Adaptation & Rehabilitation

Evidence of increased Variability

Increased Climatic Variability

Increased Demand & Limited Supplies

Increased Land Use Changes & Intensity

Land Use Change and Climate Change Interaction

Community Consultations Started in 2007

20 Communities in the Canadian Side of the Basin

2008-2010
- Elkford
- Kimberley

2010-2011
- Rossland
- Castlegar
- Kaslo

2012-2013
- Revelstoke
- Sparwood
- Dist. East Kootenay

Join other community leaders in Cranbrook

You are invited to participate in a regional workshop for municipal, regional and First nations governments in the Columbia Basin. This workshop will introduce and seek feedback on a climate change adaptation initiative for local communities.

Why Attend:

Our communities are vulnerable to climate change. We need to:
- Understand the potential impacts
- Improve our resilience
- Learn to adapt to the change
- Find out what resources are available to help you.

When:

28-29th November 2007
Note: the workshop begins at 6pm on Wednesday 28 and finishes 3.30pm Thursday 29

Where:

The Rail Museum, Cranbrook, BC

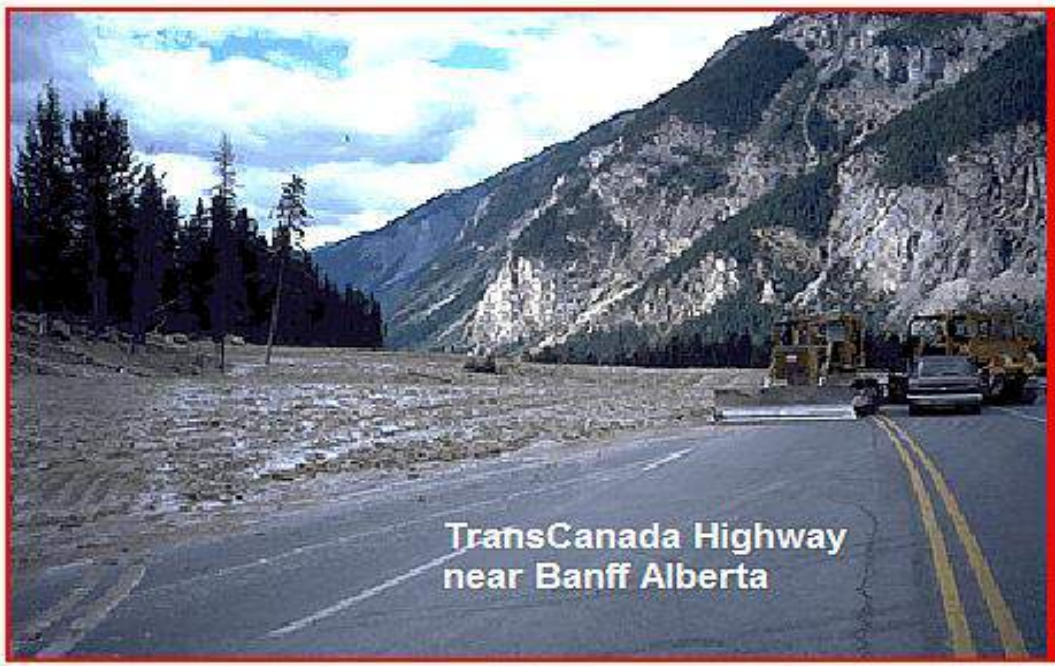
RSVP by 31 October 2007

Initiative Coordinator: Michelle Laurie
Phone: 1-250-231-0635
Email: michelle.k.laurie@gmail.com

AKBLG

Community Process

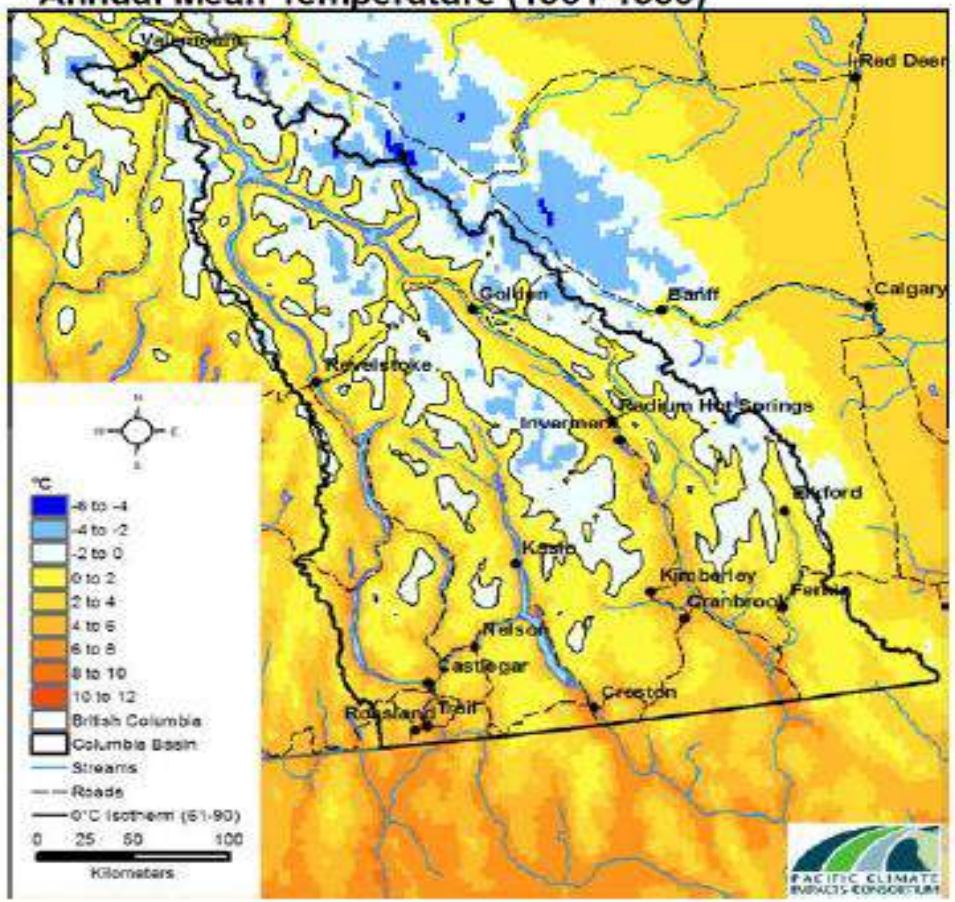
1. Learn about Climate Change
2. Identify Priorities in the Community
3. Assess Vulnerability and Risk
4. Develop Adaptive Strategies and Actions
5. Implement Strategy & Monitoring Program



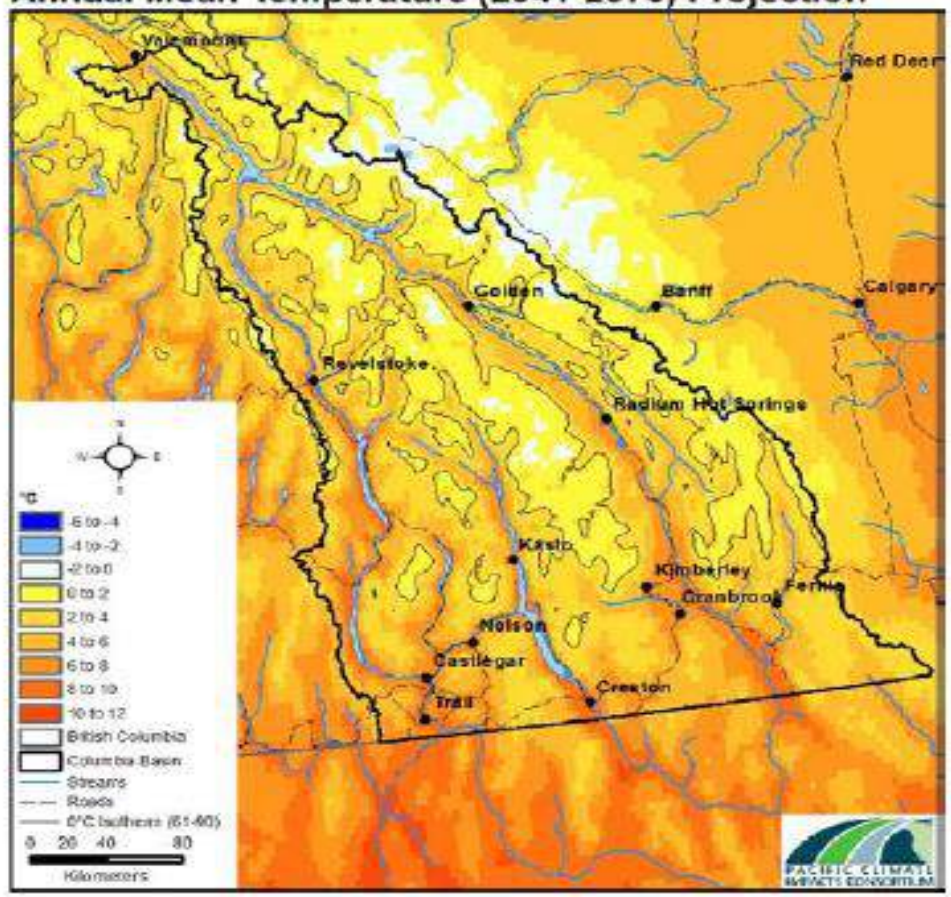
Climate Projections (1961-1990 vs. 2041-2070)

Annual Mean Temperature

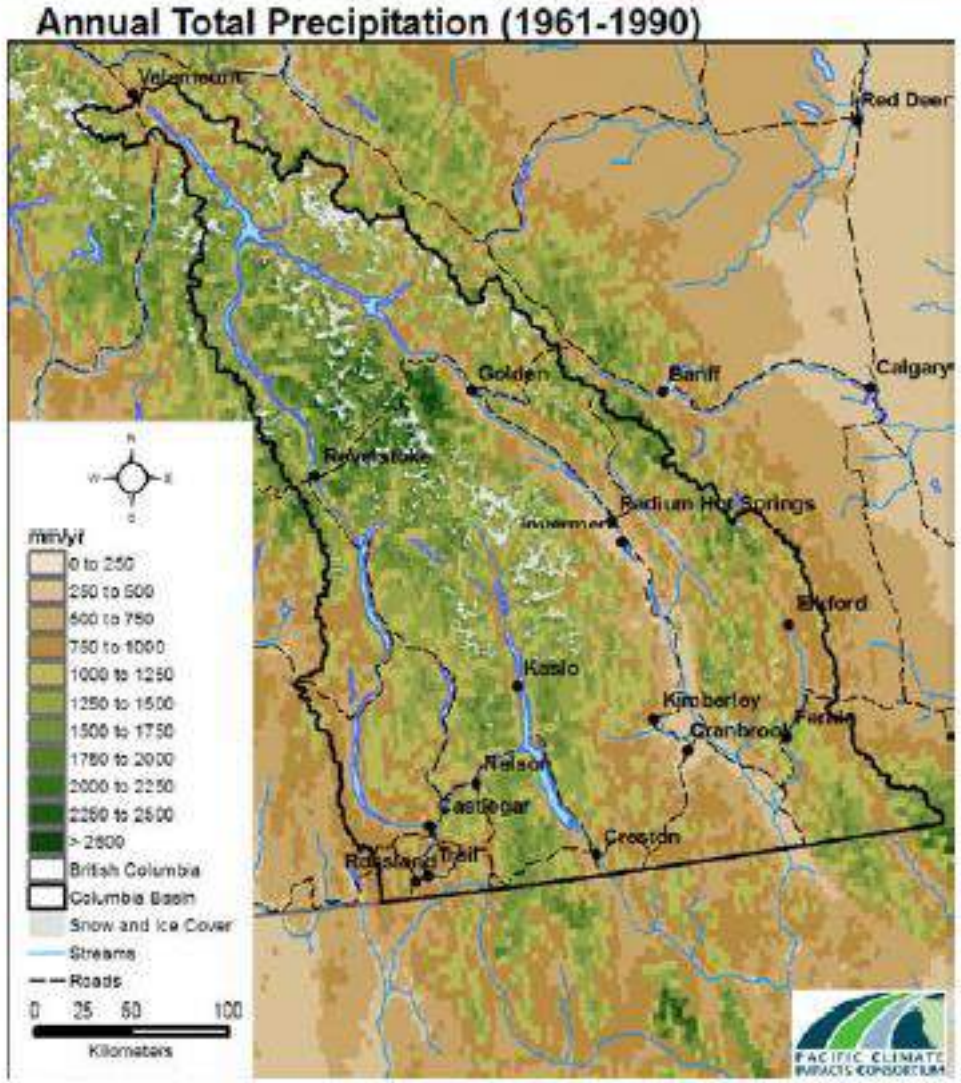
Annual Mean Temperature (1961-1990)

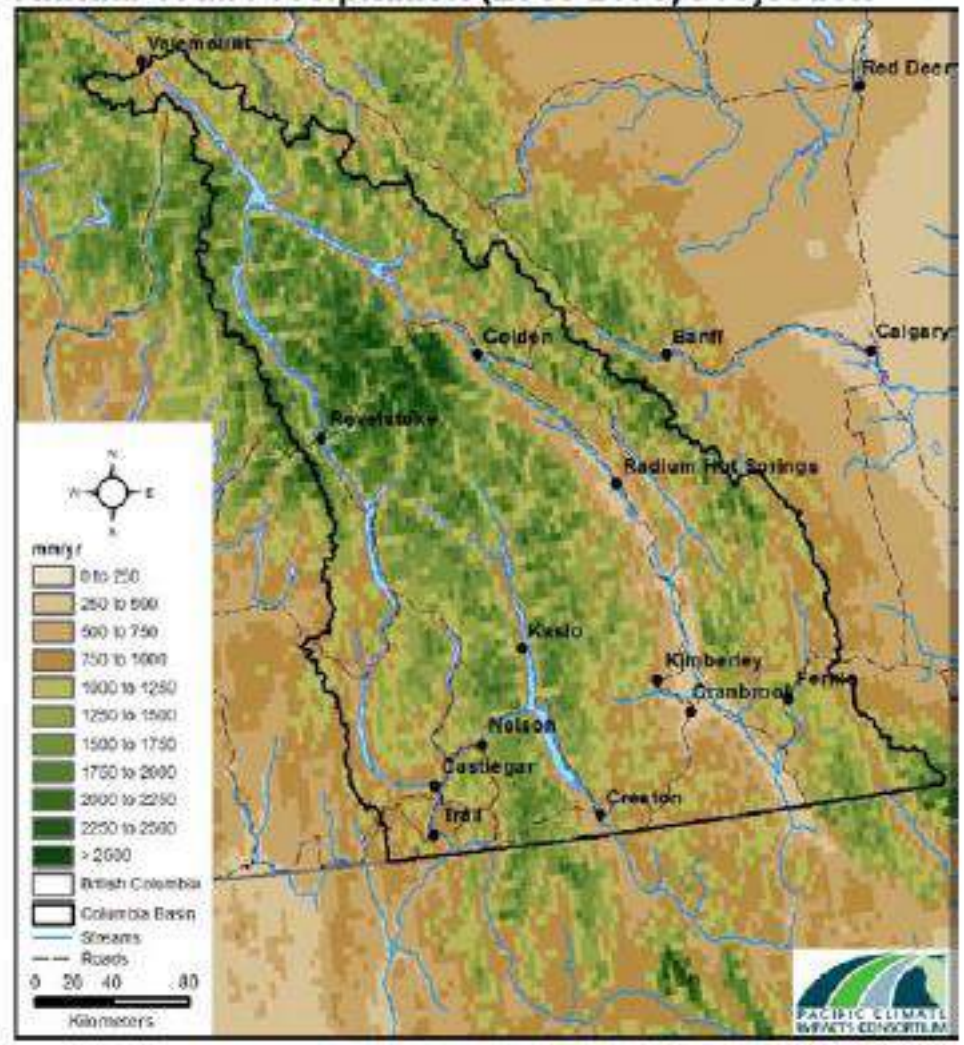


Annual Mean Temperature (2041-2070) Projection



Annual Total Precipitation

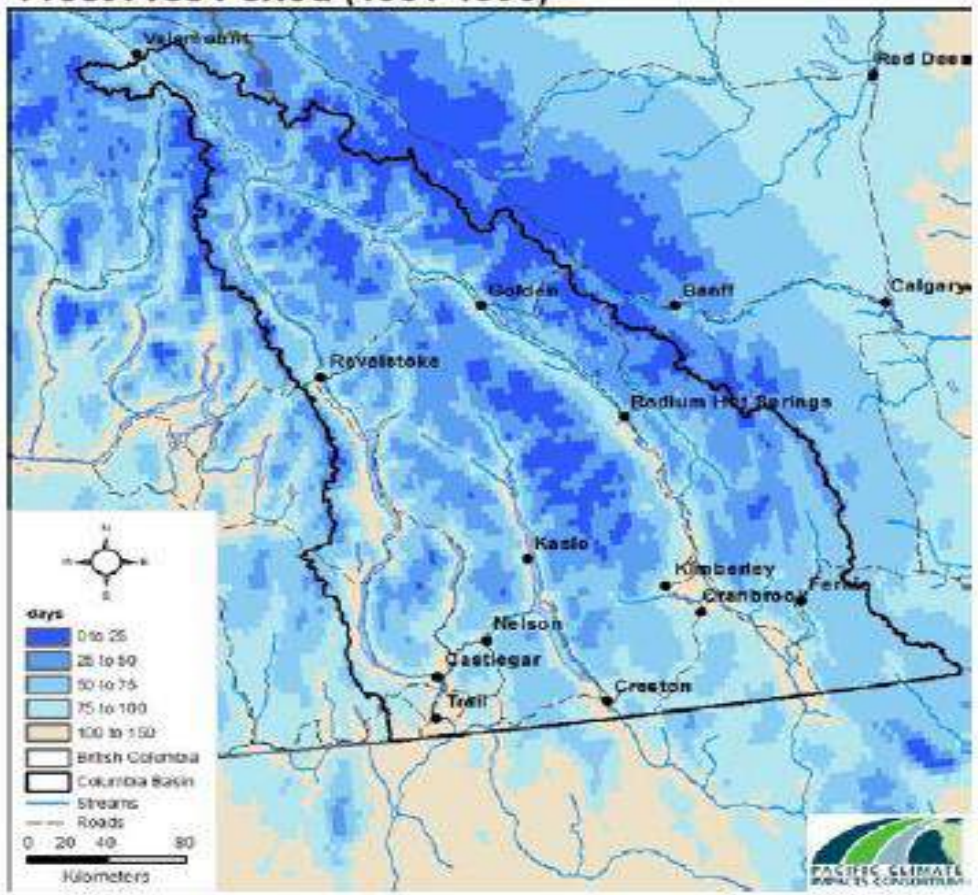




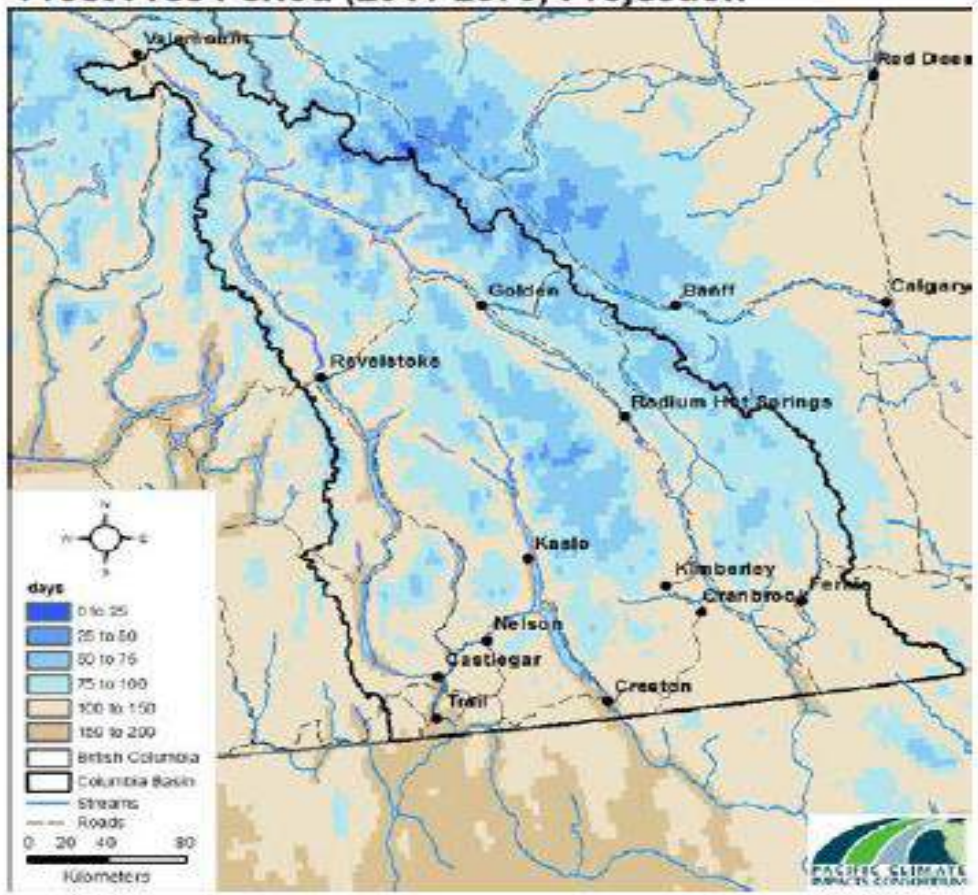
Climate Projections (1961-1990 vs. 2041-2070)

Number of Frost Free Days

Frost Free Period (1961-1990)

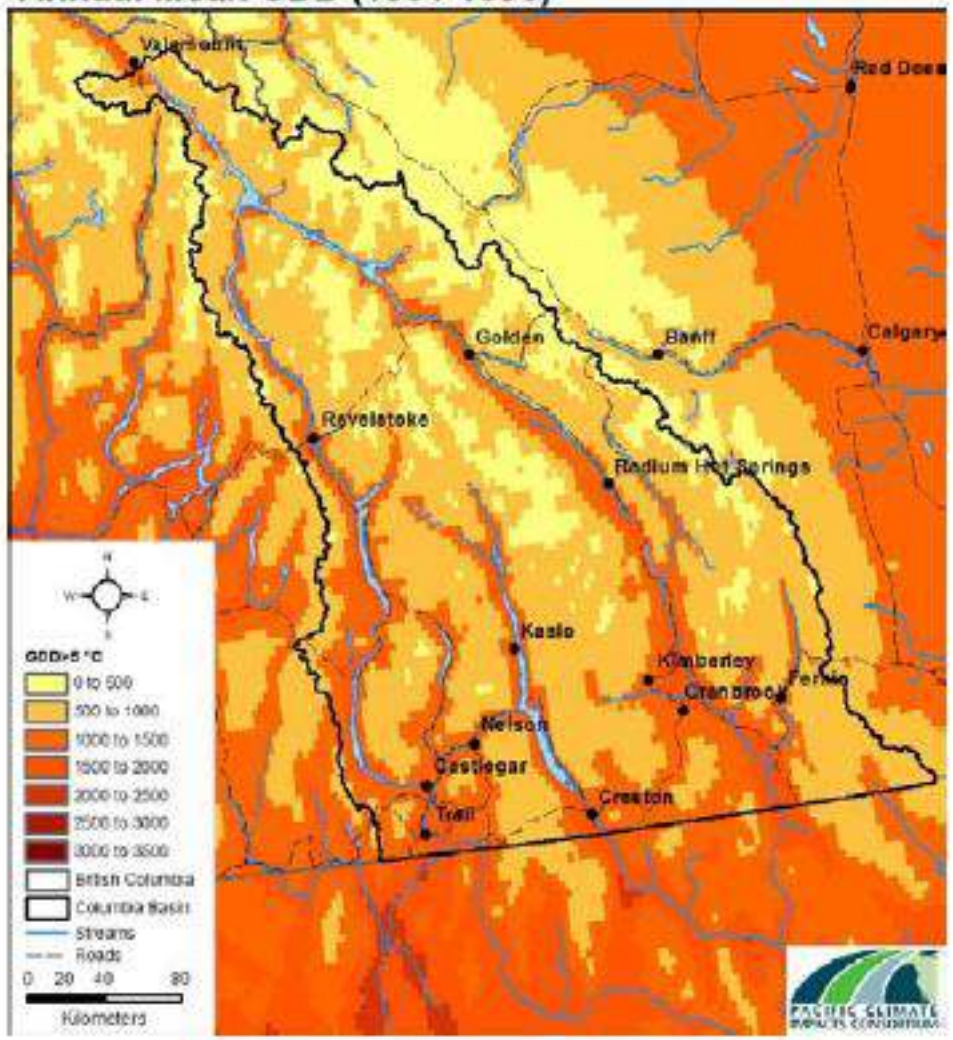


Frost Free Period (2041-2070) Projection

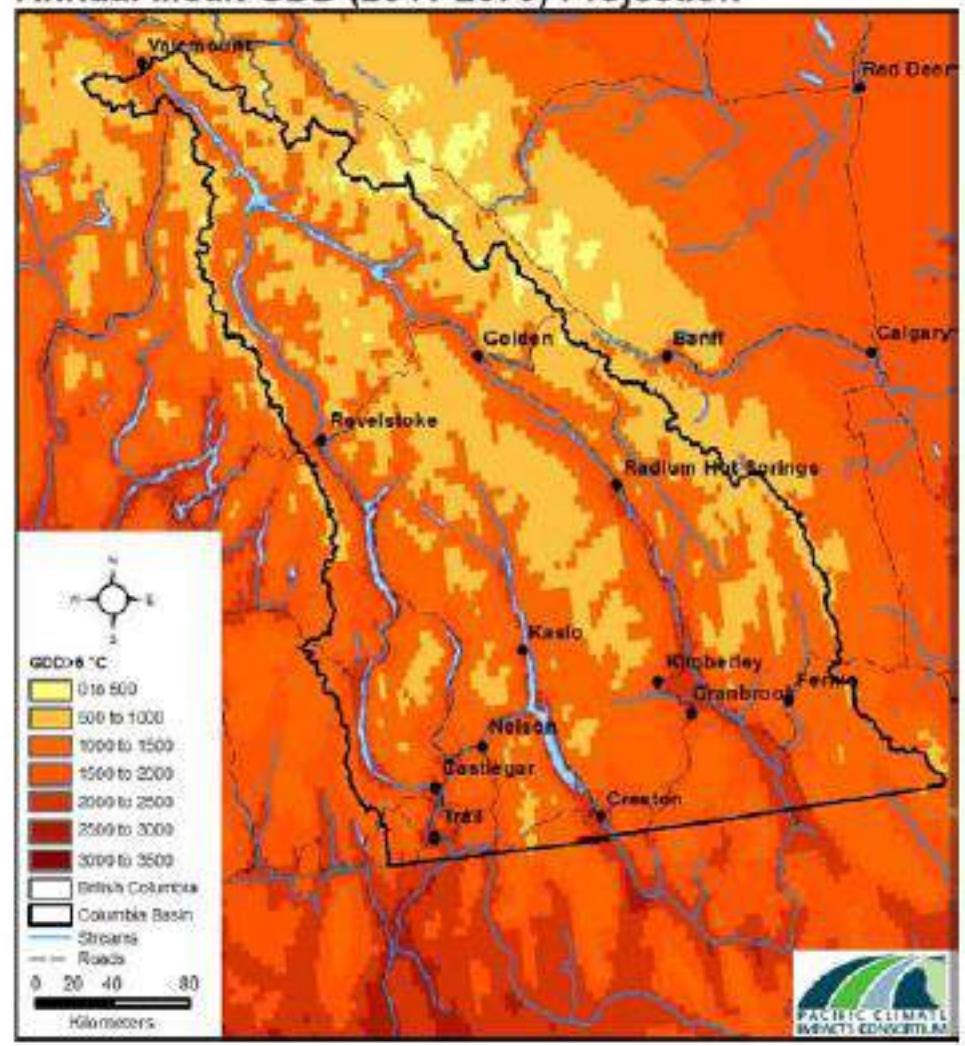


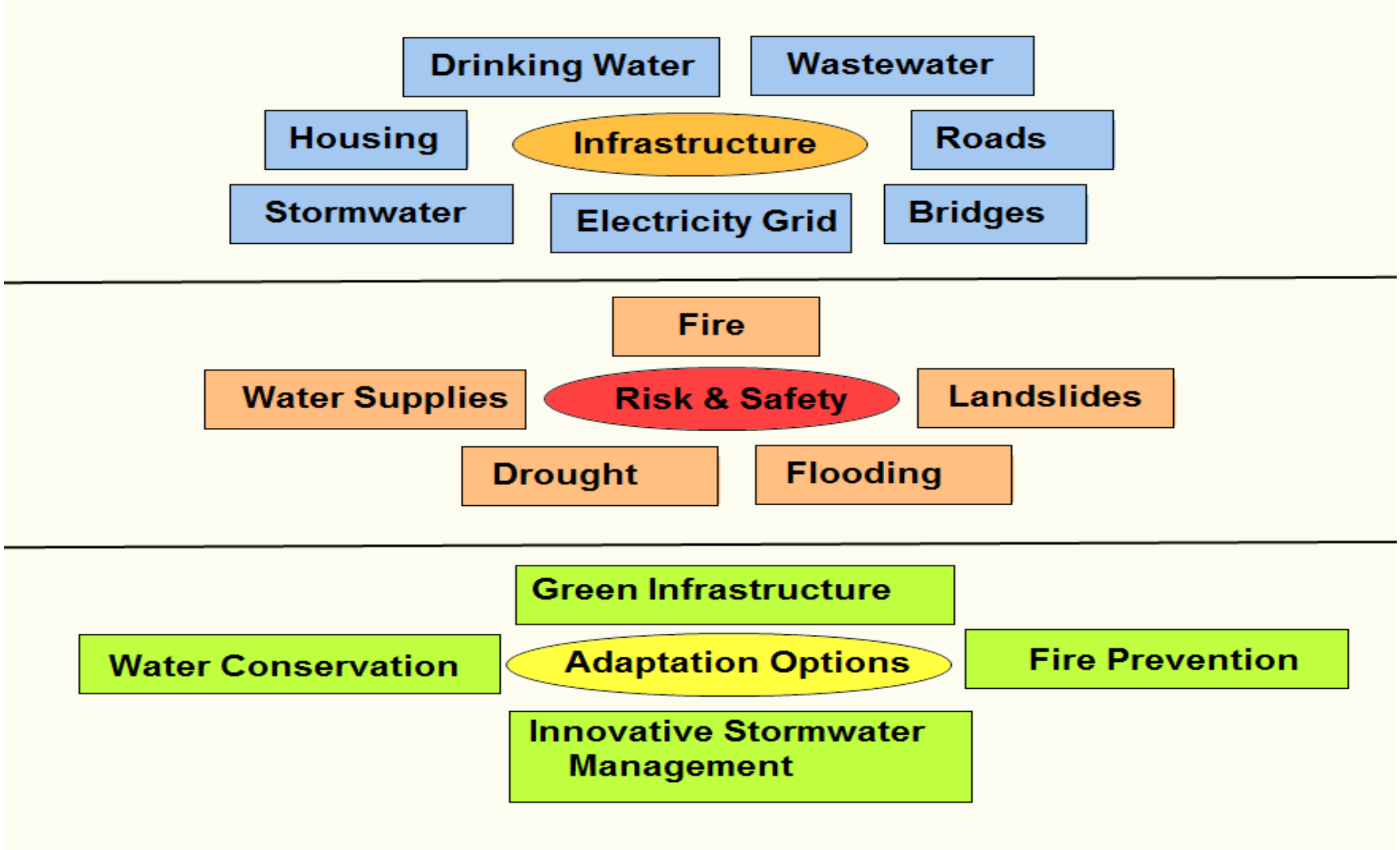
Growing Degree Days

Annual Mean GDD (1961-1990)

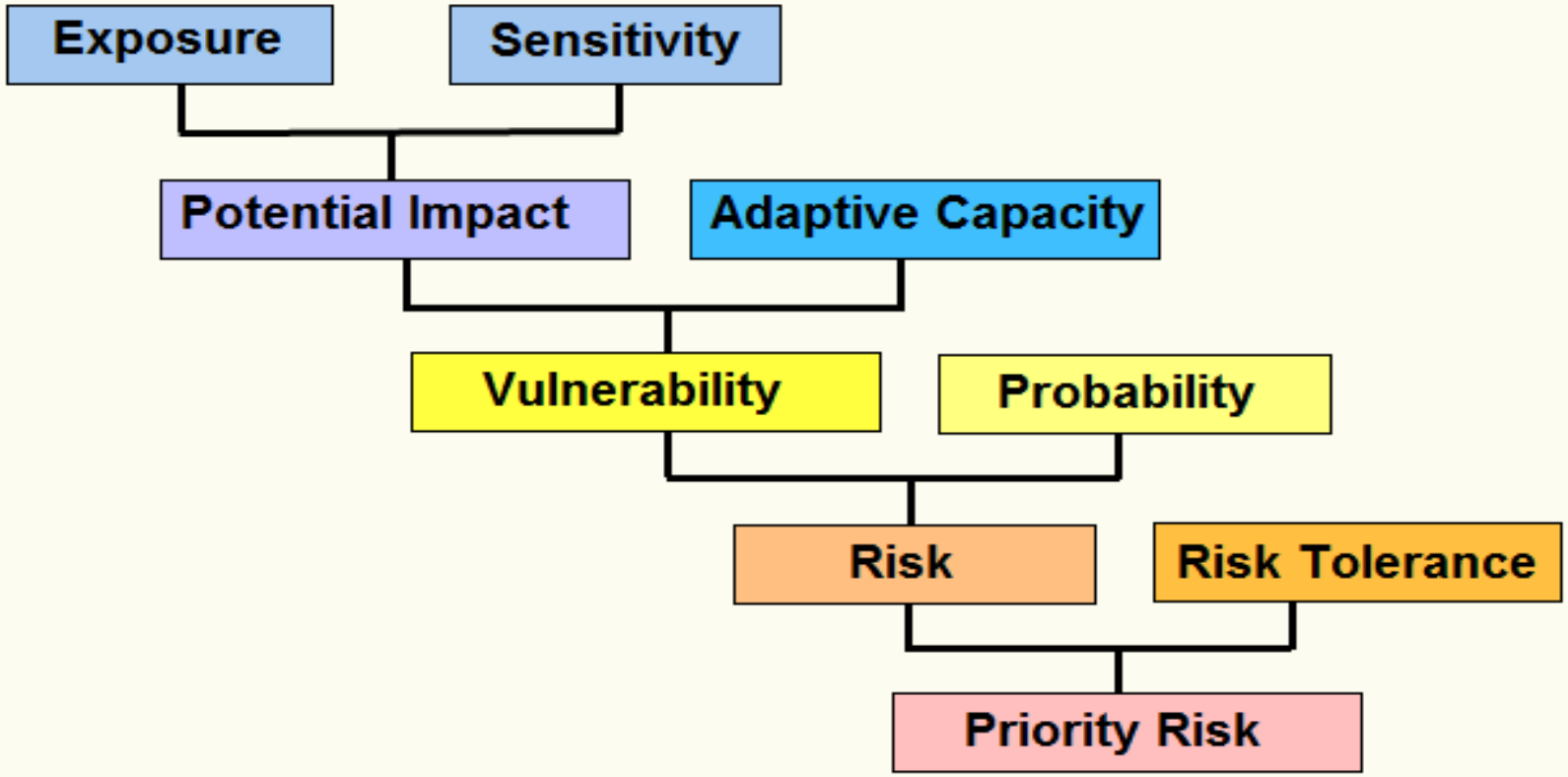


Annual Mean GDD (2041-2070) Projection




Drinking Water
Wastewater
Housing
Infrastructure
Roads
Stormwater
Electricity Grid
Bridges
Fire
Water Supplies
Risk & Safety
Landslides
Drought
Flooding
Green Infrastructure
Water Conservation
Adaptation Options
Fire Prevention
Innovative Stormwater Management

Approach



Vulnerability = Exposure x Sensitivity x Adaptive Capacity

Risk = Vulnerability x Probability

Priority Issues Identified by the Different Communities

Communities	Water Availability	Wildfire	Flooding Stormwater	Food Security	Infra-Structure	Tourism (Snow)	Energy
Elkford	3	1	2				
Kimberley	1	2			3	4	
Kaslo	1			2			
Rossland	1		3	4			2
Castlegar	1		3	2			

1	Highest Priority
2	2nd Priority
3	3rd Priority
4	4th Priority
	Minor Concern

Priority Issues Identified by the Different Communities

Issues	Priorities	Extent of Problem	Initiatives
Water Availability	Highest Priority	Shortages in Winter & Summer	Water Conservation Winter & Summer
Wildfire	2nd Priority	Increased Disease & Drought	Reduce Fuel Load near Communities
Flooding Stormwater	3rd Priority	Increased Frequency	Improve Protection Risk Mapping
Food Security	4th Priority	Winter Access Issues	Extended Growing Season & Greenhouses

Flooding: Sensitivity, Adaptive Capacity, Vulnerability

Flooding Risks	Sensitivity (L, M, H)	Adaptive Capacity (L, M, H)	Vulnerability (VL,L,M,H,VH)
Flooding of buildings or lands	High	Low	Very High
Damage to bridge integrity	High	Low	Very High
Storm water management stress	Moderate	High	Low
Death/ injury to river recreation users	Low	Moderate	Low
Pumphouse floods and compromises water supply	High	Moderate	High

Flooding Risk Assessment Summary

Vulnerability							
	Very high *(High sensitivity, low adaptive capacity AC)*	• Flooding of buildings and land • Damage to bridge		Damage to bridge	Flooding of buildings and land		
	High (High sensitivity, moderate AC or Moderate sensitivity low AC)	• Pumphouse floods and compromises water supply		Pumphouse flooding			
	Moderate *(Moderate sensitivity and adaptive capacity)*						
	Low *(low sensitivity moderate AC or moderate sensitivity high AC)*	•Stormwater management stress •Death/ injury to river users		Death/injury to river users	Stormwater management stress		
	Very Low *(Low sensitivity, high adaptive capacity)*						
			Unlikely to occur	**May occur once**	**Likely to occur at least once**	**Likely to occur several times**	**Occurs frequently**

Probability

Wildfire: Sensitivity, Adaptive Capacity, Vulnerability

Wildfire Risks	Sensitivity (L, M, H)	Adaptive Capacity (L, M, H)	Vulnerability (VL,L,M,H,VH)
Wildfire enters District boundary	High	Low	Very High
Smoke alert from nearby wildfires	Moderate	Low	High
Evacuation of whole or part of community	Moderate-high	Moderate	Moderate- High
Road and highway closure (Hwy 43)	Moderate-high	Moderate	Moderate-High
Backcountry/ forest closures due to high fire risk	Moderate	Low	High
Damage to Infrastructure and Homes	High	Moderate	High
Loss of life from wildfires	High	High	Moderate
Closure of Mine due to fire risk (for at least one day)	Moderate	Low	High
Lawsuit against District for fire damage	Moderate	Moderate	Moderate

Wildfire Risk Assessment Summary

Vulnerability							
	Very high *(High sensitivity, low adaptive capacity AC)*	• Wildfire enters district			Wildfire Enters		
	High *(High sensitivity, moderate AC or Moderate sensitivity low AC)*	• Smoke alert • Evacuation Road and highway closures • Damage to infrastructure and homes • Mine closure		Evacuation Mine closure	Damage to Infrastructure Road highway closure	Smoke alert	
	Moderate *(Moderate sensitivity and adaptive capacity)*	• Lawsuit • Loss of life		Lawsuit Loss of life			
	Low *(low sensitivity moderate AC) or (moderate sensitivity high AC)*	• Backcountry/ forest closure				Backcountry forest closure	
	Very Low *(Low sensitivity, high adaptive capacity)*						
			Unlikely to occur	**May occur once**	**Likely to occur at least once**	**Likely to occur several times**	**Occurs frequently**
	Probability in 20 year planning period						

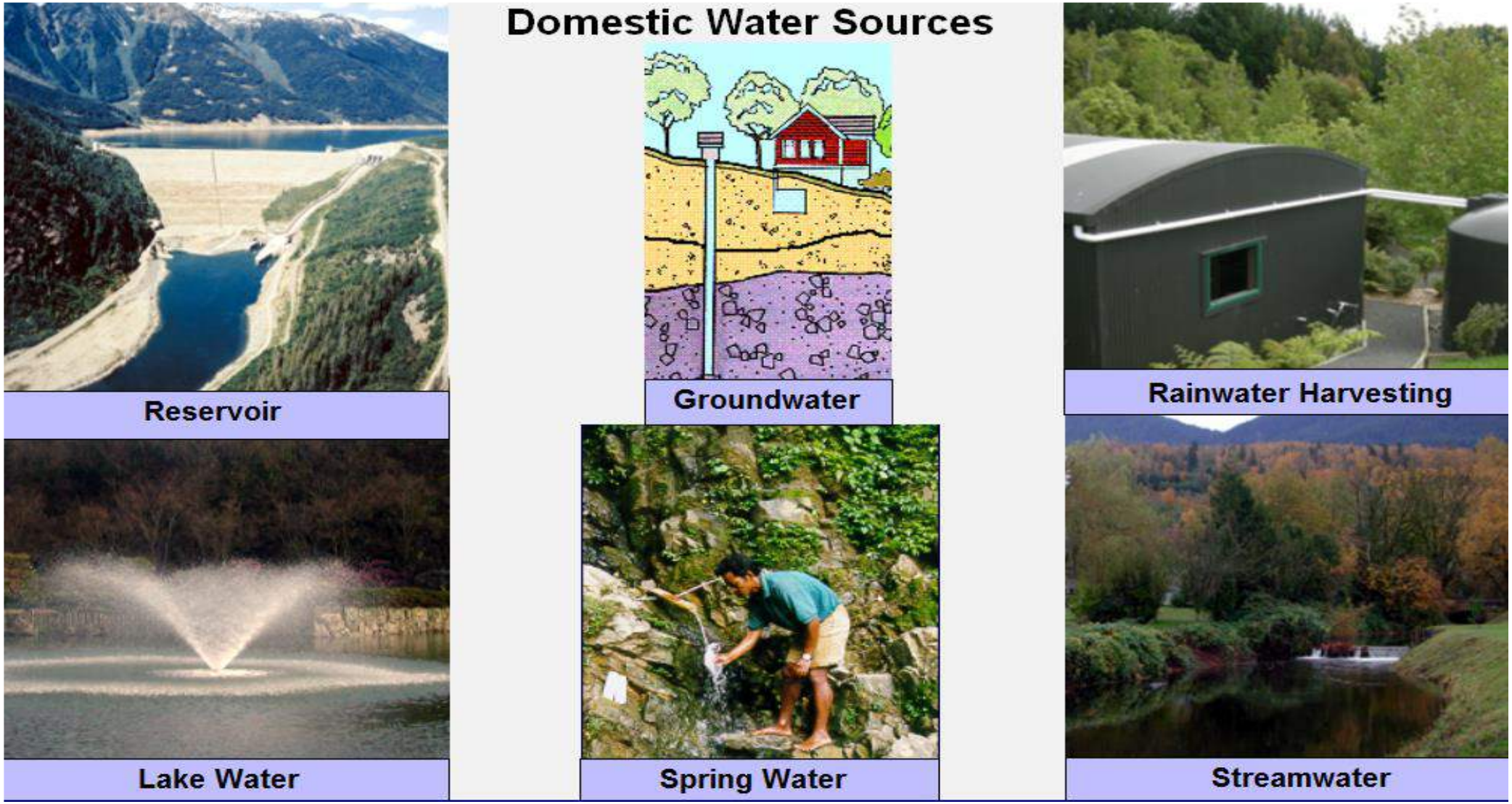
Water Quality: Sensitivity, Adaptive Capacity, Vulnerability

Water Quality & Availability	**Sensitivity (L, M, H)**	**Adaptive Capacity (L, M, H)**	**Vulnerability (VL,L,M,H,VH)**
Decreased water quality	Low	Low	Moderate
Decreased water Availability	Moderate	Low	Moderate-High
Decreased aquifer recharge rate	Moderate	Low	Moderate-High
Decreased watershed health and integrity	Moderate	Moderate	Moderate
Increased turbidity of river water	High	Low	Very High
Increased cost of water treatment due to health regulation	Moderate	Moderate	Moderate

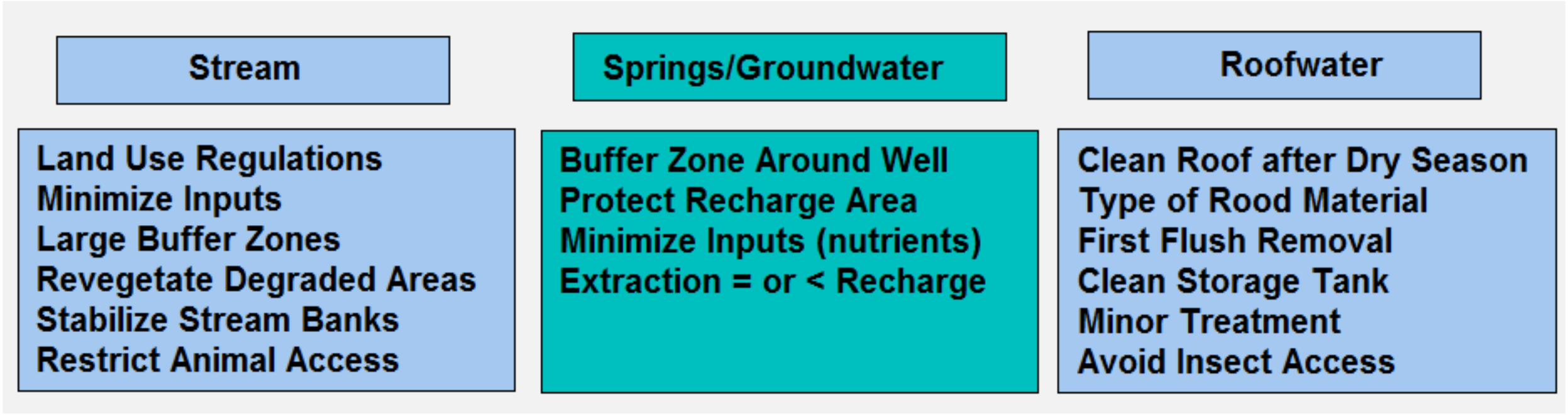
Water Quality Risk Assessment Summary

Vulnerability			Unlikely to occur	May occur once	Likely to occur at least once	Likely to occur several times	Occurs frequently
	Very high *(High sensitivity, low adaptive capacity AC)*	•Turbidity				Turbidity in river (impacting fish)	
	High (High sensitivity, moderate AC or Moderate sensitivity low AC)	• Water Availability (Unknown probability) •Aquifer recharge – (Unknown probability)					
	Moderate *(Moderate sensitivity and adaptive capacity)*	• Water quality • Watershed health and integrity • Increased cost of water treatment due to health regulation		Water quality	• Watershed health and integrity • Increased cost of H_2O treatment		
	Low *(low sensitivity moderate AC) or (moderate sensitivity high AC)*						
	Very Low *(Low sensitivity, high adaptive capacity)*						
			Probability in 20 year planning period				

Specific Adaptation Methods



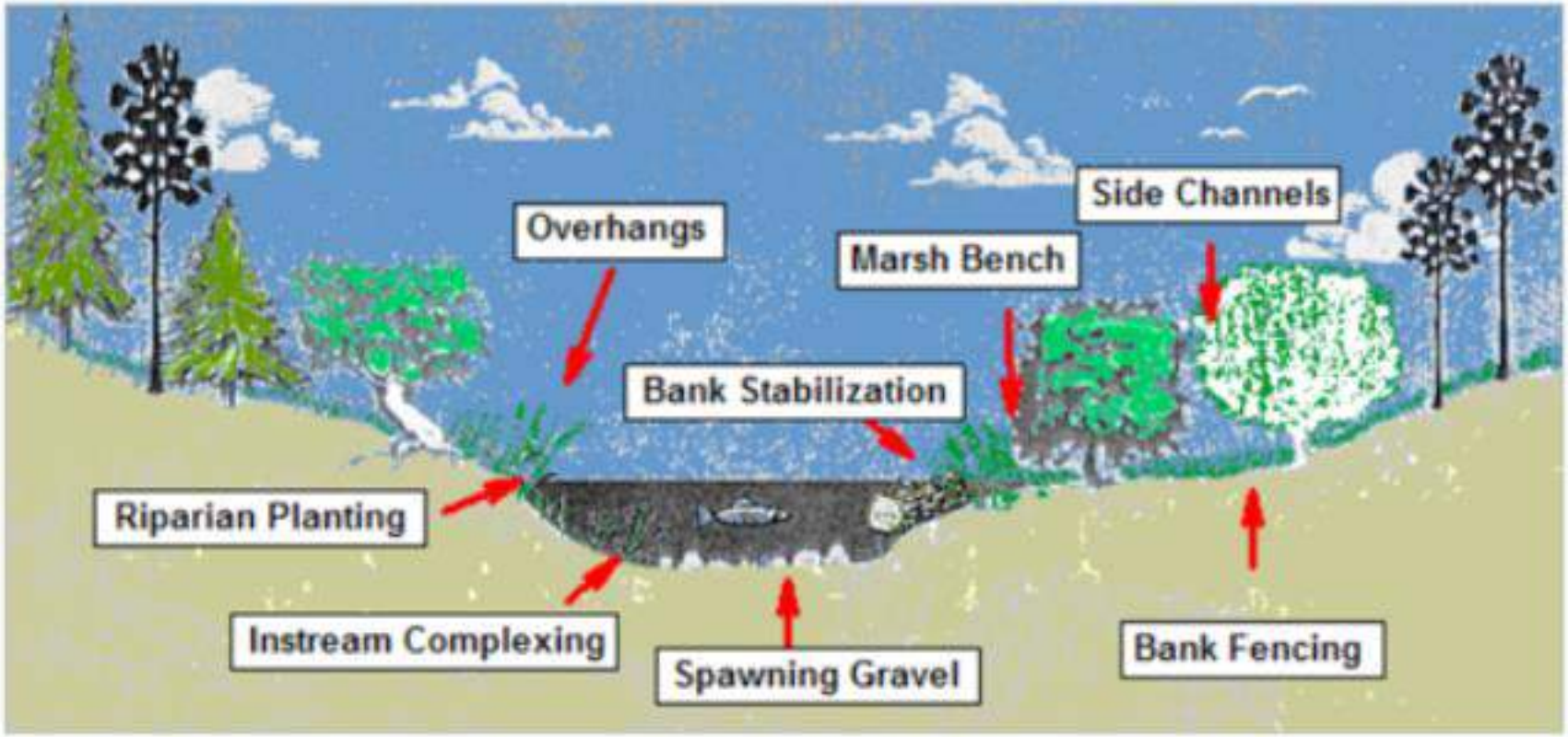
Different Water Sources Need Different Protection



Stream Rehabilitation

Watershed Restoration Techniques

Techniques are designed purposely to be low tech and labour intensive, and to be conducted largely by volunteers and community groups. They provide high visibility and generally high effectiveness for habitat restoration.



Stream Bank Rehabilitations

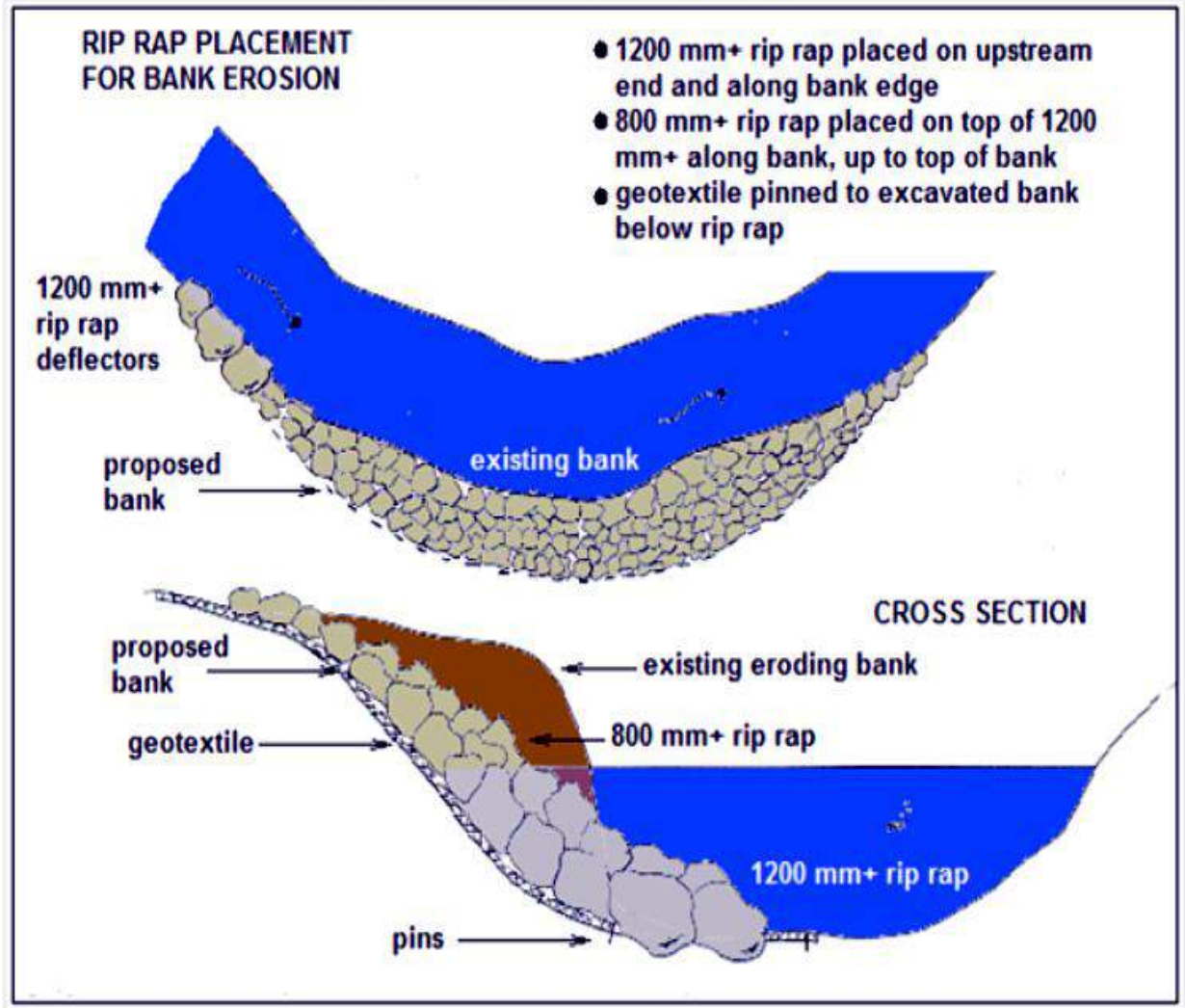
Purpose

- protects banks from erosion
- provides cover for fish
- introduces complexity
- nutrient cycling
- tree root stabilization
- site with more than 10 m section with problems

Construction

- outside of meander
- select suitable trees (conifers)
- clear stream debris
- place geotextile down bank with 1 m fringe into stream
- 400 to 600 + rip rap are placed between stream revetment
- each tree can be wrapped to the bank

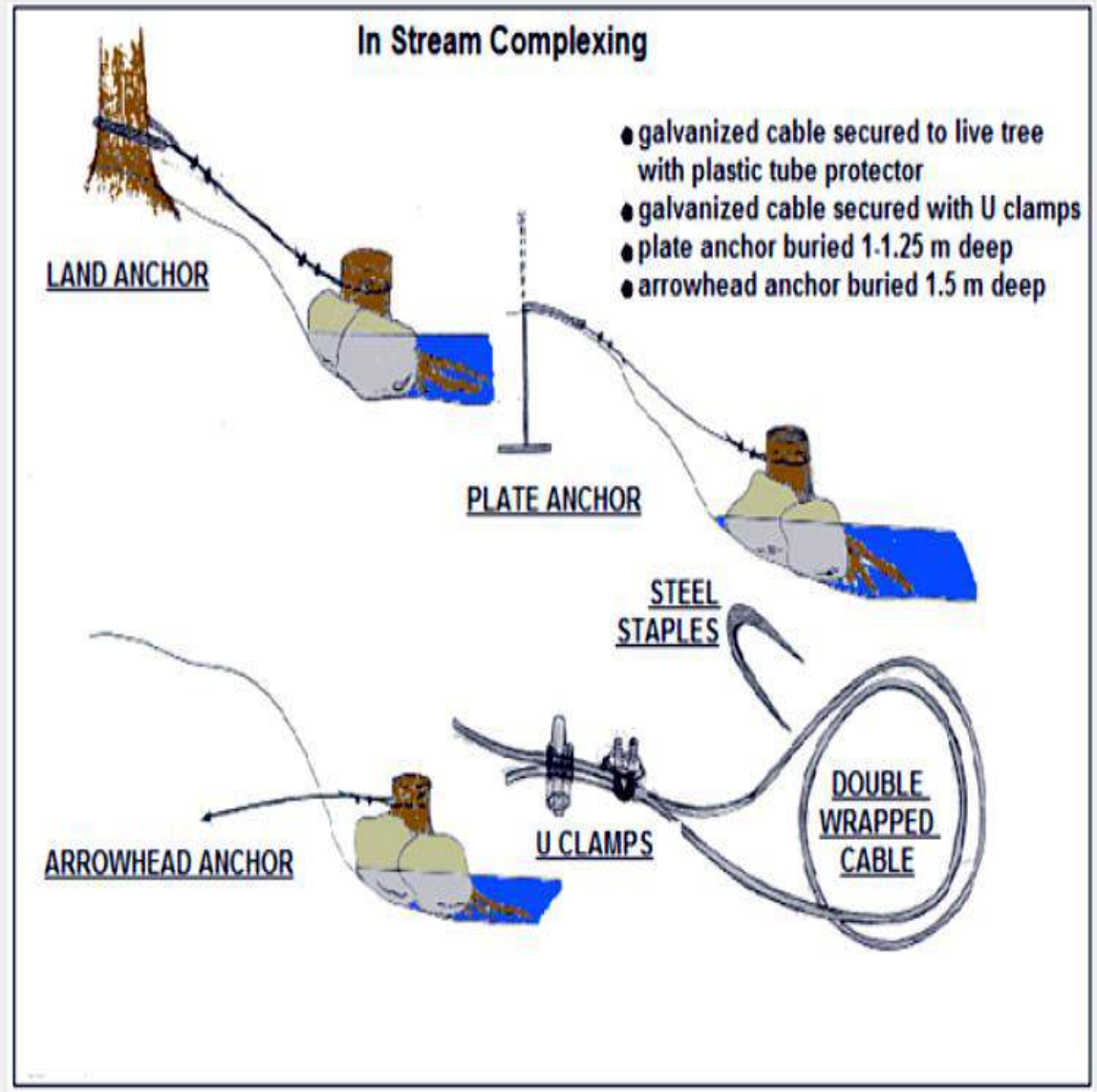
Bank Stabilization (Rip-Rap)



In Stream Complexing

Purpose	Construction
• cover and protection for fish • nutrient input • reduces stream velocity • created pools • increases rearing and spawning habitat • cooler temperatures	• where cover protection is limited • large logs are needed • placed instream and along banks • anchored using steel cables and land anchor • root wads can also be used

Adding Large Woody Debris to Create Pools and Riffels



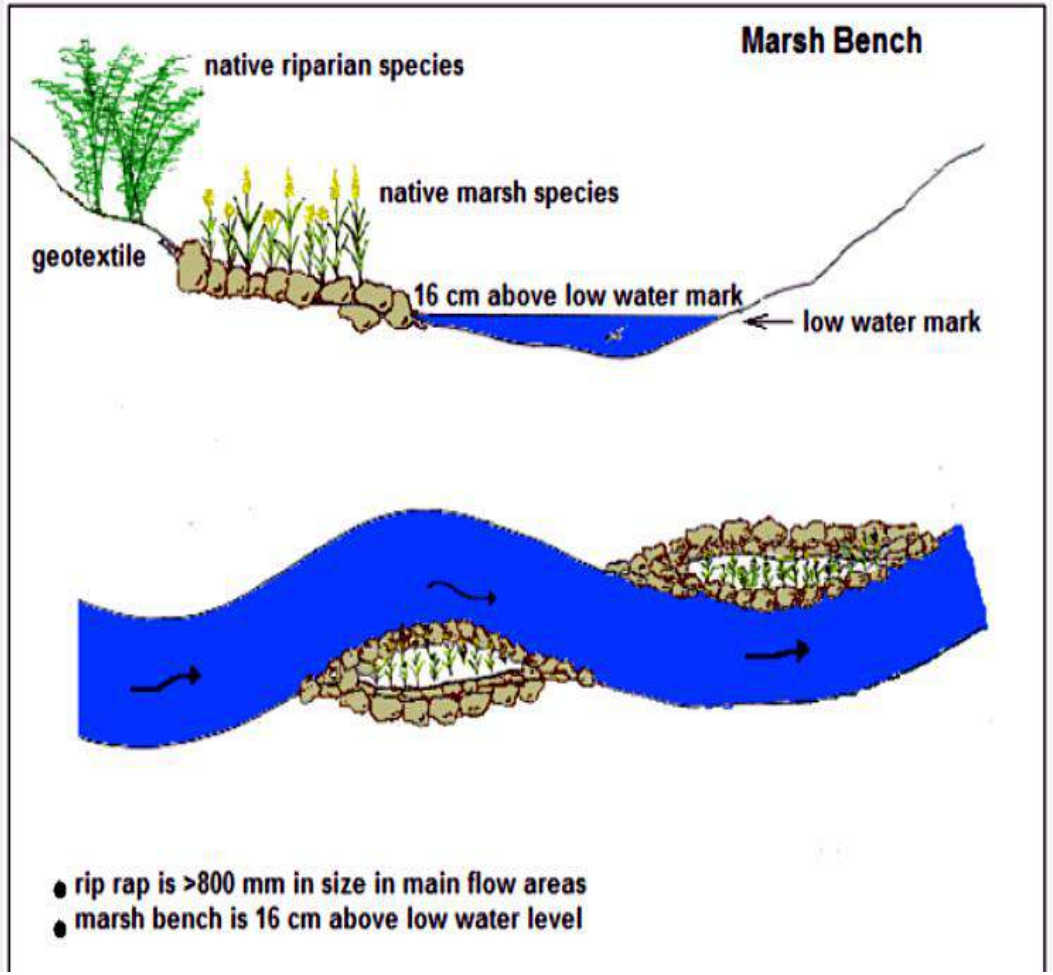
Why Fence Streambanks

Purpose	Construction
• keeps livestock away • controls erosion and sedimentation • input of manure and micro-organisms reduced • reduces widening of stream due to trampling • decreased excess nutrient input (eutrophication) • increased oxygen	• consider severity of area affected by flooding • construct fence beyond zone of flooding • minimum 8 m from banks • crossings may be required • use gravel crossings to reduce sediments

Mash Benches and Wetlands

Purpose	Construction
• produces rearing habitat • improves water quality • shelter and nutrients • stabilizes sediments • filters pollutants • regulates stream flow	• site must be compatible for wetland conditions (slope, elevation, soil type) • near stream for through flow • inside stream meander • excavation 50 cm below low stream flow level • use geotextile over inside edge • place rip rap on top • area on top planted with riparian species • outside stream edge is armored with rip rap

Mash Benches and Wetlands



Vegetating Riparian Buffer Zones

Purpose

- improves vegetation adjacent to creek
- regulates temperature
- controls erosion
- improves cover and nutrient cycling
- filter pollutants
- increased biodiversity

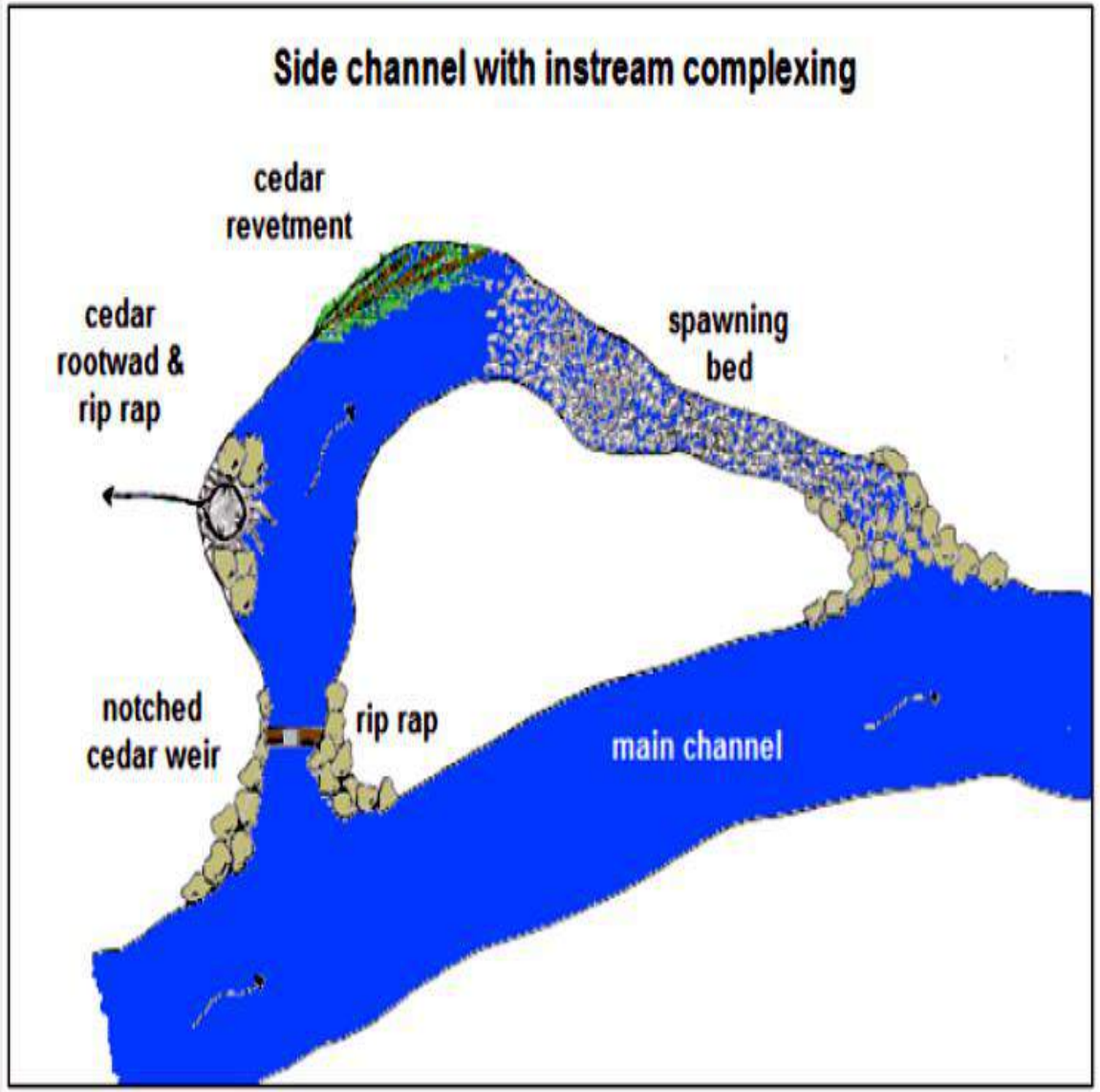
Construction

- section that needs revegetation
- selected species that are native to the region
- use mixture of marsh plants, grasses, shrub and trees
- marsh for stream / land interface (fish protection)
- shrub for cover (insects)
- early spring or fall planting
- trees from nursery seedlings or salvage (some planting from whips of mature trees)

Why Build New Side Channels

Purpose	Construction
• duplicates most favourable aspects of spawning and rearing habitat • creates additional habitat • combines all aspects of stream rehabilitation	• large undertaking with potentially maximum benefits • site should be stable and have cool water supply • excavate trench connected with adjacent stream • upstream end needs to be reinforced with rock berm (steady flow) • creates pools and riffles • add gravel • large woody debris • overhangs

Building Side Channels



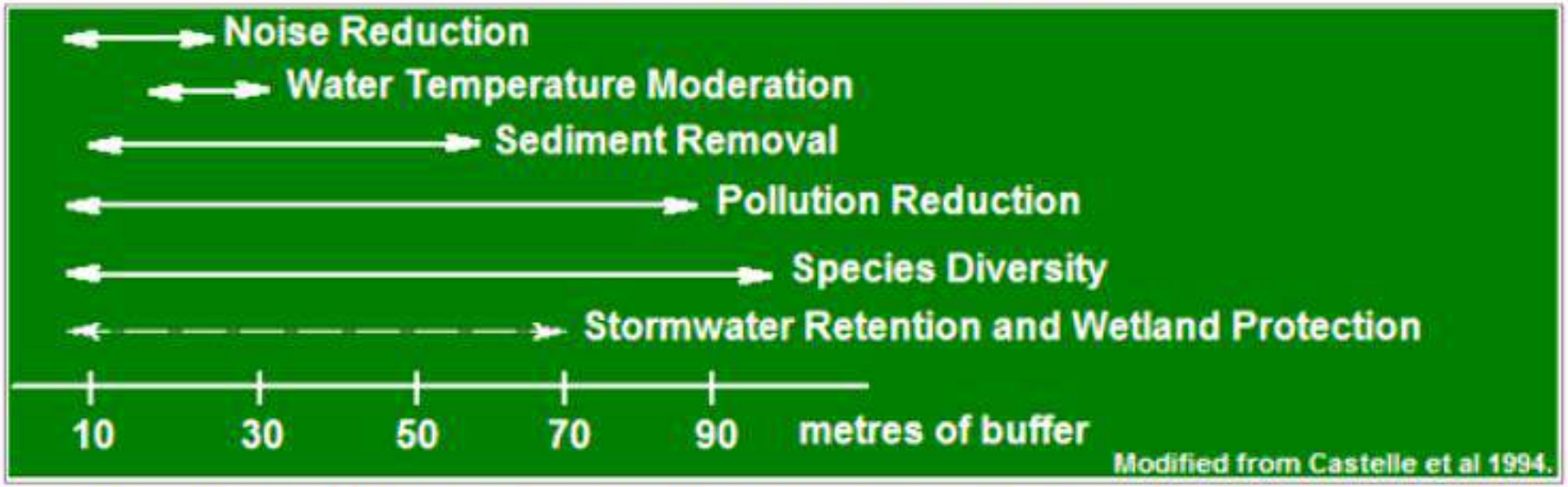
Building New Side Channels

Riparian Buffer Zone:
Transition Between Aquatic & Terrestrial Environment

Influences micro-climate, facilitated nutrient flow and plant diversity. Acts as a protection for sediment & contaminant inputs, provided corridor for wildlife movement, and works as a filter systems

Functions and Size of Riparian Buffer

Functions and Size of Riparian Buffer Zones



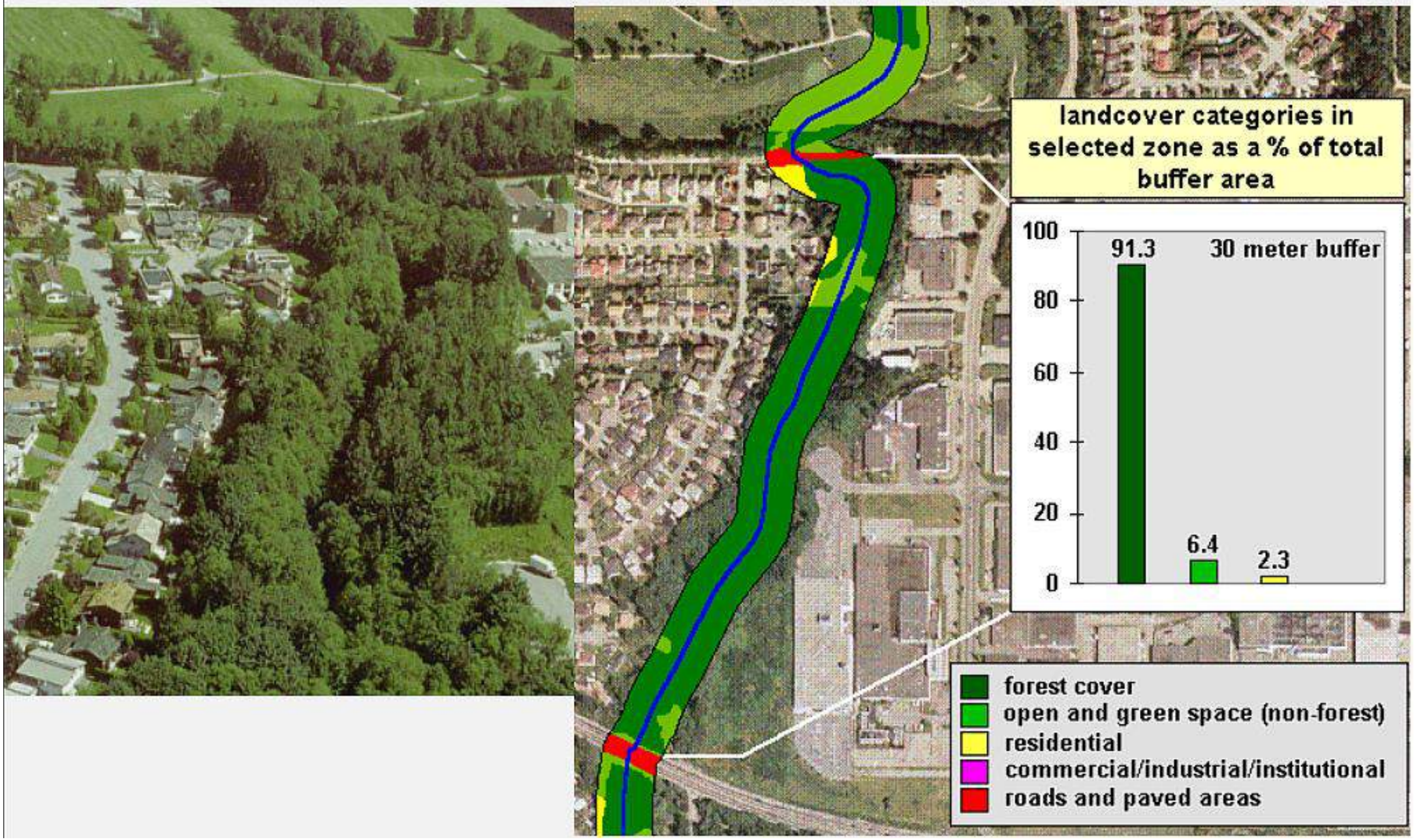
The Decision is Usually a Compromise Between Political and Public Acceptability

Dependent on:

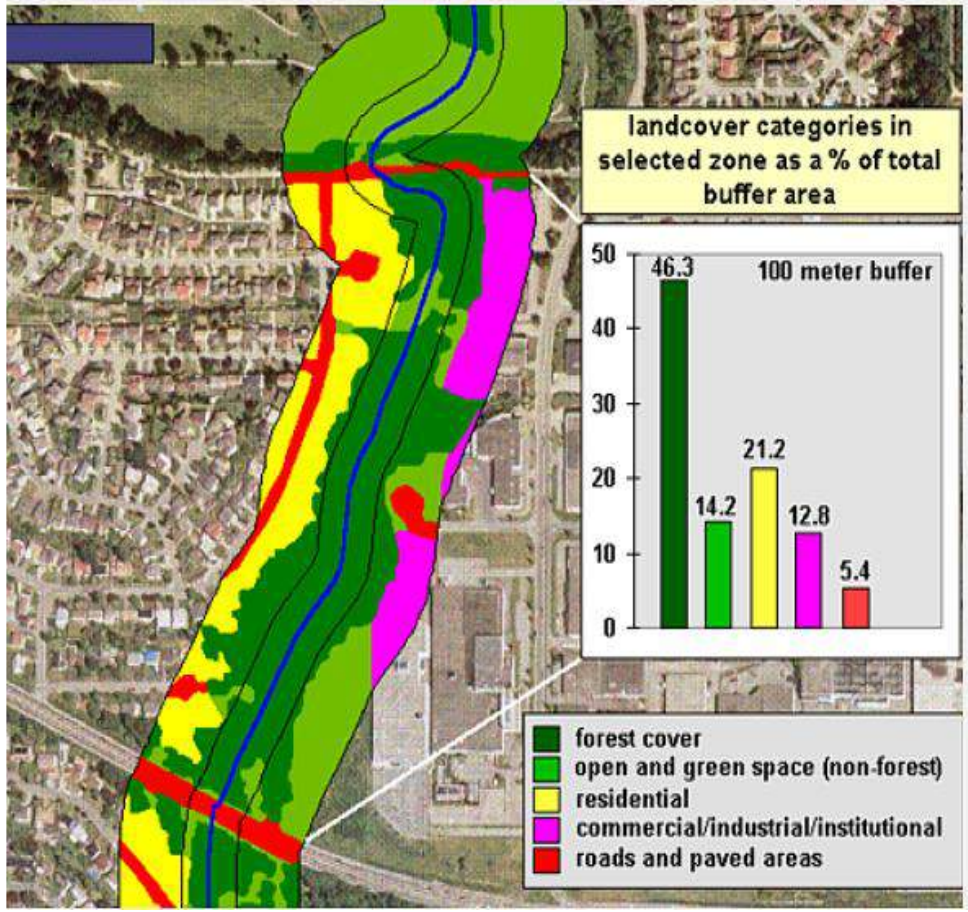
Functional Value of Resource
Intensity of Adjacent Use
Buffer Zone Characteristics
Specific Buffer Requirements
Size of Stream

General Guidelines:

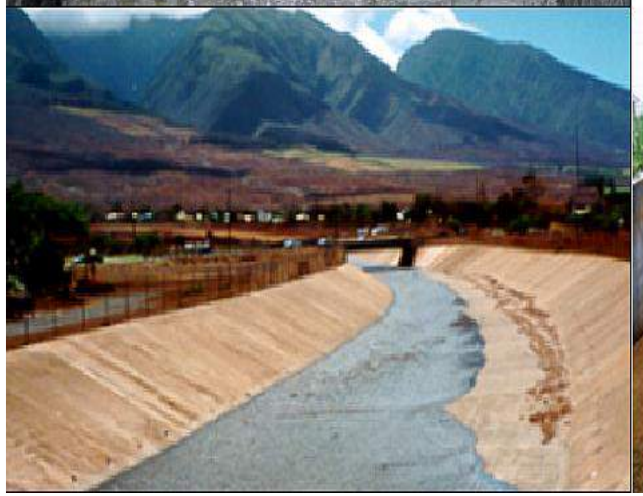
5 - 10 m Buffer is too Small
15 - 30 m Buffer is a Minimum
30 - 100 m is a Realistic Compromise
Variable Size is Best but Difficult to Enforce from a Legal Perspective


landcover categories in selected zone as a % of total buffer area
100
80
60
40
20
0
91.3
6.4
2.3
30 meter buffer
forest cover
open and green space (non-forest)
residential
commercial/industrial/institutional
roads and paved areas

100 m Buffer Zone

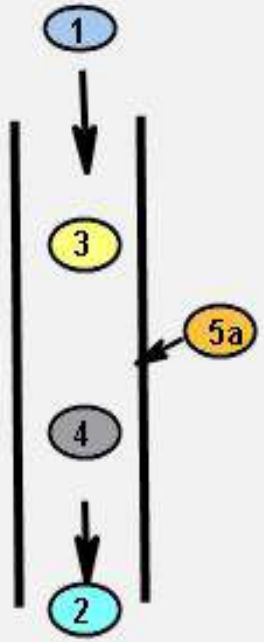


ONCE CHANNELIZED IT IS DIFFICULT AND EXPENSIVE TO RECREATE NATURAL CHANNELS



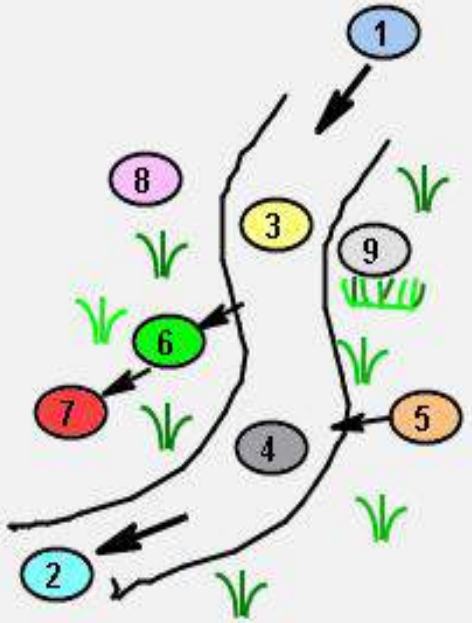
Differences Between:

Channelized River



1. Inflow from Upstream
2. Outflow Downstream
3. Evaporation
4. Rainfall into River
5. Natural Inflow Drainage
5a. Inflow from Piping System
6. Channel Outflow Seepage
7. Groundwater Recharge
8. Evapotranspiration
9. Wetlands

Natural Channel



DETENTION SYSTEMS & CONSTRUCTED WETLANDS

1. Detains & Stores Stormwater
2. Collects Sediments
3. Retains & Filters Pollutants
4. Takes up Excess Nutrients
5. Phytoremediation
6. Recreational Opportunities

To Minimize Mosquito Problems

1. Minimize Amount of Stagnant Water (aerate, of maintain flow)
2. Minimize Eurtrophication
3. Plant Appropriate Wetland Plants (Biodiversity)
4. Introduce Fish (Stickleback)
5. Treatement at Larvae Stage

Adaptation Strategies

Demand Management	→	Urban, Agricultural, Recreational Use
Stormwater Management	→	Site, Neighborhood, Watershed, Design Flood
Drought Management	→	Allocation Strategy, Conservation
Hazard Protection	→	Beneficial Management Pratices
Rainwater Harvesting	→	Green Water Management, Soil Infiltration
Fire Risk Reduction	→	Reducing Fuel Loads & Fire Breaks



Sources for more detailed Information on the Adaptation Program:

Columbia Basin Trust:
http://adaptationresourcekit.squarespace.com/community-action-plans/

Elkford Climate Adaptation Program
http://adaptationresourcekit.squarespace.com/storage/Elkford_CCA_Report-_FINAL-31.pdf

Food Security, Virtual Water and Increased Climatic Variability
http://wmc.landfood.ubc.ca/webapp/VWM