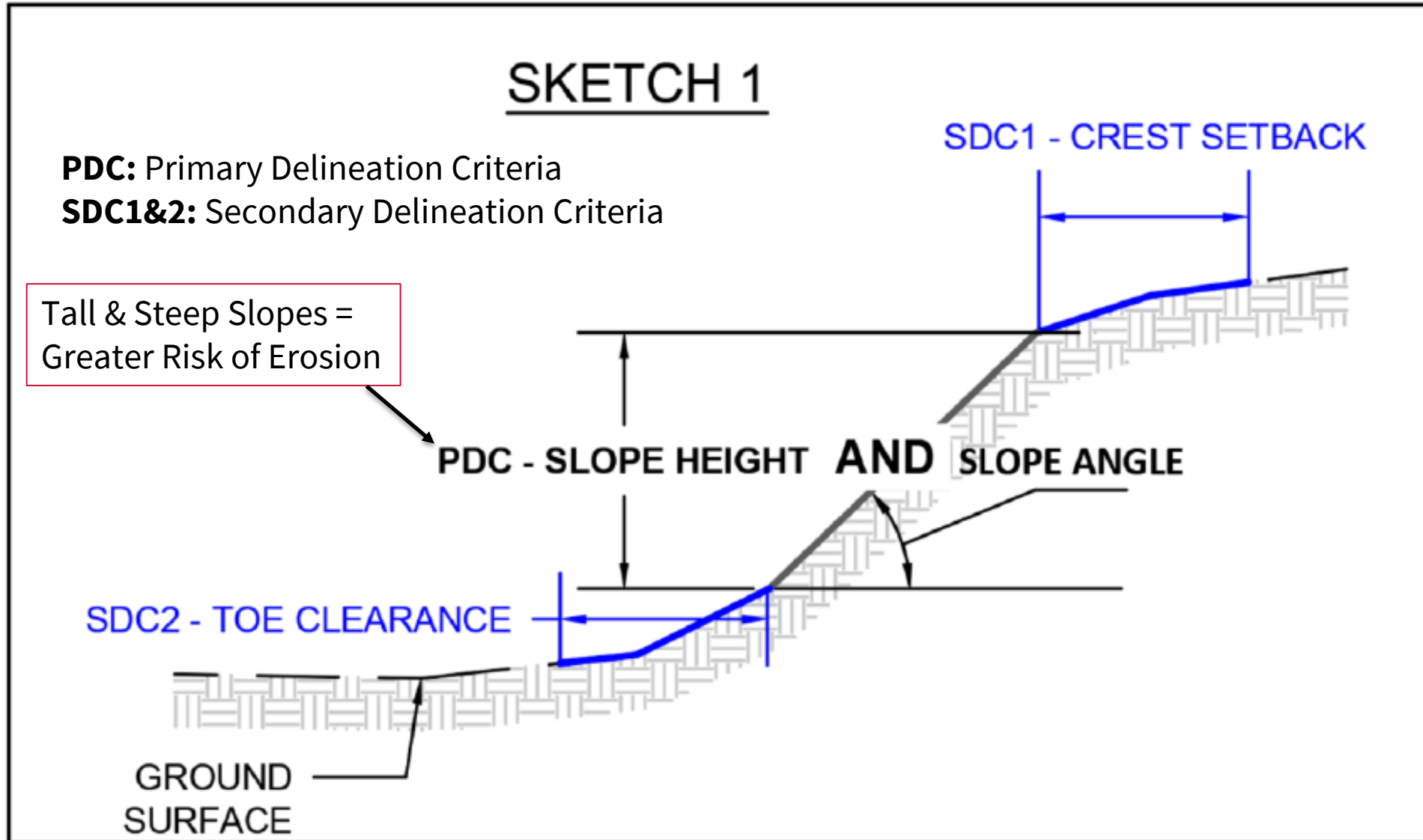
- Erosion Potential Ranking System from qathet Regional District Coastal Flood Mapping: Phase 2 - Islands (Tetra Tech, 2022)

Storms Primarily from North and South

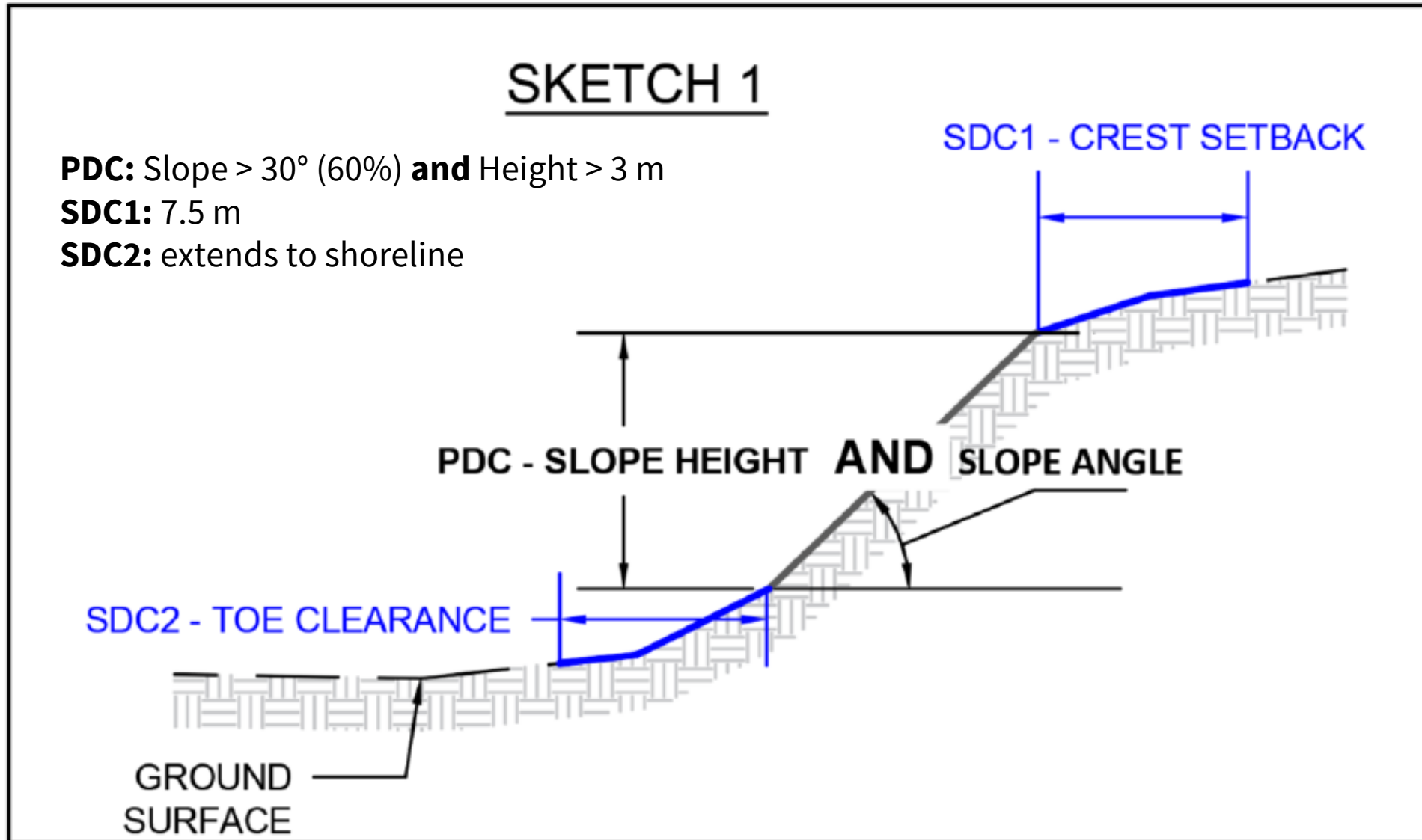


Slope Hazard Evaluation Criteria

3 Types of Slopes: Rock, Inland and Coastal



Slope Hazard Evaluation Criteria - Rock Slopes



Rock Slope Example



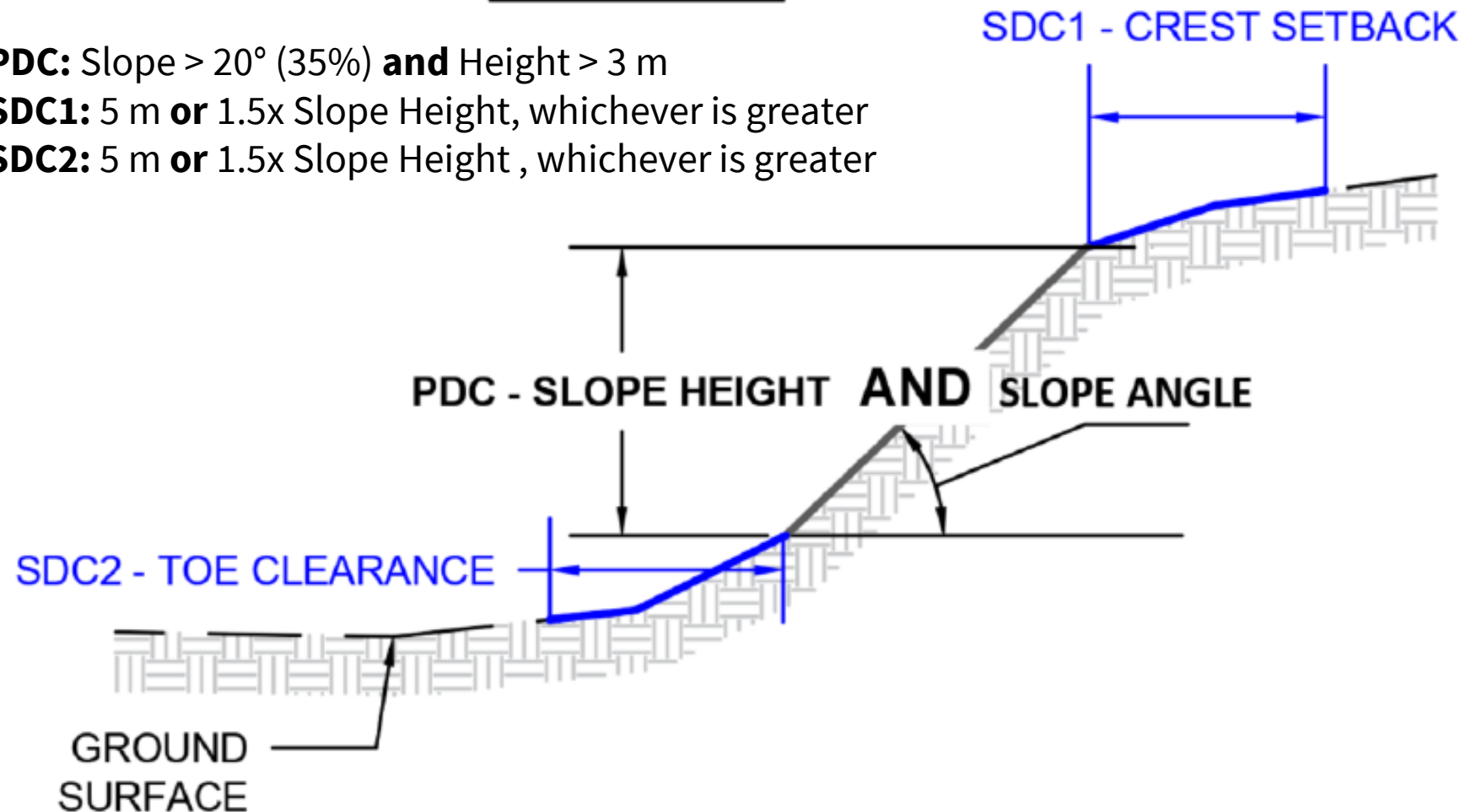
Slope Hazard Evaluation Criteria - Inland Slopes

SKETCH 1

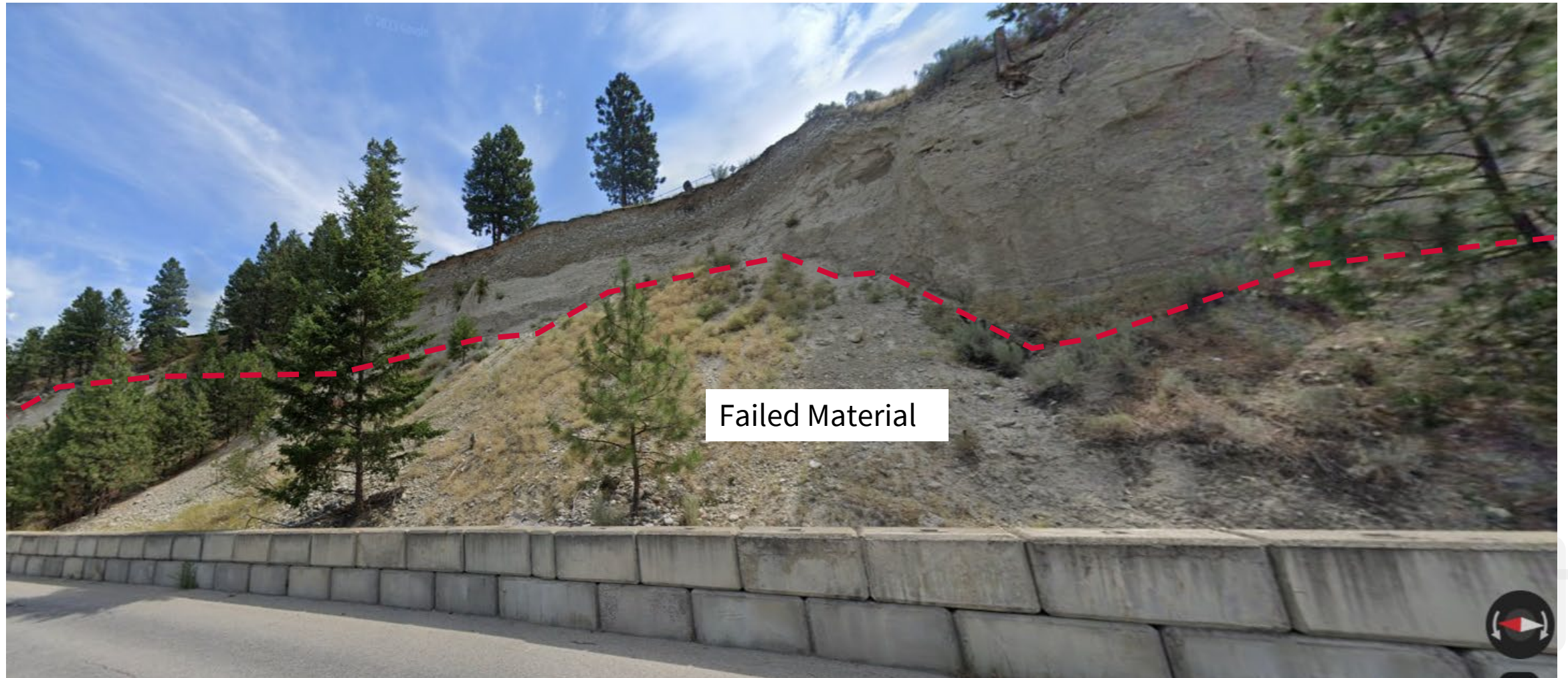
PDC: Slope $> 20^\circ$ (35%) **and** Height > 3 m

SDC1: 5 m **or** 1.5x Slope Height, whichever is greater

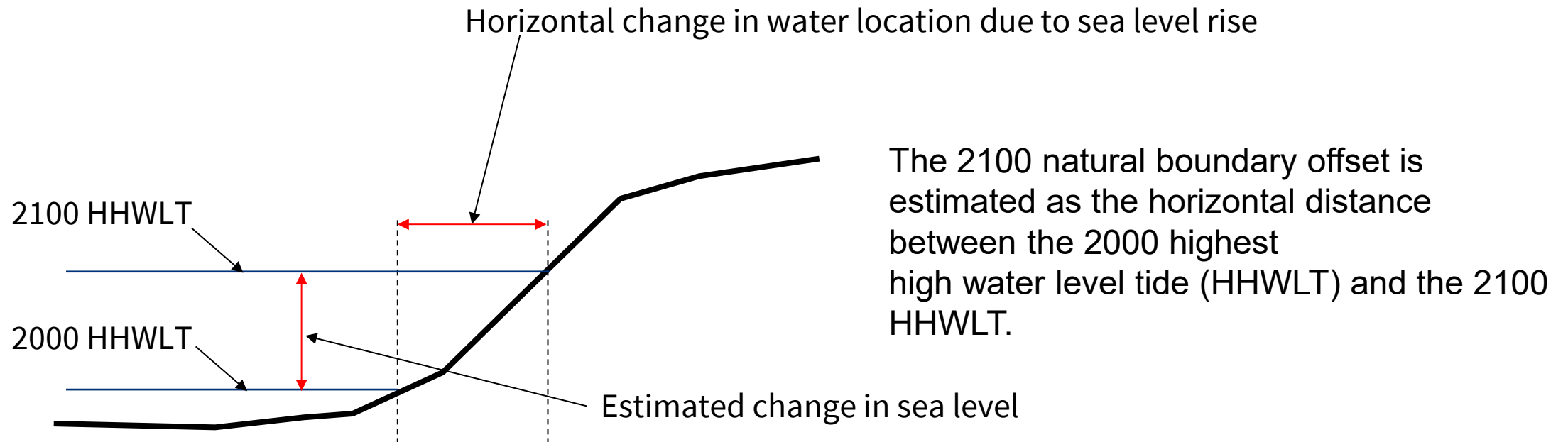
SDC2: 5 m **or** 1.5x Slope Height, whichever is greater



Inland Slope Example



Slope Hazard Evaluation Criteria - Coastal Slopes



The 2100 HHWLT is based on the Flood Hazard Area Land Use Management Guidelines, Ministry of Forests, Lands, Natural Resource Operations and Rural Development, 2018.

Slope Hazard Evaluation Criteria

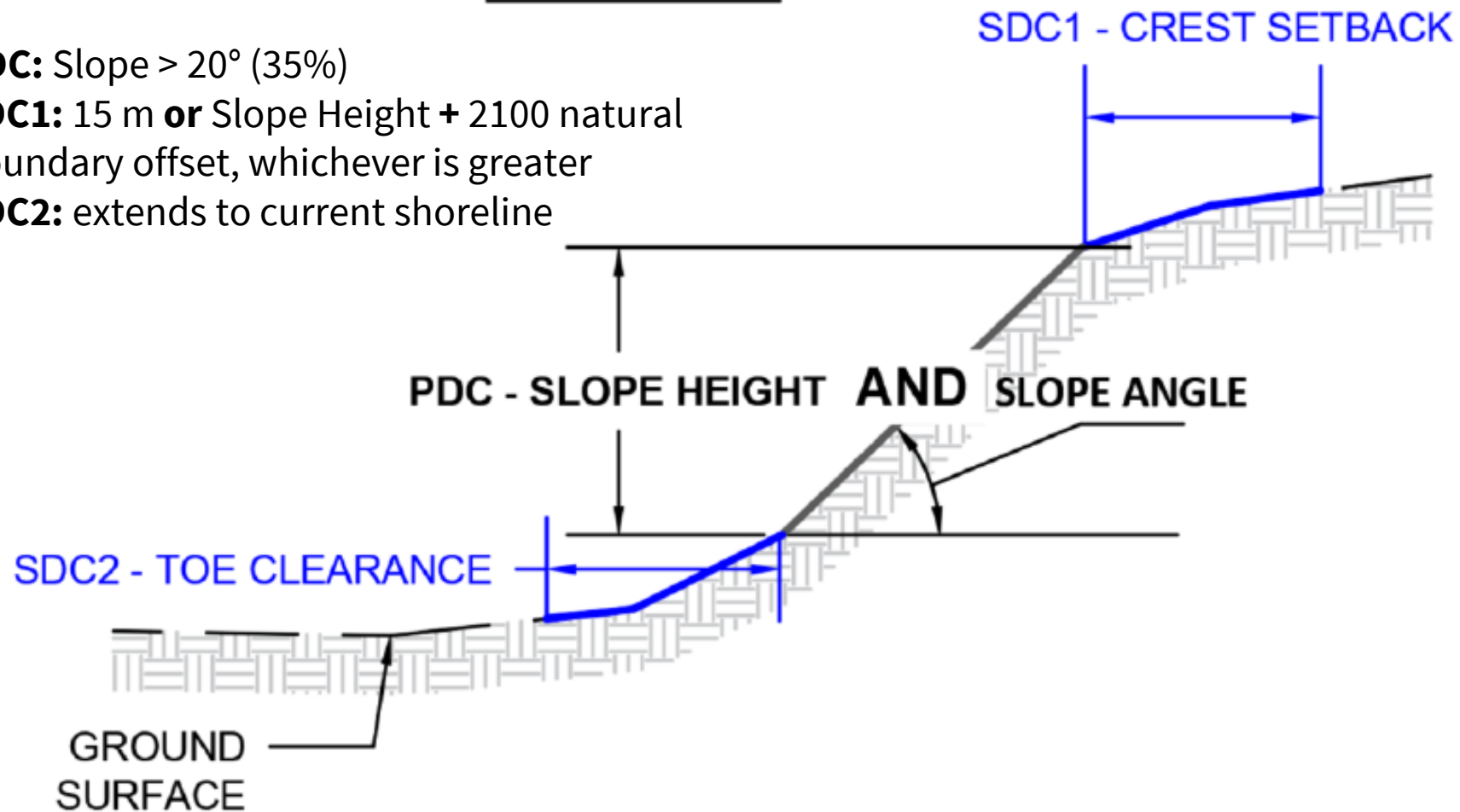
Coastal Slopes – Low Erosion Potential

SKETCH 1

PDC: Slope $> 20^\circ$ (35%)

SDC1: 15 m **or** Slope Height + 2100 natural boundary offset, whichever is greater

SDC2: extends to current shoreline



Coastal Slopes – Low Erosion Potential Example

Cobble & Boulder
Shoreline



Heavily Vegetated

Slopes appear
short and not steep

Slope Hazard Evaluation Criteria

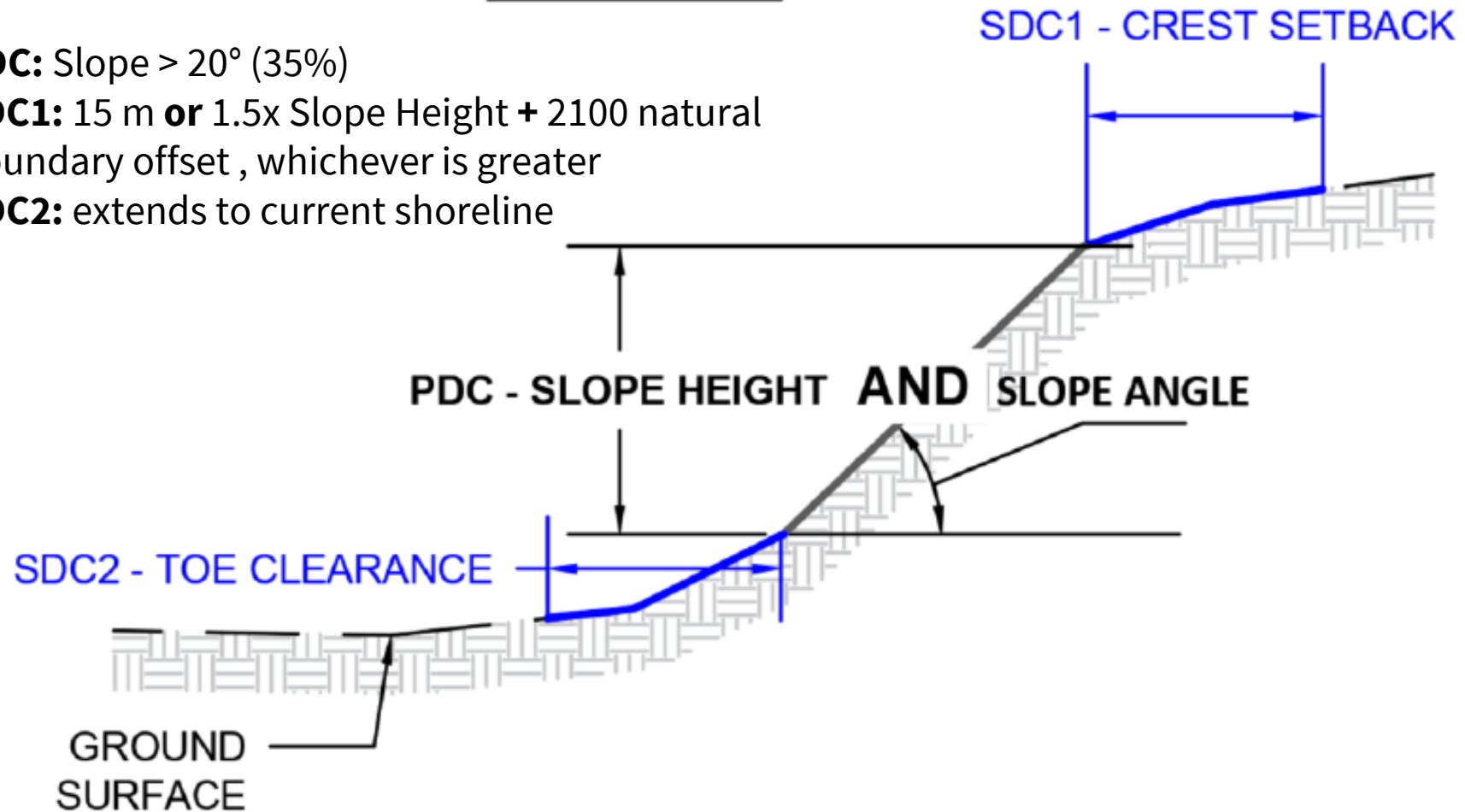
Coastal Slopes – Moderate Erosion Potential

SKETCH 1

PDC: Slope $> 20^\circ$ (35%)

SDC1: 15 m **or** 1.5x Slope Height + 2100 natural boundary offset, whichever is greater

SDC2: extends to current shoreline



Coastal Slopes – Moderate Erosion Potential Example

Slope Material
Appears Moderate
to Highly Erodible



Heavily Vegetated

Steep Slopes

Slope Hazard Evaluation Criteria

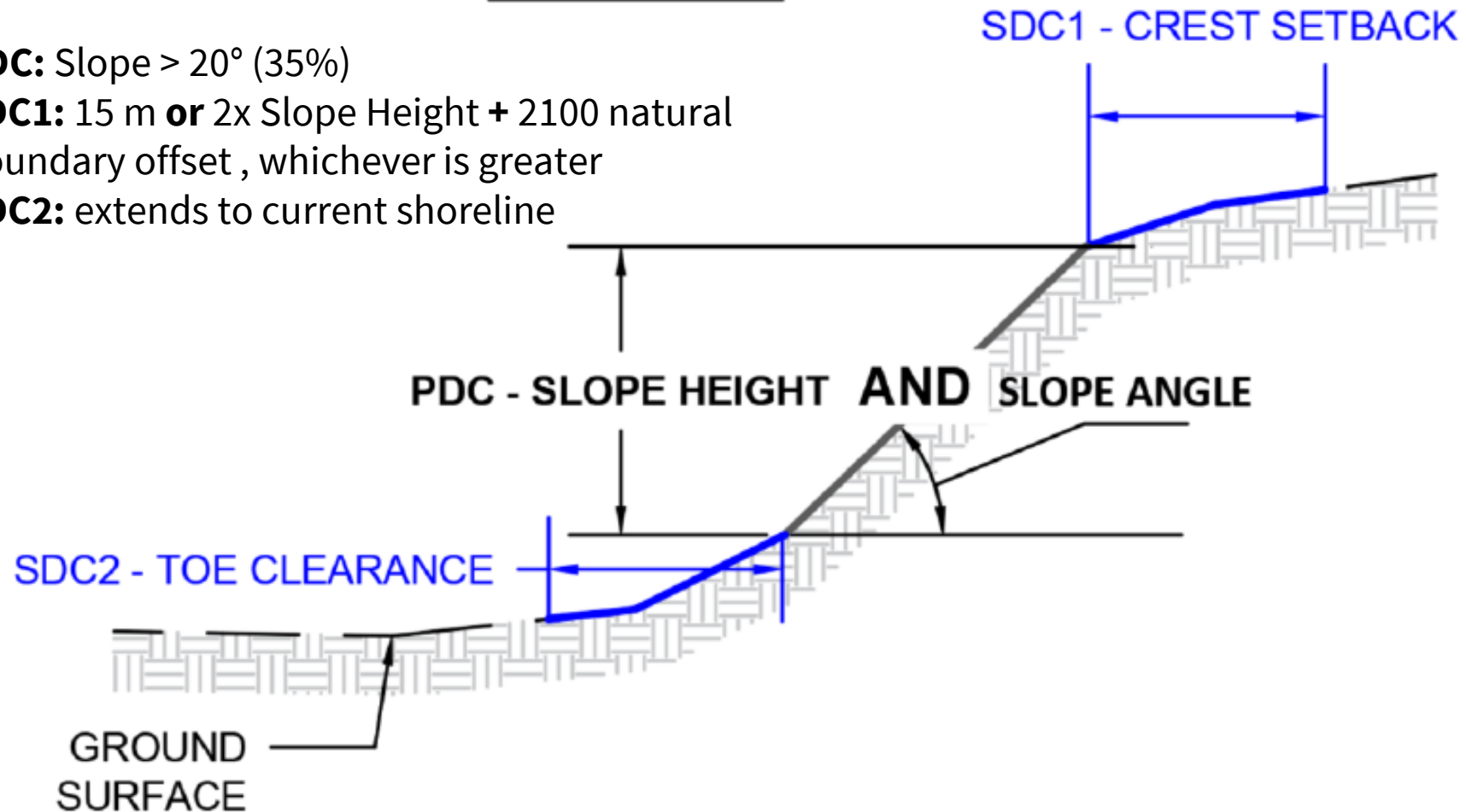
Coastal Slopes – High Erosion Potential

SKETCH 1

PDC: Slope $> 20^\circ$ (35%)

SDC1: 15 m **or** 2x Slope Height + 2100 natural boundary offset, whichever is greater

SDC2: extends to current shoreline



Coastal Slopes – High Erosion Potential Example

Slope Material
Highly Erodible

Shoreline Material
Highly Erodible

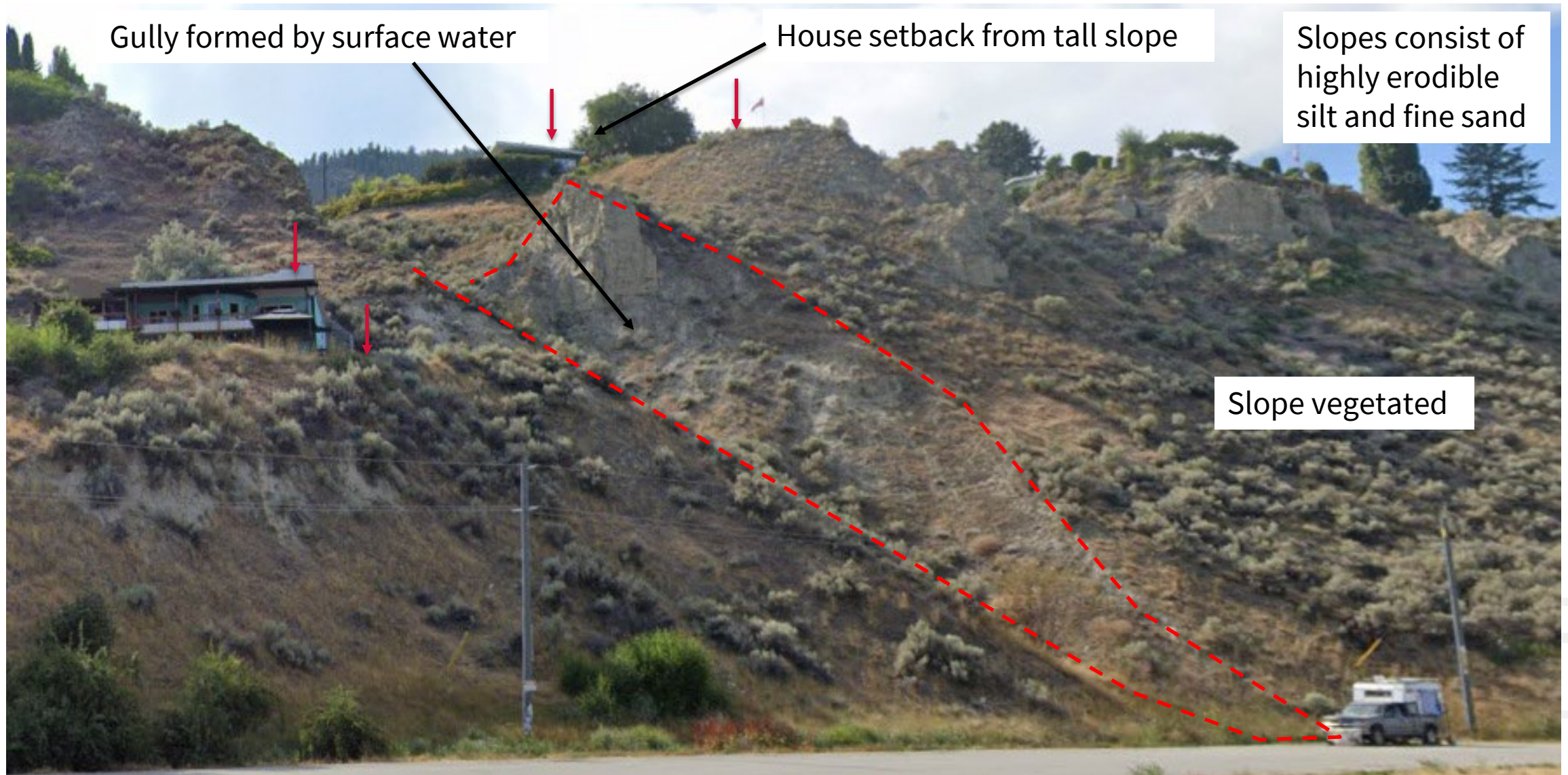


Sparsely Vegetated

Tall & Steep Slopes

Slope Failure

Slope Setback



Coastal Erosion Mitigation – Hard Structures



Coastal Erosion Mitigation – Hard Structures



Coastal Erosion Mitigation – Soft Design Techniques

Additional material could be used to re-establish eroded land above high tide. Geotextiles (i.e. geocells) could be used to prevent erosion during storm events.

Additional beach nourishment (gravel and cobbles) could be used to reduce erosion

Native vegetation

Anchored logs absorb energy from waves



Coastal Erosion Mitigation – Soft Design Techniques



Geocells infilled with soil to allow vegetation to establish

Questions?