



Ministry for the Environment

National-level mapping: Methodologies to delineate braided rivers

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Lincoln Agritech Ltd

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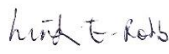


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1. INTRODUCTION

This report has been prepared by Lincoln Agritech and University of Canterbury Waterways Centre in response to the Ministry for the Environment's (MfE) request for further work following on from the feasibility study completed in 2024. The scope of work for this Phase 2 project, included holding a collaborative forum with relevant stakeholders, completion of GIS mapping and reporting. Following the forum, further work was requested and has been undertaken by North Arrow Research to develop the delineation methodology further.

The braided rivers forum was held in February 2025 and brought together researchers, practitioners, and policy specialists from the following organisations: Lincoln Agritech, University of Canterbury, Regional Councils, Department of Conservation and NIWA. The purpose of the forum was to advance understanding and management of these unique environments.

1.1 Braided Rivers Forum Key Findings

Braided rivers are highly dynamic, multi-channel systems characterized by shifting braid bars, high lateral mobility, and a self-sourced sediment supply. They provide critical ecological habitats, contribute to groundwater recharge, and support important surface–subsurface exchanges. Their behavior is strongly influenced by sediment supply, climatic variability, and invasive species, and while traditional monitoring metrics are often oversimplified, advances such as remote sensing, machine learning, and 4D geomorphic monitoring are improving system-scale understanding. Current definitions of riverbed and banks are inadequate. A zonal approach encompassing the braidplain, fairway, river corridor, and riverscape offers a more effective framework. Differentiating historical from contemporary braidplains is critical for both management and policy, and flexibility is essential to account for temporal and spatial variability. Regional councils require clear yet adaptable frameworks that balance ecological protection, flood protection, and land-use certainty, with proposed approaches including a toolkit for mapping zones, criteria-based decision-making, and nationally consistent definitions. Best practice methodology should draw on multiple data sources, including recent channel activity (10–30 years), historical migration (50–100 years), Digital Elevation Model's (DEMs) and topographic data, and ecological or flood risk attributes, while also incorporating regional differences such as upland versus lowland systems. Braidplain aquifer mapping is emerging as a priority for planning and risk management. Implementation at a national scale is feasible through satellite imagery (40+ years), LiDAR DEMs, and existing datasets, but requires national standards, robust data curation, and central hosting.

Looking ahead, the focus should be on forecasting river movement, identifying areas of risk, and integrating ecological and physical attributes. To support this, national datasets provide consistency, but local precision remains limited; effective management will require improved data exchange, filtering by scale and reliability, and a shift from linear, channel-based perspectives to planar, riverscape-based classification and management. The forum agreed that braided rivers require flexible, zonal definitions that reflect their dynamic nature. A nationally consistent framework using multiple datasets and modern tools should guide management, while retaining flexibility for local conditions and future adjustments.

2. DELINEATION OF BRAIDED RIVERS

2.1 Lateral mobile rivers: multiple lines of evidence

2.1.1 Methodology

Delineation of lateral mobile rivers is not straightforward and is an ongoing process. As the name suggests, lateral mobile rivers shift laterally through the braidplain over time. To accurately predict where the river might flow in the future—5, 10, or 100 years from now—we need to understand the geomorphology of the valley and employ multiple lines of evidence to delineate the active channel. There are situations when certain delineations will be preferred over others.

In this context, we present a methodology that employs three different lines of evidence spanning various time-scales and processes. We define the valley bottom based on geomorphological criteria, representing the largest area the river could occupy at any given period. We then utilise archival satellite remote sensing data, offering 30 years of land coverage, to map the active and wetted channels, as well as subsurface processes, informed by data about the braidplain. In Figure 1, we illustrate the overall methodology used to combine these different lines of evidence, ultimately defining the active channel and floodplain of a laterally mobile river.

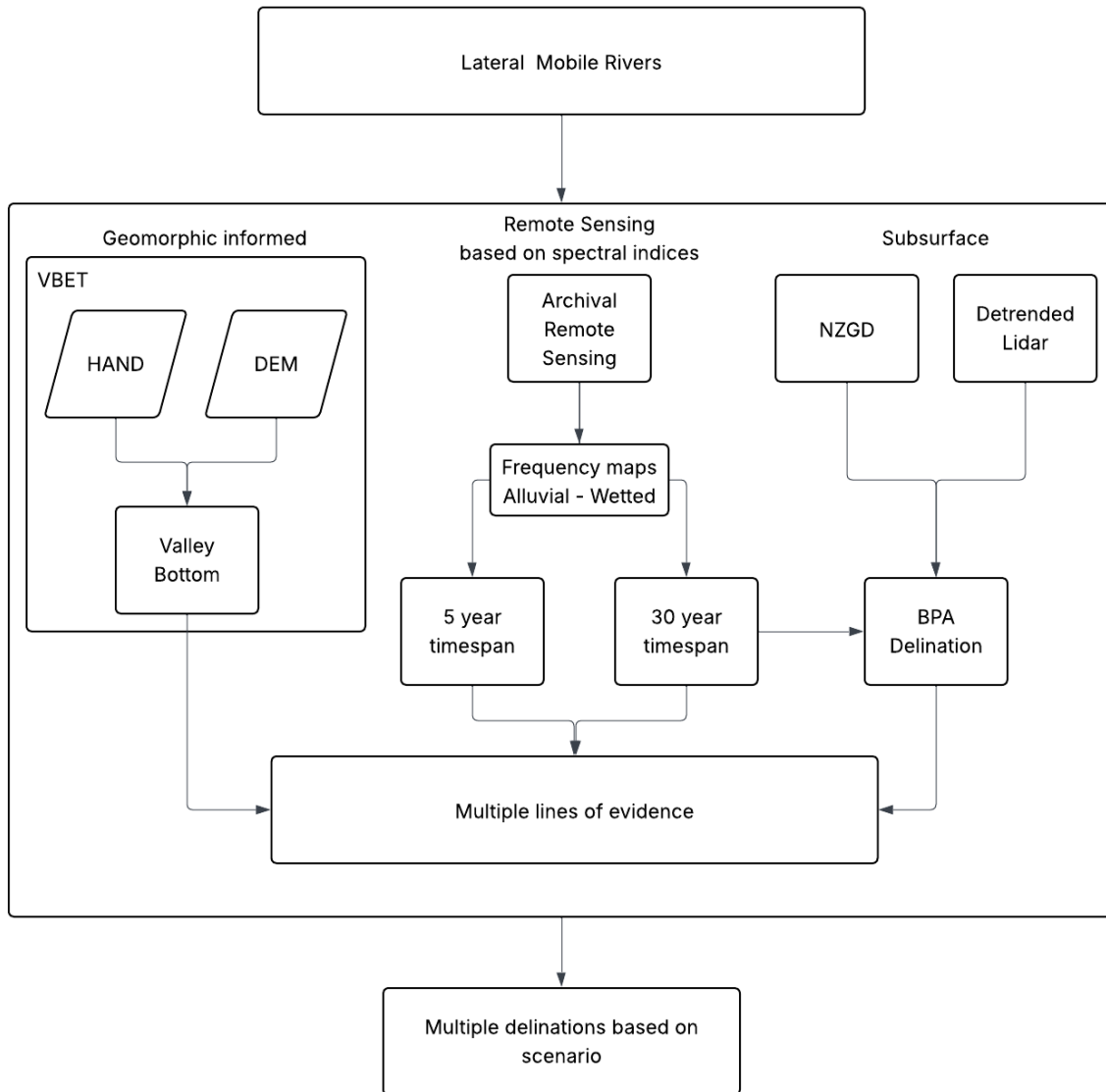


Figure 1: Methodology for lateral mobile river delineation

2.2 Riverscapes Framework and a geomorphically informed valley bottom

The Riverscapes Framework is a waterfall-style, cloud-based approach that integrates different tools to examine catchments at various levels and stages, from fluviogeomorphology to river health and ecosystems. In this project, we only utilise some of its capabilities, and more importantly, use the VBET tool as one of the lines of evidence to define the floodplain and ultimately the active channel.

To that end, we have created the New Zealand National Project within the Riverscapes Data Exchange. The project was initiated using the River Environmental Classification version 2 (REC2). We utilise LINZ context data (e.g., catchment boundaries, infrastructure, etc.) and the LINZ 1m lidar-derived National DEM as the topographic layer.

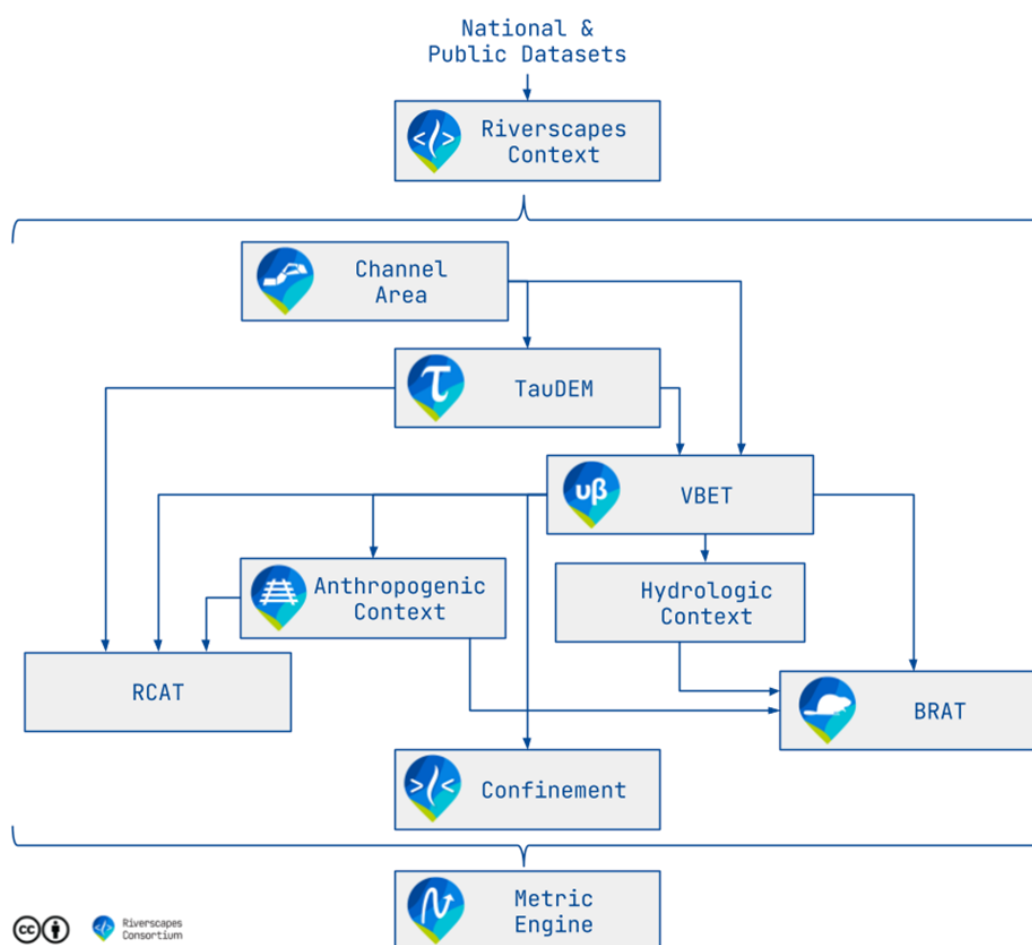


Figure 2: Riverscapes waterfall model to show the different tools used for working with riverscapes and river health. (<https://tools.riverscapes.net/>)

The Riverscapes Framework is a collaborative, open-source ecosystem of tools, models, and datasets designed to support the analysis, monitoring, and restoration of riverine landscapes—

referred to as riverscapes. It is hosted and maintained by the Riverscapes Consortium, a collective of scientists, restoration practitioners, conservationists, and data specialists working to address the global challenge of riverscape degradation. The framework maintains different geospatial tools for river management, as shown in Figure 2. (<https://www.riverscapes.net/page/about>)

The Riverscapes Context Tool helps integrate publicly available geospatial datasets into Riverscapes projects by automating their retrieval, processing, and organisation. This includes tasks like mosaicking Digital Elevation Model (DEM) tiles and clipping data to watershed boundaries—activities that are often time-consuming and prone to errors when done manually. By streamlining these processes, the tool helps maintain consistent data quality and format, allowing for smooth use of the contextual layers either on their own or as inputs for other Riverscapes tools.

The Channel Area is an initial step in the waterfall workflow to define the spatial extent of the drainage network, based on the Riverscape Context data available. The outputs are then used as inputs to other tools in the workflow, as shown in Figure 1. The Terrain Analysis Using Digital Elevation Models (TauDEM) toolset was developed by the Utah State Hydrology Research Group. The toolset takes a DEM and a river channel as inputs and produces various topographic related products. Of these, the most important for this workflow is the generation of a Height Above Nearest Drainage Raster (HAND), which serves as a key input to the Valley Bottom Extraction Tool (VBET).

The VBET algorithm was developed to delineate valley bottoms within riverscapes by combining topographic and hydrologic data. Using a DEM and a channel polygon as inputs, VBET utilises three lines of evidence—slope, HAND, and channel presence—to produce a probability raster that indicates the likelihood of valley bottom presence. These inputs are transformed using log-likelihood functions and weighted based on stream size, resulting in a raster with values from 0 to 1. The HAND and Slope transformations were tailored to the New Zealand catchment geomorphology. Thresholds are then applied to extract polygons representing geomorphic units such as floodplains and channels. VBET further divides the valley bottom into discrete geographic objects (DGOs), which function as spatial units for calculating riverscape metrics. DGOs' polygonal unit size varies with stream order.

These DGOs serve as a spatial sampling framework for calculating riverscape metrics at the reach scale. To support broader spatial analyses, VBET also produces Integrated Geographic Objects (IGOs), which are point features situated at the centre of each DGO. IGOs enable the aggregation of metrics across moving windows, allowing users to summarise conditions over longer river stretches or entire catchments. This dual structure supports both fine-scale reach-level assessments and integrated landscape-scale evaluations, thereby enhancing the flexibility and scalability of riverscape analyses.

2.3 Remote sensing of the contemporary active channel

Delineation of the active and historic braidplain supported the development of an EO framework used to classify the river corridor, as defined by the VBET algorithm, into areas that are: a) inundated; b) exposed gravels; and c) fully vegetated. This simple, threefold scheme provides a basis to determine the spatial envelope in which fluvial processes are reworking the bed, expressed as the wet channels and unvegetated gravels and areas that have remained or evolved as stable riparian areas.

The approach taken involves automated classification of 'analysis-ready' multispectral imagery from the Landsat series of satellites. The NASA/USGS Landsat satellite Earth Observation program started in 1972 and provides the longest continuous space-based record of the Earth's surface. This approach offers a consistent, well-understood data type. For NZ, a compilation of analysis-ready data (ARD) is available through Google Earth Engine that extends back to the 1980s, with further data available through various online data portals. This time series offers the potential to process individual images, providing periodic snapshots of the state of the river corridor, or by combining classifications over specific time-windows, it is possible to extract probabilistic models of the river corridor, which quantify the likelihood of individual pixels belonging to a specific landcover class within a particular sampling period.

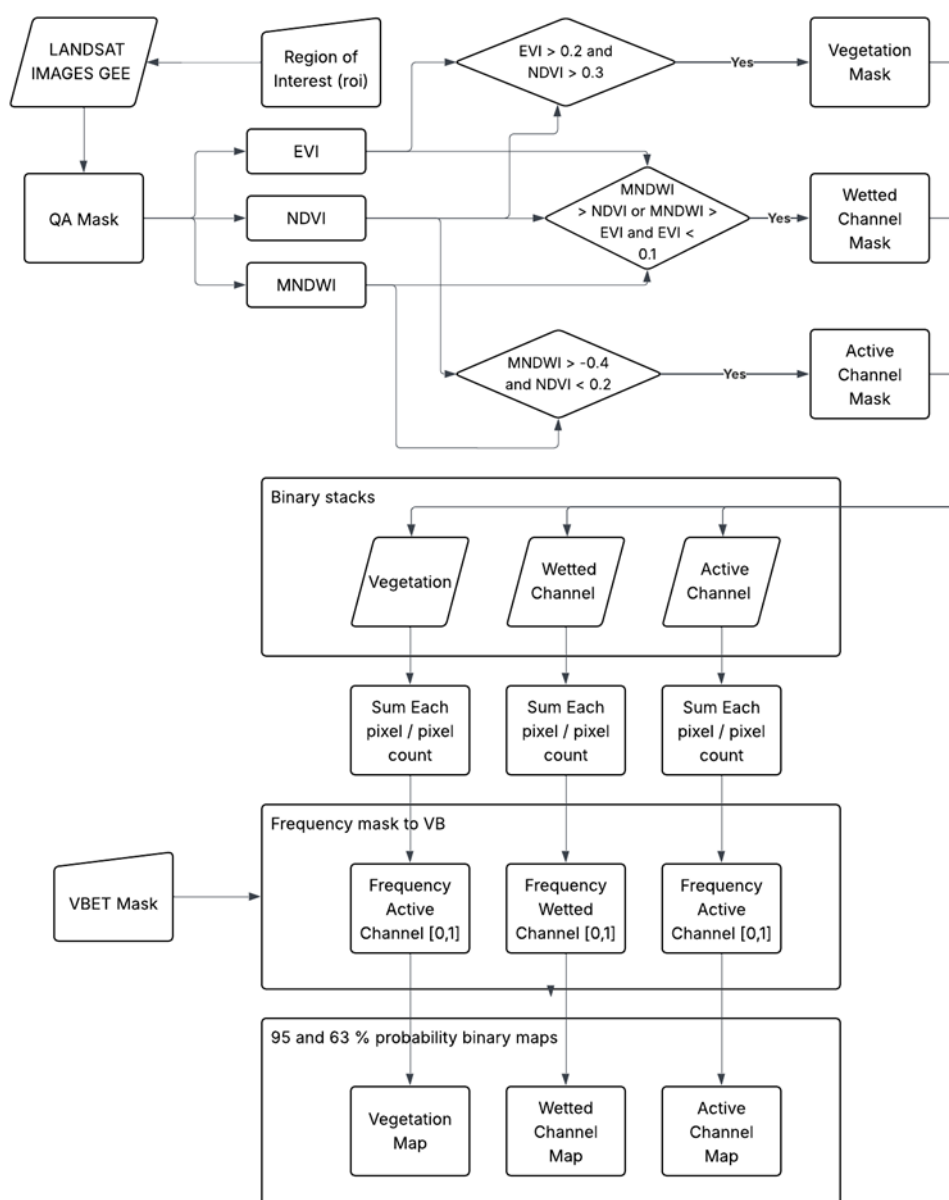


Figure 3: Remote sensing workflow for the generation of the vegetation, wetted channel and active channel.

The approach developed for this report involves a stepwise, automated classification scheme. This workflow uses 30-meter resolution Landsat 5 TM Collection 2, Landsat 7 ETM+ Collection 2, and Landsat 8 OLI/TIRS Collection 2 atmospherically corrected surface reflectance data.

Landsat satellites operate with 7 to 11 spectral bands, including visible, near-infrared, shortwave infrared, and thermal infrared bands. Quality assurance (QA) bands are included to identify pixels affected by adverse conditions such as clouds, shadows, and instrument artefacts, ensuring the integrity of scientific analyses.

To avoid misclassification of pixels, only images with less than 20% cloud cover were used as input for the workflow. Binary water and alluvial masks were created for each image using a combination of spectral indices. Spectral indices are mathematical combinations of different spectral bands in multispectral images used to highlight specific features in the data, such as vegetation, water content or soil. The spectral indices used here are NDVI (Normalised Difference Vegetation Index), which is used to highlight healthier and denser vegetation (Huang et al. 2021). It is a combination of the reflectance in the Near Infrared (NIR) and the Red spectral bands:

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

MNDWI (Modified Normalised Difference Water Index) (Zhou, et al. 2015), is used to enhance open water features while suppressing land and vegetation and is a combination of the reflectance in the shortwave infrared (SWIR) and GREEN spectral bands:

$$MNDWI = \frac{GREEN + SWIR}{GREEN - SWIR}$$

The EVI (Enhanced Vegetation Index) (Matsushita et al. 2007), which is also used to highlight vegetation, is an optimized version of the NDVI that improves its sensitivity by reducing atmospheric influences, soil brightness and sensitivity to biomass variability. EVI is a slightly more complicated index, that combines NIR, RED and BLUE spectral bands with a gain factor, G, that enhances the vegetation signal (typically 2.5), C1 and C2 are aerosol resistance coefficients, with typical values of 6 and 7.5 respectively and L adjusts the background influence, like soil brightness, typical used value is 1:

$$EVI = G \times \frac{NIR - RED}{(NIR + C1 \times RED - C2 \times BLUE + L)}$$

The wetted channel classification was developed by Zou et al. (2018), where every pixel that fills the condition of $MNDWI > NDVI$ or $MNDWI > EVI$ and $EVI < 0.1$ is considered water. For active channels, we used the approach from Boothroyd et al. (2020), where the condition for a pixel to be considered an alluvial deposit was $MNDWI > -0.4$ and $NDVI < 0.2$, and for vegetation $NDVI > 0.3$ or $EVI > 0.2$. These conditions were used to create a binary mask for each image, which was then stacked.

The frequency calculation involved summing the pixel values within the Wetted and Active channel binary masks over the entire 30-year period, as well as in 5-year intervals. This summation was then divided by the count of valid pixels in the image stack (Figure 2 and Figure 3). The validity of each pixel was determined based on the Landsat QA mask, ensuring that pixels with clouds or shadows were excluded from the calculation. The final data was clipped using the defined valley bottom for further analysis.

The distribution of images varies across all pixels between different years because it depends on cloud cover and pixel quality. Some Landsat missions overlap, increasing the chances of clear skies, especially from 2010 onwards. Newer satellites have improved sensors, resulting in more

images passing the QA/QS flags. Each pixel has a quality flag, and some are discarded due to shadows or clouds. We minimised this by selecting images with less than 20% cloud cover. It is important to note that catchments can be covered by one or more satellite paths, so the number of images varies across areas. This is another reason why we need to normalise the data to determine the frequency. Figure 3 shows the complete Landsat frequency analysis workflow.

The workflow was implemented on Google Earth Engine and the Python library Geemap. This approach allows for the creation of image stacks. For each image stack, it is possible to estimate the probability of a specific pixel belonging to either the 'wetted', active' or 'vegetated' class based on a confidence interval. This provides a framework that explicitly accounts for the intrinsic dynamism of laterally mobile rivers. Additionally, by combining or subdividing the sampling windows, it is possible to develop probabilistic models that reflect either the recent (last 5-10 years) or the longer-term (30-year) structure of the river corridor. These data can also be easily segmented spatially into longitudinal or lateral models of the corridor structure and its change over time.

2.4 Mapping the Braidplain Aquifer (BPA)

Braided rivers consist of open river channels or braids, high permeability bed sediments, and water held within the bed sediments (the bed reservoir or braidplain aquifer). Together, these three components make up a braided river system. The bed sediments are a lag deposit formed by sediments mobilised during flood flows. The flood flow loosens the sediments, and removes the fine material held in the matrix, making them extremely high permeability. The surrounding and underlying sediments are relatively compact and lower permeability since they receive the fine sediment fraction from flooding events, which colmates into (fills) the pore spaces. For mapping purposes, there are two key geological boundaries to be determined for each river, the width and thickness of the braidplain reservoir.

Many rivers in Aotearoa are managed by flood engineers to be held in place by planting or armouring embankments and lowering of the active bed through gravel extraction. For these river systems, the lateral extent of the braidplain reservoir is easy to identify. For a river that is laterally mobile, the difference between what can be considered bed reservoir is time dependant. Without field investigations it can be difficult to know whether the river is using the groundwater within terraces along the margin of a braidplain is being used by the river for active hydrological functioning. We have assumed in most cases that the active river extent seen in Landsat imagery (1980-2025) though to the current satellite imagery represents the braidplain reservoir, a span of ~40 years.

The thickness of the braidplain reservoir is important for determining the state of hydraulic connectivity with the regional aquifer system. Most river systems are hydraulically connected to the regional water table. However, a river system can become hydraulically disconnected from, or perched above, the regional water table if the water table is situated below the braidplain reservoir (Wilson et al. 2024). The thickness of the braidplain reservoir is determined by the energy of the river system during flood events. In a river which is overly narrowed (e.g. the Wairau) the active bed thickness is up to 5m. In more passive rivers the bed thickness may be as little as 1m. The bed thickness is not evident in imagery, and can only be determined via coring, in some cases GPR surveys, and from the depths of pools in bathymetric surveys.

The only feasible method to map hydraulic connectivity at national scale is to kriging the water table surface beneath the river and subtract that from the river bed surface. An assumption then needs to be made as to the braidplain reservoir thickness. However, in doing this exercise, it became apparent that the transition from hydraulic connection to disconnection can be identified to within a few tens of meters.

2.4.1 Methodology

Two nationwide data sources are suitable for kriging the water table. These are water level predictions made for the groundwater redox predictions model (Sarris et al. 2025), and the composite water table dataset (Durney et al. 2024). The composite water levels data set consists of data from the NZ Geotechnical Database, and median time series from regional council groundwater databases. The data span several decades, so there is considerable temporal variability, however this is made up for by its spatial density and coverage, which serves to spatially smooth temporal fluctuations.

We have chosen to use the composite dataset in preference to the redox predictions data because it consists of raw water level measurements. Depth to water table values were converted to water level elevations by subtracting them from the 1m lidar DEM elevations.

A routine was established which could be applied to each river independently. For each river system, water level measurements were selected by sampling data with 5km distance from the braidplain margins. These values were then filtered twice by calculating the median value of clusters of wells within 5000m proximity removing any spurious values. This process removes outliers from wells in proximity, which can cause problems in fitting a kriging model. Having removed outliers, an experimental variogram was formed and an exponential model fitted using an L-BFGS-B optimiser with sum-squared error used to minimise the error of the residuals. This optimiser includes constraints on kriging parameters, ensuring a model which is physically sensible. The filtering combined with model optimization produces a suitable variogram to kriging the water table across a grid beneath each river system.

Active river bed elevations for each river were determined from the national lidar 1m DEM. A script was written to extract and clip the lidar tiles for each river to the active braidplain margins. The kriged water table estimate was then subtracted from the DEM to determine the depth to the water table and reveal where the river system is likely to be perched above the regional groundwater system.

2.4.2 Detrended Rasters

To help define the BPA, a detrended raster was created for each river system. The process for this was to firstly draw a draft BPA outline, then triangulate that polygon to create sampling points at the triangle centres. These points were used to extract elevations from the 1m lidar DEMs, which were then kriged across a grid. The resulting grid was then subtracted from the lidar to create a detrended lidar.

2.4.3 Mapping BPA

Mapping the BPAs of the six selected rivers involved the use of a variety of tools. Initially the 30-year alluvium identified from the Landsat imagery was used to guide the BPA in conjunction with the national 1m DEM, detrended DEM, and the NZGD (New Zealand Geotech Database). This along with aerial photography gave a good indication of the BPA. It is important to note that this represents what we consider to be the current extent of the BPA, which is time-dependent, and will naturally shift through time as the river migrates. Difficulties arose in areas where tributaries fanned into the main stem, reminding us that braided rivers are highly dynamic landscapes where boundaries should be considered indicative rather than fixed.

Difficulties were also encountered in locations where training banks have been established to direct the river away from farmland, or to protect infrastructure, e.g. bridges. The river naturally wants to access these areas which are at a similar or lower elevation than the current active bed. In most cases we have not mapped these areas as braidplain aquifer. While the river can still access water from these protected areas, the gravel cannot be mobilized by the river, so the sediments will become lower in permeability through time due to the process of colmation and consolidation.

3. MULTIPLE LINES OF EVIDENCE DELINEATION

A key challenge arises where a laterally mobile river is unconfined, such as in settings without valley walls or well-defined historic terraces. A notable example in New Zealand is the large piedmont braided rivers of the Canterbury Plains, which comprise multiple coalescing distributary fans built over the Quaternary. In such environments, the active river corridor may even be superelevated above the surrounding fan surfaces, a condition that, under natural circumstances, promotes avulsion and ongoing fan construction. In practice, however, these river systems are often tightly managed through anthropogenic interventions such as stopbanks and groynes, which restrict their capacity to shift laterally. As a result, the corridor available for channel migration is artificially constrained. Multiple lines of evidence can be used to support such scenarios, to identify case-dependent definitions of river width that prioritize differing sources of information, reflecting specific priorities or temporal contexts (see Figure 4 below).

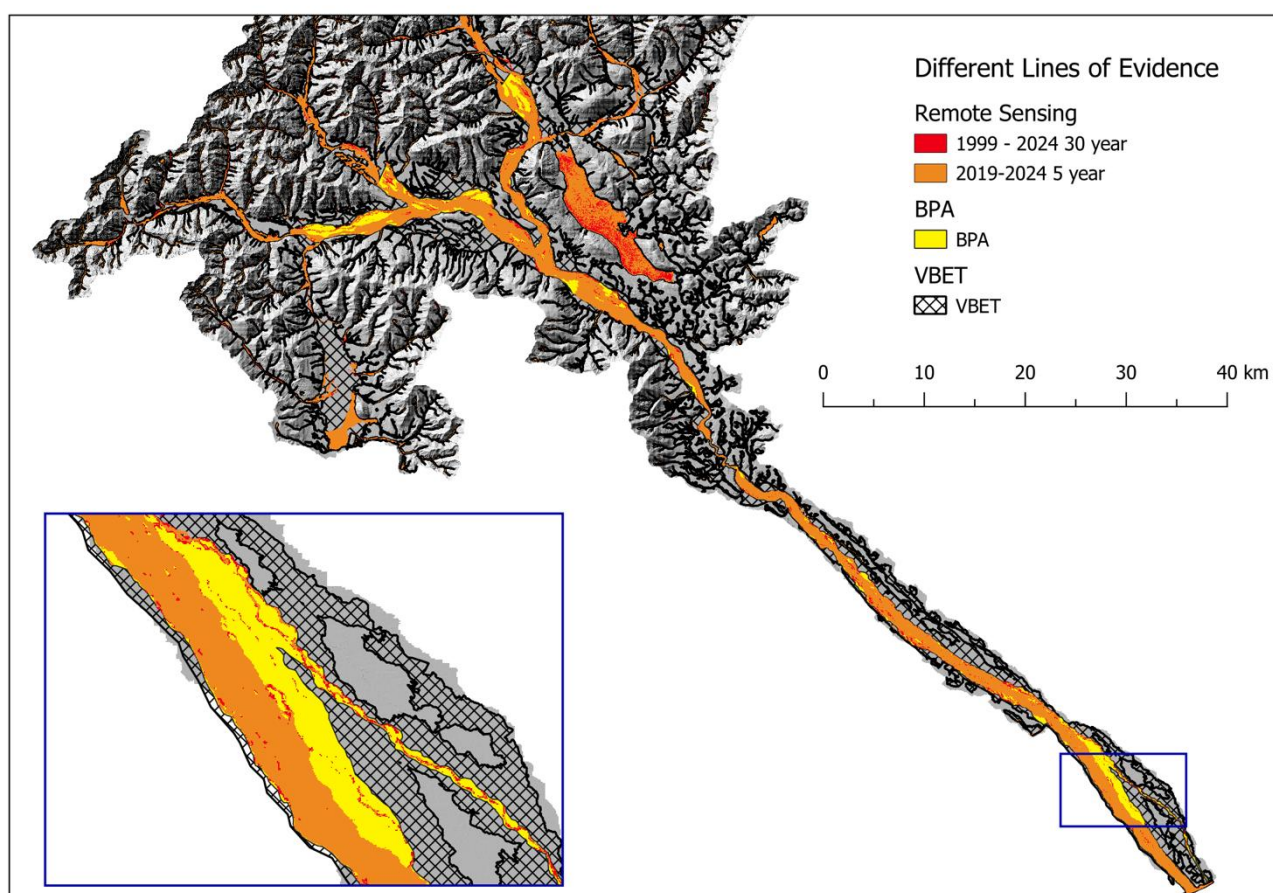


Figure 4: Different lines of evidence provided by the different methods over the Rakaia catchment.

3.1 Challenges in the delineation of lateral mobile rivers

Delimiting laterally mobile rivers using solely topographic information is also sensitive to the resolution, precision and classification methods used to derive the underlying DEM data. Fluvially sculpted landscapes are characterized by subtle topography that is overprinted by patterns of lateral migration occurring over multiple timescales. The geomorphic approach to define the riverscape encoded in the VBET algorithm uses two primary lines of topographic information: (i) height above nearest drainage or HAND; and (ii) local slope gradient. HAND, in particular, is highly sensitive to even small changes in local height that are used to define flow paths. Features such as small farm drains, road berms, or gravel pads can result in minor redirections of flow paths, but that can lead to long sub-parallel flow alignments that result in anomalously large values of HAND. To address this, the VBET algorithm was subject to an extensive process of calibration, but further scope for refinement still exists and the VBET model should be treated with caution, particularly in unconfined river settings.

The terrain attributes used in VBET are also subject to large errors when calculated using the national 8 m contour-derived DEM from LINZ. This dataset is principally for intended cartographic use and contains numerous significant data artefacts and that are particularly evident in shallow unconfined settings. By contrast, where the 1 m resolution DEM derived from the nascent national lidar coverage, was resampled to a coarser 5 m resolution, this data model provides a good basis for valley bottom mapping due to its high vertical fidelity.

The incorporation of spectral information through orbital Earth observation data provides a critical additional perspective for mapping laterally mobile rivers. It too, however, has limitations associated with temporal and spatial resolution. The frequency with which we can observe a river and the level of detail in each pixel strongly determines the fidelity of the resulting data model. For example, the dynamic active channels of a braided river may migrate between satellite overpasses and where the scale of individual anabranches is close to or below the image resolution, mixed pixel effects may result in an inevitable loss of detail.

The reliance on optical data for classification is also affected by phenomena that include wet surfaces, shadows, turbidity, and glint, resulting in misclassification as water, or the reverse. Another issue associated with wetlands is that shallow, vegetated, waterlogged areas often appear as land in optical images, even though they function similarly to waterbodies.

It is becoming increasingly common to combine Synthetic Aperture Radar (SAR) data with optical imagery. This approach utilizes multi-date composites to identify areas of persistent wetness, alluvial regions, and vegetation. The results can then be validated using targeted high-resolution strips or ground information.

Another potential solution is to use higher-resolution data in priority areas by leveraging commercial satellites that provide meter-scale resolution, whether through SAR or optical systems. By mosaicking multiple scenes, it is possible to derive detailed data models without incurring the high costs associated with mapping every area at that level of resolution.

4. FINDINGS

4.1 Attribute table

At the DGO and IGO levels, we summarize long-term (30-year) and mid-term (5-year) classifications of Landsat data related to alluvial deposits and wetted channels. For each unit, we derive satellite-based attributes, including metrics on wetted, active, and stable areas. These metrics are evaluated using two thresholds: the first at 95% of the total frequency (measured by the number of times a pixel has been classified as either water, alluvial, or vegetation in their respective frequency maps) and a second at 68% of the total frequency. We also calculate the corresponding percentages of the total DGO area and the "widths" of each class (Figure 5). The class widths are determined by normalizing the area based on the DGO length (for example, $\text{Wetted Width}_{95} = \text{Wetted Area}_{95} \div \text{DGO Length}$). We also extract the percentage of the DGO as each class, as shown in Figure 6. We present these metrics alongside attributes from the Riverscapes Tools and zonal statistics to provide a consistent and comparable description of river conditions across different reaches.

Attributes from satellite data:

- Wetted area at 95% probability in sqm
- Active area at 95% probability in sqm
- Stable area at 95% probability in sqm
- Wetted area at 68% probability in sqm
- Active area at 68% probability in sqm
- Stable area at 68% probability in sqm
- Percentage of DGO as Wetted area at 95% probability
- Percentage of DGO as Active area at 95% probability
- Percentage of DGO as Stable area at 95% probability
- Percentage of DGO as Wetted area at 62% probability
- Percentage of DGO as Active area at 62% probability
- Percentage of DGO as Stable area at 62% probability
- Wetted width at 95% = Wetted area/DGO length
- Active width at 95% = Active area/DGO length
- Stable width at 95% = Stable area/DGO length

Plus, a list of attributes available from the Riverscapes Tools and Zonal Stats.

We also obtained land parcels of state-owned land¹ from LINZ. This dataset was mapped onto the braidplain aquifers to identify state organisation, and private ownership of land within the active river system. LINZ prefer a disclaimer to be attached to this dataset, which hasn't been received at the time of writing this report.

¹ [Central Record of State Land | Toitū Te Whenua - Land Information New Zealand](#)

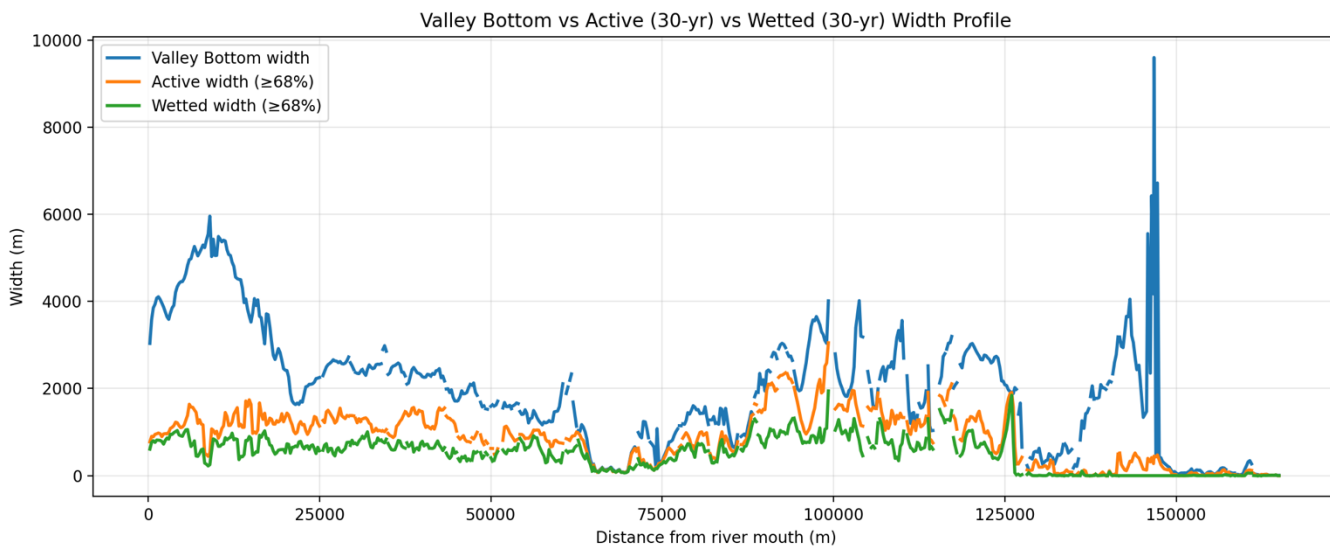


Figure 5: Rakaia main stem plot of the width of the valley bottom, active channel (30-year record), and wetted channel (30-year record) from the mouth to the end of the catchment at each defined reach.

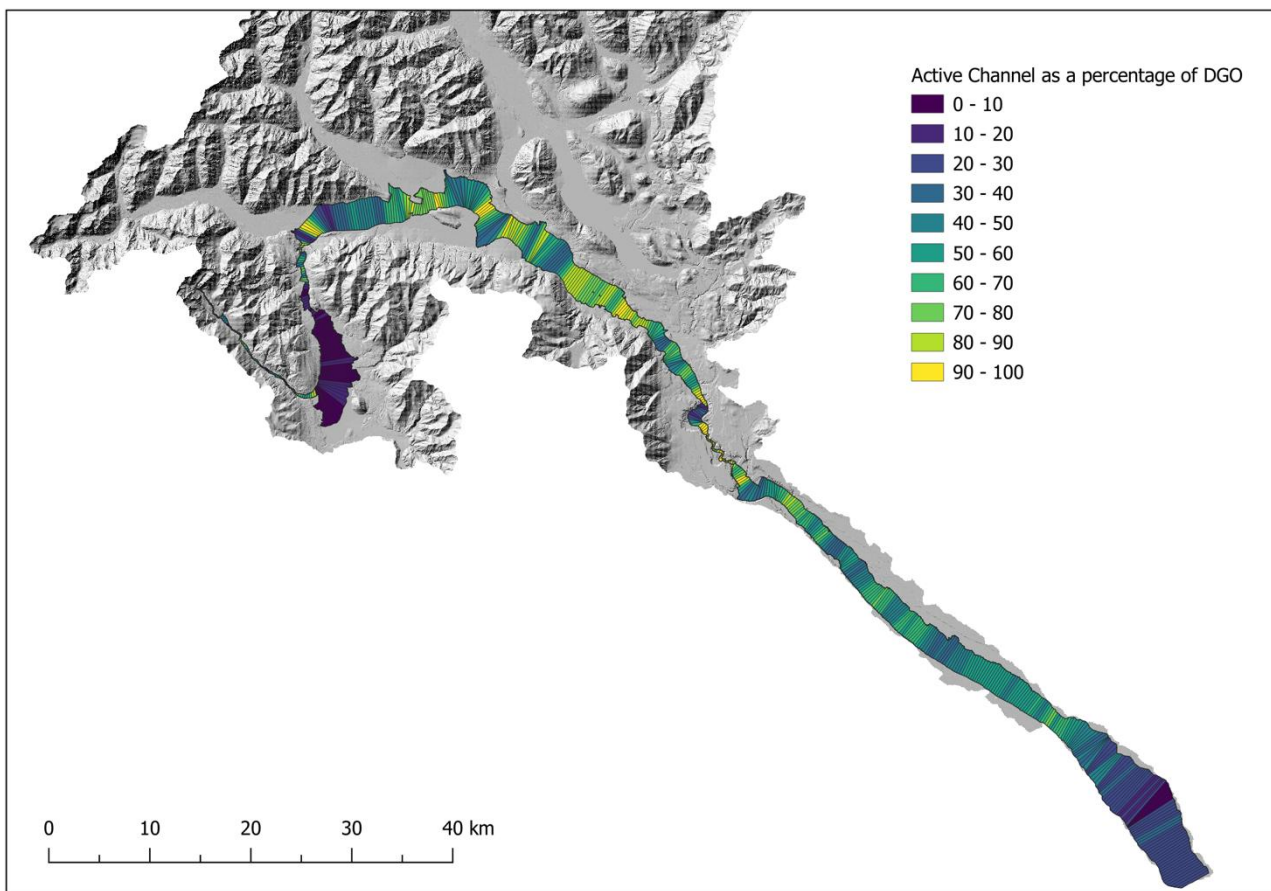


Figure 6: Rakaia main stem plot of the width of the valley bottom, active channel (30-year record), and wetted channel (30-year record) from the mouth to the end of the catchment at each defined reach.

4.2 River system connectivity with groundwater

We found that all the mapped rivers were hydraulically connected with their regional aquifers. There were two exceptions; long sections of the Waimakariri and Rakaia rivers as they cross the Canterbury Plain. However, the nature of the hydraulic connection of these two river systems is not straightforward because the Canterbury Plains consists of a composite system of aquifers with shallow systems leaking vertically downwards to deeper systems. The Waimakariri and Rakaia River systems both have shallow aquifers which extend laterally away from the river system and leak vertically downwards to the regional water table. In the case of the Waimakariri River, there is a shallow lens within the Springston Formation that extends eastwards towards Christchurch and is used for stock and domestic water supply. The Rakaia system has highly productive shallow lenses on both banks. In both cases, there have been no field investigations to determine whether the shallow lenses extend beneath the braidplain aquifer.

To conclude, the determination of hydraulic connectivity is best determined by targeted investigations rather than based on national scale datasets. The presentation of hydraulic connectivity on river maps could be both inaccurate and misleading, and so is not recommended. We have therefore not included connectivity information on our attributes, although the shapefiles are available to MfE on request.

4.3 Further work

The braidplain aquifer mapping that we have completed is quite labour intensive, and rolling out the process for the remainder of the motu would be challenging. For future mapping of braided rivers, we suggest that the braidplain aquifers we have mapped be used as training data for a machine learning approach. This approach would use the same datasets we have used manually (DEM, detrended DEM, aerial imagery, historic alluvial extent) to train a model (eg via a neural network). The trained model would then be applied to other braided rivers on a river by river basis. The resulting files would then be manually checked.

For land ownership, it would be valuable to access the land title database from LINZ, which could be made available under an agreement between LINZ and MfE. It is also worthwhile extending the mapped land beyond the active river system or braidplain aquifer. The reason for this is that we identified state-owned land which is being used for farming (Figure 7). In some cases, this state-owned land is part of the active river system, and in some cases the land has recently been part of the active river system but has been reclaimed through the construction of training banks. This is significant because it flags that the narrowing of river systems through land reclamation is being carried out on both private and state-owned land.

The scope of work for this project included focusing on six priority catchments in New Zealand. We would recommend that additional tranches of rivers are identified where this same exercise can be carried out and made available for regional and local councils to manage their laterally mobile rivers.

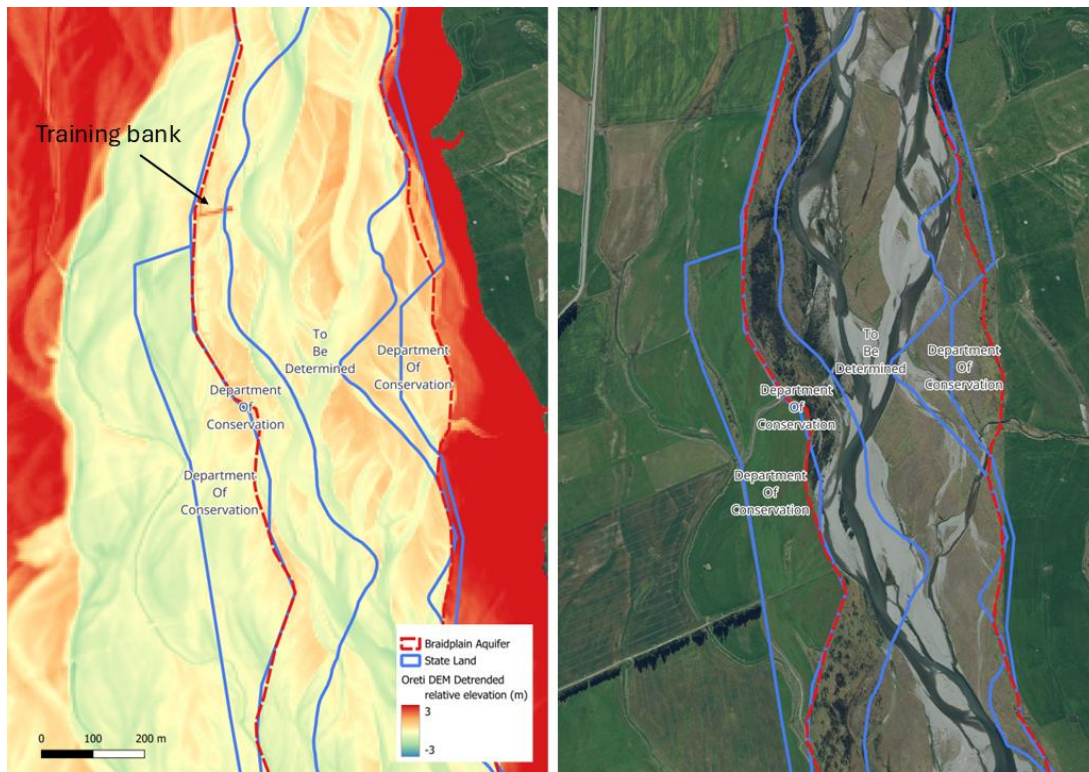


Figure 7: An example of land reclamation from river system on state land

5. CONCLUSION

The main challenge is recognising that different applications may require different boundaries, all depending on scale. Ultimately, the end user may need a line on a map, but that line should be viewed as dynamic, shifting over time in response to the natural behaviour of the river. This methodology provides the opportunity to understand that lateral mobile rivers are dynamic and that delineation can change. Here, the geomorphic-informed valley bottom defines the maximum area where the river could be in the future, and the remote sensing archival imagery gives a contemporary view of the river and how it is evolving. We believe that this information, together with the groundwater evidence, has the potential to form a real-time or near real-time observatory of our changing rivers.

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