GEOLOGICAL SURVEY OF CANADA
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GeoTour guide for Terrace, British Columbia

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GEOTOUR GUIDE
FOR
TERRACE, BRITISH COLUMBIA

OUR LAND. OUR COMMUNITY

Figure 1. *View from Birch Bench subdivision looking to the southwest across the eastern end of Terrace, the Skeena River, Ferry Island (left), and the Coast Mountains (back, right). The Terrace Airport sits on the flat bench on the left skyline.*

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BRITISH COLUMBIA | Ministry of Energy, Mines and Petroleum Resources

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TERRACE – LIVING ON THE LAND

We live within the great Coast Range where the big Skeena River flowing west to the Pacific crosses the wide north-south Kitsumkalum-Kitimat Valley. This region is underlain by diverse geological materials and is continually shaped by earth processes. Terrace, like any other community, is dependent on the Earth for water, food, materials, energy. Not only does the Earth provide resources, but it accepts our wastes. This *GeoTour* field guide explores how our community of Terrace "lives off the land". What earth materials underlie this landscape and how do they affect us? How has the local landscape shaped human use of our area? What local earth resources do we depend on? Where does our drinking water supply come from? Where does our sewage go? Where does our garbage go? Where does the energy that fuels our lives come from? Are we sustaining the land that sustains us?

This guide tells its story of the geological landscape of Terrace by taking a tour. These *GeoTour* locations will be familiar to many, but this guide may inspire you to look with new "landscape eyes".

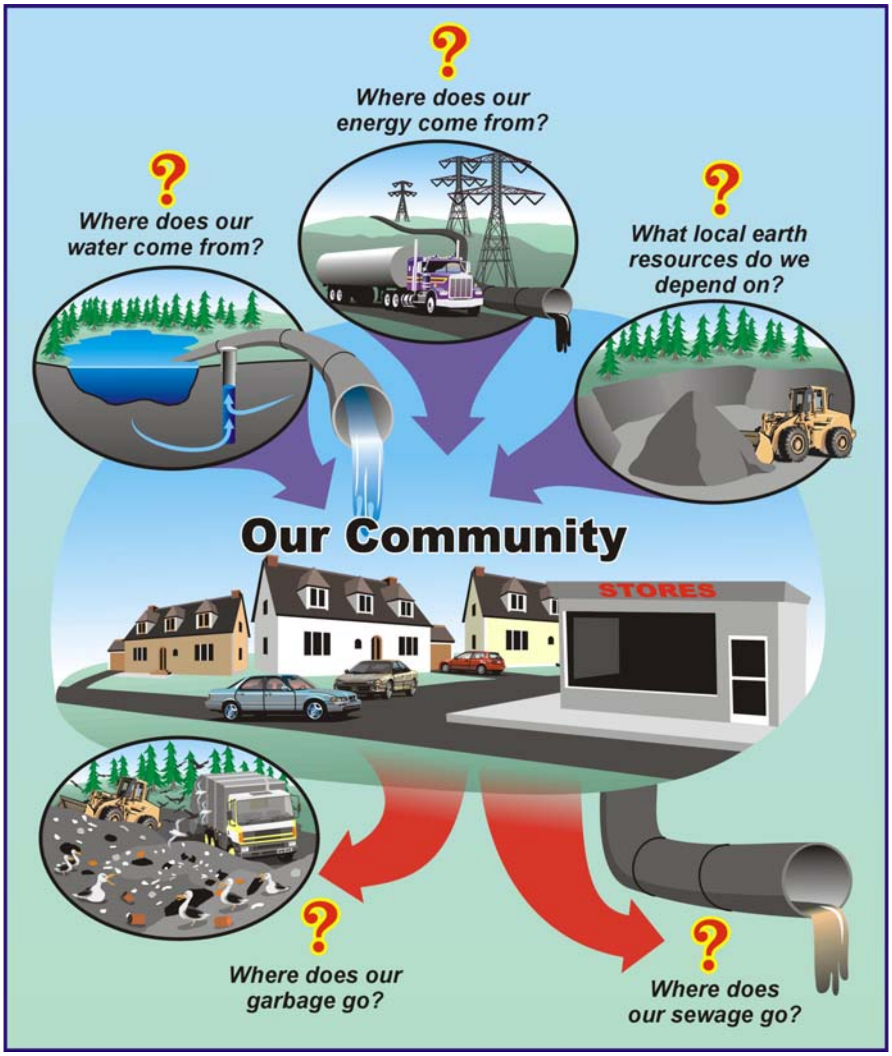


Figure 1a. *Our community lives on and lives from the land. Our local lands provide essential resources such as water and sand and gravel for roads, asphalt, and concrete. Lands further away provide energy resources such as petroleum and natural gas, as well as metals and minerals. Our local lands also receive our wastes: garbage goes to landfills and waste water is treated and returned to the land.*

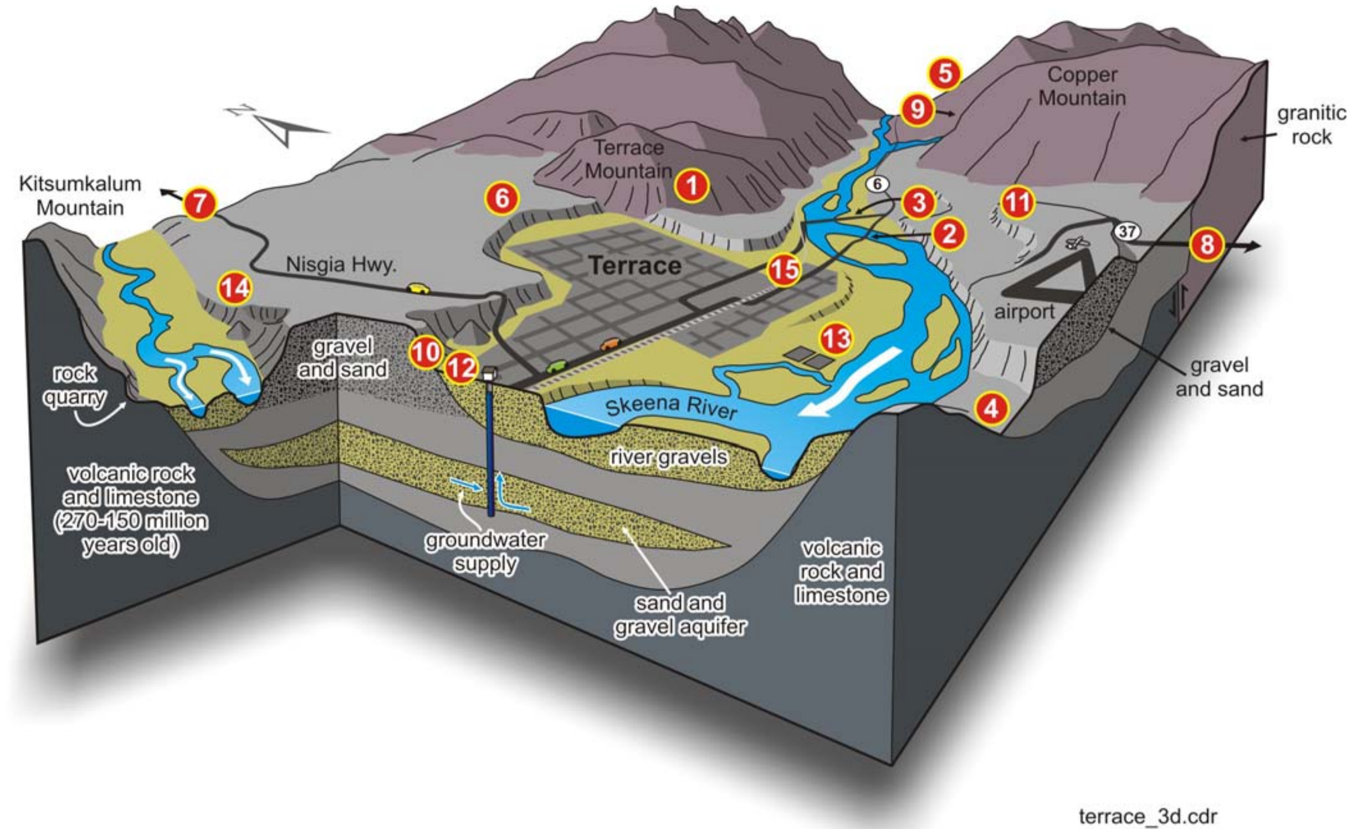


Figure 2. *A schematic cut-away view of the Terrace area and underlying geological materials looking to the northeast. Circled numbers indicate the location of **GeoTour** sites discussed in guide.**1.** Terrace Mountain lookout. **2.** Ferry Island Park river gravels. **3.** Old Bridge and Skeena River. **4.**Old Remo Road limestone. **5.** Kleanza Creek Provincial Park. **6.** Heritage Park Museum mining displays. **7.** Nass Valley lava flow. **8.** Mount Layton hot springs. **9.** Copper River landslide. **10.** Sand and gravel quarry. **11.** Concrete plant, Thornhill. **12.** Frank Street municipal water well. **13.** Municipal wastewater treatment plant. **14.** Municipal landfill. **15.** Rail terminal for petroleum products.*

HOW OUR LAND CAME TO BE.
A QUICK TOUR THROUGH GEOLOGIC TIME

So, how old is Terrace? Well, European settlement of the Terrace area goes back to the mid 1800s. On the other hand, First Nations settlement in the region is much older and goes back thousands of years. But the land itself is much, much, much older. What follows is a brief summary of the geological history that geologists have pieced together for the Terrace area.

(1) ANCIENT SEAFLOOR AND VOLCANOES

The oldest rocks in the Terrace area are volcanic lava and limestone that formed 270 million years ago. Many mountains in the Terrace area are carved from these rocks. The volcanic rocks erupted from ancient volcanoes on oceanic islands similar to modern-day Japan or Aleutian Islands. Limestone reefs formed in shallow waters surrounding these islands (**Site 4)**.

(2) CRUNCH!

These volcanic islands collided with the western edge of North America, starting 180 million years ago, as the Atlantic Ocean started to open, and North America moved westwards. This collision welded the lavas, limestone, and other rocks to North America, adding to its landmass and moving its coastline westwards from east of Prince George (near the present site of McBride and Mackenzie) to the present day Terrace area. The collision caused mountains to rise as the lava and limestone were deformed into folds and broken by faults.

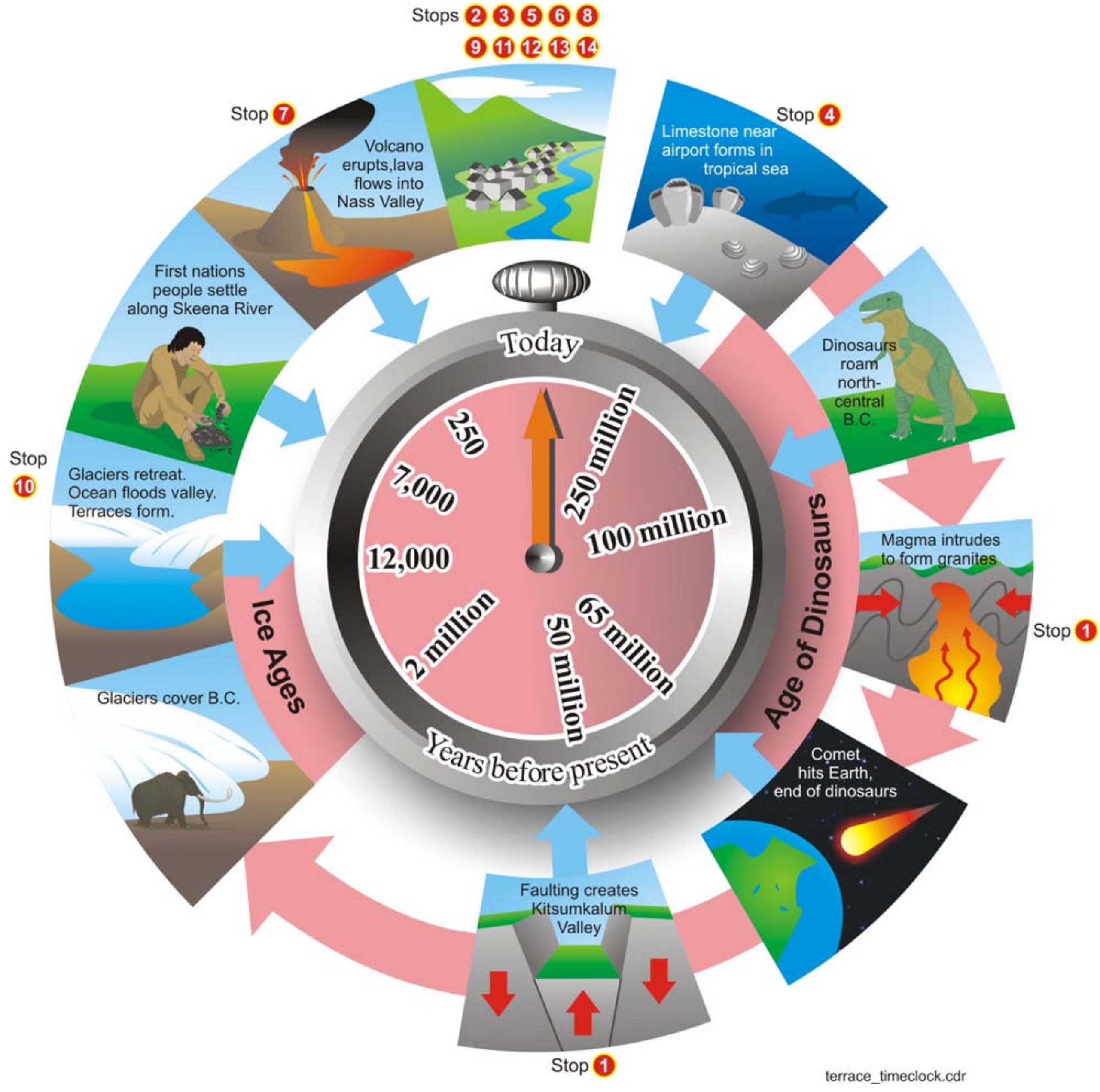


Figure 3. *Geological history of the Terrace area is presented as a clock and shows how the geological materials at Geotour stops or sites fit into geological time. Note that equal divisions of the clock face represent highly unequal periods of time. Each geological material has a history of formation. Geologists use fossils and radioactive elements contained in each geological material to determine its age. Much of this ancient history has been destroyed by erosion over geological time, leaving many gaps in our understanding.*

(3) SHALLOW SEAS, DINOSAURS, AND COAL

Over time, the mountains eroded and a shallow sea spread eastwards to cover a large area from Terrace and Smithers to Dease Lake and Spatsizi Plateau Park. Rivers flowed into the sea from the east depositing thick deposits of sand, mud, and swamp peat. Dinosaurs roamed coastal swamps. Today, widespread sandstone and mudstone rocks contain coal deposits, natural gas, dinosaur footprints, and fossils.

(4) CRUNCH AGAIN! AND GRANITES INTRUDE

Another giant volcanic ocean island, referred to as "Wrangellia" by geologists, slammed into the western margin of North America, extending the continent westwards to the Queen Charlotte Islands. The collision folded and faulted the region and caused the Coast Mountains to rise. Along the coast, a subduction zone formed as Pacific Ocean crust slid below the Coast Mountains, causing deep rocks to melt. Some melted rock (magma) crystallized deep in the earth to form great volumes of granitic rock (**Site 1**) that today make up much of the Coast Mountains.

(5) THE LAND PULLS APART

About 50 million years ago, much of British Columbia started to pull apart. The land broke into fault blocks, and the great Kitsumkalum-Kitimat valley formed (**Site 1**). Rocks under the valley subsided while the flanking mountains to the west and east rose along faults. These ancient faults remain today and act as conduits for hot waters that circulate deep below the valley, and rise to the surface at the Mt. Layton hot springs (**Site 8**).

(6) THE ICE AGE

Two million years ago, great continental ice sheets started to form in northern North America. Ice Ages came and went. The last great Ice Age reached its maximum about 25,000 years ago when the ice sheet was two kilometers thick over the Terrace area and most parts of British Columbia. The slow-moving ice flowed from the BC Interior, where it was thickest, down the Skeena and Kalum-Kitimat valleys to the ocean, deepening the valleys. At the end of the Ice Age, the glacier front retreated northwards up the Kalum-Kitimat Valley. Several times the glacier retreat paused and thick plains of sand and gravel accumulated at the glacier snout (**Site 10**).

(7) TODAY, THE RIVERS CARVE THEIR VALLEYS

The modern Skeena River was born as the glaciers retreated, carrying waters from the central interior westward to the Pacific Ocean. The Skeena and Kitsumkalum rivers cut down through the thick glacial deposits that filled the valleys, forming riverside cliffs that exposed the layers of glacial gravels and sands that today are important earth resources (**Site 10**) and aquifers (**Site 12**). As the rivers cut downwards, they also migrated back and forth, forming river plains. Today the City of Terrace is built on a staircase of flat terraces or "benches" that mark former river plains, now abandoned above the present river plain. The city is named after these geological features. A good example of a former river plain surface, now left high and dry, is the "Horseshoe" area on the north side of Terrace. The cliffs around "the Horseshoe" were cut by the Skeena River at an earlier time.

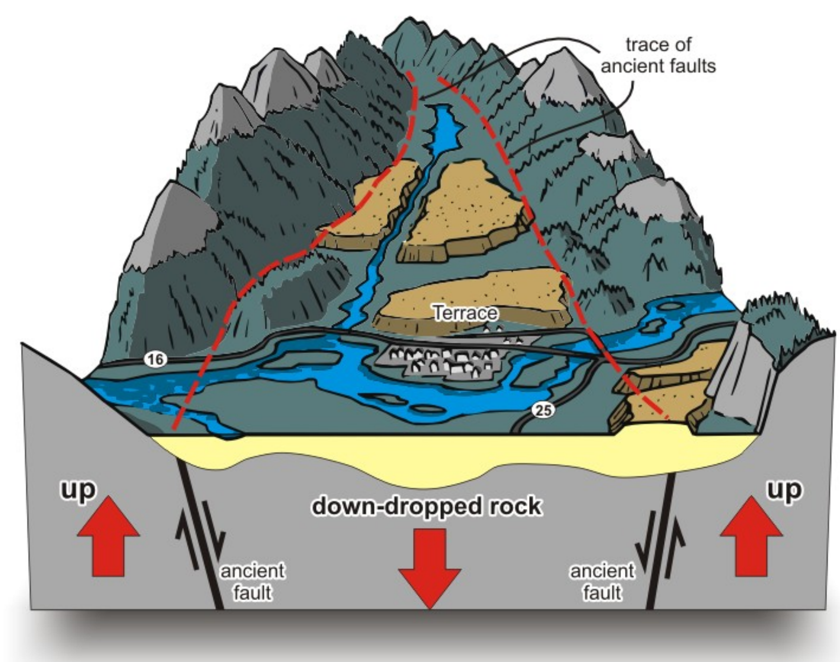
(SITE 1) TERRACE MOUNTAIN LOOKOUT:
THE BIG VALLEY, A "FAULTY" HISTORY, AND GRANITE FOUNDATIONS

Figure 4. *View from Terrace Mountain looking west across the Kitsumkalum-Kitimat Valley to Sleeping Beauty Mountain and Coast Mountains. Terrace is in the foreground. Curiously, the Skeena River flows across, rather than down, the valley. Photo by Bonnie Hayward.*

TAKE A LOOK AT THE VIEW!

So, with our geological history in mind, let's head out and take a look at the landscapes of Terrace. The first site is the viewpoint on Terrace Mountain above the east side of town. From the viewpoint, a landscape unfolds to the west and southwest.

Figure 5. *The Big Valley – a faulty history. The Kitsumkalum Valley formed by movement on faults that caused the valley to subside relative to the adjacent mountains.*



Terrace lies within the north-south Kitsumkalum-Kitimat Valley, bound to the west by the Coast Mountains and the east by the Hazelton Mountains. This is one of the largest coastal valleys in British Columbia. The Skeena River flows in its own smaller valley from east to west, crossing the larger north-south valley. Geologists find this curious – the Kitsumkalum and Kitimat Rivers seem too small to have carved the big valley. It is likely that at some time in the geological past, a much larger river flowed down the Kitsumkalum-Kitimat Valley, eroding its great width.

HOW THICK WAS THE GLACIER DURING THE LAST ICE AGE?

You can an answer to this question by observing the shape of the mountains. Most of the Coast Mountains to the west have rounded summits that indicate that glacier ice flowed over them. Only the very highest peaks are sharp and irregular, indicating they poked above the highest limits of the glacier. So as you look at the view, imagine the valleys filled with glacier ice and only the highest sharp peaks sticking through!

TAKE A LOOK AT WHAT'S AT YOUR FEET!

At the lookout, you are standing on a light grey coloured granitic rock. The rock has a salt-and-pepper texture reflecting the intergrowth of light (feldspar, quartz) and dark minerals (hornblende, black mica) that crystallized from a rock melt (magma). The Coast Mountains, from Vancouver to Alaska, have been referred to as "Granite Country" because of the tremendous abundance of granitic rock relative to other parts of British Columbia. Granitic rock usually contains fractures that tend to be widely spaced and therefore granite resists erosion. As a result, granite often forms very stable, steep cliffs such as the western face of Copper Mountain, and is therefore a favourite of local climbers.

Figure 6*. Granitic rock with salt and pepper texture. Photo by Bonnie Hayward.*

GO TAKE A LOOK

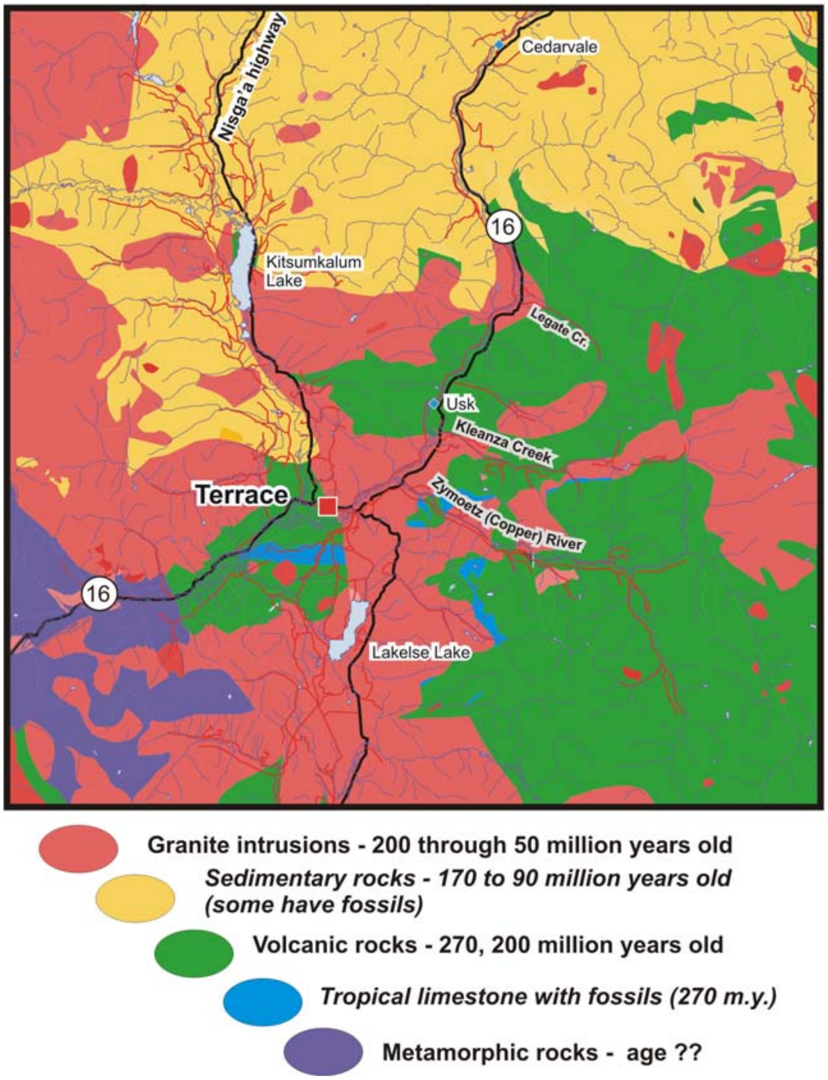
Drive east from downtown on Park St up to Birch Bench. Turn left on Johnstone Street. The trail head is on the right. The trail to the lookout rises about 200 metres and takes about 45 minutes to an hour and a half to climb**.**

(SITE 2) FERRY ISLAND PARK AND SKEENA RIVER GRAVEL BARS: DIVERSE ROCK TYPES, NICELY POLISHED

Figure 7*. Gravels exposed on the gravel bar at Ferry Island. Photo by Bob Turner.*

Ferry Island is just one of many islands in the Skeena River near Terrace. Upstream of Terrace, the Skeena River flows fast in a narrow valley. As the river enters the broad Kalum-Kitimat Valley, the river slows. Currents that have pushed gravel along the river bed from high in the mountains weaken, and the gravel accumulates, forming mounds on the river bed that we call bars and islands. Ferry Island is an example of a large island that is old and stable enough to have an established forest. Islands fill the Skeena River all the way to the sea – this is the final dumping ground of the Skeena River as it meets the Pacific Ocean.

Many different rock types underlie the Terrace region. If you drive to Hazelton, the dominant rock type is sandstone and shale. Kitsumkalum mountain is volcanic rock. If you drive west of Terrace to the Coast Mountains, the dominant rocks are granite and gniess. Geologists compile maps of the distribution of different rock types and sediment types, or "geological maps". These maps are very valuable in the search for mineral and energy resources such as copper, sand and gravel, oil and gas (see Figure 8).



Gravels offer a simple way to view the diversity of bedrock types. Gravels are fragments of rock that have been worn smooth by bumping, grinding, and sand blasting that take place in rivers over long periods of time. The smooth surfaces of pebbles, particularly if they are wetted, reveal detailed textures and colours that greatly assists in their identification. The diversity of pebble types reflects the extensive network of streams on all landscapes that scavenge materials eroded from rock, glacial gravels, and glacial tills, and concentrate them in stream beds.

***Figure 8**. Map of rock types underlying the Terrace region (by Joanne Nelson).*

***Figure 9.** Different types of pebbles found on a bar in the Skeena River. Clockwise from lower left corner: 1) Brick red to purple volcanic lavas; 2) grey green lava with white rectangular feldspar crystals; 3) green lava (metamorphosed); 4) grey layered sandstone and mudstone; 5) white "salt and pepper" granitic rock. Photo by Bob Turner.*

River bars such as those around Ferry Island offer an excellent opportunity to inspect gravels, at least when the river levels are low (not during spring runoff and during heavy autumn rains!). Try to give each rock type a name based your observations of its colour, lustre, or texture. For example, you might decide you would call one the "grey dull swiss cheese rock" because it is full of holes, another "white, shiny, harder than knife rock", and another "grey and black speckled "salt and pepper" rock". Good luck!

Here is what a geologist might call those same rocks.

- Grey dull swiss cheese rock = volcanic lava
- Brick red and purple rock, with some holes = volcanic lava)
- Light grey and dark grey layered rock = sandstone (light grey) and mudstone (dark grey)
- white, shiny, harder than knife = quartz from quartz veins
- Grey green to pistachio green rock = metamorphosed volcanic rock
- Purple-brown or red-brown shiny speckled rock = volcanic lava
- Grey and black speckled "salt and pepper" rock = granitic rock
- Layered grey and black speckled "salt and pepper" rock and black rock = gniess

GO TAKE A LOOK: FERRY ISLAND

Drive east from Terrace on Highway 16 to Ferry Island. Turn south (right) into the parking lot at the access road to the Ferry Island Campground. Take the trail east from the parking lot, under the highway bridge, and down to the gravel bar. At low water, the bar is large. At high water in spring and early summer the bar may be completely submerged.

(SITE 3) OLD BRIDGE AND SKEENA RIVER

***Figure 10**. View of the Skeena River and Old Bridge from Lakelse Road park. Site 3 is at the south (left) end of the bridge at a small beach and rock point. Photo by Bob Turner.*

At the south end of the Old Bridge (Skeena Bridge) over the Skeena River is a fisherman's access to a small beach and a rock point. The rock ridge of Terrace Mountain meets the Skeena River here an the Skeena River has only partly cut a channel through these hard granitic rocks. The footings of the Skeena Bridge take advantage of the low ridge of granitic rock that crosses the Skeena River. Most of the Skeena River flow is forced through a narrow underwater canyon over 20m deep below the main span of the bridge.

Walk out on the rock point. During floods, this rock ridge is submerged by the Skeena River. Can you see evidence that the river has flowed over these rocks? Look for potholes that are drilled into the rock by pebbles driven by swirling river water.

GO TAKE A LOOK

Drive east from the downtown on Highway 16. Turn north (left) at Highway 37 and east (left) at Queensway just before Skeena Bridge. A gravel road leads down towards the river about 100 m west of the bridge.

(SITE 4) TROPICAL TERRACE? TERRACE'S OLDEST RESIDENTS? LOCAL LIMESTONES TELL THE STORY

Who are Terrace's oldest residents? One might argue that some clams, sponges, and other small creatures that have left us their fossilized remains in limestones near Terrace deserve that title. Geologists will tell you that they are about 270 million years old! And that they lived below a tropical sea! Things sure have changed since then.

Figure 12*. 270 million year old fossil of a tropical clam in limestone.*

Figure 13*: Cliff of limestone 270 million years old. Grey fossil-bearing limestone is interlayered with layers of hard white quartz-rich rock. Photo by Joanne Nelson.*

GO TAKE A LOOK

Drive west on Queensway from Skeena Bridge to Old Remo Rd. Turn west (right) and drive xx km. Pull off the road near the horse sign. Look for a small trail on the north side of the road leading down the slope. A short walk through the forest brings you in sight of a cliff rising out of the forest. The rock rubble at the base of the cliff is a good place to look for fossils, such as brachiopods, pieces of coral and crinoids, fusilinids (look like rice grains). If you are adventurous, climb the rubble to the layered rock in the cliff. More small fossils there, but please, leave them so others can admire them too!

(SITE 5) KLEANZA CREEK: THERE'S GOLD IN THEM THAR HILLS

Figure 14*. Kleanza Creek at the Provinical Park picnic site where the creek flows out of the canyon. Photo by Bob Turner.*

Kleanza Creek Provincial Park is situated 15 km northeast of Terrace on Highway 16, next to the beginning of a logging main that continues on the north side of the creek. During the late 1800's and early 1900's, placer gold was mined from the gravels of Kleanza Creek. "Kleanza" is a Gitxsan word for gold. Now the creek is highly valued as a salmon run, and forest growth and natural erosion have mostly hidden the evidence of the century-old workings.

If you want to try out gold panning for yourself, go outside the park to the upper reaches of Kleanza Creek or try any of the other streams that flow into the Skeena. All you need is a pie tin or frying pan. Fill it about half full of wet sand and half full of water. Hold it under the surface of the stream; rock it to settle the heavy grains to the bottom and then wash the lighter grains off the top. Repeat until you have a little bit of dark-colored residue in the bottom. Swirl this around and look for shiny, pinprick-sized gold grains. Chances are you won't find any - the early prospectors were very thorough in their work - but you may be rewarded with a little train of black metallic grains (magnetite) or pink ones (garnet).

(SITE 6) HERITAGE PARK MUSEUM: THE HARD LIFE OF EARLY MINERS

Skeena River valley has been a well-travelled transportation corridor probably since the first peoples arrived. Until the late 1800's, getting there required a canoe and a team of strong, determined paddlers to negotiate the rapids, and riches were mainly trade goods running between the coast and the interior. The coming of sternwheelers in 1890, and the railroad in 1914, brought a new kind of explorer to the region: hardrock prospectors and miners. They plowed through thickets of devil's club and scrambled up the highest peaks in search of gold, silver, and copper. They threaded trails through precipices: one of these climbed in 64 dizzying switchbacks to a high pass at the head of Chimdemash Creek. The Bornite Mountain hiking trail north of Kleanza Creek once led to the Singlehurst property, one of the busiest mining operations in the Terrace area. Sixty-five men worked there in 1900. They drove a shaft into the gold-bearing quartz vein by hand, constructed a headframe, and used a horse-powered winch (a "whim") to haul ore and rock waste out of the shaft.

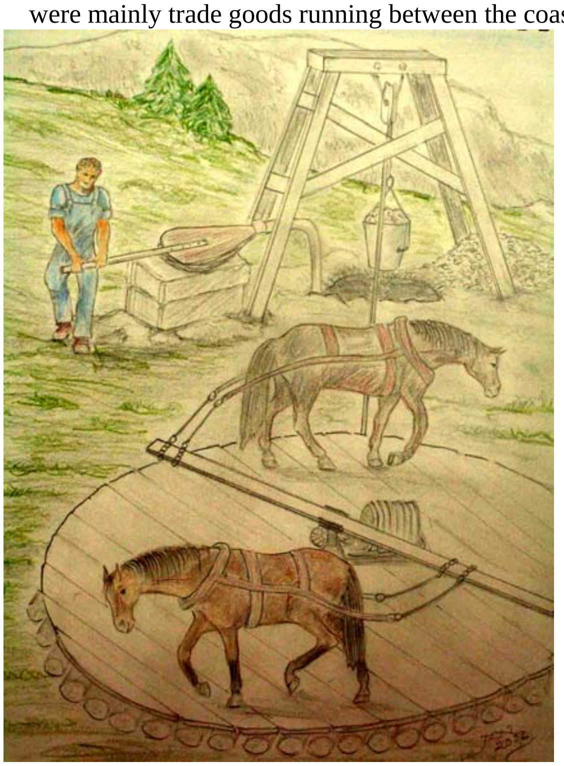
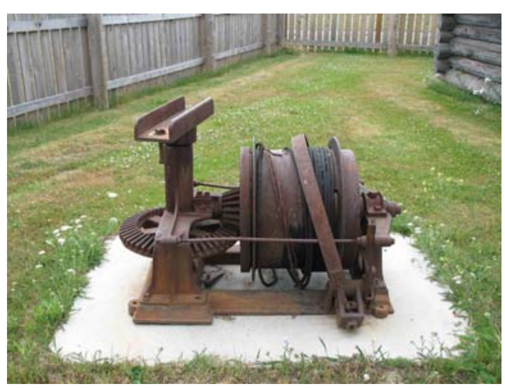


Figure 15 *"Air in. Ore out" Life at the Singlehurst mine. A horse-powered winch ("whim") lifts a bucket of ore from the shaft of the Singlehurst mine. Miners at the bottom of the shaft work in tunnels that follow the ore. They depend on their co-worker with a giant bellows on surface to pump fresh air into the mine down a long pipe. (Drawing by Joanne Nelson).*

GO TAKE A LOOK

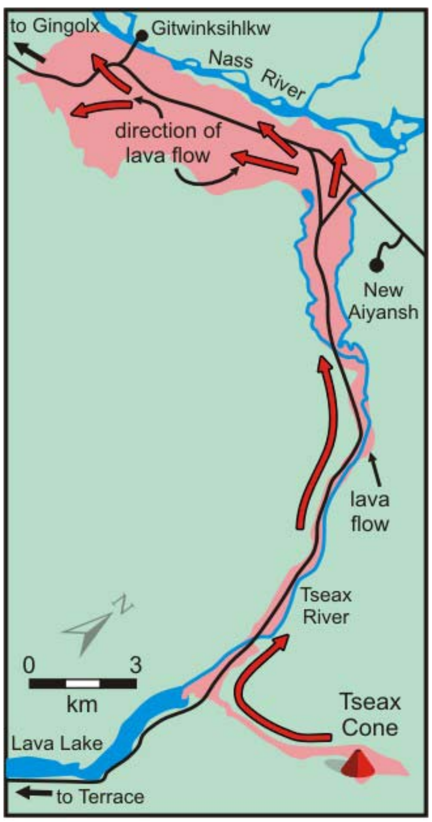
There's a miner's cabin at the Heritage Park Museum on Kalum Drive north of Terrace where you can see the whim and ore bucket from the Singlehurst mine. Go inside the cabin and check out the ore and fossil specimens and hand-forged miners' tools. Pick up the hand steels and imagine drilling a hole into the rock, hammer blow by hammer blow, one chip at a time. Think: maybe this blast will be the good one, maybe reveal a glittering fracture face of free gold. Or maybe not. Or maybe next week you can pack back down the mountain for the winter, enjoy a little piano music or a dance for the bachelors hosted by one of the families at Usk … Across the lawn at the historic park, the Kalum Lake Hotel gives a glimpse at what civilized comforts a weary miner could enjoy after a season working his claims. (Also www.heritageparkmuseum.com)



Figures 16 and 17*. The bucket (right) and whim or horse-powered winch (left) from the Singlehurst mine are on display at the Heritage Park Museum. Photos by Bob Turner.*

(SITE 7) NASS VALLEY LAVA FLOW: A NATURAL TRAGEDY

Figure 18*. Near Gitwinksilk, the lava surface is made up of lava rubble. The surface of the lava "froze" into a rock crust while underlying lava remained liquid and continued to flow, causing the crust to break into rubble.*



An hour north of Terrace up the Nisg'a' Highway is an amazing sight. The highway leaves the wet forested landscapes typical of the Coast Range to enter an open expanse of bare rock and rock rubble that extends along the valley floor for more than 20 kilometres. This is a lava flow that erupted into the valley only 250 years ago. So recently that little grows on the lavas except for moss and lichen. The lava flow destroyed several Nisga'a villages with great loss of life and temporarily blocked the Nass River. The lavas permanently blocked Tseax River, flooding the valley and forming Lava Lake. It transformed a lush forested valley to a rocky desert landscape. The lava flowed from a fracture in the Earth near Tseax Cone, a 100 m high cone of volcanic cinders erupted during the lava eruption.

Figure 19*. Map of Nass River lava flow.*

Figure 20*. A close up of dark lava filled with gas bubble casts. Gas was "fizzing" from the lava as it flowed, much like a soda drink. As the lava cooled, these bubbles were "frozen" into the rock and are still there today. Photos by Bob Turner.*

(SITE 8) MOUNT LAYTON HOT SPRINGS: WATER FROM DEEP IN THE EARTH

The hot waters that flow to the surface at Mount Layton hot springs south of Terrace remind us that deep below us the Earth is very hot. These hothsprings are the hottest in Canada at 89 degrees Celsius, and have been developed into a resort and water park. So as you soak in the hot tub or pool, remember you are being warmed by the Earth, literally!

Figure 21 and 22*. (left) Swimming pool at hot springs. (right) Unused concrete pool built around one of the hot springs. Photos by Bob Turner.*

Mount Layton hot springs, also known as Lakelse hot springs, include at least half a dozen warm seeps that straddle Highway 37 and flow into wetlands that surround the resort area. Warm springs may also occur on the floor of Lakelse Lake, as soft spots are reported in the winter lake ice by locals.

The Kalum-Kitimat valley formed millions of years ago by movement on faults that allowed rocks under the valley to sink, while adjacent rocks rose to form the Coast and Hazelton Mountains. Geologists refer to the Kitsumkalum-Kitimat valley as a fault-bound valley. It is likely that the magma that erupted as the Nass Valley lava flow 250 years ago rose along these same faults.

HOW DO FAULTS CREATE HOT SPRINGS?

Faults are the pathways that allow hot waters to move quickly to the surface before supply the deep earth with water! Snowmelt and rainwater that fall on the mountains percolate down along faults. As the waters descend, the waters are warmed by the Earth, which increases in temperature with depth. Earth heat comes from heat generated by radioactive decay of elements such as uranium. Deep below the valley, down perhaps 6 or more kilometers, the waters reach temperatures of 100 degrees Celsius or more. Some of these hot (and lighter) waters rise on other faults, pushed to the surface by the weight of cool (and heavier) descending water. Hot waters cool somewhat as they rise, mixing with cool shallow groundwater, and reach the surface at temperatures near 89 degrees Celsius.

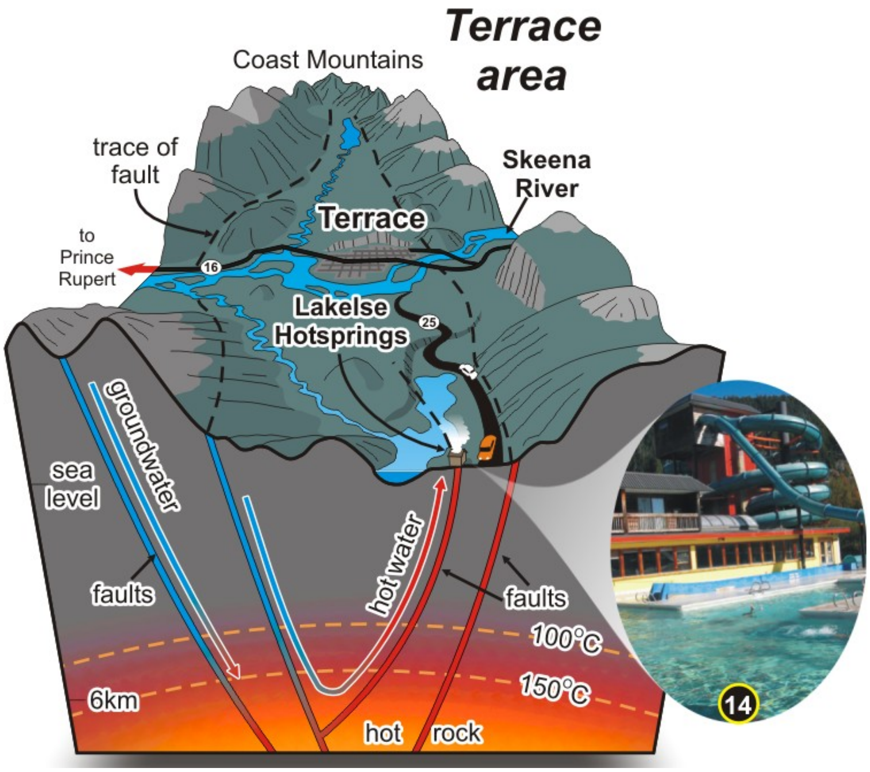


Figure 23. *Schematic view of the geothermal "plumbing system" that feeds the hot springs*

GO TAKE A LOOK

The hot springs resort is about 30 kilometres south of Terrace along the Highway 37.

(SITE 9) HIGHWAY 16 SAND AND GRAVEL PITS: VITAL RESOURCES FROM ANCIENT GLACIAL RIVERS

Figure 24. *A gravel pit in an Ice Age bench along Highway 16 just east of the Kitsumkalum River bridge. The cliff exposes thick sand and gravel deposits (grey) overlain by a 3-5m layer of clay and silt (tan). Photo by Bob Turner.*

The Terrace area has extensive deposits of sand and gravel. You might be surprised to learn how important these earth materials are to the community. Buried gravel and sand layers below Terrace "aquifers" contain groundwater that supplies the City of Terrace with its high quality drinking water (**Site 12**). Gravel and sand are also essential components of concrete and asphalt (**Site 11**). Pause for a second to consider Terrace without concrete (no large buildings, highway overpasses, sidewalks, roadside curbs, storm sewers!) or asphalt (no paved roads or parking lots!). Fortunately for Terrace, it is blessed with many nearby quarries to meet this need.

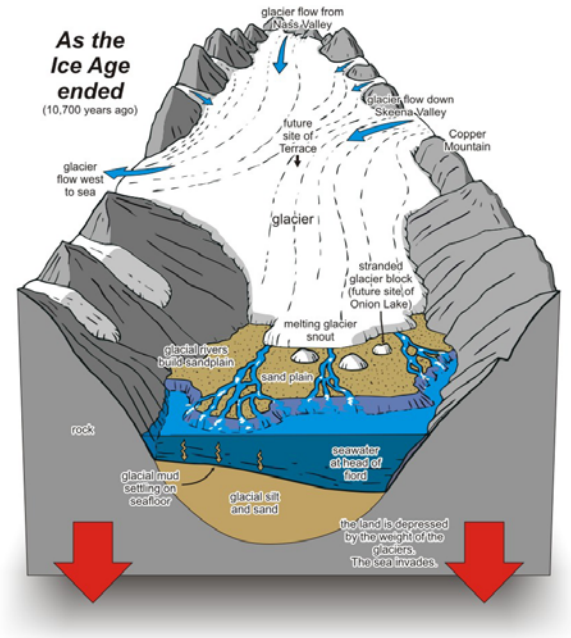
Figure 25. *(below) A gravel pit along Highway 16 near the Kitsumkalum River. Sand and gravel deposits are sorted by screening into separate piles of gravel and sand, and each is sold for different purposes. Photo by Bob Turner.*

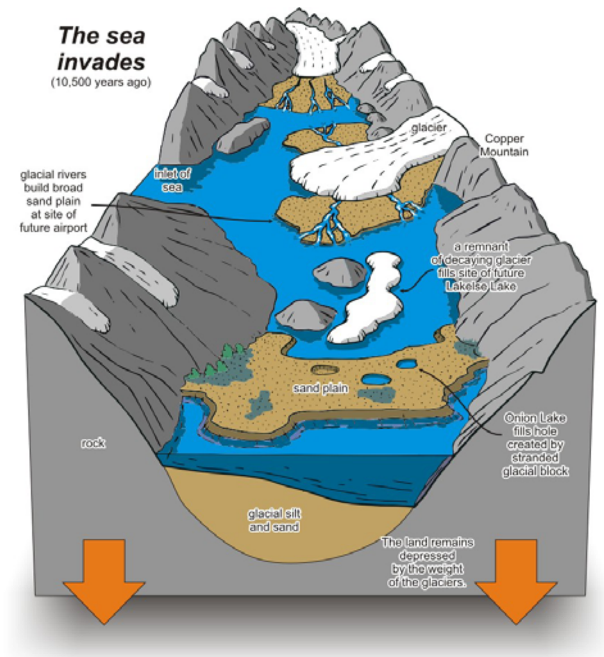
GO TAKE A LOOK

Drive west from downtown along Highway 16. A large gravel pit operation is on the north side of the highway just before the bridge over the Kitsumkalum River.

SO WHERE DID ALL THIS GRAVEL COME FROM?

The answer: ancient rivers. Sand and gravel deposits form the flat benches north of town and south of the river at the airport. These benches are flat because they formed as ancient river plains. The Skeena and Kitsumkalum rivers have cut down through these thick deposits, forming their own gravel deposits as low terraces such as the "Horseshoe" area of north Terrace. The gravel banks, bars, and islands of the Skeena River, visible when river levels are low, remind us that rivers create sand and gravel deposits as they flush the finer materials such as silt and clay downstream, leaving behind clean gravels and sand.





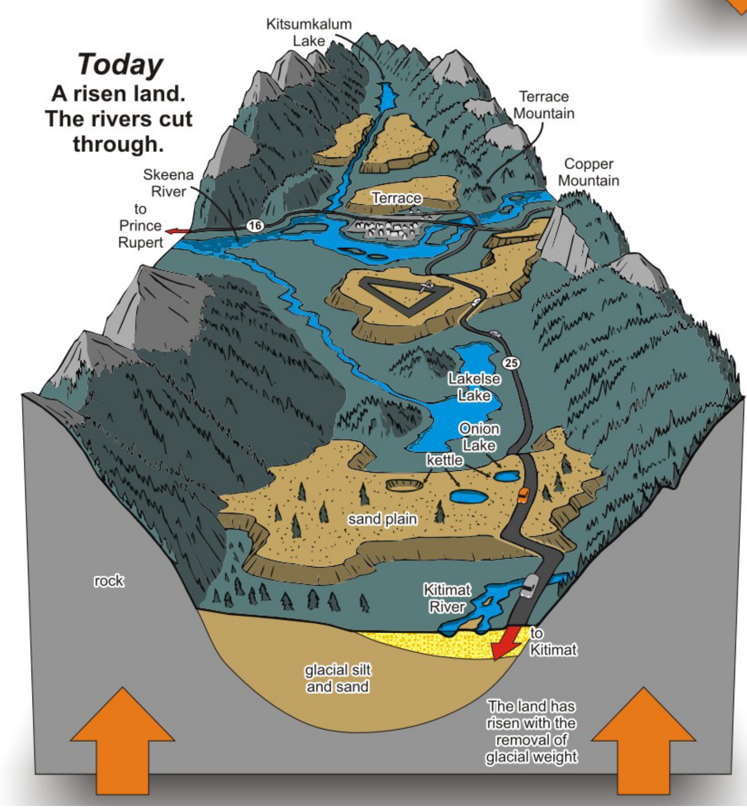


***Figure 26**. An interpreted history of the Terrace area at the end of the Ice Age illustrating the formation of sand plains that today are the flat elevated benches (or terraces) that host the airport, the Heritage Park Museum and cemetery in northern Terrace, and Onion Lake south of Lakelse Lake.*

(SITE 10) MAKING CONCRETE AND ASPHALT: DIGGING OUR LOCAL GRAVEL AND SAND

Try to imagine Terrace without concrete. No Highway 16 bridge. No multistory buildings downtown. No basements. No house foundations. No curbs. Now try to imagine Terrace without asphalt. No sealed or paved roads. No paved parking lots. Roads sure would be dusty in summer and muddy in winter. Hundreds of thousands of tons of concrete and asphalt are made and used each year in the Terrace area. It might surprise some to know that over 80% of all the asphalt and concrete used in the Terrace area is made of local sand and gravel.

Figure 27. *Concrete plant on Old Lakelse Lake Drive in Thornhill. The plant makes concrete aggregates, septic tanks, highway barriers, brick, block, paving stones, slabs, chimney blocks, and premixed sack products.*

Concrete is the most widely used construction material worldwide. Twice as much concrete is used in construction than all other building materials combined, including wood, steel, plastic and aluminum. Concrete is made by combining nine parts sand and gravel with one part cement. Sand and gravel make up the bulk of concrete; cement is the glue that holds it together. To make the cement "glue", limestone, shale, and sand are mixed and ground to a fine powder, and then roasted at high heat. Cement necessary for Terrace's concrete must be imported because the necessary limestone and shale are not available locally. Terrace has several plants that combine locally quarried sand and gravel with imported cement to make concrete.

GO TAKE A LOOK

Drive east from Terrace on Highway 16 across the Skeena River to Thornhill. Turn south on Old Lakelse Lake Drive. As the road climbs up the bench, note the abandoned and active quarries along the west side of the road. The Skeena Concrete Products Ltd plant is on the west side at the top of the bench.

Figure 28. *Asphalt plant on along Highway 16 east of Thornhill. Sand and gravel are quarried from Ice Age deposits, sorted, and combined with liquid asphalt at the plant.*

Asphalt is similar to concrete in that it is largely made up of local gravel and sand. It differs by using a different "glue". Rather than using cement, it liquid asphalt, a tar-like substance that belongs to the hydrocarbon family that includes petroleum, natural gas, and gasoline. The liquid asphalt is brought to Terrace by rail car from a petroleum refinery in Lloydminster, Alberta. This plant processes heavy oil extracted from the Earth below Alberta.

GO TAKE A LOOK: ASPHALT PLANT, HIGHWAY 16, EAST OF THORNHILL

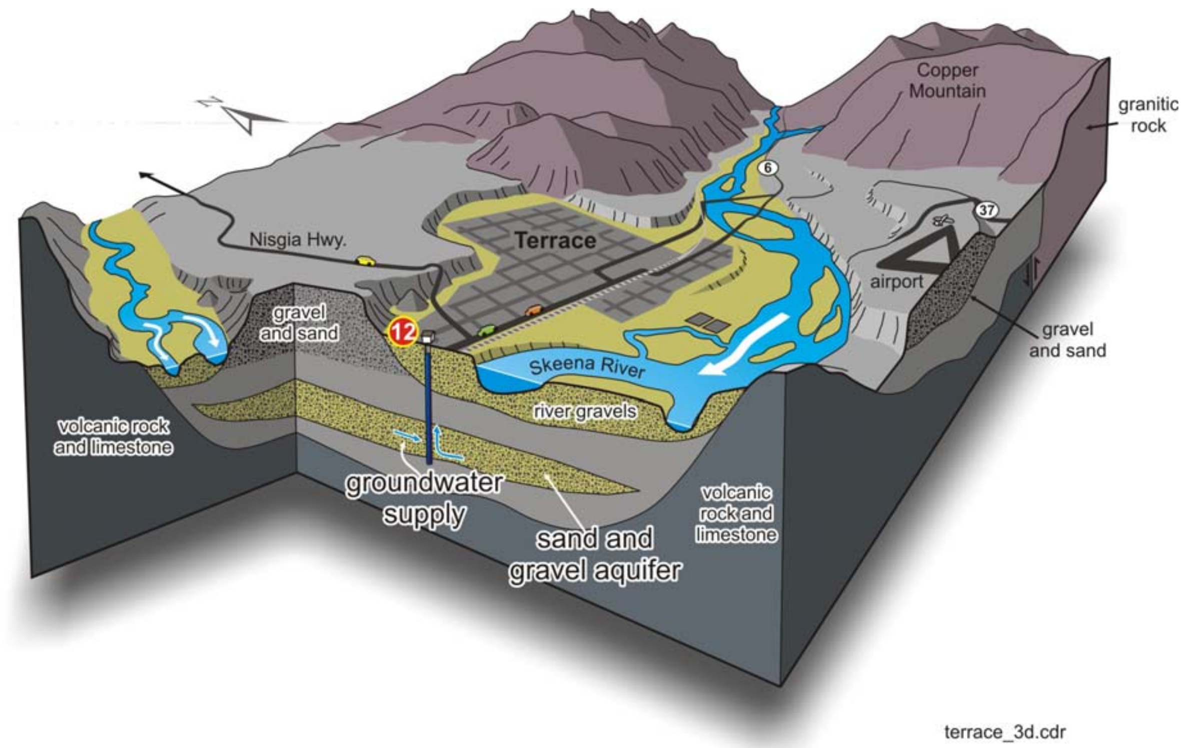
Drive east on Highway 16 from Terrace through Thornhill to the Terrace Paving access road on the south side. Call ahead if you would like to arrange a tour.

(SITE 11) WHERE DOES OUR WATER COME FROM? THE RIVER? THE MOUNTAINS? TRY UNDER YOUR FEET!

Water supply is a vital resource. The City of Terrace is supplied with water from a well within the town limits. The well is drilled into a deep sand and gravel deposit below Terrace that contains abundant groundwater.

***Figure 29**. (left) City of Terrace wellhouse on Frank Street. Photo by Bob Turner.*

***Figure 30.** (below) A schematic cut-away view of the underground below Terrace. Sand and gravel bodies act as aquifers that contain the vital water supplies for Terrace.*



Terrace's sand and gravel aquifer is about 15 metres thick and lies 40 metres below the surface. The spaces between the sand and gravel grains are full of very clean water. The sand and gravel provides natural filtration as the groundwater moves slowly through the aquifer. Separating this underground water supply from all the human activity in Terrace is a thick layer 20-30 metres thick of silt and clay. Water does not readily flow through these fine materials and this layer acts as a barrier against contaminants that might trickle downwards from the streets of Terrace. However, because the City is built on top of its water supply, it is possible that some spill someday could infiltrate down to the aquifer and contaminate it. Once contaminated, it would likely take many years to decades to "flush out" the aquifer. Therefore, it is very important that industry, businesses, and homeowners use "best practices" to protect this water supply.

Water use in Terrace averages 10,000 to 11,000 cubic metres per day, or 10 to 11 million litres per day. Water use doubles in the summer to over 20,000 cubic metres per day. To meet this demand, the City of Terrace uses additional water drawn from a reservoir on Deep Creek north of town. The source of water in Deep Creek is snowmelt and rainfall within the Deep Creek Watershed on the north side of Terrace Mountain.

(SITE 12) WHERE DOES OUR WASTEWATER GO? AFTER TREATMENT, INTO THE SKEENA RIVER

So, where does our sewage go when we drain the sink or flush the toilet? The answer for most parts of the town is the City of Terrace wastewater treatment plant on Graham Avenue near the Skeena River on the southwest side of town. The facility treats the waste water and discharges it into the Skeena River. The treated wastewater meets all requirements set by BC Environment.

Wastewater treatment combines three major steps. **Step 1:** Solids, rags, sticks, plastics and other large objects greater than 25 mm are removed from the sewer flow using a screen. This debris is bagged and sent to the landfill. **Step 2**: After screening, the remaining sewer flow enters and flows through two aerated lagoons (see picture below) where bacteria breakdown of organic matter in the sewage. Air bubbled from a pipe system on the floor of the lagoon, and surface water sprays ensure the bacteria have sufficient oxygen to thrive. The wastewater circulates for about 3 weeks through two lagoons before it is ready for release into the river. **Step 3** Once treated, the sewer flow is discharged into the Skeena River through an outfall pipe.

Figure 31. *A secondary treatment lagoon at the Graham Avenue wastewater treatment plant, City of Terrace. Small fountains within the lagoon mix and circulate oxygen into the wastewater. This oxygen is essential to bacteria that feed on and digest the organic matter, converting it to non-harmful products. Abundant green algae and plants on the surface reflect the nutrient-rich nature of the wastewater.*

GO TAKE A LOOK

The City of Terrace wastewater treatment plant is at the west end of Graham Avenue southwest of town. Tours of the plant are available if arranged in advance through the City of Terrace.

(SITE 13) WHERE DOES OUR GARBAGE GO? TO A LANDFILL NEAR TOWN.

How well do we manage our solid waste? How effectively do we reuse materials? Or recycle what we do not reuse? Dealing with garbage is a major task for local governments. Most garbage from the Terrace area goes to the municipal landfill about 4 km north of town on the Kalum Lake Road/Nisga'a Highway. There is also a landfill in Thornhill on Old Lakelse Lake Drive. Both landfills bury garbage within old sand and gravel quarries. A new landfill is currently under consideration by the Regional District of Kitimat-Stikine. The Terrace Bottle Depot on Kofoed Drive manages the recovery of beverage containers, residual paints, solvents, and other flammables. It also accepts corrugated cardboard, office paper, and plastic milk jugs.

Figure 32. *Garbage at Thornhill Landfill looking north toward Copper Mountain. The landfill is within an old sand and gravel quarry. Can you spot anything in this garbage pile that could have been recycled?*

GO TAKE A LOOK

The Thornhill Landfill is located on Old Lakelse Lake Road, half way up the Airport Bench. Batteries, appliances, and automobiles are separated from mixed garbage.

(Site 14) Natural gas. Gasoline. Diesel. Heating oil. Aviation and jet fuel. Propane. Where does it all come from?

Gasoline, other petroleum products, propane, and natural gas ducts are vital energy sources for transportation, industry, and homes. They reach Terrace in a variety of ways. Natural gas travels by pipeline from gas plants in northeastern BC. Gasoline, diesel fuels, heating oil, aviation and jet fuel are transported to Terrace by rail car and truck from refineries in Prince George and Edmonton. These are part of a broad range of products that along with asphalt and plastics are refined from oil and natural gas.

***Figure 33**. Natural gas pipeline in Thornhill.*

***Figure 29.** Rail terminal for petroleum products, Terrace. Gasoline and diesel brought in by rail car is stored and transferred to tanker trucks for distribution to gas stations.*

Oil and natural gas come from the Earth. Most natural gas used in British Columbia comes from deep reservoirs below northeastern BC. Oil and natural gas are referred to as "fossil fuels" because they are derived from ancient animals and plants that were buried on in sediment on ancient seafloors and later became trapped in rock reservoirs. Oil and gas are extracted from these reservoirs by drilling wells, often to depths of 1000 to 2000 metres below the surface. Natural gas occurs in tiny holes in the rock, millimetres to centimeters in size, that occur within sandstone or limestone layers. Oil, which may occur with natural gas, largely comes from reservoirs that lie under various parts of Alberta, or as is increasingly the case, from the giant deposits of tar sands in northeastern Alberta.

Go take a look

The Petrocan rail terminal is on the north side of Highway 16 in eastern Terrace.

What about climate change?

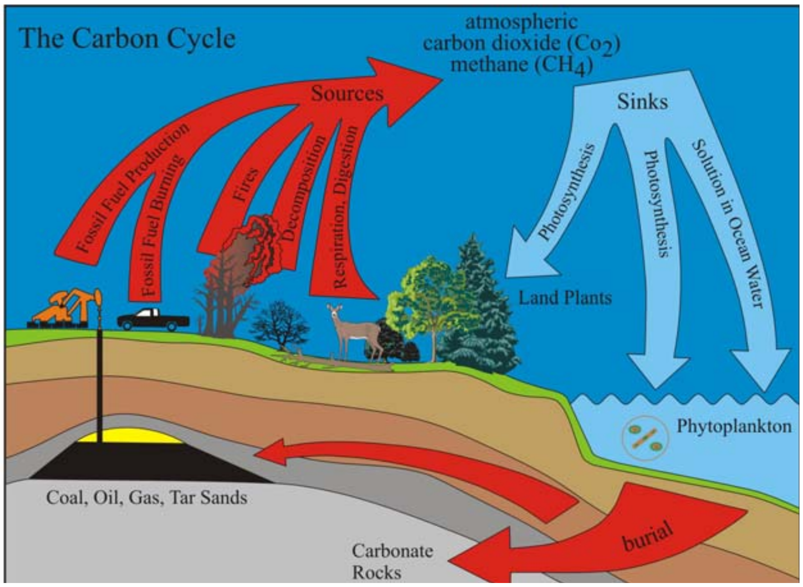


Figure 30. *The carbon cycle. Fossil fuel production and burning is rapidly adding carbon that was long ago stored in the Earth. This is upsetting the natural balance developed by nature.*

In spite of the tremendous benefits and convenience of fossil fuels, a consensus has developed in the scientific community that the greenhouse gases produced from use of oil and natural gas are dramatically changing the composition of our atmosphere, and producing very worrying global climate change.

Northern BC has warmed significantly in the last 100 years, and direct evidence of this is seen in the widespread and rapid retreat of glaciers in the Coast Mountains around Terrace.

GET INFORMED

What are the likely impacts of climate change to British Columbia and the rest of Canada? Visit the Government of Canada websites **www.adaptation.nrcan.gc.ca** and **www.climatechange.gc.ca** that describe the science behind climate change, and likely impacts.

WANT TO KNOW MORE?

WRITTEN FOR A PUBLIC AUDIENCE

Geology of the Northwest Mainland. The geology and paleontology of the Skeena, Nass and Kitimat drainages of British Columbia. Published by Kitimat Centennial Museum Association in 1985 and written by Allen Gottesfeld. An excellent reference on geology, fossils, mines, and geological history of northwestern BC.

Northern British Columbia Geological Landscapes Highway Map
Published by Geological Survey of Canada, Popular Geoscience 94E (British Columbia Geological Survey, Geofile 2007-1) in 2007. A geological map of northern BC with explanations and illustrations of geological features along major roads.

GeoTour guide for Hazeltons, British Columbia. Published by Geological Survey of Canada, as Open File 5560, and British Columbia Geological Survey, as Geofile 2010-1. A popular guide to sites of geological interest, earth and water resources, and other features in the Hazeltons area.

GeoTour guide for Prince George, British Columbia. Published by Geological Survey of Canada, as Open File 5559, and British Columbia Geological Survey, as Geofile 2010-2. A popular guide to sites of geological interest, earth and water resources, and other features in the Prince George area.

WRITTEN FOR A TECHNICAL AUDIENCE

Quaternary geology and geomorphology, Smithers-Terrace-Prince Rupert area, British Columbia. Geological Survey of Canada Memoir 413, 71 pages.

Geology of Terrace map area, Geological Survey of Canada, Memoir 329, 117 pages. 1964.

WHO PUT THIS GUIDE TOGETHER?

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