

BEYOND CONTOURS

An Atlas of Terrain Cartography

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B E Y O N D C O N T O U R S

An Atlas of Terrain Cartography

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This atlas is produced as a portion of the requirements of the
GIS: Cartography and Geovisualization program of the Centre of
Geographic Sciences, NSCC, Lawrencetown, Nova Scotia. The product
is unedited, unverified and intended for educational purposes only.

Cartography by Deanne Watts, 2025



Whangapoua Bay. This photo was taken from a lookout point on Aotea, overlooking the stunning Whangapoua Bay on the Island's East Coast. See Pages 4-7 for the corresponding terrain plates.

To all of those whose presence, laughter,
and companionship made these wild landscapes
feel like home.





Freshet on the Skeena. This photo was taken from a pullout on Highway 16, somewhere between Prince Rupert and Terrace, BC. This captures just a glimpse of the stunning terrain of the North Coast, and the jaw-dropping views along the Skeena River. See Pages 10-11 for the corresponding terrain plates.

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Doubtful Sound Terrain. While not taken in Wellington proper, this photograph of Doubtful Sound was taken during a weekend trip, and the unforgettable landscape felt a bit too beautiful not to include! See pages 5, 7 and 13 to view the widely varied terrain of New Zealand.



Preface

Beyond Contours: An Atlas of Terrain Cartography explores six cartographic techniques that can be used to represent relief topography across mapping products. These explorations were carefully studied through coursework as a part of *Cartography 1023: Design and Visualization Techniques*, a course within the *GIS: Cartography & Geovisualization Program* offered through Nova Scotia Community College's Centre of Geographic Sciences.

These six techniques, including false colour image enhancement, enhanced hillshade, Imhof-inspired swiss-style relief, and relief enhancement using LiDAR, were all achieved using a combination of ArcGIS Pro, Adobe Photoshop, and opensource Blender software, and can be applied individually or through strategic combinations to achieve complex, dimensional representations of relief topography.

I developed this terrain atlas not only as an exploration of cartographic techniques, but also as a tribute to the landscapes that have shaped me. Over the past decade, the places I have lived have had a profound influence on my identity, worldview, and, ultimately, the path that lead me to the field of cartography. Within this atlas, I have included a series of photographs from my personal collection, capturing the terrain of these regions and complementing the relief maps and cartographic imagery found on pages 3 - 13. I look forward to continued exploration of cartographic techniques that capture the dimension and beauty of the landscapes we inhabit.



"Nothing beats Wellington on a good day!" This photograph of downtown Wellington was taken from a lookout on Mount Victoria. See Pages 12-13 for the corresponding terrain plate.



FALSE COLOUR IMAGE ENHANCEMENT

Nicaragua and Costa Rica

The relief illustrated on the opposite page depicts the provinces of Nicaragua and Costa Rica, as originally illustrated by Jacques Nicolas Bellin in 1764. The map uses pictorial elements and stylized hachuring to represent areas of relief, while also depicting rivers, settlements, routes, and notable ports. Bellin notably emphasized the region's topography, and highlighted the rugged coastlines of both the Pacific Ocean and Caribbean Sea.

For this map, I applied false-colour image enhancement techniques in Adobe Photoshop, using subtle but intentional colour washes to replicate the look of antique hand-painted watercolour maps. Through careful selection of features and application of digital brushwork, I simulated traditional watercolour effects to enhance the otherwise monochromatic map. Layered selections, varied blending modes, and controlled opacity and flow rates allowed for a refined, visually striking revision to the map that enhances and accentuates the map's key features and terrain.

I selected this map to commemorate my time spent in the small town of Corozalito on the central coast of the Nicoyan Peninsula. I spent my summer of 2016 studying nesting behaviour of olive ridley sea turtles on Playa Corozalito, slathering on layers of sunscreen, and trying to emulate the local carefree lifestyle and open minded approach to life, known as Pura Vida, or, the pure life.

CARTE DES PROVINCES
DE NICARAGUA ET COSTA RICA.

Echelle de Cinquante Lieues Communes



ENHANCED HILLSHADE

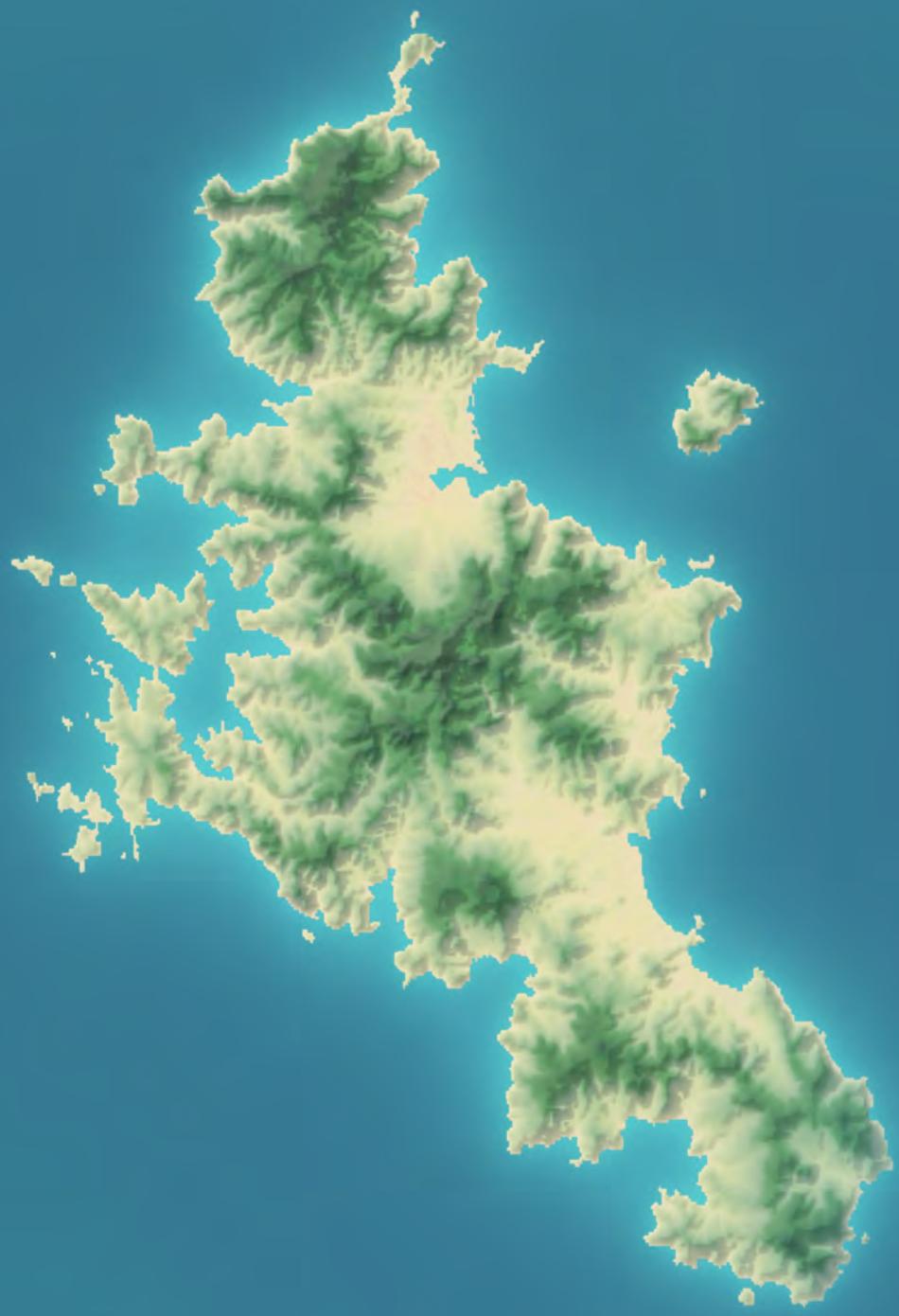
Aotea (Great Barrier Island), New Zealand

This relief imagery showcases the small but mighty Aotea (also known as Great Barrier Island) along with its smaller counterpart, Te Hauturu-o-Toi (or, Little Barrier Island), located approximately 90km off the east coast of Auckland, New Zealand. Aotea is a unique, off-grid island community that relies entirely on solar power, rainwater collection, and a strong sense of community. Te Hauturu-o-Toi, located 30 km west of Aotea, was New Zealand's first nature reserve, and remains one of the country's few pest-free areas. It is home to several rare and endangered native species, and is accessible only to those who hold an entry permit. Mount Hobson (Hirakimatā), is Aotea's centrally located highest point, boasting an impressive 2,057 ft of elevation. The surrounding landscape features a striking combination of rugged peaks, low-lying pastures, long sandy beaches, and a dramatic coastline.

To create this enhanced hillshade imagery, I used ArcGIS Pro followed by refinement in Adobe Photoshop to create a complex visualization of Aotea's terrain. In ArcGIS Pro, I developed hillshade raster layers using the hillshade function and a digital elevation model (DEM) of the region to produce several raster images

with varying degrees of contrast by adjusting the altitude, azimuth and vertical exaggeration parameters. I also used the shaded relief function with the same parameters as my medium contrast raster, to combine with the hillshade layers. In addition, I developed a hypsometric tint by styling the DEM using an appropriately styled colour ramp to replicate Aotea's lush vegetation and topography. After exporting these layers to Adobe Photoshop, I carefully combined them using opacity adjustments, varied blending modes, style effects such as feathers and halos, and selective highlights and shadows to create an artistic rendering of the island's topographic relief. These refinements enhance the depth and realism of the complex terrain.





ENHANCED HILLSHADE WITH ARTISTIC FILTERS

Aotea (Great Barrier Island), New Zealand

This relief imagery builds upon the composite enhanced hillshade as described on page 4, which was created using DEM-derived hillshades, shaded relief and hypsometric tints to create a dimensional representation of Aotea and Te Hauturu-o-Toi's (Great Barrier Island and Little Barrier Island) terrain. More information on these two unique islands can be found on Page 4.

I applied layered stylistic filters to various layers of my composite hillshade in Adobe Photoshop to achieve a unique, textured effect on both the land and water. For the water, I combined the mosaic tile filter and the palette knife filter, and adjusted opacity, blending modes, and halo effects to create a dynamic aesthetic reminiscent of ocean waves. For the terrain, I subtly incorporated the mosaic tile filter to compliment the water's texture, while using the dry brush filter to enhance the rugged landscape. By preserving the shadow and highlight layers developed for the composite hillshade, I maintained a sense of depth and relief to ensure that the artistic manipulations didn't overpower the underlying topography.

I selected this location to commemorate my time living, working, and exploring this unique paradise. In 2018, I worked with a small bio-security company slowly but steadfastly working towards New Zealand's ambitious 'Predator Free 2050' initiative, helping to manage invasive species that threaten the island's native flora and fauna.





IMHOF INSPIRED RELIEF

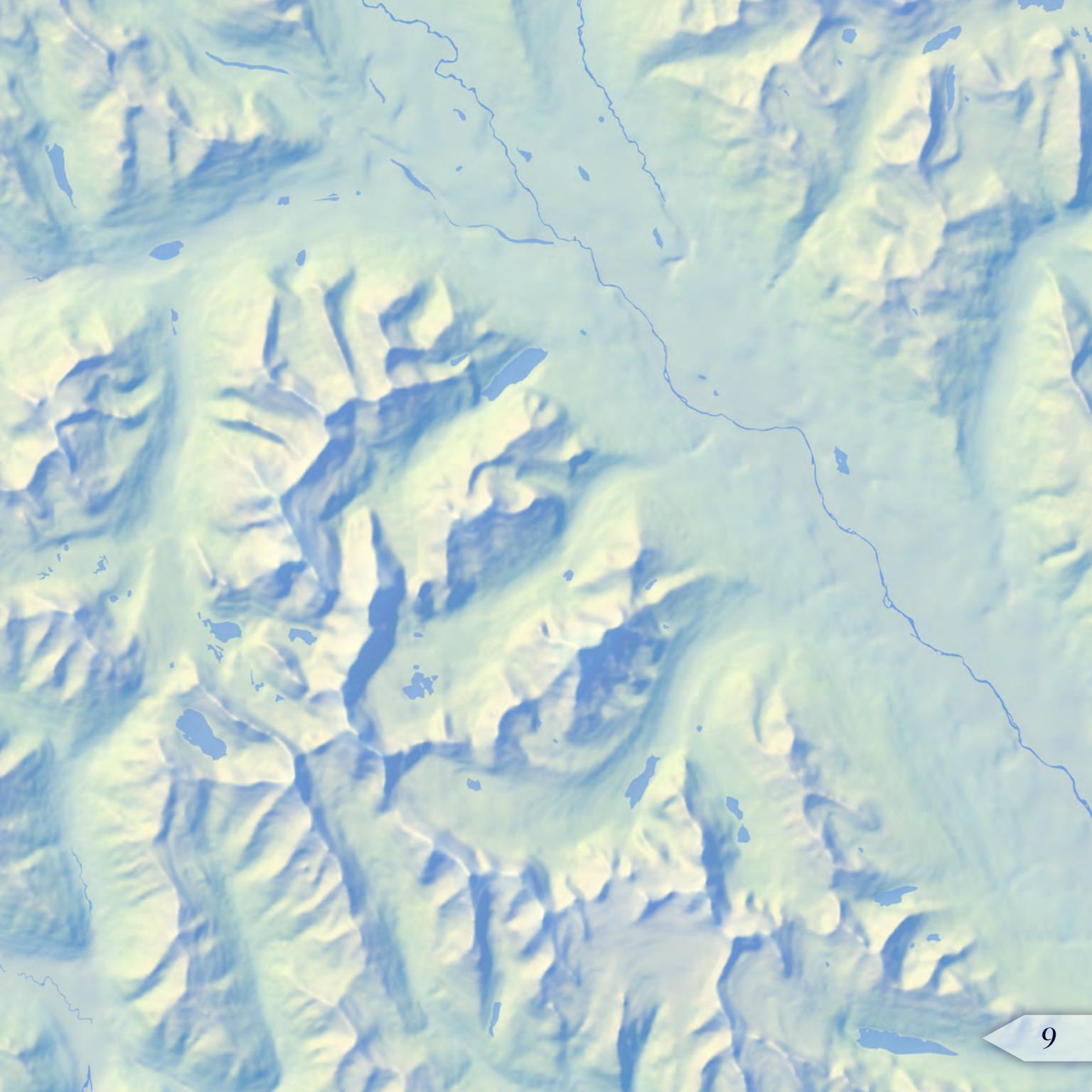
Lake Louise, Alberta, Canada

This terrain imagery captures Lake Louise, Alberta, located in Banff National Park, nestled in the heart of the Canadian Rocky Mountains. Defined by its drastic elevation changes and rugged peaks, the area is punctuated with stunning sapphire and emerald-coloured lakes. This particular frame showcases Lake Louise and its surrounding peaks, including Mount St. Piran to the north, Popes Peak, Mt. Huber and Hungabee Mountain along its western perimeter, and Mount Aberdeen and Mount Temple to the south. To the east lies the bow valley corridor, extending from the southern foothills of the Rockies and up towards Jasper, AB, in the north.

To create this relief imagery, I followed a tutorial inspired by Eduard Imhof's Swiss-style shaded relief method using ArcGIS Pro. First, I processed a DEM using the Topo to Raster tool, utilizing vector contour data from the Government of Canada's CanVec topographic data series. With the DEM ready for further processing, I generated a series of hillshades using the hillshade raster function and the raster calculator. I refined these layers with the Focal Statistics tool to achieve a soft, out-of-focus perspective, replicating the atmospheric effects one might experience when viewing the landscape from an airplane.

Next, I continued to refine the hillshade layers using the Slice and Focal Statistics tools, ultimately generating layer(s) that replicate an "aerial perspective". I styled these layers with a soft colour ramp, using golden yellows and deep blue hues to emphasize the highlights and shadows as seen during the infamous golden hour in the Rockies. By combining this series of rasters, including a hypsometric tint (a colourized DEM), greyscale hillshade, and aerial-perspective layers, and adjusting their opacities, I achieved the Imhof-inspired relief as seen here. The combination of highlights, shadows, and colour ramps allows for varied cartographic effects, that are replicable and customizable to enhance the thematic style of relief across cartographic mediums. I refined the terrain shown in the map by overlaying vector data, showcasing some of the many waterbodies found in the area.

This region holds personal significance to me, evoking memories of summers spent camping beneath the Rocky mountain stars in my youth, as well as two transformative summers spent working and living above the clouds at the Lake Agnes Tea House, situated 2,000ft above Lake Louise.



BLENDER RELIEF

Prince Rupert, British Columbia, Canada

The relief imagery shown here focuses on the North Coast of British Columbia, emphasizing the dramatic fjord-like relief of the coastal mountains that surround the expansive Skeena River. Situated on Kaien Island, approximately 20km north of the mouth of the Skeena River, is the City of Prince Rupert. The city is nestled below the rain shadow of Mount Hays' towering 2,323 ft of elevation, resulting in a unique microclimate within the already humid coastal rainforest. Its unique location, paired with the incoming coastal weather systems from the pacific causes exceptionally high rainfall, earning Prince Rupert the title of Canada's雨iest city. Despite the gloom, it is affectionately referred to by locals as the City of Rainbows.

To create the relief imagery of this North Coast region, I followed along with Daniel Huffman's tutorial entitled, "Creating Shaded Relief in Blender". I began by preparing my elevation data in ArcGIS Pro, using processing tools to mosaic, reproject, resample and rescale a set of DEMs that covered my area of interest. As indicated in the title of the tutorial, the remainder of the process used to create the shaded relief was achieved using the open-source software called Blender. Once I brought my DEM from ArcGIS Pro into

Blender, I followed along with steps to apply various adjustments to the "plane", "camera", and "light source" settings, in combination with texturizing the plane using the DEM's inherent elevation data. This allowed me to create the dramatic hillshade imagery seen here. By experimenting with parameters such as vertical exaggeration, lens angles, light source type and angles (to mimic natural sunlight), I was able to emphasize or downplay the relief as needed, ultimately achieving a suitable representation of the region's complex terrain.

I selected this region not only for its beauty and dramatic terrain, but also in memory of the three rainy but beautiful years I spent living and working in Prince Rupert. The unique climate and conditions of the area fostered a resilient community, whose positive outlook and aptitude to seek rainbows amidst rainstorms continues to inspire me to this day. To quote a local forest-engraving that has stuck in my mind, "it never hurts to keep looking for sunshine."

LiDAR RELIEF

Wellington, New Zealand

This relief map of Wellington, New Zealand, emphasizes Mount Victoria, a central feature of the city's recreational scene with its numerous walking and biking tracks, playgrounds, viewpoints, and parks leading up to the summit.

This approach to illustrating terrain relief was achieved using a combination of LiDAR and vector data in ArcGIS Pro, running tools like Convert LAS and LAS Dataset to Raster tools to generate a DEM of my coverage area. I then strategically applied LAS Filters to the LiDAR data to capture details like high and low vegetation, ground, buildings, and water, to generate a series of layers for further processing. Next, I processed these exported feature-specific layers using tools like the hillshade and shaded relief raster functions, and the focal statistics analyst tool to generate dimensional layers to be combined into a composite basemap for the coverage area.

These layers were then combined using varying levels of opacity, customized colour ramps, and application of subtle Imhof-inspired shadows and highlights to emphasize infrastructure and terrain, creating a complex composite basemap of Wellington. The final map features overlaid vector data for roads, trails, and points

of interest, with annotated labels for key features and a stylized layout design for export.

This map is a tribute to my six-month stay in Wellington, where I found refuge from the city noise and my eight roommates on Mount Victoria, just a short walk from my home. I spent my time on Mount Victoria exploring the many winding trails and taking in the stunning views of the city below.

Walkable Wellington:

A glance at Wellington's inner city walking tracks



N



0

250

500

m



Sunset from Mount St. Piran. This photo was taken from the summit of Mount St. Piran, at an elevation of approximately 8,600 ft. See Pages 8-9 for the corresponding terrain plates.

ACKNOWLEDGEMENTS

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Front cover: Little Barrier. Back Cover: Little Barrier at Sunset. Both images were taken from a viewpoint atop Mount Hobson, Aotea's highest point. See Pages 4-7 for the corresponding terrain plates.

