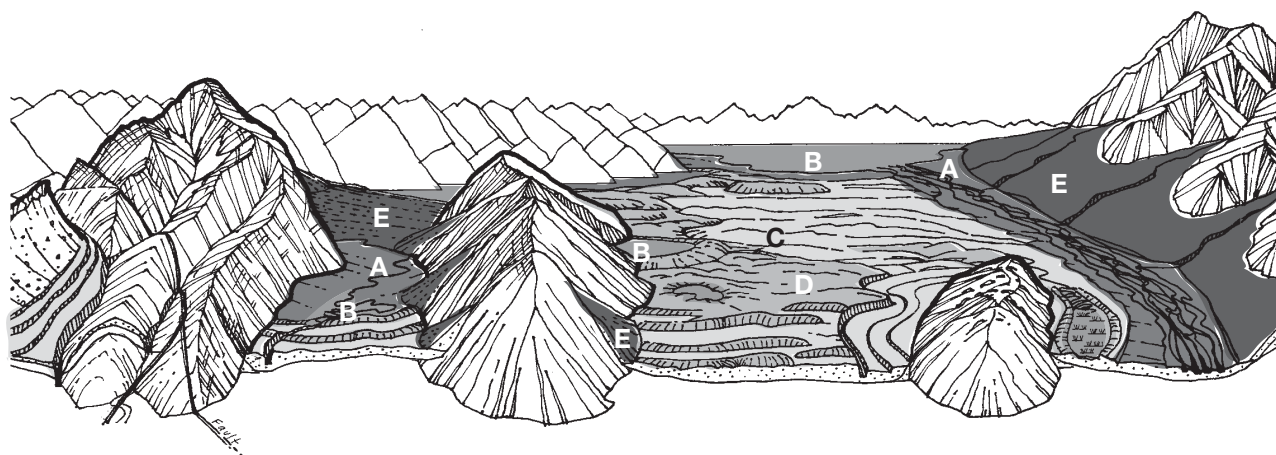
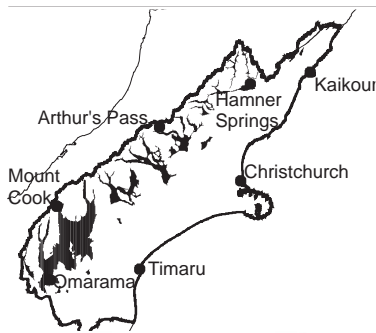


# (c) Inland basins and major river valleys



Land form	Resource composition (biota, soil, water)	Natural stresses	Induced changes/disturbances
<b>A</b> Floodplains - active and infrequently flooded (older/higher)	<ul style="list-style-type: none"> <li>Vegetation sequence from active riverbed to scabweeds, fescue tussock and matagouri on higher floodplains. Small areas of developed pasture on deeper soils.</li> <li>Rainfall 700-1000 mm</li> <li>Recent soils - relatively fertile but weakly developed, generally shallow and stony, low water holding capacity.</li> </ul>	<ul style="list-style-type: none"> <li>Flooding - fluvial erosion and deposition</li> <li>Drought and strong winds - desiccation</li> <li>Freeze / thaw activity</li> </ul>	<ul style="list-style-type: none"> <li>High rabbit proneness - occasional rabbit plagues</li> <li>Cultivation for pasture renewal</li> <li>Extensive grazing on drier areas</li> </ul>
<b>B</b> Wetlands and lakes - including valley floor and terrace moraine	<ul style="list-style-type: none"> <li>Wetlands, tarns, and lakes (including hydro lakes)</li> <li>Sedge, reed and rushlands, red tussock, raupo</li> <li>Rainfall 700 - 1000 mm</li> <li>Fertile gley and organic soils</li> </ul>	<ul style="list-style-type: none"> <li>Seasonal drought</li> <li>Flooding</li> </ul>	<ul style="list-style-type: none"> <li>Intensive cattle and sheep grazing, particularly in lake and wetland margins</li> <li>Drainage of wetlands and surrounding land</li> <li>Cultivation for pasture renewal</li> <li>Water abstraction from lakes</li> </ul>
<b>C</b> Intermediate terraces	<ul style="list-style-type: none"> <li>Depleted short tussock; sorrel is dominant, some hieracium and scabweed.</li> <li>Rainfall 600 - 800 mm</li> <li>High % bare ground: 50% is common</li> <li>Infertile yellow-brown earths; stony and shallow, high aluminium content.</li> </ul>	<ul style="list-style-type: none"> <li>Seasonal drought</li> <li>Soil factors limit plant growth / recovery</li> <li>Freeze / thaw activity</li> <li>Strong drying winds - wind erosion and desiccation</li> </ul>	<ul style="list-style-type: none"> <li>High rabbit proneness - occasional rabbit plagues</li> <li>Extensive sheep grazing</li> <li>Forestry planting</li> </ul>
<b>D</b> High terraces and moraines	<ul style="list-style-type: none"> <li>Short tussock grassland, hieracium in undeveloped areas, oversown and topdressed tussock grasslands, fertilised pastures (except on moraine soils).</li> <li>Rainfall 800 mm.</li> <li>Yellow-brown earths, relatively deep &amp; fertile.</li> </ul>	<ul style="list-style-type: none"> <li>Some freeze/thaw activity</li> <li>Seasonal drought</li> <li>Strong drying winds - wind erosion and desiccation</li> </ul>	<ul style="list-style-type: none"> <li>High rabbit proneness - occasional rabbit plagues</li> <li>Extensive sheep grazing, plus intensive grazing on terraces</li> <li>Cultivation for pasture renewal, cash crops on terraces</li> <li>Irrigation</li> <li>Forestry planting</li> </ul>
<b>E</b> Fans	<ul style="list-style-type: none"> <li>Short tussock, matagouri, fertilised pastures.</li> <li>Low rainfall 500-800 mm.</li> <li>Yellow-brown earths, stony &amp; relatively drought-prone.</li> </ul>	<ul style="list-style-type: none"> <li>Seasonal drought</li> <li>Some freeze/thaw activity</li> <li>Strong drying winds - wind erosion and desiccation</li> </ul>	<ul style="list-style-type: none"> <li>High rabbit proneness - occasional rabbit plagues</li> <li>Extensive sheep grazing, plus intensive grazing</li> <li>Cultivation for pasture renewal, cash crops</li> <li>Irrigation</li> <li>Forestry planting</li> </ul>



red tussock-crested grebe-intermontane basins

### Location

Includes basin floors of the Mackenzie in the south, the Rangitata and Ashburton lakes, upper Rakaia and Lake Coleridge, upper Waimakariri, with smaller scale basins in the north.

### Nature

- Basins are drier in the south and east.
- Drier terraces, fans, moraines and floodplains including matagouri shrublands, tussock grasslands, cushion and gravel fields.
- Remnant beech forest on older, higher terraces.
- Major lake systems in most basins, with associated red tussock and raupo wetlands supporting native fishes, insects and birdlife (e.g., crested grebe).
- Distinctive limestone country (not shown), e.g., Castle Hill basin.

### Resource Values

- Intensive pastoral production on basin floors, includes most productive parts of the high country.
- Lakes and rivers provide significant landscape, Ngai Tahu, recreation, and tourism values and hydro resources.
- Most high country settlement is in the basins.

#### Effects/trends

- Bare ground precedes an increase in briar. Increased briar cover reduces exposure of soil to erosion processes.
- On shallow, stony soils replacement of tussock with browntop and sweet vernal leads to increasing vulnerability to vegetation loss and soil exposure to erosion processes.
- Invasion of lupins and willows into riverbeds.

#### Key issues for soil conservation

- Erosion risk: cultivation, extensive grazing in drier areas
  - Pest management (rabbits)
- Related issues:
- Change in landscape / natural character (lupins, willows, briar)

- Declining extent and reduced quality of wetland systems
- Compaction of wetland soils due to grazing and drainage leads to desiccation of wetlands
- Reduction of vegetation stature and narrowing of riparian buffer strips.
- Increased risk of eutrophication of small lakes.

- Related issues:
- Reduced indigenous biodiversity and aquatic habitat
  - Change in landscape and natural character (loss of wetlands)

- Vegetation depletion due to cumulative effects of sheep and rabbit grazing, opening up short tussock cover to sorrel / hieracium.
- Evidence of wind erosion ( pedestalled vegetation)

- Erosion risk: grazing
- Soil quality: loss of surface cover, soil organic matter, soil nutrients and soil biology
- Pest management (rabbits)
- Note - This landform component includes the most depleted areas in Canterbury - rehabilitation will require more active measures than just removing grazing pressure.
- Loss of system resilience due to loss of vegetation cover, moisture stress & limited rates of vegetation recovery.

- Related issues:
- Reduced indigenous biodiversity

- In developed areas, improved soil quality (organic matter, nutrients).
- In undeveloped areas replacement of short tussock dominated system with hieracium / browntop / bare ground.
- Evidence of wind erosion (pedestalled vegetation), due to opening up of vegetation cover (e.g., by grazing, cultivation). This land is able to recover vegetation cover much better than land type C above, but species diversity will be very low, consisting mainly of low stature plants.
- Wilding spread

- Erosion risk: extensive grazing, cultivation.
- Soil quality: in undeveloped areas, loss of surface cover, organic matter, soil nutrients, soil biology.
- Pest management (rabbits)

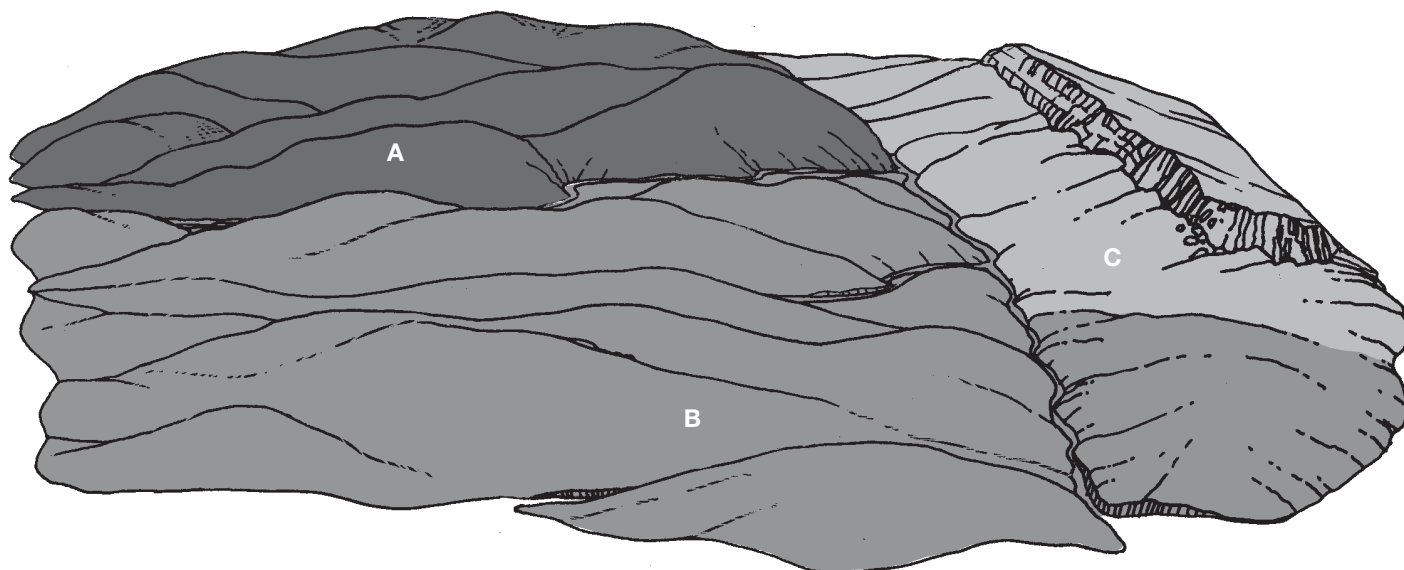
- Related issues:
- Change in landscape / natural character
  - Reduced indigenous biodiversity (wildings)

- In developed areas, improved soil quality (organic matter, nutrients).
- Replacement of tussock with exotic grasses. Spread of matagouri on more disturbed areas. Increase in hieracium, particularly in drier areas.
- Evidence of wind erosion associated with cultivation of drought-prone soils.
- Wilding spread

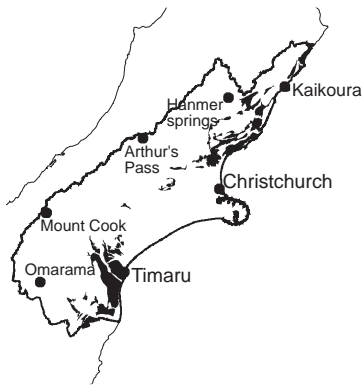
- Erosion risk: extensive grazing, cultivation, rabbits
  - Pest management (rabbits)
- Related issues:
- Change in landscape / natural character
  - Reduced indigenous biodiversity (wildings)

# (d) Soft rock hill country & downs

(e.g., loess, sandstone, mudstone)



Land form	Resource composition (biota, soil, water)	Natural stresses
<b>A</b> <b>Erosional hillslopes</b>	<ul style="list-style-type: none"> <li>• Steep hillslopes mantled with loess or weathered soft rock. Altitude generally &lt; 700m.</li> <li>• Mixed short tussock, pasture and scrub, particularly matagouri, manuka and coprosma.</li> <li>• Plantation forestry.</li> <li>• Rainfall 600 -1200mm.</li> <li>• Yellow-grey to yellow-brown earth steepland, loessial soils (moderately dispersible). Natural fertility relatively low, but higher than hard rock hill country soils.</li> <li>• Small hill country streams, subject to pronounced seasonal low flows.</li> </ul>	<ul style="list-style-type: none"> <li>• Subject to deep-seated forms of erosion.</li> <li>• Seasonally dry at lower altitudes.</li> </ul>
<b>B</b> <b>Low relief downs, crests &amp; summits</b>	<ul style="list-style-type: none"> <li>• Smooth, rolling, loess-mantled downlands. Altitude generally &lt; 500 m.</li> <li>• Improved pasture, crops, woodlots, silver tussock.</li> <li>• Rainfall 600-900mm.</li> <li>• Mainly yellow-grey earths. Relatively low fertility.</li> <li>• Small streams subject to pronounced seasonal low flows.</li> </ul>	<ul style="list-style-type: none"> <li>• Seasonally dry.</li> <li>• Relatively exposed to westerly winds.</li> </ul>
<b>C</b> <b>Limestone landforms</b>	<ul style="list-style-type: none"> <li>• Stronger, more stable landforms than A or B.</li> <li>• Improved pasture, some exotic forest, pockets of remnant native scrub and broadleaf shrubland, silver tussock.</li> <li>• Rainfall 600-900 mm.</li> <li>• Soils derived from limestone (rendzinas), moderately fertile.</li> </ul>	<ul style="list-style-type: none"> <li>• Seasonally dry.</li> </ul>



**Location**  
 Scattered hill country through both north and south Canterbury, the larger areas including the Timaru and North Canterbury downlands, such as the Ashley Forest and Waikari Valley areas.



matai-long tailed bat-  
 soft rock hill country

**Nature**

- Smooth, rounded, rolling to strongly rolling downland landforms. Includes distinctive limestone landform features, with pronounced escarpments and dip slopes.
- Introduced grasses predominate, with scrub and remnant, induced tussock grasslands and shrublands.

**Resource Values**

- Pastoral grazing and forestry.
- Remnant indigenous forest and shrublands.

Induced changes/disturbances	Effects/trends	Key issues for soil conservation
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- Predominantly semi-intensive grazing.
- Vegetation clearance. Cultivation for pasture renewal.
- Plantation forestry.
- Farm roads and tracks.

- Intensification of use over last 30 years (includes inputs of fertiliser & pasture species, vegetation burning). Reversion to scrub in some areas.
- Increased vulnerability to erosion following replacement of forest with shallow rooting species. Deep - seated erosion following rainfall storm events.
- Continuing loss of indigenous forest, shrubland remnants and riparian vegetation in developed areas.

- Erosion risk: grazing, cultivation for pasture renewal, earthworks, vegetation clearance, removal of deep-rooted vegetation.
- Pest management: rabbits.

Related issues:

- Water yield: potential reduction in stream flows with extensive exotic forestry.

- Intensive grazing.
- Mixed cropping, small areas of intensive cropping.

- Improved soil fertility and structure under pasture.
- Local redistribution of soil due to cultivation, leading to increased variability of topsoil depth.
- Almost total loss of indigenous vegetation. Increase in silver tussock with topdressing.

- Erosion risk: intensive arable, horticulture, mixed cropping

Related issues:

- Loss of indigenous biodiversity.
- Water quality degradation: sediment, nutrients, microbial in the downs area.

- Extensive to intensive grazing.

- Habitat loss - last strongholds for scrub / tussock progressively disappearing.

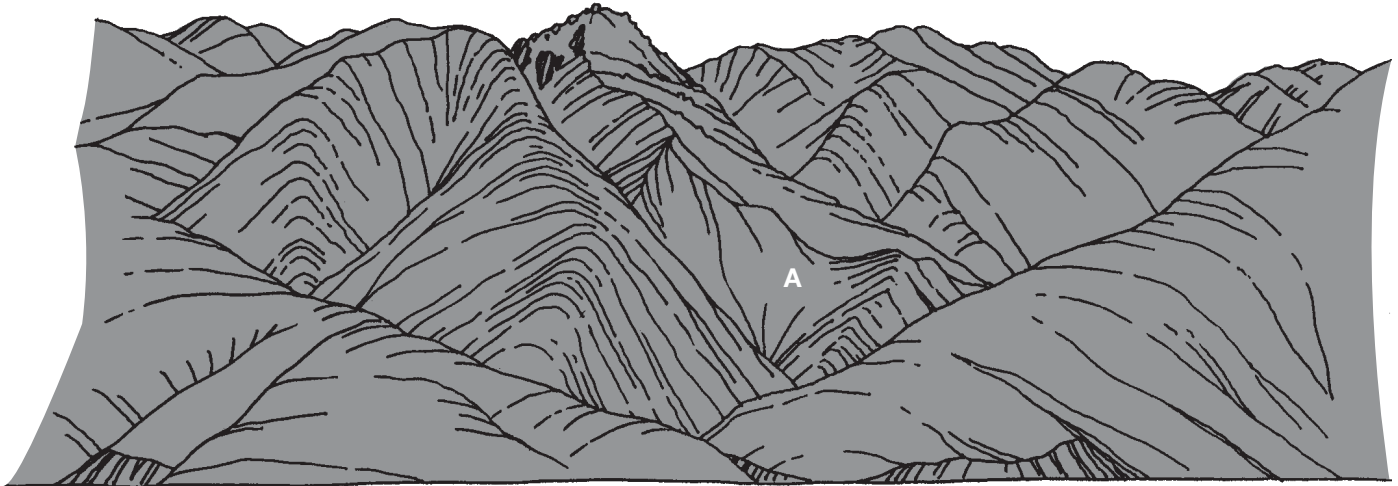
- Erosion risk: cultivation for pasture renewal.

Related issues:

- Loss of indigenous biodiversity.

# (e) Hard rock hill country

(e.g., greywacke)



## Land form

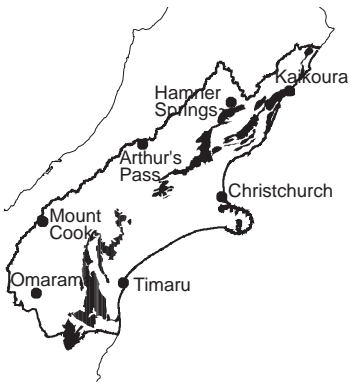
## Resource composition (biota, soil, water)

## Natural stresses

A

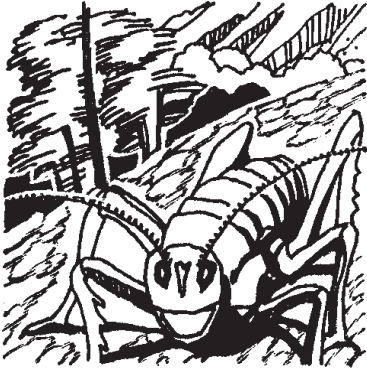
### Erosional hillslopes, crests & summits

- Predominantly steep colluvial-mantled, hard rock hillslopes. Relatively stable. Minor areas of easier sloping ridge and spur crests and loess-mantled lower slopes. Altitude generally < 1000 m.
  - Mixed short tussock, pasture and scrub, particularly matagouri, manuka and coprosma. Plantation forestry. Remnant pockets of indigenous forest and shrubland.
  - Rainfall 600 - 1200mm.
  - Yellow-grey to yellow-brown earth steepland soils. Natural fertility relatively low.
  - Hill country streams subject to pronounced seasonal low flows.
- Seasonal drought at lower altitudes.
  - Exposed sites subject to seasonal cold, dry winds.



## Location

Hard rock hills about the High Country zones through most of the region. Typical areas include the Lowry Peaks, Doctors Hills, Hunters Hills and Albury Range.



beech-weta-hard rock hill country

## Nature

- Moderately steep to steep hill country, including the lower eastern flanks of the Alps and the low eastern foothill ranges.
- Introduced grasses predominate, with scrub and remnant, induced tussock grasslands, forest and shrublands.

## Resource Values

- Pastoral grazing and forestry.
- An important recreational area for tramping, hunting, fishing and water based activities.

### Induced changes/disturbances

- Extensive and semi-intensive grazing.
- Vegetation clearance (burning).
- Cultivation for pasture renewal.
- Plantation forestry.
- Farm roads and tracks.

### Effects/trends

- Intensification of use over last 30 years (includes inputs of fertiliser & pasture species, vegetation burning). Reversion to scrub in some areas.
- Invasion by broom, gorse, and hieracium.
- Spread of wildings.
- Continuing loss of indigenous remnant forest & shrublands, & riparian vegetation in developed areas.

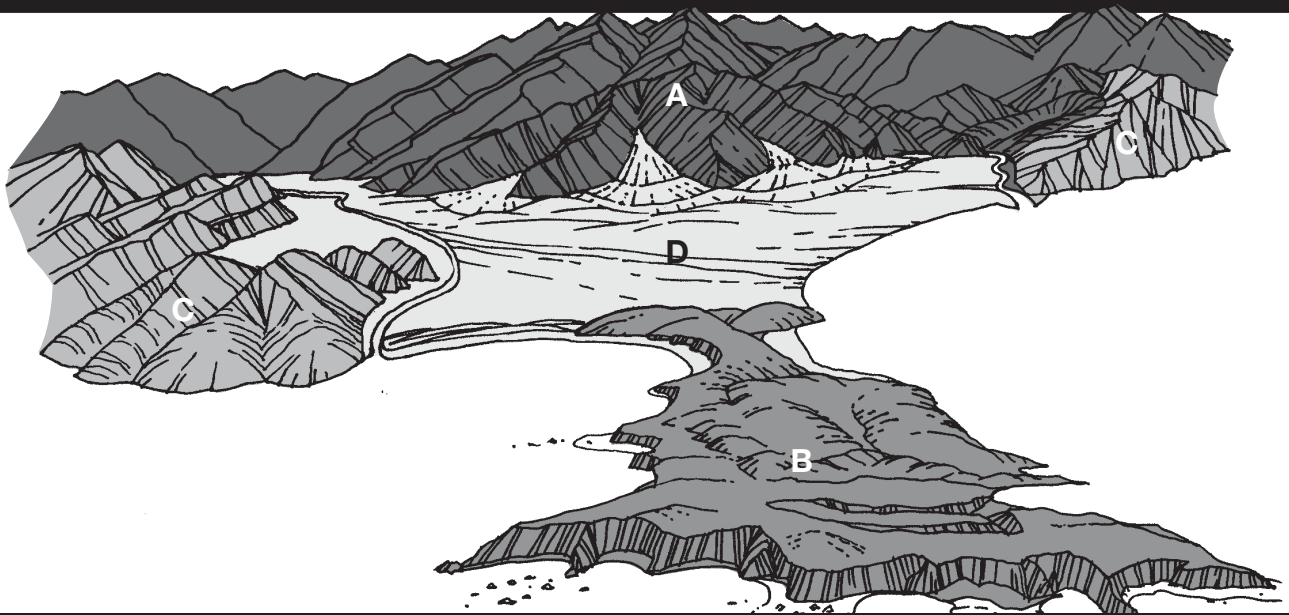
### Key issues for soil conservation

- Erosion risk: burning of undeveloped land
- Soil quality: Long term nutrient decline in remaining limited areas of undeveloped pastoral land.
- Pest management: localised rabbits, wallabies, possums.

#### Related issues:

- Water quality degradation: nutrients and microbial in lower foothills.
- Water yield: potential reduction associated with extensive afforestation.
- Habitat loss: forest, shrublands, riparian vegetation.
- Loss of indigenous biodiversity / habitat degradation: Continued clearance of remnant bush.
- Change in landscape and natural character (wildings).

# (f) Kaikoura coastal zone



Land form	Resource composition (biota, soil, water)	Natural stresses
<b>A</b> <b>Coastal mountain ranges</b>	<ul style="list-style-type: none"> <li>• Steep to very steep, dissected mountain ranges with extensive rock, sharp bluffy summits &gt;1200m &amp; colluvial foot slopes.</li> <li>• Mainly beech forest on south faces, with induced grassland &amp; scrub on north faces.</li> <li>• Rainfall 1200 - 1700 mm.</li> <li>• High country yellow brown earths &amp; alpine soils at higher altitudes.</li> <li>• Short, steep streams to coast. High sediment loads.</li> </ul>	<ul style="list-style-type: none"> <li>• Geologically unstable due to effects of rapid tectonic uplift &amp; faulting on bedrock.</li> <li>• High wind velocities.</li> <li>• Freeze/thaw activity.</li> <li>• Intense cyclonic storms &amp; earthquakes.</li> <li>• High energy fluvial regimes.</li> <li>• A wide range of erosion types and copious sediment sources.</li> </ul>
<b>B</b> <b>Coastal soft rock hill country</b>	<ul style="list-style-type: none"> <li>• Strongly rolling to steep, dissected coastal hill country to 500m &amp; mountain country up to 1200m, underlain by hard limestone and mudstones.</li> <li>• Mixture of tussock grassland, some improved grasses, extensive scrub &amp; areas of indigenous and exotic forest on steep lands.</li> <li>• Rainfall 800 - 1500 mm.</li> <li>• Yellow-grey to yellow-brown earths, with some limestone derived soils (fertility low-moderate).</li> </ul>	<ul style="list-style-type: none"> <li>• Mudstone-derived soils prone to severe slip erosion.</li> <li>• Intense cyclonic storms trigger slope failures which contribute to high sediment loadings of streams.</li> </ul>
<b>C</b> <b>Coastal hard rock hill country</b>	<ul style="list-style-type: none"> <li>• Steep to very steep coastal hill &amp; mountain country on hard sedimentary rock; rock outcrops &amp; scree.</li> <li>• Mixture of tussock grassland, some improved grasses, reverted shrubland &amp; areas of indigenous forest.</li> <li>• Rainfall 1200 - 1500 mm.</li> <li>• Yellow-brown earths. Topsoil generally thin.</li> <li>• Short, steep streams to coast. Rapid response to rainfall. High sediment loads. Sparse aquatic flora and fauna.</li> </ul>	<ul style="list-style-type: none"> <li>• Vulnerability to slope failure in greywacke-argillite bedrock is mainly influenced by structural discontinuities, depth of weathered mantle and seepage and joint water pressure.</li> <li>• High intensity rainstorms trigger slope failures.</li> </ul>
<b>D</b> <b>Aggradational fan plain</b>	<ul style="list-style-type: none"> <li>• Rolling to undulating fan to 160m asl, with wetland fringe.</li> <li>• Originally wetlands with dense bush. Now drained and developed for pastoral use with improved pasture species. Remnant coastal forest.</li> <li>• Rainfall 750 - 1300mm</li> <li>• Recent soils with high fertility.</li> <li>• Spring-fed streams. A shallow unconfined aquifer underlies the entire Plains; two small confined aquifers.</li> </ul>	<ul style="list-style-type: none"> <li>• Active fan building of Kowhai river, Mt Fyffe streams, and steep coastal streams where they meet narrow coastal plains.</li> <li>• Flooding, sediment deposition and scouring.</li> <li>• High water tables.</li> <li>• Tsunami risk.</li> </ul>



## Location

A narrow coastal zone extending east from the tops of the Seaward Kaikoura Range through to the sea.



marlborough rock daisy  
-black eyed gecko-  
kaikoura coastal zone

### Nature

- A zone of complex landforms, including the Seaward Kaikoura Mountain range, steep coastal hill country, active fans, former wetland areas of the Kaikoura Plains, and the Kaikoura Peninsula.
- Steep, intensely faulted, and unstable catchments subject to intense storms and tectonic movement.
- The meeting place of Marlborough and Canterbury vegetation types with some unique plant associations.
- Unique fauna such as Hutton's Shearwater (*Puffinus huttoni*)

### Resource Values

- High natural values with a rocky seascape, towering mountain backdrop and extensive native flora and fauna bounding national transport routes. Important for recreation and tourism.
- Dairy and pastoral farming.
- Maori settlement once concentrated along the Kaikoura coast (particularly the Peninsula); many mahinga kai and wahi tapu sites.

Induced changes/disturbances	Effects/trends	Key issues for soil conservation
<ul style="list-style-type: none"> <li>• Extensive grazing - by domestic stock mainly at lower altitudes.</li> <li>• Vegetation clearance (burning, mechanical clearance)- lower altitude sites.</li> <li>• Few farm tracks.</li> </ul>	<ul style="list-style-type: none"> <li>• Significant areas of high altitude land retired from domestic stock grazing.</li> <li>• Significant areas under conservation management plans (re-vegetation with exotics: localised area on Mt Fyffe).</li> <li>• Improving ecosystems on retired lands and other areas under DOC management.</li> <li>• Increased proneness to animal and plant pests, including wilding pines.</li> <li>• Potential for increased streambank erosion due to removal of riparian vegetation at lower altitudes.</li> </ul>	<ul style="list-style-type: none"> <li>• Erosion risk: uncontrolled wild animals, extensive grazing, earthworks, vegetation clearance.</li> <li>• Bush-cleared slopes vulnerable to erosion.</li> <li>• Pest management: goats, rabbits.</li> </ul> <p>Related issues:</p> <ul style="list-style-type: none"> <li>• Pest management: nodding thistle.</li> <li>• Lost of natural character, landscape values, wilding pines.</li> </ul>
<ul style="list-style-type: none"> <li>• Extensive to semi-intensive grazing.</li> <li>• Roads / tracks.</li> <li>• Vegetation clearance (burning, mechanical clearance).</li> </ul>	<ul style="list-style-type: none"> <li>• Increased deep-seated forms of erosion following extensive removal of bush.</li> <li>• Increased stream bank erosion due to removal of riparian vegetation.</li> <li>• Increased proneness to animal and plant pests.</li> </ul>	<ul style="list-style-type: none"> <li>• Erosion risk: cultivation for pasture renewal (localised), grazing, vegetation clearance, earthworks, bush cleared slopes vulnerable to mass movement. [Coastal road and railway links at risk]</li> <li>• Pest management: goats, rabbits, possums.</li> </ul> <p>Related issues:</p> <ul style="list-style-type: none"> <li>• Habitat degradation and loss of indigenous biodiversity.</li> <li>• Loss of landscape values.</li> <li>• Pest management: nassella, gorse, broom.</li> </ul>
<ul style="list-style-type: none"> <li>• Extensive to semi-intensive grazing.</li> <li>• Roads / tracks.</li> <li>• Vegetation clearance (burning, mechanical clearance).</li> </ul>	<ul style="list-style-type: none"> <li>• Increased stream bank erosion due to removal of riparian vegetation.</li> <li>• Increased proneness to animal and plant pests.</li> <li>• Increased mass-movement and fluvial erosion following high intensity rainstorms.</li> <li>• Increased sediment loading in streams following removal of deep-rooted vegetation.</li> </ul>	<ul style="list-style-type: none"> <li>• Erosion risk: vegetation clearance, earthworks, bush cleared slopes vulnerable to mass movement. [Coastal road and railway links at risk]</li> <li>• Pest management: goats, rabbits, possums.</li> </ul> <p>Related issues:</p> <ul style="list-style-type: none"> <li>• Habitat degradation.</li> <li>• Water quality degradation: sediment and nutrients into surface water.</li> <li>• Loss of landscape values.</li> <li>• Pest management: nassella, nodding thistle, gorse, broom.</li> </ul>
<ul style="list-style-type: none"> <li>• Roads / tracks (including works related to maintenance of national road and rail links).</li> <li>• Intensive grazing, horticulture, some production forestry.</li> <li>• Livestock access to streams.</li> <li>• Effluent disposal.</li> <li>• Minor urban development.</li> <li>• Increased settlement in rural areas.</li> <li>• Wetland drainage</li> </ul>	<ul style="list-style-type: none"> <li>• Improved soil quality (organic matter and nutrients).</li> <li>• Improved pastures and use of pastures</li> <li>• Increased animal and plant pests.</li> <li>• Reduction in surface water quality.</li> <li>• Potential for reduced quality of groundwater.</li> <li>• Dune erosion due to removal of vegetation cover</li> </ul>	<ul style="list-style-type: none"> <li>• Erosion risk: earthworks &amp; vegetation clearance in braided floodplains and fan channels.</li> <li>• Pest management: possums, rabbits.</li> <li>• Hazards: flooding, gravel inundation, gully erosion, coastal erosion.</li> </ul> <p>Related issues:</p> <ul style="list-style-type: none"> <li>• Habitat degradation, including wetlands.</li> <li>• Pest management: rooks, African feather grass, old man's beard, ragwort, gorse, broom.</li> <li>• Water quality degradation: surface water - sedimentation and nutrients; groundwater - microbial and nutrients.</li> </ul>