The Power of Water: Using a Thermal Bathing Resort to Maximize the Potential of Geothermal Power Production

by

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ABSTRACT

In 2011, Calgary, Alberta based Borealis Geopower bought the geothermal rights to the Canoe Reach arm of Kinbasket Lake, near Valemount, British Columbia. New to Canada, a pilot project of a 2 megawatt geothermal power facility will begin within the next five years. The project is a positive addition to the area, as it is a non-polluting energy source with an effluent of clean hot water. This thesis proposes a maximization of this energy source by combining the power facility with an education center and bathing facility. Included in this bathing experience are ancillary cabins and paths to promote the users' interaction and enjoyment of the project and landscape. Finally, this thesis develops a material strategy, choreographing the visitors' experience of the geothermal resource within the site's mountainous topography.

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CHAPTER 1: INTRODUCTION

AN INTEGRATED APPROACH

Geothermal springs have been used by humanity for bathing for thousands of years. Throughout the ages, hot springs have provided healing, relaxation, comfort, and community. The development of the electric generator created a new use for geothermal springs, as its heat could also be used to produce electrical energy. The principle benefits of geothermal power include: its reliability, low operating cost, renewability and benign effect on the environment. By combining the two activities of bathing and power generation in an integrated facility, this project will allow the visitor to discover the many benefits of geothermal water. Power production will be displayed to the public, creating a connection between people and industry, and raising awareness of the potentials of green energy generation. Furthermore, this green energy awareness will be accompanied by a bathing resort focussed on relaxation and comfort in a beautiful natural setting.

BATHING

The benefits of geothermal water have long been appreciated, as is evident by the bathing traditions of Ancient Rome and Japan. In each of these bathing traditions, hot water creates community, a connection with the natural world, and positive health benefits.

Why is bathing a pleasurable experience? In her book Thermal Delight in Architecture, Lisa Heschong describes temperature as a unique sensory experience.[1] One architectural method used to connect humanity to thermal delight is the hearth. However, fireplaces are falling out of favour, having been replaced by central heating systems in a labyrinth of ducts within our walls. Heschong makes the argument that because of such new systems, people are losing their ability to understand their role in “relationship to the larger environment.”[2] Bathing however, puts the person in a place where she can’t help but notice her thermal environment. This quality, argues Hershong, elevates bathing to the realm of the sacred. Indeed, the heat of the bath and the steam of the sauna were

1. Lisa Herschong, *Thermal Delight in Architecture* (Cambridge: MIT Press, 1979), 1.
2. Ibid., 39.

thought of as rather mysterious phenomena for our ancestors, they sought to use steam and vapour to explain how the world worked, and they created, a cosmology composed of spirits and gods. Fire and steam were valued because they were elemental. They offered an experience of the purity associated with the spiritual realm, and thus provided a link between the physical world of human beings and the principles of the universe.[3] In his book *Undesigning Bath,* Leonard Koren supports Heschong's argument. He says, the gods of nature speak to us through our senses, "in bathing environments that offer intense, intimate contact with... sounds, touch, smells and emotional resonances... nature communicates eloquently."[4] By making the source of our thermal comfort obvious and evocative, our connection to the natural world is heightened both physically and spiritually. According to Gaston Bachelard in his *Water and Dreams: An Essay on the Imagination of Matter*, "only water can sleep and all the while keep its beauty, only water can die, be still, and yet keep its reflections. In reflecting the face of a dreamer who is true to the Great Memory, to the Universal Shadow, water gives beauty to all shadows, it gives new life to all memories."[5] By immersing ones self in hot water and seeing ones face reflected in its beauty, he becomes aware of the timeless depths of the elements and thus more aware of the natural world.

Because of this connection between bathing and the natural world, Leonard Koren believes that bathing environments should be completely natural. He claims that most architecturally designed baths are "gross and clumsy", missing the subtle and elusive issues of nature which are at "the core of superior baths".[6] I agree with Koren, in many cases, un-designed baths allow a better connection to the natural environment. However this is not always the case, as is evident in the Therme Vals in Switzerland by Peter Zumthor, Augen Gneiss stone is used as cladding for the entire building, inside and out. Zumthor describes the bath as a "grass covered stone object set deep into the mountain and dovetailed into its flank."[7] The use of the stone and the half submerged nature of the building cause the bather to feel deep in the mountain and emerged in the elements. Here

3. Ibid., 55.

4. Leonard Koren, *Undesigning the Bath* (Berkley: Stone Bridge Press, 1996), 34.

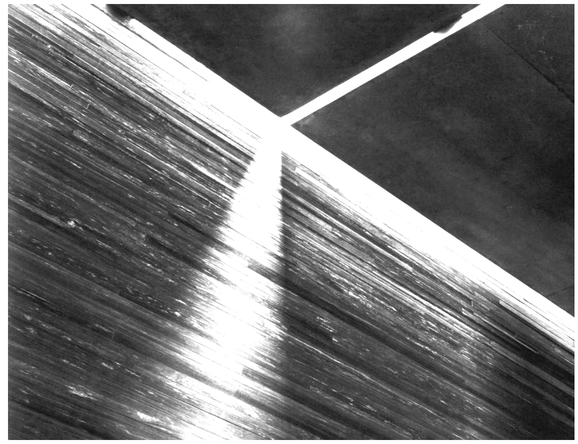
5. Gaston Bachelard, *Water and Dreams: An Essay on the Imagination of Matter* (Dallas: The Pegasus Foundation, 1994), 66.

6. Koren, *Undesigning the Bath,* 62.

7. Peter Zumthor, *Peter Zumthor Therme Vals* (Zurich: Verlag Scheideggar and Spiess, 2007), 31.

they are connected directly by the source of thermal comfort to the natural world in a highly designed environment.

Raw Augen Gneiss.
From Truffer AG Mining Company, Augen gneiss intrusive into Birch Creek schist. Circle district, Yukon region, Alaska.



The Augen Gneiss quarried and finished, applied as envelope for the Therme Vals.
From Zumthor, *Peter Zumthor Therme Vals.*

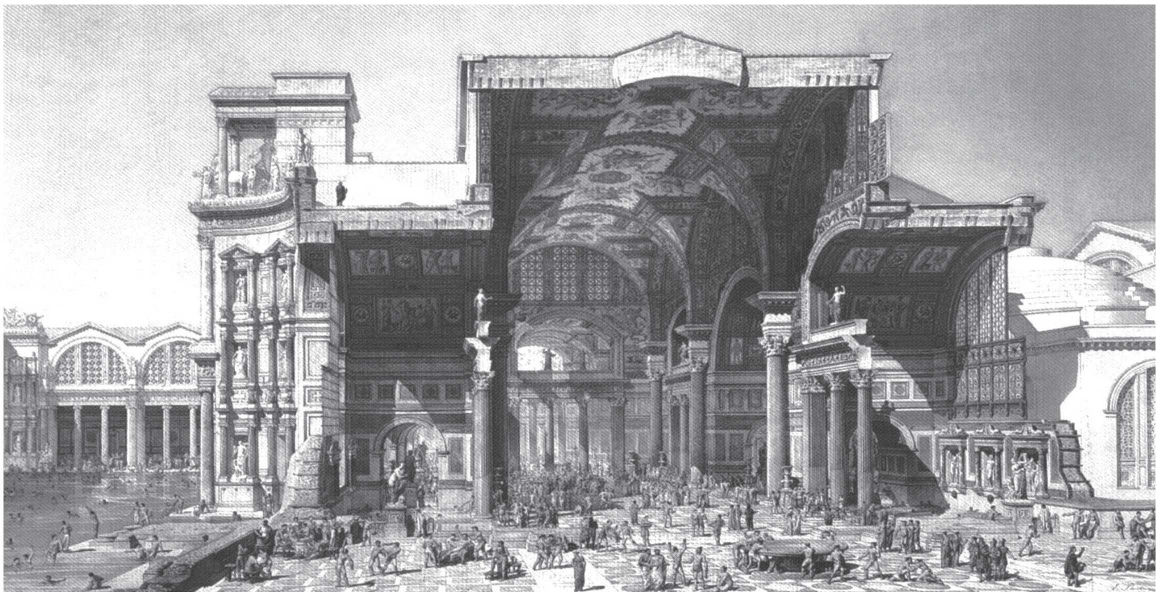
Roman Baths

Thermal Baths not only connect us to the natural world, but also to each other. Koren observes that "traversing thermal extremes with others has a positive social bonding effect."[8] A solid example of the bonding effect of bathing is discussed by Fikret Yegul, in his book *Baths and Bathing in Classical Antiquity*. He provides an extensive overview of Roman bathing traditions, beginning with the origins of the Roman bathing custom in the Greek bath's. Interestingly, early Greek baths adapted their design to the natural forms of caves and rock, "these baths may have owed their inspiration to ancient establishments built over grottoes and springs believed to have been sacred to certain chthonic powers and nymphs."[9] Likewise, the Roman baths have their roots tied to a connection or worship of the natural world. As the Roman society developed, the bath became intertwined with social norms and customs. Thus, the Roman baths were organized around the creation and preservation of community. Yegul depicts the baths as a socially satisfying experience. The cozy warmth of the baths and their classless world of nudity encouraged friendships and intimacy. He then outlines the structure of the Roman bathing establishment, giving examples of the separation of the sexes within the bathhouses. It seems ordinarily, men

8. Koren, *Undesigning the Bath*, 28.

9. Fikret Yegul, *Baths and Bathing in Classical Antiquity* (Cambridge: MIT Press, 1992), 25.

and women bathed separately. However, this was not always the case, as some emperors throughout the ages of Roman rule tolerated mixed bathing. Whether it was a completely inclusive environment or an environment which separated the sexes, the Roman baths were places of conversation and community, aligning society in a common ritual.



The Thermae of Diocletian, Rome. Restored perspective of the figidarium and natatio (Paulin) From Yegul, *Baths and Bathing in Classical Antiquity*.

Japanese Baths

As discussed by Lee Butler in his article "Washing off the Dust: Baths and Bathing in Late Medieval Japan", the Japanese bath, like the Roman bath, developed from a spiritual connection with the natural world. Initially the natural hot spring was "a location to meditate and even to attain enlightenment."[10] Like the Romans, these rough natural springs evolved into an elevated part of daily life and culture.[11] Late medieval bathing had a social or cultural attitude, seeing bathing as an activity to be done with others, whether friends or peers, family or neighbours.[12] This attitude toward bathing has continued into modern day Japan. Contemporary Japanese bathing tradition is discussed at length by

10. Lee Butler, "Washing off the Dust: Baths and Bathing in Late Medieval Japan," *Monumenta Nipponica* 60, no. 1 (Spring, 2005): 1-41.

11. Ibid., 8.

12. Ibid., 16.

A woman's bath in Edo Japan. The illustration demonstrates the social aspect of bathing and the development of "skinship" between friends and family. A practice that carries on in Japan today.
From Clark, *Japan, A View from the Bath*.

Scott Clark in his book, *Japan a View from the Bath*. Clark takes an anthropological approach to the study of Japanese bathing culture. He notes that a spiritual connection with the elemental nature of water pervades Japanese bathing attitudes today. The Japanese bath "relaxes and invigorates not only the Japanese body but also the *kokro*: the heart or spirit. Through a combination of social, religious, and cultural factors, a bath promotes the physical health of Japanese people as well as their psychological well-being."[13] Moreover, the development of personal familial relationships and deep friendship is furthered because of the bath. "The Japanese talk today of 'skinship' a word made from combining the word skin and friendship, the friendship is associated with skin to skin contact. Being together in the bath and touching the skin provides intimate contact between parent and child."[14] Moving out of the private bath, Clark describes the bathhouse as a community centre where "people knew each other; community information was exchanged... [the people] bathed together, visiting, and usually sharing a drink before departing home."[15] He discusses the development of Japanese resort bathing, dividing them into three separate categories: entertainment resorts, tourist resorts and therapeutic resorts. Clark describes a commonality of the "symbolic relaxation of boundaries [which] allows strangers to interact more freely than in most situations" and he demonstrates how "people stripped of every conceivable stamp of class distinction in the form of clothes... find it hard to retain superiority or inferiority complexes. In the bath... human pretensions evaporate... into the

13. Scott Clark, *Japan, A View from the Bath* (Honolulu: University of Hawaii, 1994), 5.
14. Ibid., 73.
15. Ibid., 76-77.

wreaths of steam."[16]

Geothermal water also is used in Japanese medicine. The most popular "cultivation of life text" in the Edo period, the *Yōjōkun*, discusses how to bathe, and the effectiveness of hot baths for conditions such as diarrhoea, food damage and stomach ache.[17]One example of a therapeutic resort in Japan is the ancient Arima Hot Springs. These springs have three separate sources, each with a specific mineral content that is believed to alleviate chronic illness. The first bath "kinsen" is high in ferruginous sodium chloride and is believed to be antiseptic. It is reportedly beneficial for inflammatory rheumatism, external wounds, chronic adnexitis and infertility. The second bath "ginsen" is high in carbon dioxide and helps with arterial damage, blood pressure and to recover an appetite. The third bath is a radioactive spring, and surprisingly is believed to improve the bathers' natural healing power. It is used to treat degenerative joint disease, chronic gout, menopausal discomfort and bronchial asthma.[18] [19]

Health Benefits

The ancient Japanese belief in the healing powers of the minerals found in geothermal water has also been proven scientifically by many International studies. These measurable health benefits are discussed by J. Chersitch, D. Freedman and T. Lotti, in the article "Balneology Today". The article notes the benefit of application of mineral waters on the skin as it describes "two joint studies ... [which] demonstrated the value of using mineral water to combat free radical damage,"[20] and the curative nature of mineral water in the treatment of "chronic skin diseases, such as psoriasis, atopic dermatitis and seborrheic dermatitis"..[21] Another positive correlation with health and bathing is given by Patricia Book in her article "Native Healing in Alaska". The article describes the Inuit traditions of sweat bathing, describing a "relief from rheumatism, colds and sinus infection... dry skin

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16. Ibid., 114.
17. Keiko Daidoji, "Water Cures in Japan: The Case of a Health Manual in the Early Nineteenth Century," *Asian Medicine - Tradition and Modernity* 5, no. 1 (2009): 89.
18. Arima Hot Springs Tourism Association, "On Benefits of Arima Hot Springs."
19. It should be noted that in the last thirty years Arima Hot Springs has expanded considerably and has become basically a suburb of the large city of Kobe.
20. I. Chersitich, D. Freedman and T. Lotti, "Balneology Today," *Journal of the European Academy of Dermatology and Venereology* 14, no. 5 (2000): 347.
21. Ibid., 347.

and insect bites, [the] reduction of psychological stress, and [an] enhancement of general well-being" after sweat bathing.[22]

Bathing connects people to the naturally occurring element of geothermal water, creating a positive interaction in which they directly benefit in terms of community and health. The process of geothermal power generation utilizes this same heated water in a nonpolluting process, additional benefits of heat and electricity. By combining the two processes, this thesis proposes a place where people can immerse themselves in a natural element, directly enjoying a benign result of our control of the environment, while learning about an alternative to a historically destructive human relationship with nature.

ENERGY

Throughout history, the human relationship with nature has been tied to the consumption of the natural world to produce energy: from coal, oil, and natural gas. As discussed by Earl Cook in his article "The Flow of Energy in an Industrial Society", the discovery of fossil-fuel energy caused an explosion of energy consumption, from 24000 kilocalories of energy a day during our agrarian past, to 230,000 kilocalories per day, and every year the world energy demand increases. The need for energy is self propelling, because the more power an industrial society consumes, the more it wants. "The more power we use, the more we shape our cities and mold our economic and social institutions to be dependent on the application of power and the consumption of energy."[23] Our appetite for power is getting stronger by the year, and will not slow down. Acknowledging the disastrous results of global warming, the polluting nature of oil extraction and distribution and the fighting over contested oil rich lands, it is clear that our petroleum based economy must be significantly altered.

> The interior portions of the globe are very hot, the temperature rising, as my observations show, with the approach to the centre at the rate of approximately 1 degree C for every hundred feet of depth. The difficulties of sinking shafts and placing boilers at depths of say, twelve thousand feet, corresponding to an increase in temperature of about 120 degrees C., are not insuperable, and we could certainly avail ourselves in this way of the internal heat of the globe... In fact, it would not be necessary to go to any depth at all in order to derive energy from the stored terrestrial heat. The superficial layers of the earth

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22. Patricia A. Book and Mim Dixon, "Native Healing in Alaska," *The Western Journal of Medicine* 139, no. 6 (Dec. 1983): 925.

23. Earl Cook, "The Flow of Energy in an Industrial Society," *Scientific American* 225, no. 3 (Sept., 1971): 141.

> ... are at a temperature sufficiently high to evaporate some extremely volatile substances, which we might use in our boilers instead of water.[24]

Written in 1900, nearly 200 years after Thomas Newcomen's development of the coal powered steam engine, this quote by Nikola Tesla's is one of his many attempts to find alternatives to fossil-fuel consumption, Tesla believed that "burning coal, however efficiently [was] a phase in the evolution toward something much more perfect."[25] He looked to geothermal water and realized that it could allow for more than a hot bath. Interestingly the first utilization of geothermal water was in Italy, when Prince Piero Ginori started the first steps toward a geothermal power plant, and by 1913 a 250 KW power station was put into service. This technology advanced quickly and by in 1942, 130 MW of geothermal power was feeding the electrified Italian railway system.[26]

The Geothermal Power Generation Process

Geothermal power technology can be divided into three separate categories: dry-steam plants, flash steam plants and binary plants. Dry-steam plants use steam in the ground over 148°C . This steam is either used directly, or flashed and purged to eliminate carbon dioxide, nitric oxide and sulphur, which are usually associated with the process. The clean steam is then used to turn turbines, which drive generators. Pollution resulting from the flash process is about 2% of that generated by traditional fossil fuel power plants. The flash steam plant very similar to the dry steam plant except the resource begins as highly pressurized water. The release of the pressure causes the water to change into steam which turns turbines. This steam is then circulated back to the reservoir and the cycle is repeated. The flash steam plant must also use a purging process to rid it of corrosive chemicals. The binary plant is the most appropriate technology for this thesis because it affects the natural environment the least, avoiding the purging process. Lower-temperature hot-water resources are passed through heat exchangers which produce a flow of secondary fluid (isobutane or isopentane, or ammonia and water) with a lower boiling point. This secondary fluid vaporizes and turns the turbines which in turn generate electricity, the fluid is then recycled back to the heat exchangers in a closed loop system.

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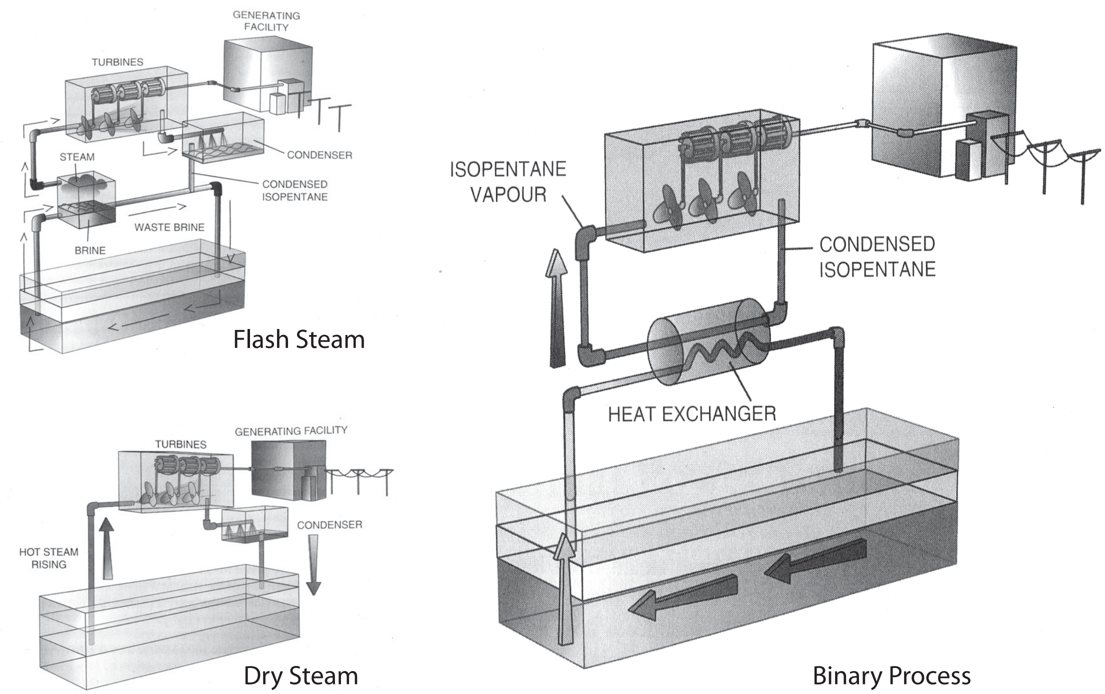
24. Nikola Tesla, *The Tesla Papers* (Kempton: Adventures Unlimited Press, 2001), 51.

25. Ibid.

26. Christopher H. Armstead, *Geothermal Energy,* 2nd Edition (London: E. & F.N. Spon Ltd., 1983), 5-6.



From Gevorkian, *Alternative Energy Systems in Building Design*.

On completion of the process, the geothermal fluid is condensed and returned to the reservoir, never actually entering the turbine, so the corrosive chemicals do not have to be purged into the environment.[27]

In recent years, an improvement to the traditional Binary system has been gaining notoriety in the geothermal field, this process is known as the Kalina Cycle. In a typical Binary power plant, a pure working fluid, water or low molecular weight organic compound, is heated in a boiler and converted into high-pressure, high temperature vapor which is then expanded through a turbine to generate electricity in a closed loop system. The Kalina Cycle utilizes an ammonia-water mixture as a working fluid to improve system efficiency and provide more flexibility in various operating conditions. The Kalina Cycle can improve power plant efficiency by 10% to 50% over traditional Binary Cycle plants, depending on the application. As plant operating temperatures are lowered, the relative gain of the Kalina Cycle increases in comparison with the traditional Binary System. Furthermore, the Kalina Power Facility has a very modest set of controls because the difference in ammo-

27. Peter Gevorkian, *Alternative Energy Systems in Building Design* (New York: McGraw-Hill Inc., 2010), 335-336.

nia concentration in various parts of the plant is not a result of overriding process control. "Rather, the concentrations at various points are a result of the pressure and temperature of the working fluid stream. At every point, the constituents of the working fluid seek their own balance". [28] Furthermore, the efficiency of the cycle allows for a much smaller power plant footprint, this is because the working fluid uses a secondary heat exchange process in the evaporator and condensers; therefore eliminating the need for a cooling tower. Due to the extreme efficiency of the Kalina Cycle and it's small footprint it becomes the obvious choice for the site.

The above geothermal energy processes produce very little emissions, and the waste stream of hot water has potential to be extremely useful. Consequently, geothermal energy production aligns itself with the field of ecology. A principle argument of environmental ecology states that "industrial systems [should use] waste streams from one process as useful inputs to the next, thus minimizing pollution."[29] Following this argument I believe that the bi-product of Geothermal Power should not be pumped back into the ground after power generation. Rather, it should be pumped through houses for heat and sprayed into green houses to provide moist hot air for growing. This water should also be used for industrial processes such as drying and curing, and it should be bathed in: providing healing and rejuvenating water for the enjoyment of the individual.

Husavik Power Facility, Iceland

One great example of Geothermal Power being maximized ecologically is the Husavik Geothermal Power Facility in Iceland. Husavik is the largest town in Northeast Iceland with a population of around 2,500 inhabitants. It is powered by the Hveravellir Energy Centre facility, which is located 20 km away from the city. The 120°C water is first used for electricity production. The process of binary heat exchange causes the hot water to lose heat and the temperature of the water drops to 80°C. The water then enters a storage tank from which it flows first through the Power Plant to provide warmth for the facility itself, before entering the distribution network of Husavik. In the town the 80°C water is used for various purposes, namely for district heating and fish drying. The unused 80°C water is

28. Henry Mlcak, Hreinn Hjartarson and Bill Lewis, "Notes form the North: a Report on the Debut of the 2 MW Kalina Cycle Geothermal Power Plant in Husavik Iceland," *GRC Husavik Paper* (Feb. 2004): 3.

29. Sim Van der Ryn and Stuart Cowan, *Ecological Design* (Washington, DC: Island Press, 1996), 19.

also mixed with the 4°C water, cooled and then used in a bathing lagoon and fish farm.

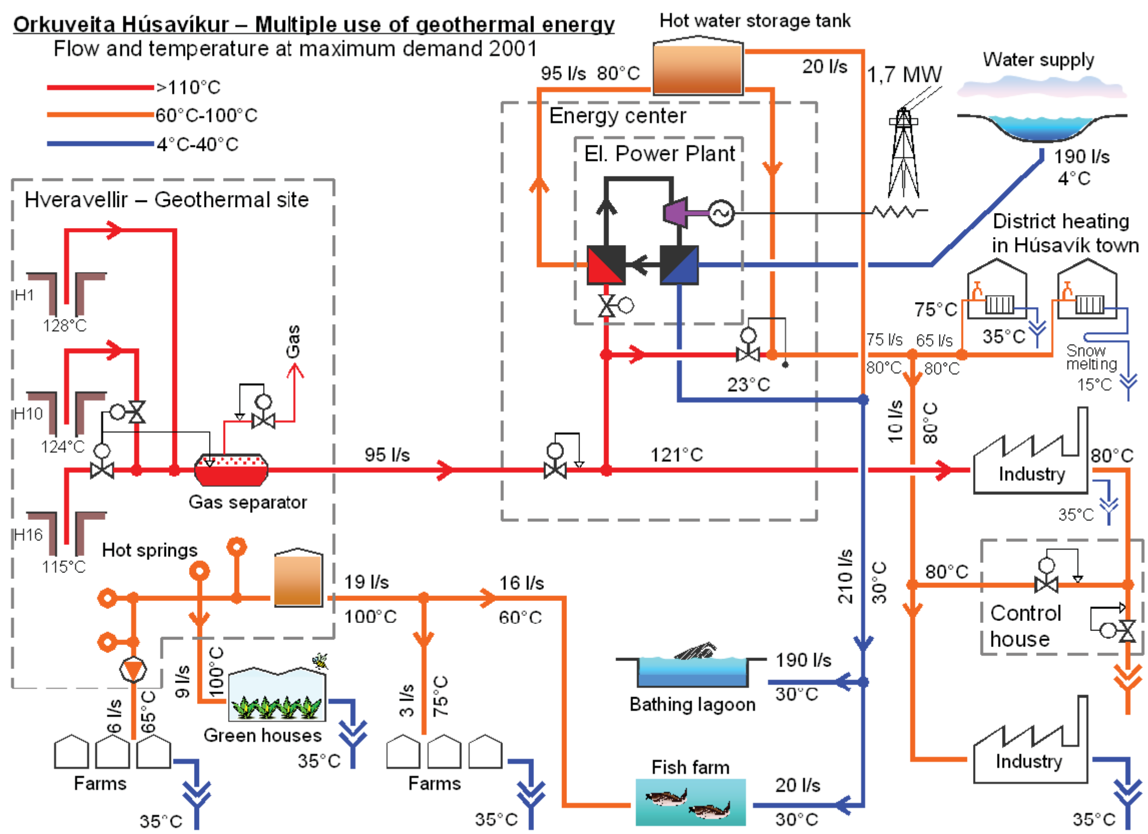
An additional argument of environmental ecology is the need to re-define the way we handle our industrial processes, no longer can we ignore how technology supports us; leaving industrial processes hidden behind fences and bars.[30] As argued by Syn Van der Ryn in his book Ecological Design:

> We want clean energy, but perhaps not in our backyards... this creates a strange schizophrenia in which our ideal is to consume sanitized versions of both nature and technology. Making nature visible is a way of reacquainting us with wider communities of life, inform[ng] us about the ecological consequences of our activities... a new kind of aesthetic for the built environment, one that explicitly teaches people about the potentially symbiotic relationship between culture, nature and design.[31].

This is where the Husavik Geothermal Power Facility loses its strength. While the pant itself has an interesting architectural envelope, the power plant is located far from the city centre, leaving it isolated. People cannot see the technology that is producing their energy, they simply enjoy the benefits. Interestingly, another power facility exists in Iceland which indirectly practices the ecological idea of making technology visible, the Svartsengi Power Plant.

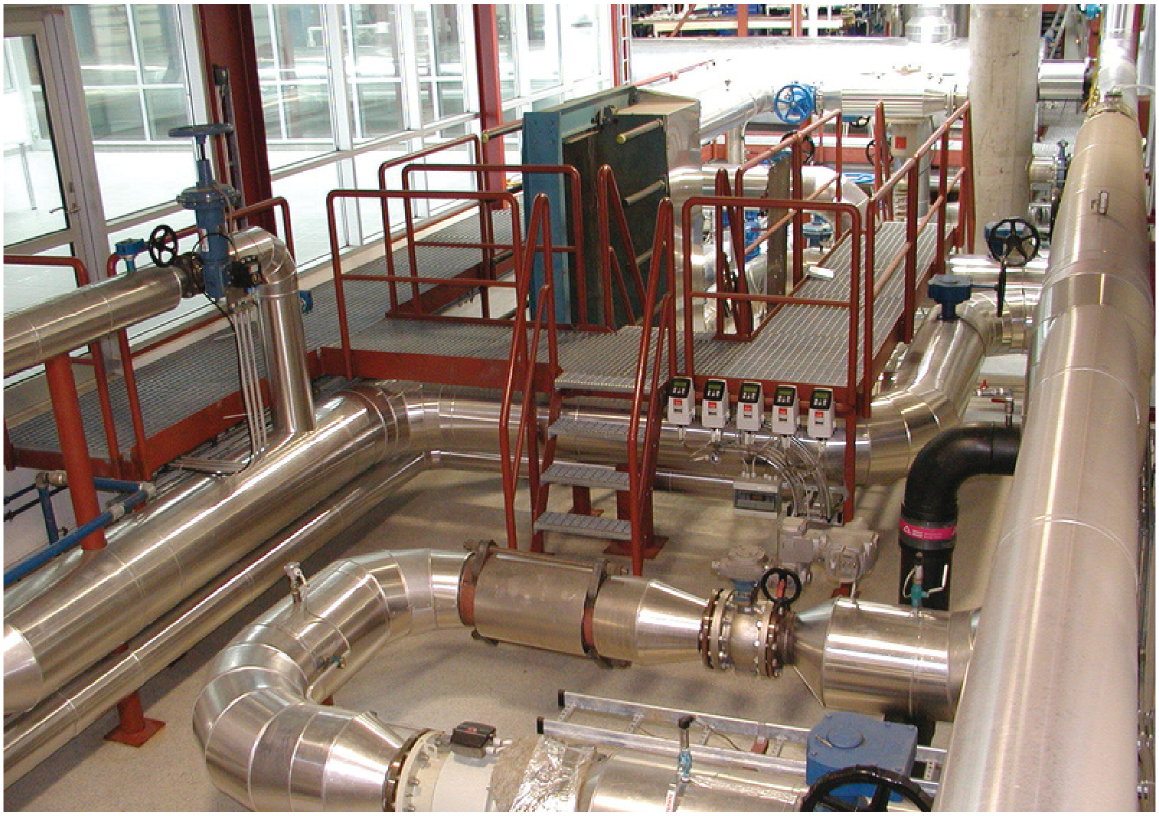
30. Ibid., 161.
31. Ibid., 164-165.

Husavik Power Plant at night. From Hjartarson, Maack and Johannesson, “Hœsav’k Energy Multiple use of Geothermal Energy.”



From Hjartarson, Maack and Johannesson, “Hœsav’k Energy Multiple Use of Geothermal Energy.”

Husavik bathing lagoon. From Gutralman, “Iceland Travel Information.”



Husavik Power Plant internal workings. Note the compact nature of the systems. The small size and extreme efficiency of the Kalina process create a unique opportunity for energy production. From Hjartarson, Maack and Johannesson, "Hœsav'k Energy Multiple Use of Geothermal Energy."

Svartsengi Power Plant, Iceland

The first electrical power plant in Svartsengi was built in 1976-1978. Svartsengi has evolved over time and now has a current capacity of 150 MW for district heating and an electrical power capacity of 74.4 MW. The Svartsengi geothermal area is close to the town of Grindavik on the Rekjanes peninsula and is part of an active fissure swarm, lined with crater-rows and open fissures and faults. The reservoir contains an abundance of energy and 12 wells supply the Svartsengi Power Plant with steam. The steam is not useable for domestic heating purposes; so heat exchangers are used to heat cold ground-water which is then pumped to the surrounding towns for general heating requirements. The effluent brine from the Svartsengi Plant was initially disposed of into a large surface pond beside the plant. Over time, this hot water slowly became popular with the locals as a bathing attraction, however the sharp rocks and high temperatures of the water were not exactly a 'safe' bathing environment. The power company then was faced with a choice, to fence off the pond, or to encourage the bathing and make it safe for visitors to enjoy. The site quickly became a popular tourist destination, and every year more people come to the site for amusement. A further attraction was the reputed benefits for people suffering from psoriasis and other forms of eczema because of the reported therapeutic effects from the silica rich brine.[32] In the case of the Svartsengi Power Plant a combination of a technological process and a recreational activity resulted by accident. The power facility sits at the side of the Blue Lagoon like an avant garde sculpture, sending forth its plumes

32. Geir Thorolfsson, "Sudurnes Regional Heating Corporation Svartsengi, Iceland," *Sudurnes Regional Heating Corporation* (June 2005), 1-5.

Svartsengi Power Plant and Blue Lagoon. From Terdiman, "Coder Corner."

Svartsengi Power Plant and Blue Lagoon. From Terdiman, “Coder Corner.”

of steam, while the bathers of the Blue Lagoon wade beneath it, submerged in its milky effluent.

Tennessee Valley Authority

Recreational enjoyment of the side effects of power production was much more carefully designed by the Tennessee Valley Authority in the 1930s and 40s. Here the TVA used the hydroelectric dam to transform the landscape and social opinions of the region. The redevelopment of the Tennessee Valley was an “experiment in implementing [a] new vision of the American landscape” one in which “human beings rightfully belonged.”[33] Unlike the Svartsgeni Power Facility, every aspect of the transformation of the Tennessee Valley was carefully designed with the human relationship in mind. Even the scar in rocky outcropping behind Norris Dam, the result of mining the aggregate used in the dam’s construction, was carefully sculpted into a boat landing to serve the flooded res-

33. Christine Macy and Sarah Bonnemaison, *Architecture and Nature: Creating the American Landscape* (London: Routledge, 2003), 143-144.

ervoir. Hills that were cut to make clearance for the dam were contoured and reforested, gently framing the giant project. Furthermore, the facility invited people inside to explore the functioning of the dam. People were encouraged to experience the force of the water contained by the dam and feel the vibrations of the generators pulsing through their bodies as they walked through the powerhouse.[34] Here a new idea became integrated into American society, one in which the wonder of the natural world became mingled with human control over nature. The sublime changed from an overwhelming sensation caused by the extremity of the natural environment, into an overwhelming sensation created by the human ability to dominate the environment with technology.[35] Moreover, a uniquely American design aesthetic was developed by the TVA, a design aesthetic that communicated the theme, "of nature tended and controlled so as to yield nourishment, power and enjoyment all together."[36] The TVA was practicing Van der Ryn's Ecological Design principles thirty years before these principles were outlined. The TVA was using architectural aesthetics to:

> -help [humanity] see and become more aware of the abstractions we super impose on the land.
>
> -make complex natural processes visible and understandable
>
> -unmask systems and processes that remain hidden from view
>
> -emphasize our unrecognized connections to nature.[37]

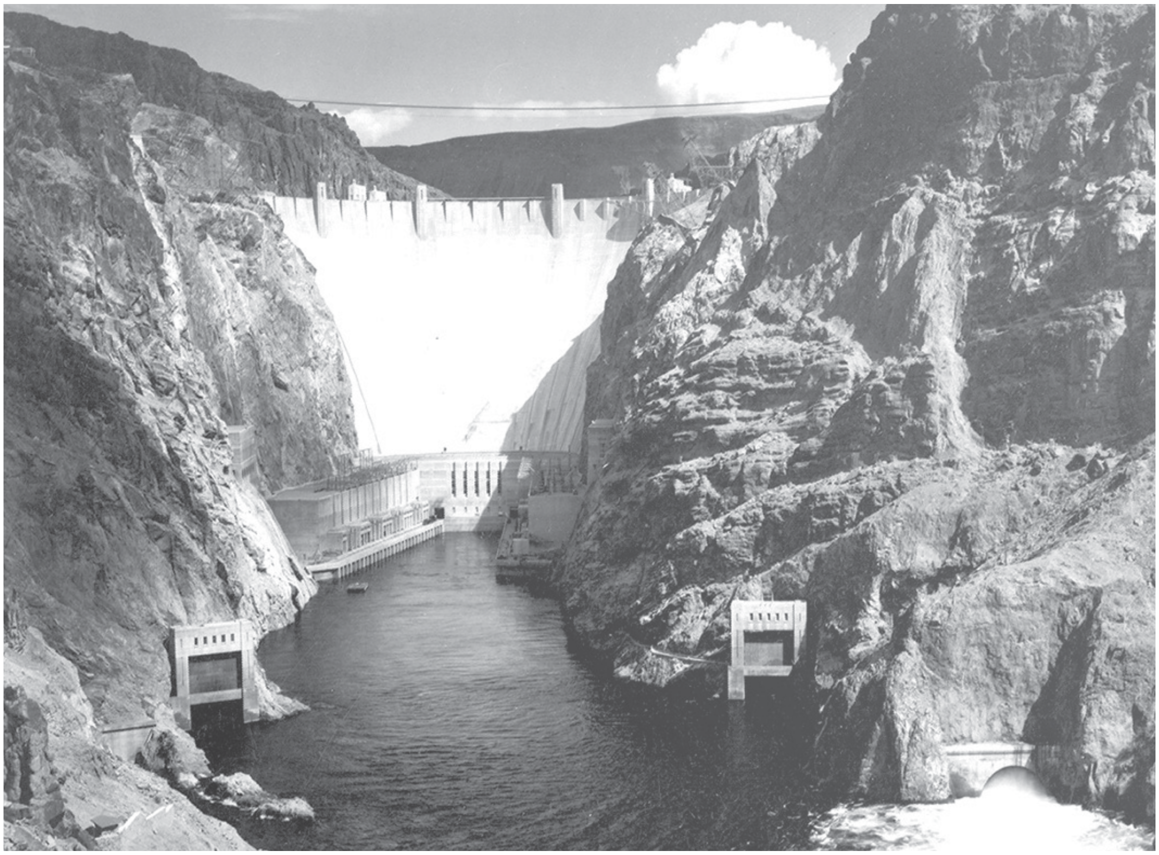
The TVA was a great success, yet designed integration of the human into power production was lost after WWII. Maximized production and functionalism became the only concern of power station designers and thoughtful human centred power facility design disappeared.

34. Ibid.

35. David Nye, *American Technological Sublime* (Cambridge: MIT Press, 1994), 56.

36. Macy and Bonnemaison, *Architecture and Nature*, 155.

37. Van der Ryn, *Ecological Design*, 165.



Hoover Dam designed by the TVA. Photograph by Ansel Adams. From Macy and Bonnemaison, *Architecture and Nature: Creating the American Landscape.*

COMBINING BATHING WITH BINARY POWER GENERATION

The Valemount Geothermal Resort will be placed 24 km from the town in a natural almost completely wild atmosphere. This site location will expose the visitor to the natural world, hereby reacquainting the visitor with wilderness and re-connecting him to the natural environment. As discussed previously, the thermal bathing portion of the program will also encourage this connection to nature. The visitor will immerse themselves in the forest as they progress through the site. However, it cannot be ignored that the resort will also interrupt the wild setting it is being placed into. The natural rhythms of the site will be altered by the intrusion of buildings, people and cars. Unlike the Yellowstone National Park described by Macy and Bonnemaison, as a “safe version of the American Wilderness” with a front and back stage where “tourists were given the illusion of the pristine “original” wilderness,”[38] the proposed project will expose the visitor to the ecological consequences of

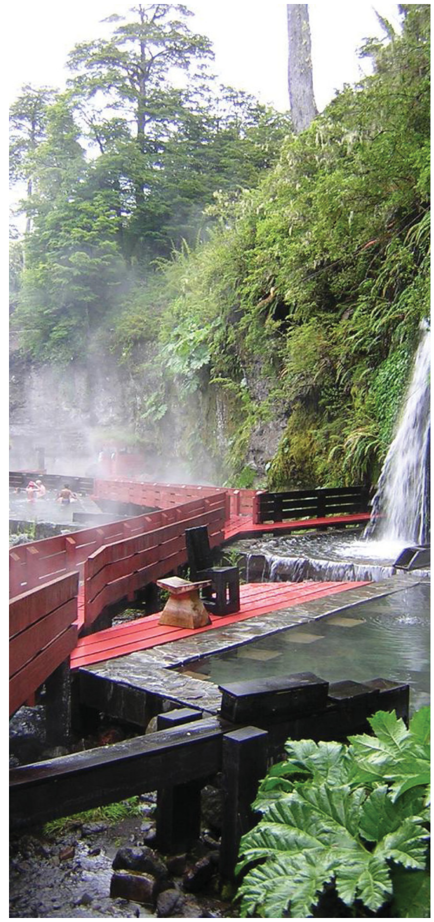
38. Macy and Bonnemaison, *Architecture and Nature*, 108.

our activities.[39] It will make its utilization of nature obvious, and avoid hiding behind an "original" wilderness aesthetic. Reminiscent of the TVA dam projects, the Valemount Geothermal Centre poses a unique opportunity to return to a design of a power facility with a human focus. One that takes advantage of the unique effluent of geothermal water to create enjoyment and nourishment of the human body. The facility can become an ecological example by using its waste streams to encourage industry, heat the town of Valemount and warm greenhouses. While the scale of the binary process of geothermal power will not allow for the same sublime awe of the Hydro-electric facilities of the TVA, a definite charm and admiration can be taken from its nonpolluting and efficient process, thus promoting the production of small scale local power generation. The technological process of binary generation will be treated much like the production of wine. The visitor will observe the technology and admire its process, and then enjoy its effluent. The Valemount Geothermal Centre will provide a new kind of aesthetic for the built environment, one that explicitly teaches people about the potentially symbiotic relationship between culture, nature and design. The centre will unmask the systems and processes of energy production that are usually hidden from view and combine these processes with the comforting and healthy practice of thermal bathing. The true challenge of the project then becomes how to architecturally combine the industry of power generation with the human-focussed activity of thermal bathing within the pristine wilderness environment of Valemount British Columbia?

Termas Geometricas, Villarica National Park, Chile

In a much smaller form than Yubatake, the Termas Geometricas designed by German del Sol, uses a flume to highlight the transportation of thermal water throughout the site. However, the more modern material of steel is used to transport the water. Visitors are made to follow the path of the water by an elevated walkway through the site, finding bathing opportunities in walled in pools along the walkway. The steel flume dumps the thermal water into these pools. While the pools are left in a basically natural state, the intrusion of the architect is made very obvious. The pathway is painted a bright red, and the flume is elevated above the ground in plain view of the visitor.

39. Ibid., 11.

The Termas Geometricas, note the local mining vernacular (left) and the steel flume (right foreground). From CVC Chile, "Filial Chile."

Yubatake (Hot Water Field), Kusatsu, Japan

The Yubatake is located in the spa resort area of Kusatsu. It is an installation designed by the famous Japanese artist Taro Okamoto. The installation uses wooden flumes to direct the 4000L/minute of hot water from the source, allowing the water to cool as it progresses to the many spa facilities around the city. Located in the center of the city the wooden flumes are obvious in their utility, however the industrial nature of the installation creates its beauty. The gourd-shaped Yubatake is lit in the evenings and incorporates foot paths and bridges, functioning as a large promenade for the town, and is the main photo opportunity for tourists.

The waterfall at Yubatake. From Rider, "Forever Wanderer."

SITE EXPLORATION

Valemount

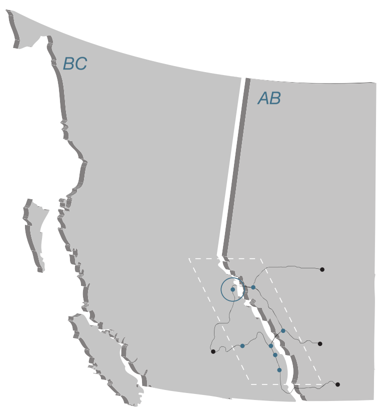
The village of Valemount sits in an interesting area between the Rocky Mountains, Cariboo Mountains and the Monashee Mountains. Prior to the arrival of European Settlers the valley was used as salmon fishing grounds for the Sushwap native group. The valley's first European exposure came with the intrusion of Pierre Bostonais, an Iroquois Meti fur trader and guide. His nickname "Tete Jaune" would later inspire the name for the Yellowhead Highway. The first settlers in the area were largely trappers, who subsisted on the plethora of wildlife in the area. Then in 1862 gold was discovered in the Creeks of the Cariboo (later to become Valemount) and the Canadian Northern Railway Company workers began to blast a passage through the mountains for a train system that would eventually connect Edmonton to Vancouver. By 1920 the Village of Valemount had become a community hub for the railway and forestry industries. The village had a roadhouse, train station and a post office.[40] The 1940s saw the creation of the Yellowhead-Blue River highway and the valley opened up further. As the population of the town was heavily influenced by the cyclical nature of the logging industry, the town saw growth and decline throughout the 60s, 70s and 80s. In 1990 the lumber giant, Slocan, purchased the local mill and a period of peak production between 1993 and 1996 saw an employment and population boom, in 1994 the plant employed over 200 people and the population increased by 17 percent. However, this boom came to an end in 1998 and the mill has all but shut down. Today, the village is heavily dependent on a developing tourist industry, and owing to its proximity to the world renowned Jasper National Park, Valemount is attracting many outdoor enthusiasts. The area is known as a mecca for hell-skiing, touring and snowmobiling in the winter. In the summer months the lake is used for fishing and boating and mountain climbing. Moreover, Valemount is located on the Rocky Mountain Trench, an area of seismic disturbance in which heat from the earths core is found closer to the surface, and thus is aligned with a series of hot springs along the BC and Alberta border, known by bathing enthusiasts as the bath path.

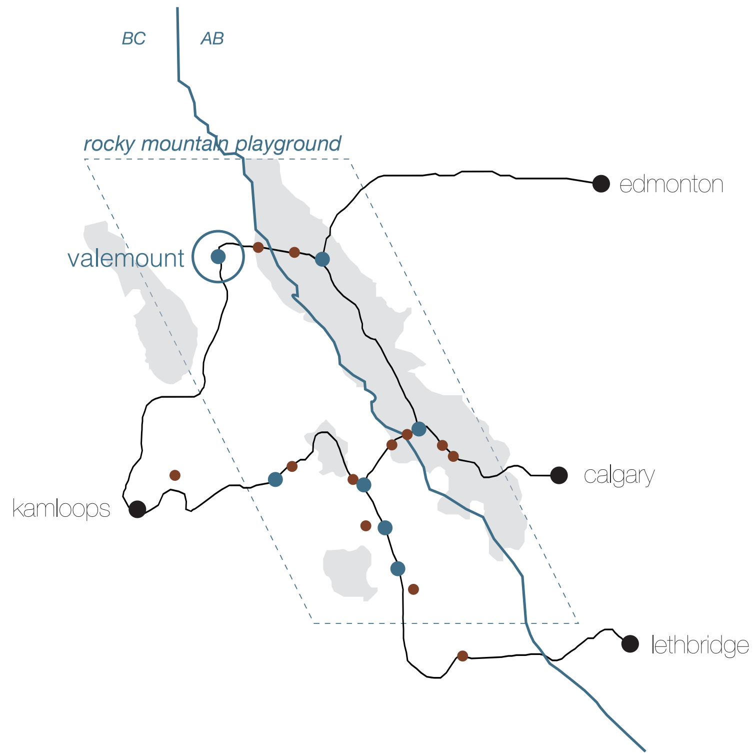
Site Location

The Canoe hot springs were once available to the residents of Valemount, however, after the flooding of the Canoe River and the creation of the Kinbasket Dam, the springs were submerged for most of the year, and an important recreational activity disappeared from the lives of the Valemount locals. Due to the low water table in 2006 a geological survey was able to be conducted on the hot spring area and found when assuming a maximum steam loss prior to mixing with shallow cold waters, a lower reservoir temperature of 125°C could be obtained from silica geothermometer. It also found when combining all the hot water coming from the banks of Kinbasket Lake the total fluid discharge could be ascertained as more than 50 L/S.[41] When comparing these numbers to the geothermal facility in Husavik (discussed earlier) it can be deduced that around 2 MW of power can be produced using the heat and pressure of the water. Accessing this lower reservoir of

40. Valemount Historic Society, *Yellowhead Pass and its People* (Valemount, BC: Valemount Historic Society, 1984), 1-15.

41. Mory Ghomshei, "Qualifying Report on: A High Grade Geothermal Resource in the Canadian Rockies; Canoe Hot Springs, Valemount, British Columbia." (2007), 8-10.





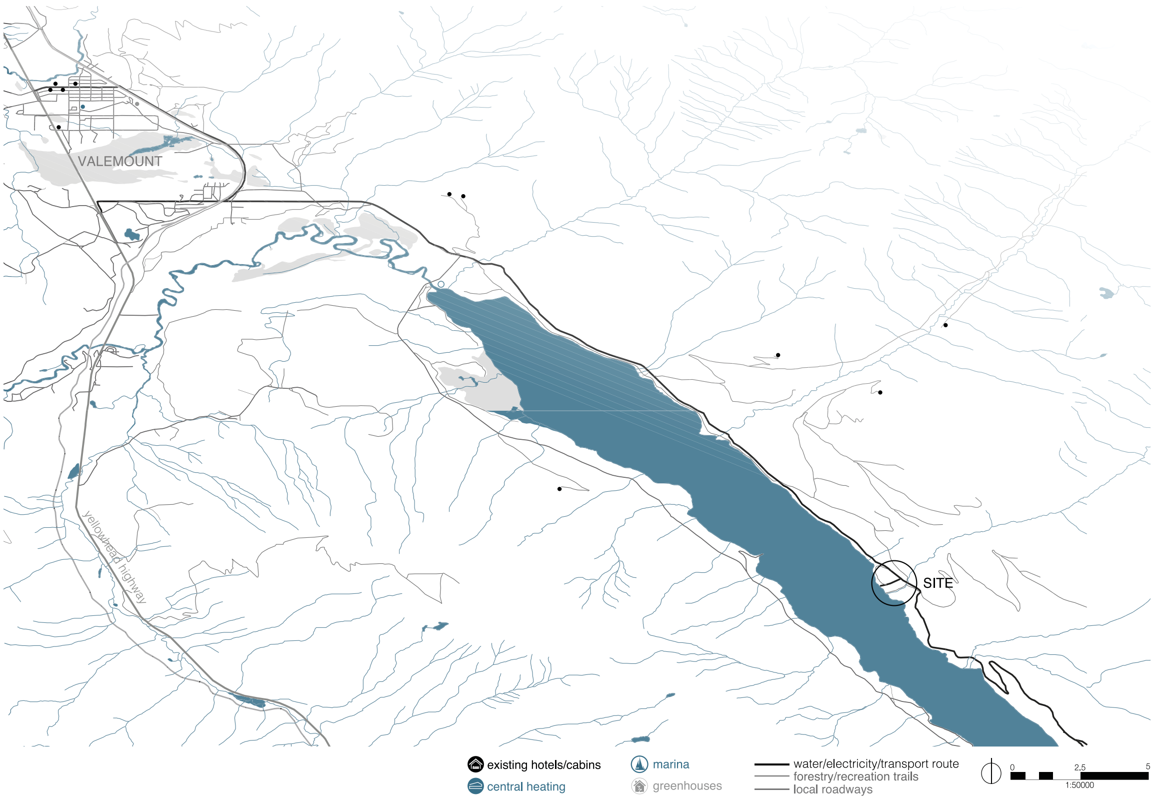

PROVINCIAL PARK


SKI HILL


HOT SPRING

Residents from the higher density areas use the mountainous regions around the Rocky Mountain Trench as a playground for high energy sports such as skiing, hiking and kayaking. The ‘bath path’ provides places of leisure where these outdoor enthusiast can relax after a day of exercise.

125°C water will be achieved by directional drilling up to 1.5 km beneath the bottom of the lake. Therefore, access to this aquifer can be achieved up to 15 km away from the surface vents. Due to poor access, and extreme slope of the site directly behind the now



The Valemount Geothermal Resort is located 21 km from the 5th Ave, Valemount's main street. From ESRI.

submerged Canoe Hotspring site, Borealis Geopower has proposed to move the drill site 11 km away from the Canoe hot spring to the Yellow Creek camp. The Yellow Creek Camp is a small campground conveniently located on the East Forestry Road, 8 km from the main power grid and 21 km from Valemount itself. This site is also a convenient location for the placement of the Thermal Baths, as it is connected to many highly frequented hiking, snowmobile and cross country ski trails. By integrating the Resort into the network of trails, the Valemount Geothermal Resort will become a place of respite for outdoor enthusiasts using the trails. Furthermore, the site has access to the lake and could easily be serviced by boat from the Valemount Marina.

Geological Setting

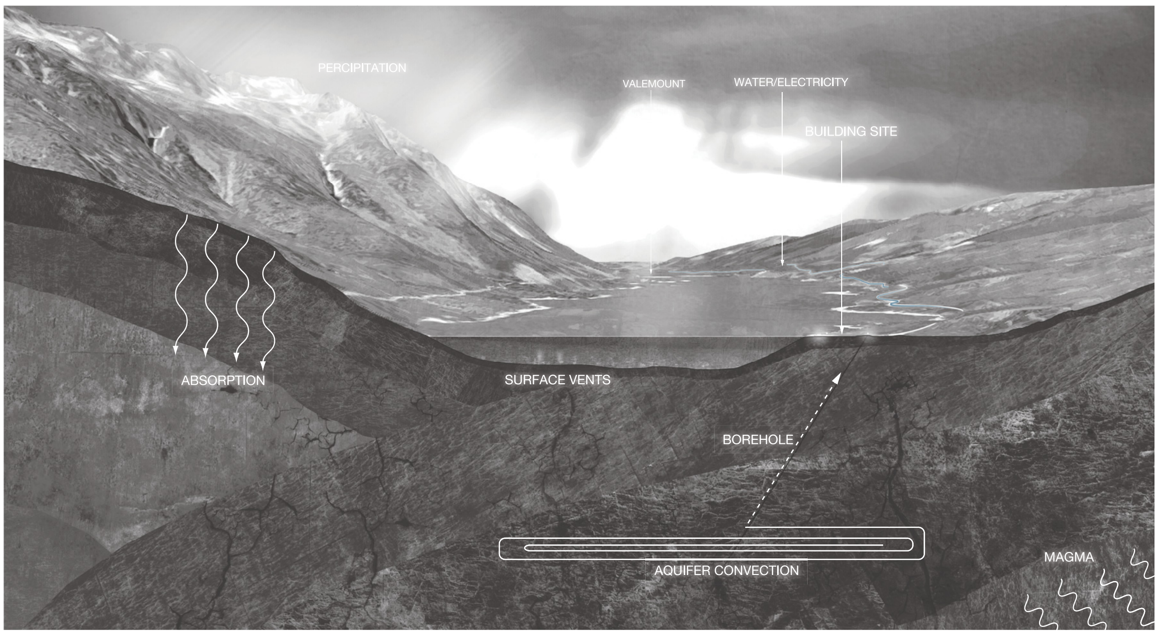
The Canoe Hot Springs are located at the bottom of the valley formed by the "Rocky Mountain Trench" between the Malton Range of the Monashee Mountains and the Canoe Range of the Rocky Mountains. The Rocky Mountain Trench, a linear system of valleys, extends for approximately 1600 km from Northern Montana to the British Columbia-Yukon border. Miocene Lake deposits have been found in the Southern Canadian portion of the trench indicating that it is significantly younger than the Mesozoic compressional structures of the Rockies. Thermal anomalies along the trench may be related to this younger tectonic trench. The hot springs themselves are bounded by three major faults. To the west the North Thompson-Albreda Fault, to the east west the Purcell Fault and to the northwest/southeast the Rocky Mountain Trench which appears to provide a conduit, bringing deep thermal water to the surface. [42]

42. Mory Ghomshei, "Qualifying Report on: A High Grade Geothermal Resource in the Canadian Rockies; Canoe Hot Springs, Valemount, British Columbia." (2007), 8-10.

Fault Locations in the vicinity of the Yellow Creek Camp site. From ESRI

Lately, no visible magmatic activity has been noticed in the direct vicinity of the hot springs. However, basaltic flows have been reported about 50 km southeast of the springs. Recent magmatic activity can therefore be considered as a possible cause of the heat. A second source could be old basement gneiss (radioactive elements) decaying beneath the site and producing a large heat source. The third, and most probable reason is because of the rising mantle of the Southern Rocky Mountain Trench.[43]

43. Ibid., 11.



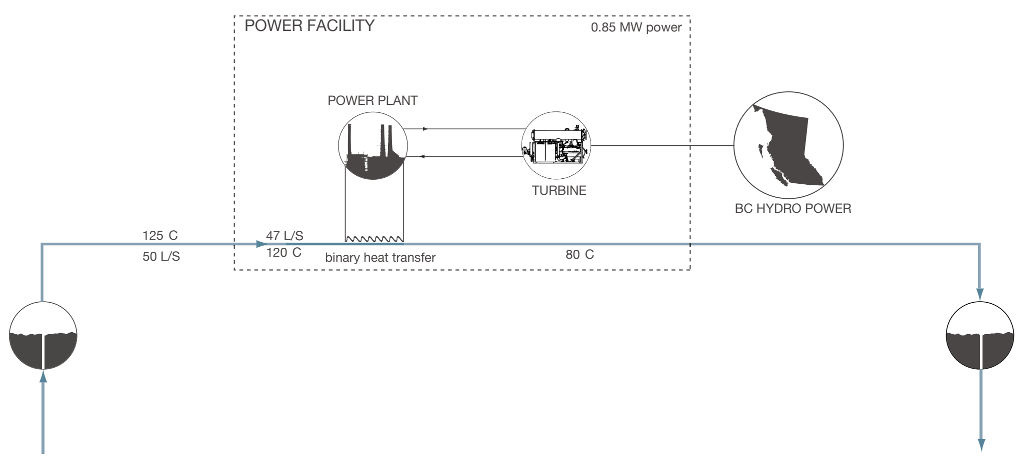
Southern Rocky Mountain Trench Hydrological Cycle.

Hydrological Cycles

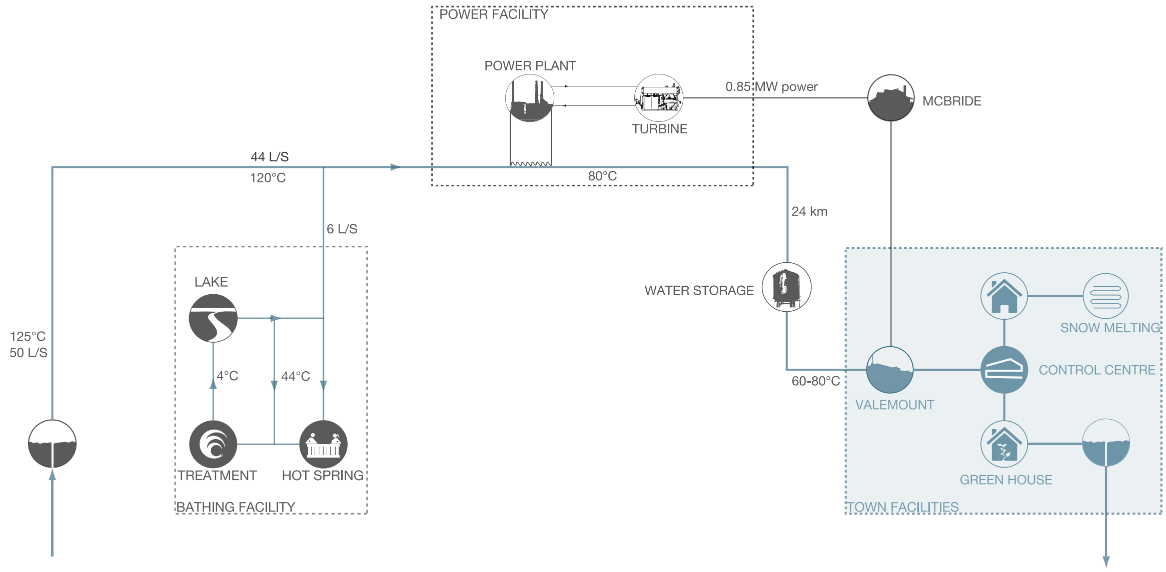
The first hydrological cycle influencing the site also affects all of the Southern Rocky Mountain Trench region. Precipitation falls from the clouds as they pass over the rocky mountains and hit the tall Monashee Mountains. This water finds its way into Kinbasket lake and settles deep into the earth. The water then progresses downwards through cracks and fissures into a layer of porous rock called an aquifer. Here the water is slowed and sits in the pours of the rock. In the case of the Valemount Valley, the Rocky Mountain Trench is pushing hot rock up from the depths of the earth. The heat from the rock warms the water in the aquifer, also increasing its pressure.

The second hydrological cycle is more localized, directly affecting the town of Valemount, As stated previously, in 2011 Borealis Geopower, a Calgary based company bought the geothermal rights to the Canoe Reach arm of the Kinbasket lake near Valemount, British Columbia. The company plans to initiate a pilot construction project of a 2 Mega Watt geothermal power facility at the Yellow Creek Camp. Borealis Geopower, will produce this power, and sell it to the BC Hydro for profit. While this is a positive step toward green energy production, it does not maximize the potential of the geothermal resource.

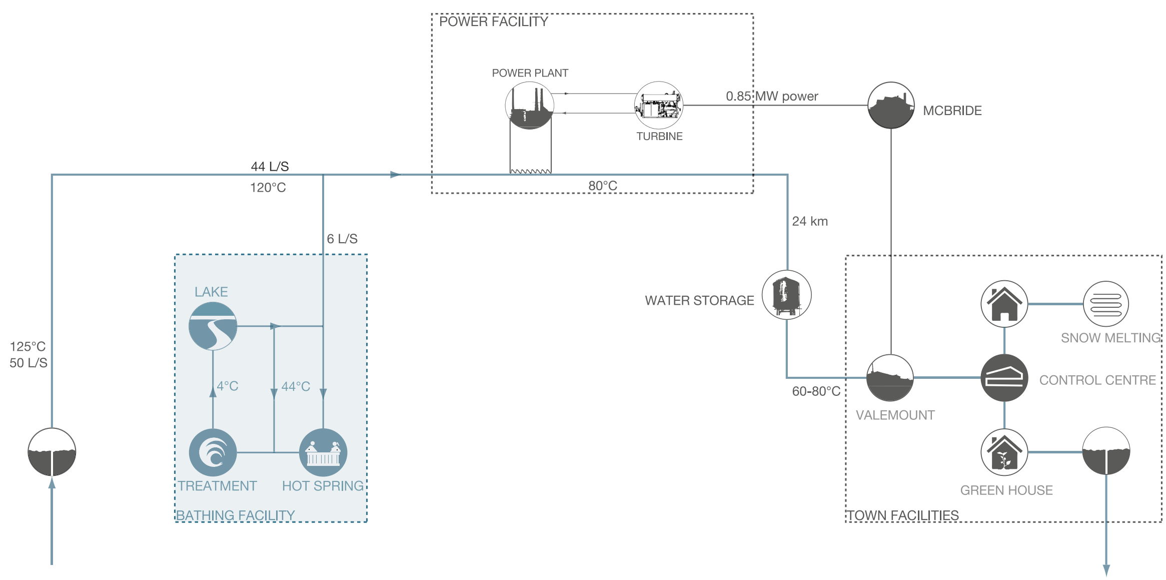
This Thesis proposes to add two new hydrological cycles to the process to maximize the potential of the geothermal resource. After the borehole is drilled down beneath the lake, the pressurized hot water in the aquifer issues forth at 80 L/S. This water is then piped through the heat exchanger in the Kalina power facility, producing 2 MW of electricity. Rather than sending the electricity straight to the grid, this thesis proposes to use the power locally, sending the power to the towns of Valemount and Mcbride, hereby cutting down on energy losses caused by long distance travel through power lines. This same water will then be piped underground to Valemount where it will be used in an extensive greenhouse facility as well as district heating for the entire town.



Borealis Geopower’s development proposal for the town of Valemount.



The Town Facility addition to the Borealis Geopower proposal (in blue).



The Bathing Facility addition to the Borealis Geopower proposal (in blue).

CHAPTER 2: DESIGN

PROGRAM

Power

Lack of understanding, and knowledge about alternative power generation techniques may be attributed to the extreme reliance on coal power generation in western Canada. Many Albertan and British Columbian tourists in transit, will be drawn to the Geothermal Center because of the bathing facility, and will stop at the Power Facility to learn about the resource. Much as the TVA did for the awareness and development of the hydroelectric technology, the interpretive component of the center will provide an interface for visitors to access information about the Kalina Power Generation process. Visitors of all ages will be introduced to the potentials of geothermal heating and electricity and become aware of the large resource existing in the Rocky Mountain Trench. The Geothermal Center will encourage a local connection between the power station and the community it serves and it will open the population's consciousness to alternative methods of energy production.

Bathing

As the premise for the project is the exploration of the potentials of geothermal water, the Thermal Bathing Center seeks to maximize the enjoyment potential of this resource. The baths will not ignore the man made technology used to produce the abundance of water within. Therefore, an artificial exploration of the water cycle on earth will be housed within the bath. The visitor will progress through these cycles enjoying layers of delight and physical enjoyment. The center will also attempt to merge the artificial nature of the bathing environment with true nature, providing strategic views of the vast Monashee Mountains and a large outdoor bathing pool. Finally, the bath will be a place of community, encouraging conversation between visitors and locals and allowing places of comfort and respite.

Lodge

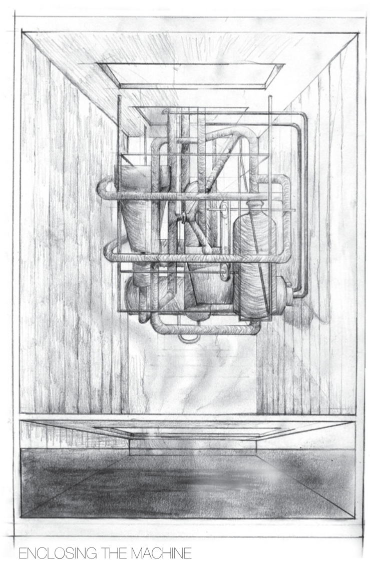
Cabins will be accessed by trail, and while they will provide many of the comforts of home, they will be treated like wilderness retreats. These cabins will service the wilderness enthusiasts occupying the area, as well as couples and families visiting the bath. Two languages of cabin will be provided. The first being a community focussed cabin oriented toward the river and serviced by a large boardwalk, the second will be a more secluded cabin oriented toward the forest, giving views over the tree's to the lake and mountains.

Pathway

Two major pathway's will link the many secondary cross country ski and hiking trails already existing in the area. The first will be a major linear axis leading between the power plant and the bath. This pathway will be marked by an elevated trestle between the two programs; this trestle will feature large lanterns which will light the trail at night. Much like the Termas Geometricas, the second pathway will be a wooden flume channeling the water from the power plant down to the cabins, and providing an outdoor bathing pool. The flume will allow the visitor to enjoy a more natural bathing environment, and it will guide the visitor through the heavily forested southwest portion of the site.

DESIGN METHOD

The true challenge of the project has been combining two very different architectural languages. One being the industrial materials of the power facility, usually cold and efficient and not typically visited for pleasure. The second being the natural surroundings of the site, the trees, lake, and mountains that seem to welcome a natural hot spring environment. Initially I sought to house the power facility and the natural world of bathing in the same cladding. I was using an architecture made of natural materials to contain both the industrial program of power plant and the natural program of bathing, in an attempt to hide the mechanisms of power production. Indeed, I was trying to blend the architecture into the natural world. However, as the design matured, I began to admire the contentious relationship between an extremely modern almost mechanistic aesthetic and the vast wilderness of the Valemount area. Thus the buildings became much like machines perched on the land, in direct contrast with their surroundings. Furthermore, materiality began to be essential to the design of the project. Steel and concrete became the materials used for systems and infrastructure. Wood, specifically local cedar, became the material of enjoyment, thus places where the visitor is in direct contact the geothermal water are encased



Early concept drawing of the design method.

Final concept drawing of the design method.

in this local cedar. Interestingly the design of the project became a series of thresholds. First, nature, a place of trees and mountains, second, the mechanistic, a place of steel and concrete housing the machines and systems essential to the project. Third, artificial nature, a place of hot water and steam housed in a wood casing.

SITE STRATEGY

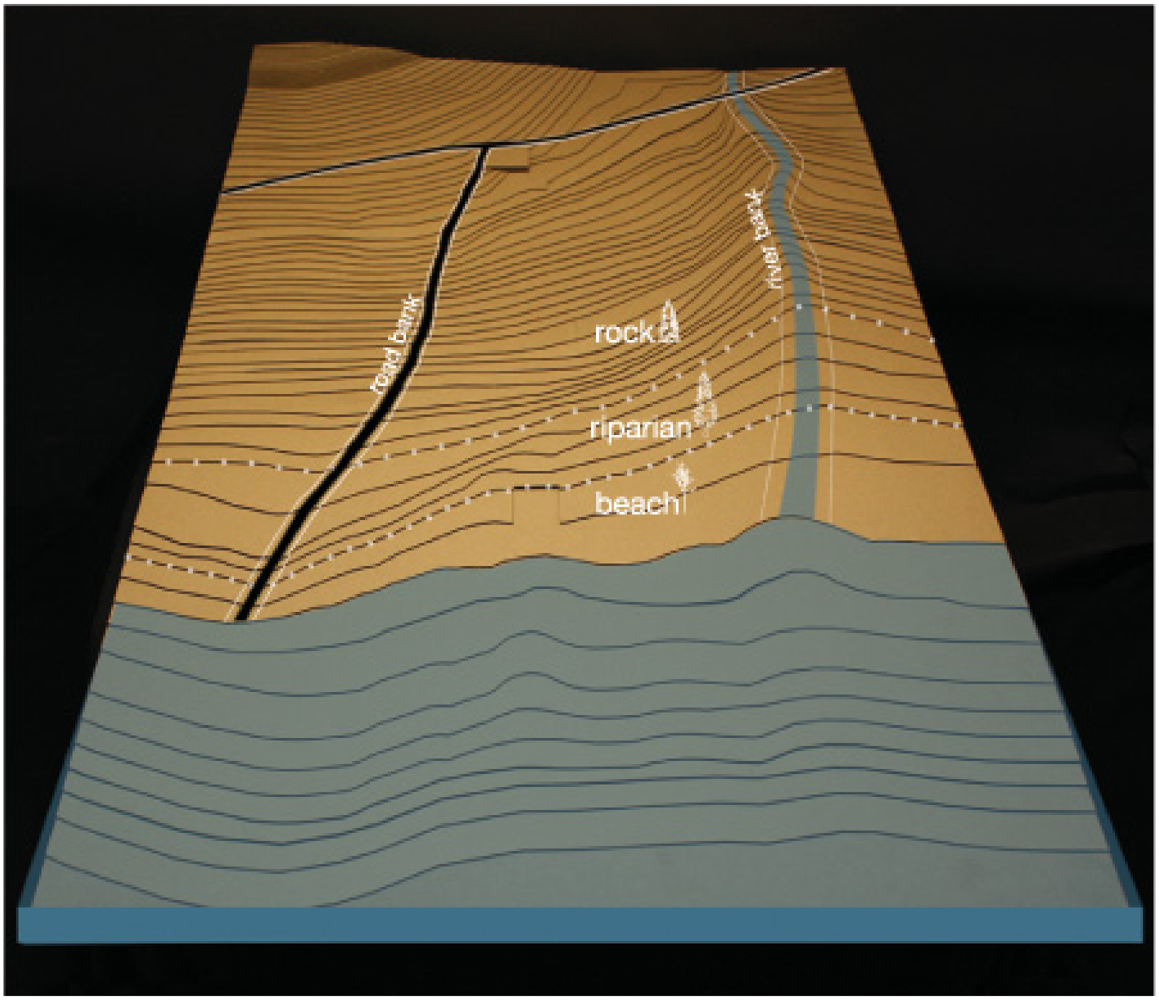
Topography

The topography of the Yellow Creek Camp site helped to organize program placement. Looking at the site I noticed a series of topographical zones, both artificial and natural. The site can be broken into three topographical zones. The first is beach, characterized by a sand and rock and some smaller aspen trees. The second is riparian, this is an area with deeper more fertile soil left in the bottom of the valley by glaciers, the riparian zone is smaller than usual around Kinbasket Lake because much of it was flooded after the creation of the dam. The third zone is rock, dominated by a shallower soil layer and spruce and pine trees. I used the edge conditions between the zones, as well as the edge conditions created by the existing roads and river to situate the built environment.

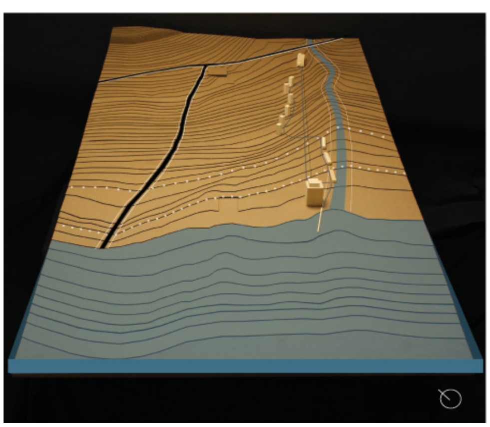
Hydrology

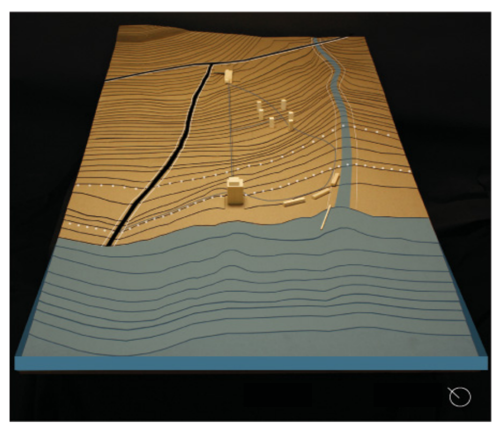
The arrangement of primary program is directly influenced by water movement. The Geothermal Energy Center is the source of water on the site and is placed at the top of the site because less energy is needed to transport the water downhill. The Bathing Center is the terminus of the water path and is placed at the bottom of the site. The ancillary program element of cabins, pathways and dock are placed using the topographical cues discussed previously.

It should be noted that views, solar orientation and strong South East winds off of Kinbasket Lake were important environmental factors informing the layout of the proposed development and were noted in the organization of the site. Using these various cues a variety of site orientations were investigated.

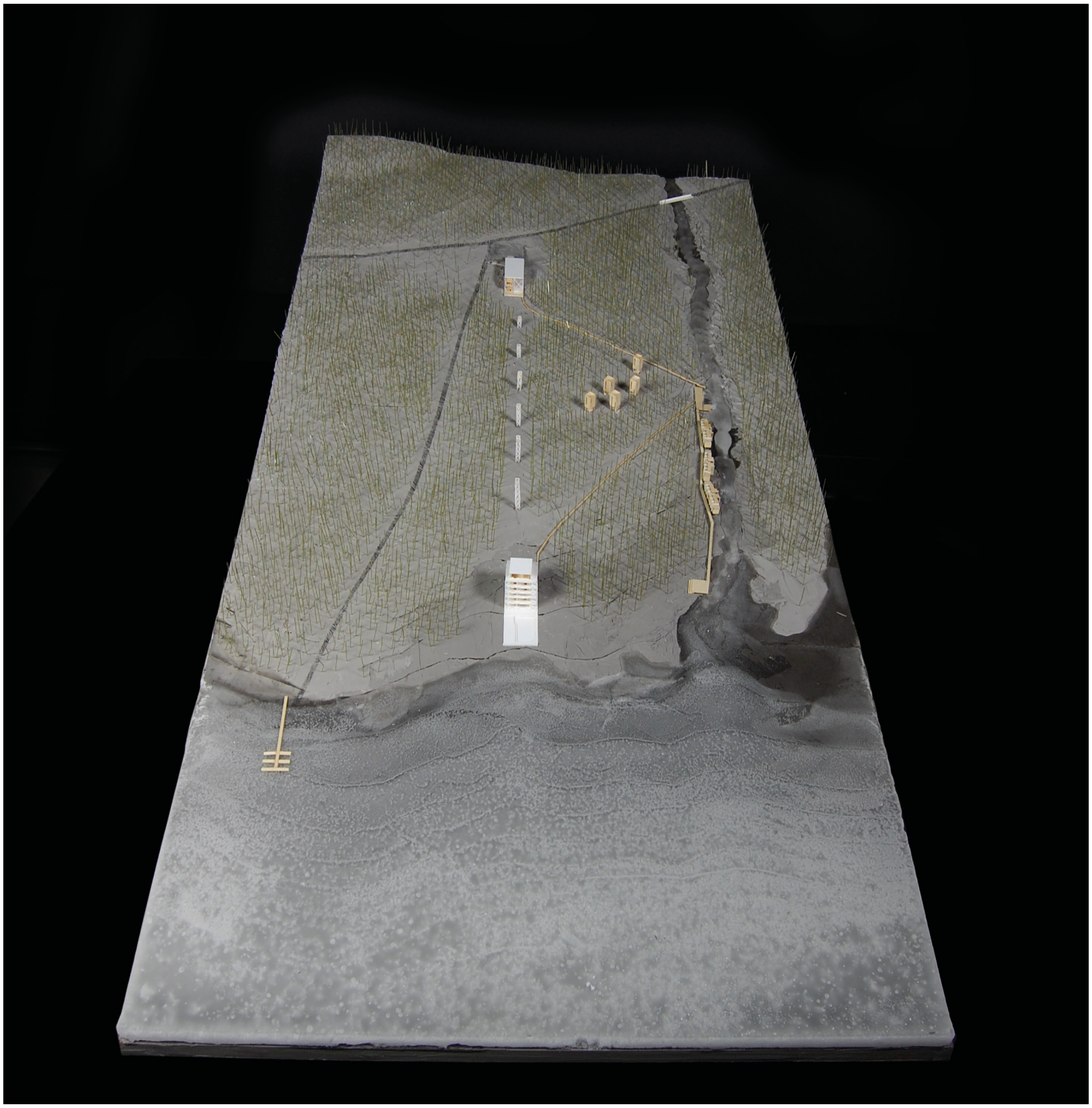


Vegetation on the site is directly related to the site topography. The beach area is sparsely populated by aspen trees. The riparian area has a deep soil and is populated by large cedar trees, and the rocky ridge has a shallower soil and is populated primarily by spruce and pine.





Two of the many options attempted for site orientation taking into account the edge conditions discussed previously. Option one does not include the existing road condition, focussing on the river edge, and therefore does not take advantage of the entire site. Option two acknowledges the existing road, yet does not fully monopolize the river edge. In both cases the dock is placed at a difficult mooring condition in front of the mouth of yellow creek.



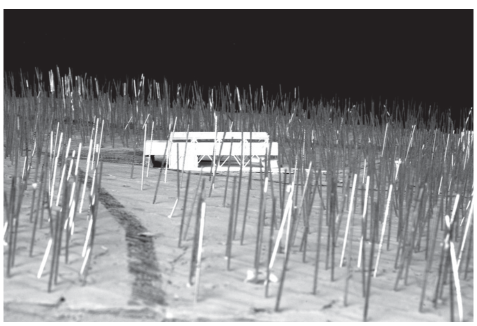
Final site strategy.

Site Orientation

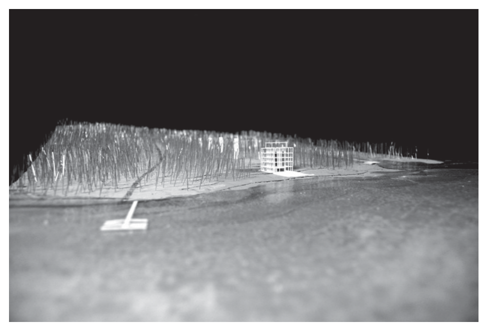
The final site orientation puts the power station at the top of the site. The power station functions as a gateway from the urban into the natural world of the site. It crosses the edge condition formed between the East Forestry road and the site itself. The tree cabins, are placed on the edge between the rock and riparian zone. The tree cabins are elevated to provide views through the trees of the site. The river cabins mitigate the edge condition between the river and the site. The bath is placed to function as a gateway between beach and water, its outdoor pool stretching toward the lake. The dock acts as an extension of the access road into the water, and is a stable, sheltered mooring station.

Access

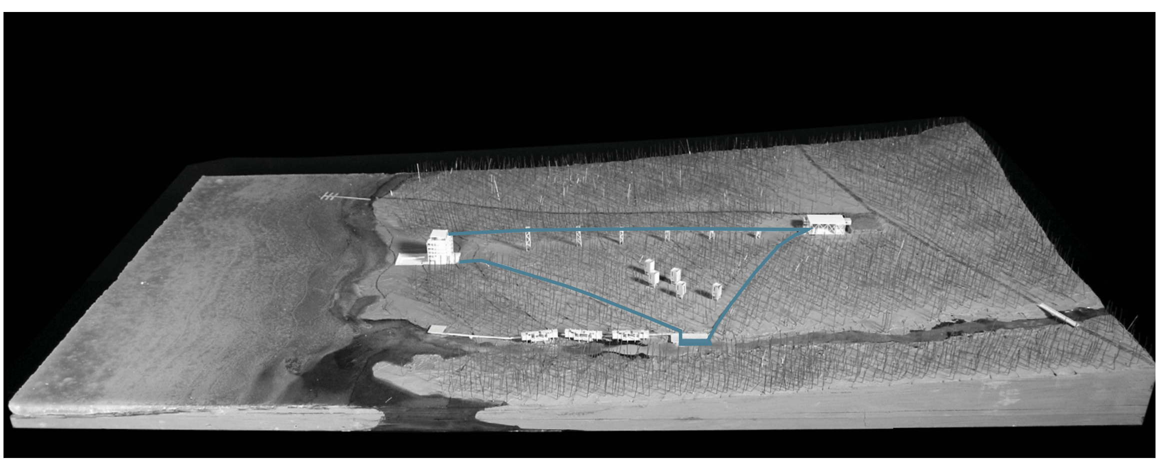
Vehicular access is handled by two roads servicing the site. These roads existed before the development of the proposal, yet are managed to heighten the enjoyment of the visitor. Arriving at the Geothermal Center by car, one passes through the community of Valemount and along the east bank of Kinbasket Lake. Through the trees, views of the Monashee Mountains pervade, before coming around a bend and seeing the North elevation of the Energy Center. Parking is provided just behind the Energy Center. An access road on the North side of the site provides an existing boat launch and parking for visitors who want to bypass the Energy Center and go straight to the baths. Visitors are intended to park their cars and proceed through the site on foot or by bicycle. The second mode of site access during the summer is a ferry between the site and the Valemount Marina. After boarding the ferry, the visitor enjoys panoramic views of the mountains before seeing the large bathing tower in the distance. The ferry dock is situated at the end of the access road beside the boat launch.



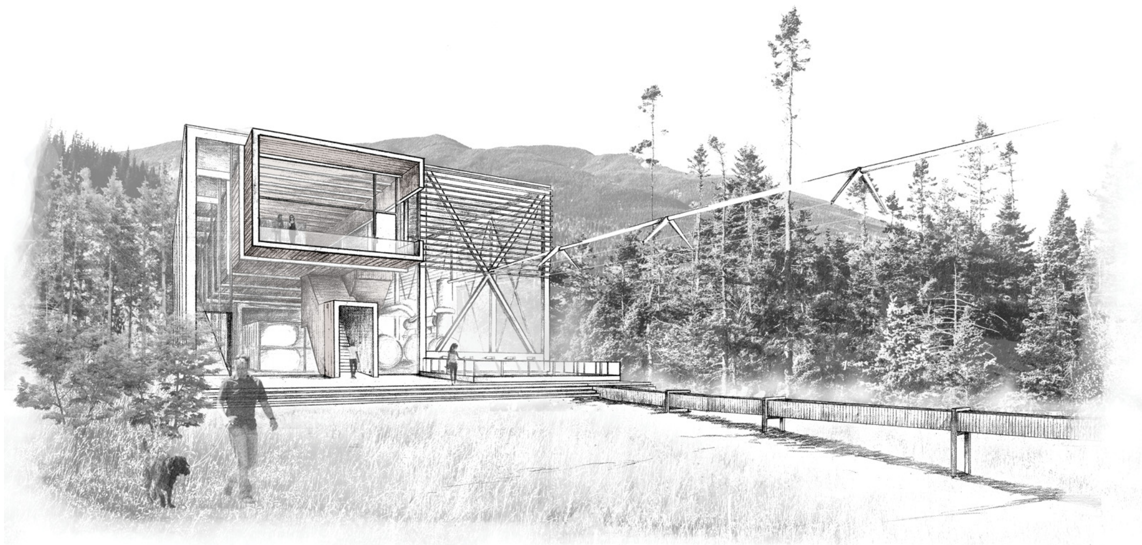
Road approach.



Ferry approach.



SIte hydrology (in blue).



Perspective drawing of Energy Center courtyard. Notice the beginning of the trestle and the flume.

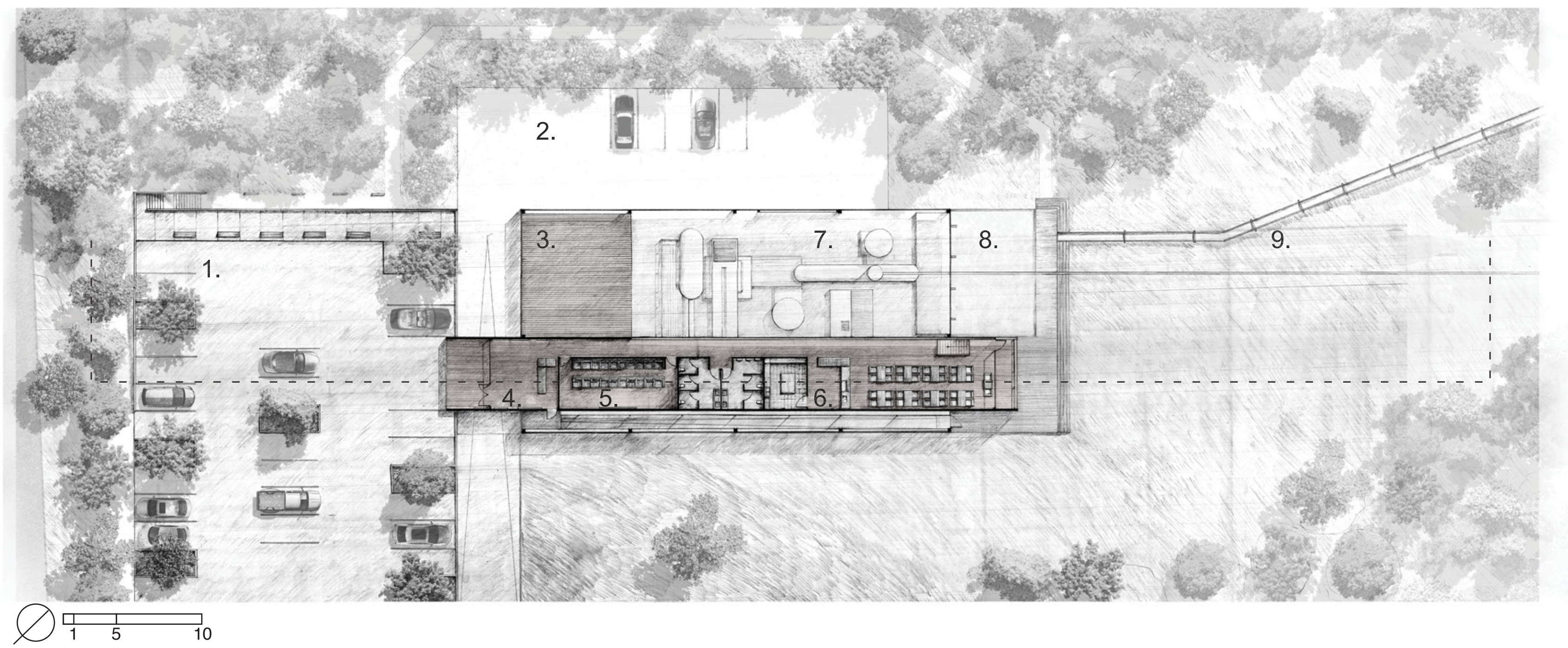
BUILDING DESIGN

The Energy Center

Anchored into the earth by a concrete foundation to exhibit the drilling process that makes the building possible, the Energy Center uses landscaping and retaining walls to take advantage of a sloped area of the site. The Center has two separate building elements, first the ‘education area’ which is a large cedar box suspended from the roof of the power facility. Vaulting over an access road and acting as a gateway between the outside world and the designed site, the education area leads the visitor from a large parking lot into the front doors of the building. Taking cues from the design strategy outlined previously the cedar lined box serves as a center for immersion in the geothermal process. It is a place where the visitor is educated about the potentials of geothermal energy both as a form of heating and electricity. This ‘education area’ has three programs organized in a linear orientation. First, the visitor is greeted with a small gallery. The gallery room provides wall space for exhibitions pertaining to sustainable energy, as well as a large greeting counter where visitors can pickup maps and learn about the site. Next, the visitor has a choice to partake in the video room, which is filled with large couches, and will show short films further describing the geothermal process as well as elaborating on the specific

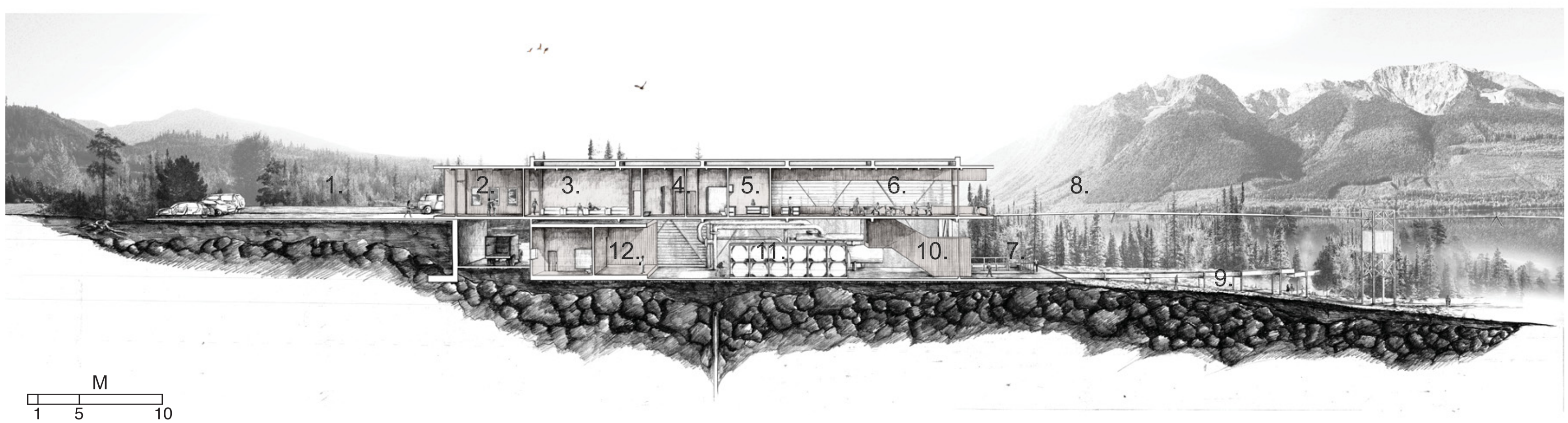
View from restaurant through the shotgun window. Notice the trestle and the Bathing Centre in the distance.

events happening on site. Progressing down the hallway past the bathrooms, the visitor will see the power process happening below, through a large window. Next, a restaurant is provided with a shotgun window giving views of the site, as well as framing the first glimpse of the Bathing Center in the distance. If the visitor decides to stay for a meal, two views are available. The first view is out the shotgun window to the Bathing Center and Mountains, the second is into the power facility. If the visitor decides not to partake in a meal, a staircase is provided which gives a closer look at the efficient machines in operation, before progressing to a large veranda which will be serviced by the restaurant in the summer months. This veranda holds a large pool of hot water, filled by pipes jutting forth from a holding tank in the facility. This pool marks the beginning reservoir of the flume. Above, the trestle is suspended, sending forth the large volume of excess water that has been cooled by the heat transfer in the power process. Here visitors can look through glazed wall of the steel framed Power Facility. They will notice the workers quarters are located at the back of the building in another cedar lined box. On the south side of the building separated by a grove of trees the service vehicle access and staff parking are provided.



1. Visitor Parking 2. Employee Parking 3. Workers Quarters 4. Gallery 5. Video Room 6. Restaurant 7. Power Plant 8. Hot Water Pool 9. Flume

Plan of the Energy Center.



1. Visitor Parking 2. Gallery 3. Video Room 4. W/C 5. Kitchen 6. Restaurant 7. Hot Water Pool 8. Trestle 9. Flume 10. Stair 11. Power Plant 12. Workers Quarters

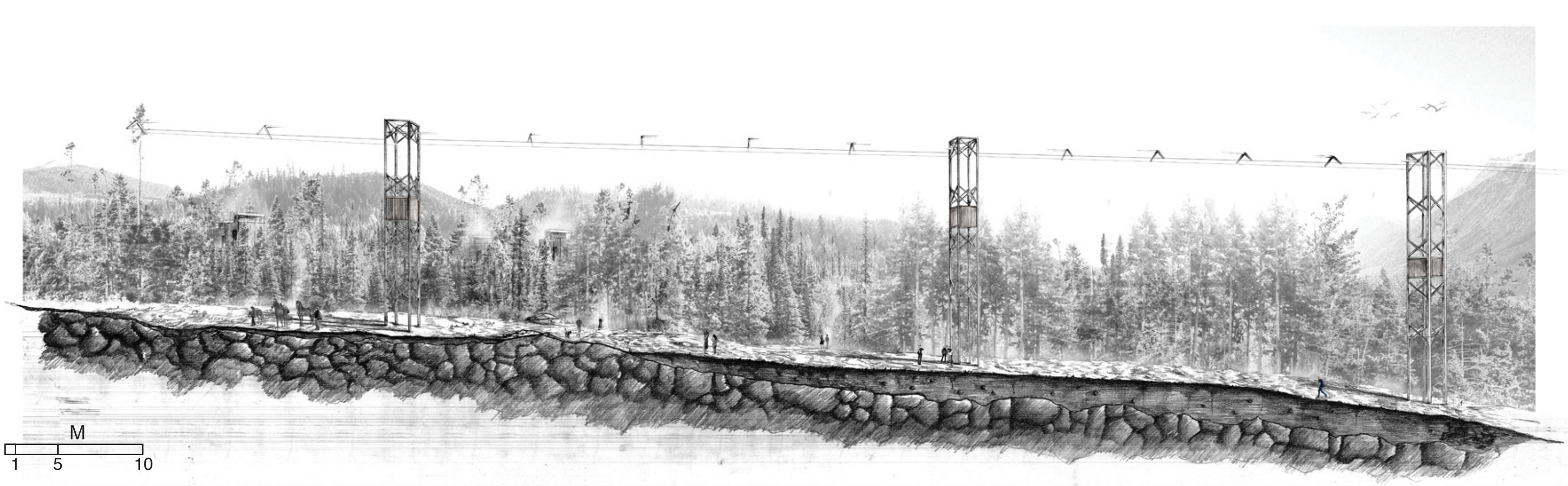
Section of the Energy Center.

The Trestle

After the hot water is brought out of the ground and makes is way through the Kalina Power Cycle, it is stored in a reservoir at the Southwest area of the Power Plant. Here it is split between two separate water pathways that make their way between the Energy Center and the Bathing Center. The Trestle is the more direct route of the two, using a bow truss and a system of towers to keep the hot water pipe elevated between the two programs. This bow truss system was influenced by farming irrigation systems. Long spans are allowed by putting the water pipe under tension. An added bonus of the bow truss system is the allowance for movement in the cables, as the farming irrigation systems are often moveable. This movement will compensate for wind gusts that frequent

Bow truss irrigation system. From Lindsay Corporation, “Irrigation Advances.”

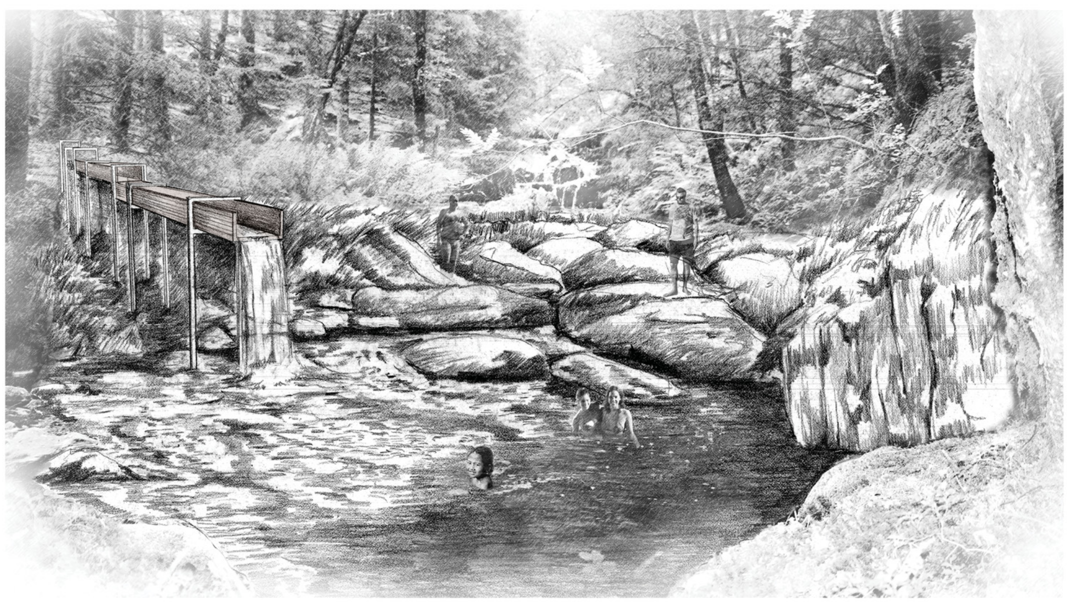
the shoreline of Kinbasket Lake. Again, the trestle takes cues from the material method discussed previously, as it uses steel to support an infrastructural aspect of the project, as well as encasing a human focussed cedar element. In this case the wooden element is a light box situated within the trestle towers. Thin slats of cedar filter light, casting a warm glow on the path beneath the trestle in the evening hours.



Section of the Trestle. Notice the light boxes housed in the steel towers.

The Flume

The second method of water travel through the site is by the flume. While the trestle moves water in a direct and linear way, the flume meanders. The visitor is encouraged to follow the flume through the forest, discovering cabins and activities along the way. In contrast to the trestle which keeps the water elevated above the visitor, the flume allows places for the visitor to touch the water, and an isolated area in which the water spills into an outdoor pool for the visitor to bathe in. Furthermore, the flume services the cabins, providing over night guests with hot water for their own private bathing needs. Again, the method of material construction uses steel and cedar, however due to the more experiential nature of the flume, wood is the primary material. The steel functions as a thin structure, holding the cedar planks together and keeping the channel off of the ground.



The forest pool and flume. Not captured in the above vignette, the forest pool is located at the beginning of the River Cabin boardwalk next to Yellow Creek.

The flume functions as a secondary pathway for visitors to travel between the Energy Center and Bathing Center. It will primarily be used by visitors spending many hours on site, or by overnight visitors occupying the site cabins.

Tree Cabin

When following the flume, the initial cabin seen by the visitor is the tree cabin. As discussed previously the tree cabin's siting was decided upon topographically. The change from deep soil to a more rocky substrate and the resulting increase in slope allows panoramic views. To increase these viewing opportunities and because of the influence of the trees around the buildings, the tree cabin is organized in a tower arrangement. The tree cabin has five floors (including roof terrace) and provides two bedrooms, a kitchen, living room, mudroom, and bathing veranda. The tree cabin provides lodging for visitors who are looking for privacy. Each cabin is located at the end of a forest path issuing from the main path along the flume. This creates a separation between the public thoroughfare and the private world of the cabin. Unlike the Energy Center the tree cabin is not anchored into the earth, rather its cedar envelope is perched on steel piles above the earths surface.

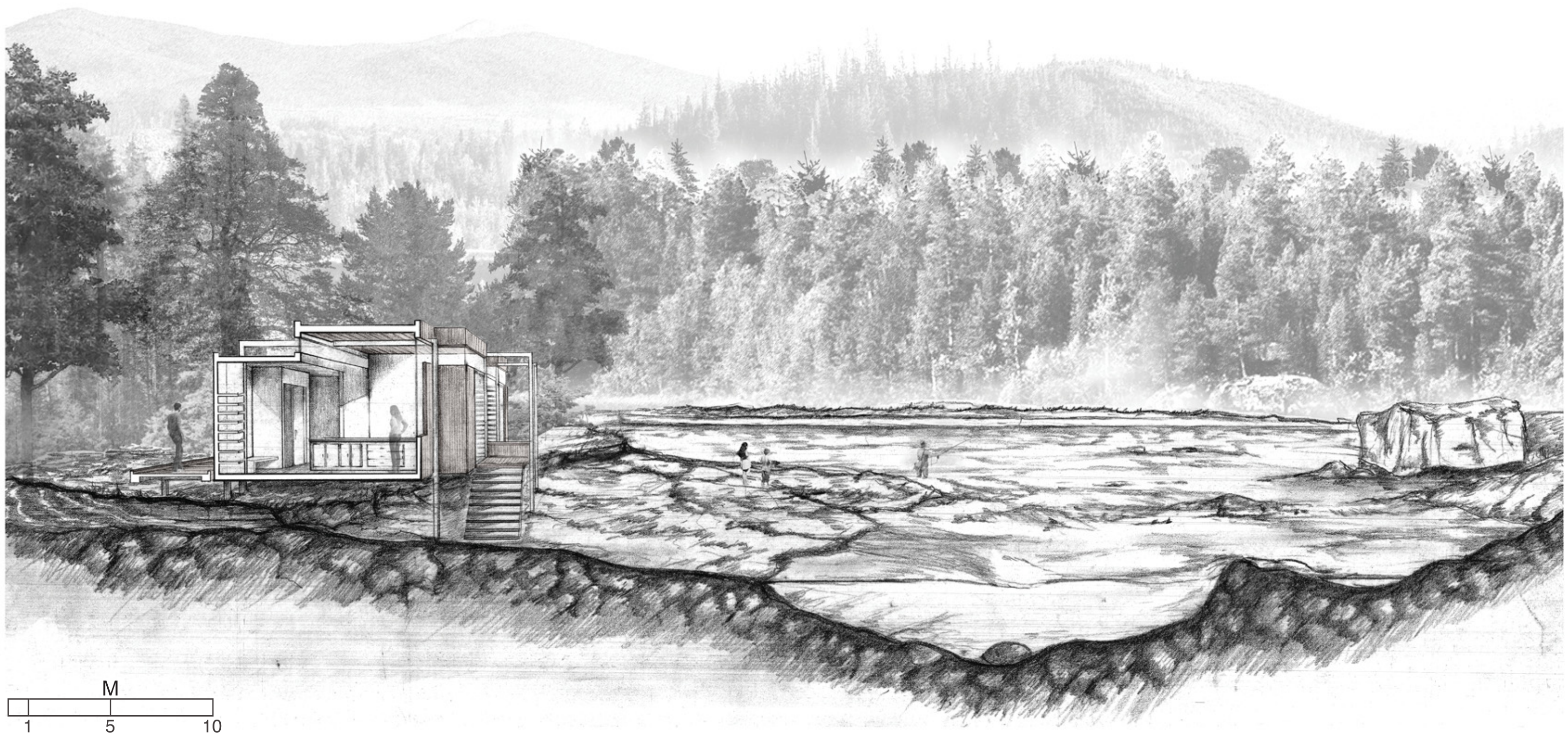
Tree cabin first floor plan.

Tree Cabin Section.

River Cabin

Akin to the tree cabin, the river cabin was positioned using topographical cues. The edge of Yellow Creek was an obvious choice for a building location. The river cabin attempts to maximize exposure to the river waters, taking cues from the form of the river itself. The building is a long horizontal structure with rooms functioning like eddies off of a central hallway. In contrast to the tree cabin, the river cabin has a public focus, with two units organized around a central veranda and bathing pool. Furthermore, an elevated walkway functions as a public street encouraging social interaction between separate groups. Like the tree cabin, the river cabin is perched on the ground, using a steel structure clad with a cedar envelope.

River Cabin Plan.

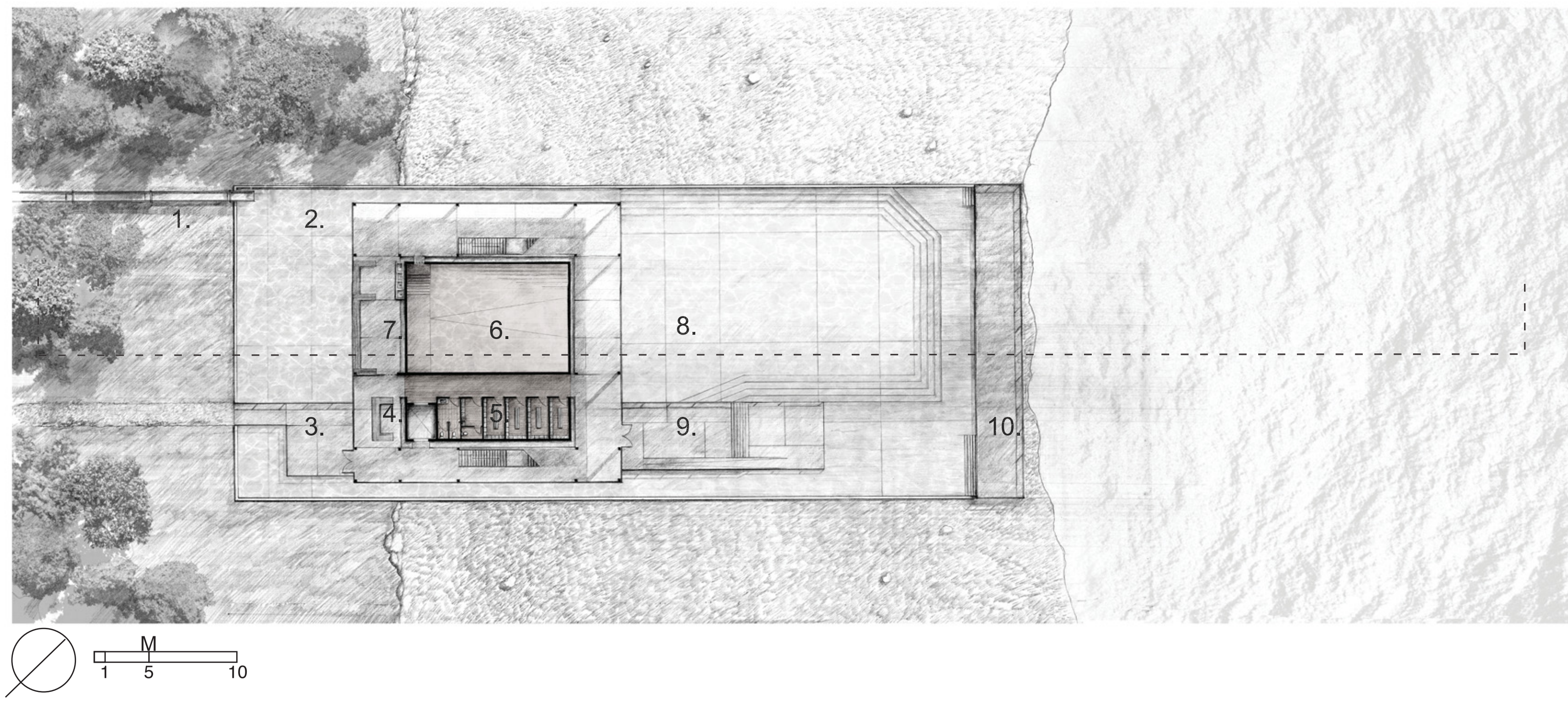


River Cabin Section.

Bathing Center

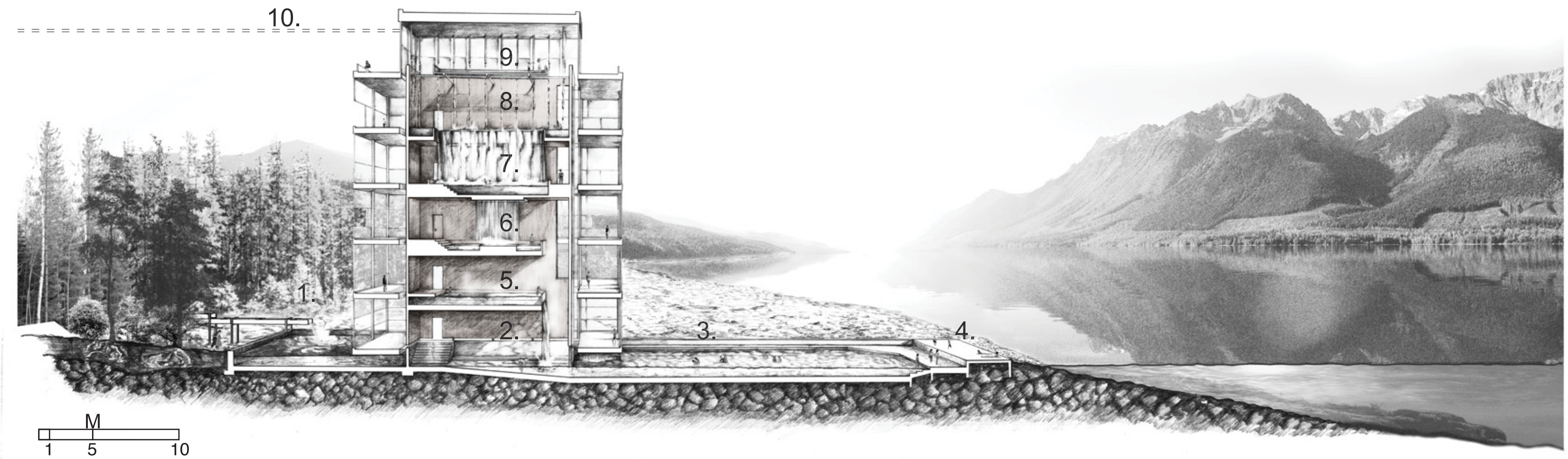
The Bathing Center is the terminus of both the flume and the trestle. A visitor following either water path will eventually find himself at the Bathing Center. Akin to the Energy Center, the Bathing Center is also anchored into the earth by a concrete foundation and bathing pool. This anchoring into the ground showcases the end of the thermal waters' journey through the site. The Bathing Center uses the material cues of steel and cedar to structure the built environment. The Center has two separate building elements, first the baths which are thought of conceptually as a large cedar box climbing totemically through the heart of the building. The second aspect of the building is a steel and glass structure that wraps the cedar totem, providing circulation for visitors, as well as the infrastructure of pipes and ducts needed to support the bathing atmosphere. These two elements are kept separated by a four foot gap allowing a noticeable threshold when the visitor moves between the world of infrastructure into the world of the bath.

Approaching the building entry, the visitor must first cross a north facing hot water reflecting pool. This pool can be waded in, and also serves as a receptacle for the end of the flume path. The first floor of the Bathing Center provides a reception desk, four change rooms, showers, an elevator and the beginning of two large sets of stairs. Furthermore, it is from this level that the visitor can access the outdoor pool, which gestures out toward Kinbasket lake and has wading pools and decks for sunbathing. The enclosed cedar bath houses a ramp which takes advantage of the existing site slope and creates a series of thresholds before giving access to the outdoor bath. The visitor must walk through a waterfall, then into a triple height room before being compressed again into a low ceilinged passage beneath the first floor and out into the majesty of the Kinbasket Valley.



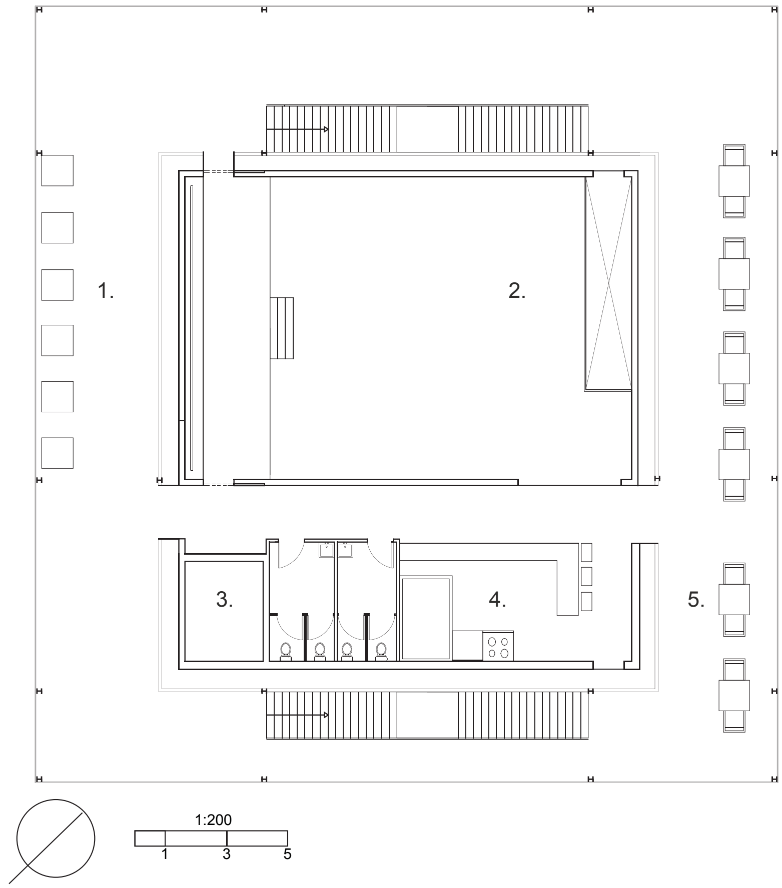
1. Flume 2. Reflecting Pool 3. Entry Deck 4. Reception 5. Change Room 6. Cedar Bath 7. Showers 8. Outdoor Bath 9. Deck 10. Sun Deck

Plan of the Bathing Center.≥



1. Reflecting Pool 2. Ground Room 3. Outdoor Pool 4. Sun Deck 5. Pool Room 6. Room 7. Fall Room 8. River Room 9. Cloud Room 10. Trestle

Section of the Bathing Center.

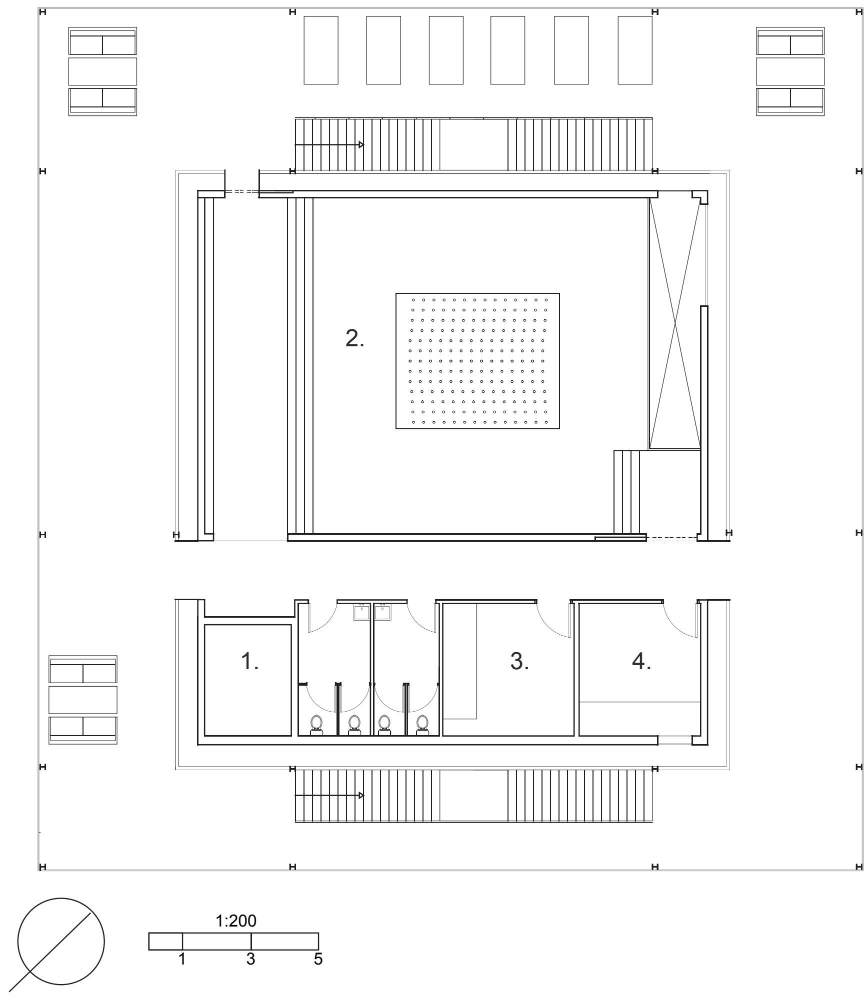


1. Sun Deck 2. Pool Room 3. Elevator 4. Kitchen 5. Restaurant Seating

Bath Second Floor Plan.

The second floor provides a small restaurant and seating area, giving the visitors a place to view activities in the outdoor pool. Inside the cedar bath is the pool room, a dark calming place, which focuses on the sound of the water falling onto the first floor.

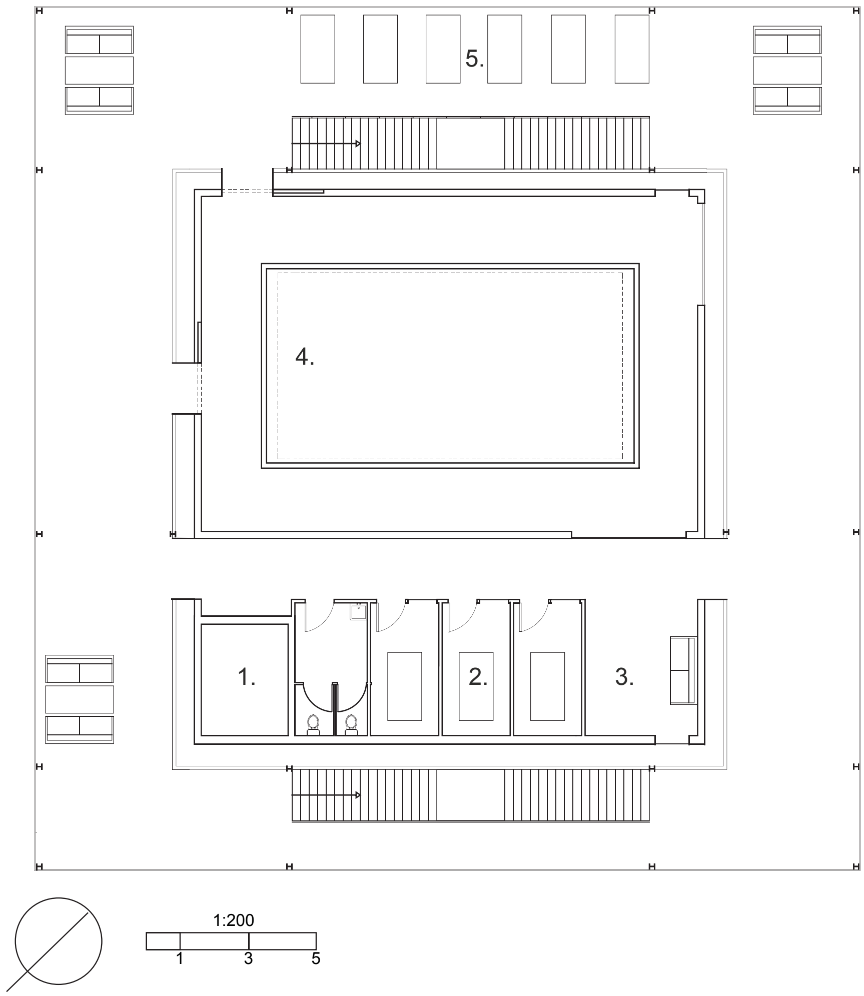
The third floor provides two sauna rooms. Focussed on smell, essential oils will be added to the sauna environments, giving the visitor a chance to focus on a sense other than touch or sight. Inside the cedar bath is the rain room, this room is again a calming place. Cool water falls from a large shower like mechanism in the roof onto a plinth built into the center of the bath. The visitor has a choice to sit along the edge of the pool in the heated water, or to lay on the slightly submerged shower plinth and cool down.



1. Elevator 2. Rain Room 3. Sauna 1 4. Sauna 2

Bath Third Floor Plan.

The fourth floor provides a massage area. Three massage rooms and a small waiting area allow the visitor the option of a relaxing treatment while enjoying the bathing atmosphere. Within the bathing environment is the fall room. Here a large pool sits in the center of the room, water falls into the pool on all four sides from a suspended gallery. Visitors must pass through the sheet of water to enter the pool. While the water is still very hot, it is not as deep as many of the bathing floors, and the falling water encourages play and activity.

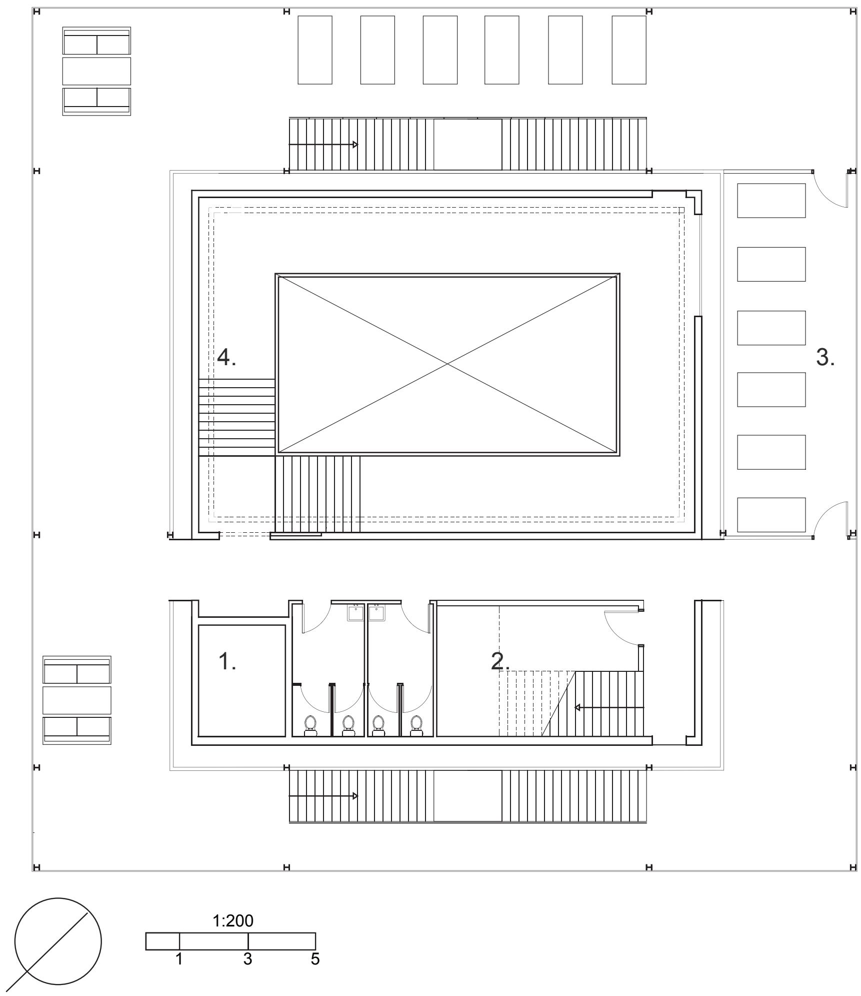


1. Elevator 2. Massage Room 3. Waiting Area 4. Fall Room 5. Sun Deck

Bath Fourth Floor Plan.

The fifth floor gives access to an outdoor area at a 70 foot elevation. The terrace provides a tanning deck, as well as an observation area. The river room, is a six foot wide gallery, surrounding a large cavity in which the water falls into the fourth floor pool. The river pool, is an intimate environment, and the hottest of the pools in the bath.

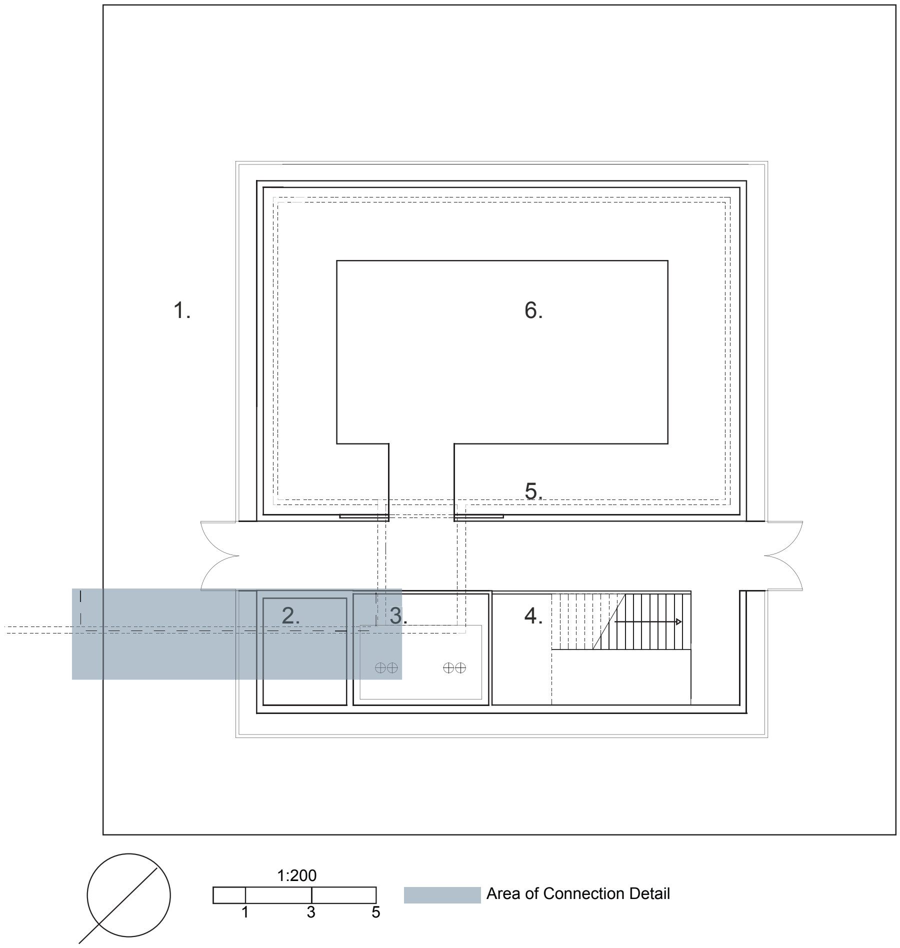
The sixth and final floor in the building is where the water carried by the trestle enters the building. The water first is held in a storage and treatment room before progressing into the cloud room, where it pours into the cedar box of the bathing environment from large



1. Elevator 2. Cloud Room Stair 3. Outdoor Deck 4. River Room Gallery

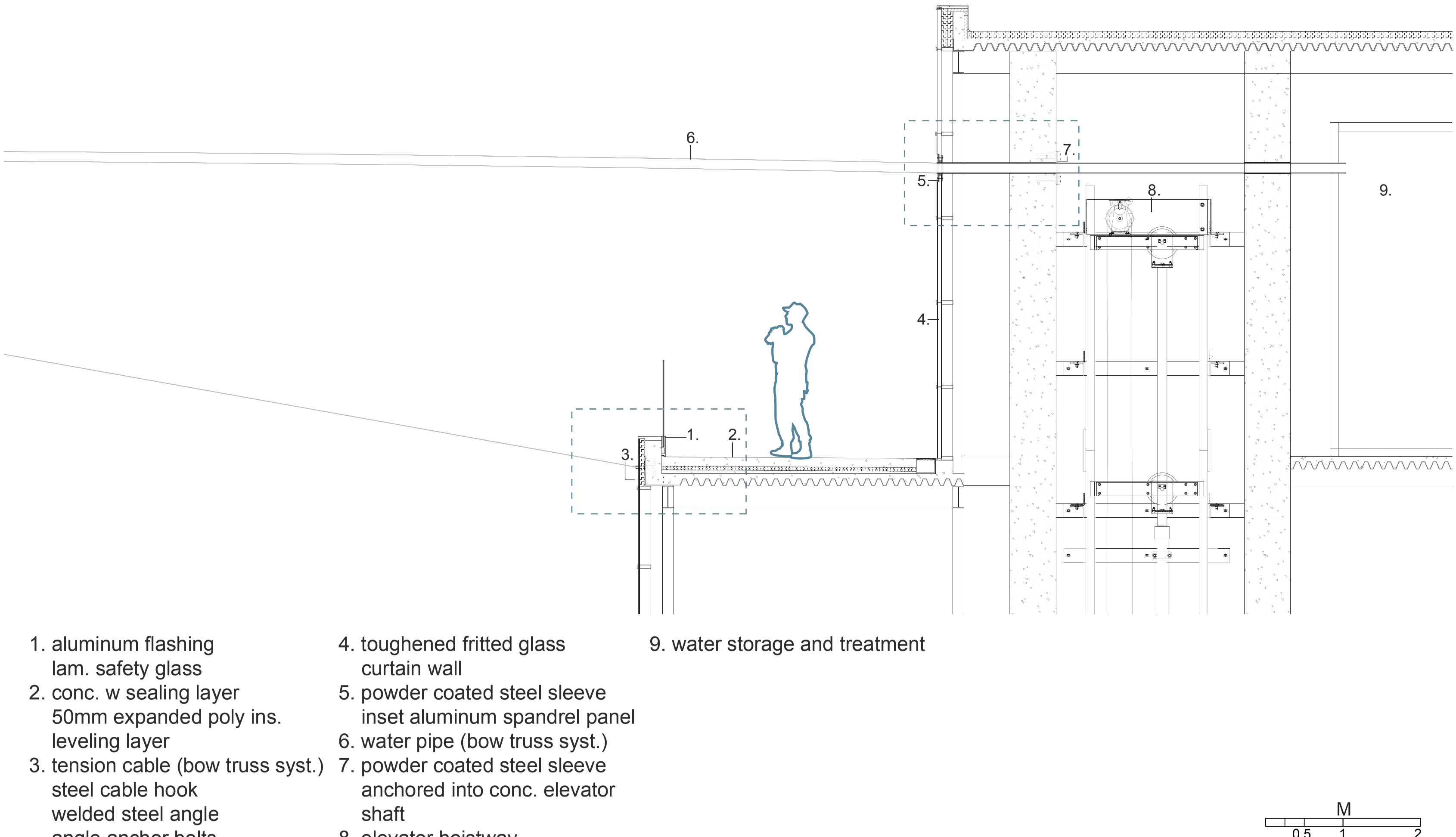
Bath Fifth Floor Plan.

pipes hanging from the roof of the building. The cloud room is separated from the cedar bathing environment and is surrounded on all sides by glazing. A suspended platform in the center of the room allows the guest to stand in the center of the water pipes, and admire a panoramic view of the valley through the wreaths of steam. Surrounding the cloud room, is a large outdoor observation deck, where the visitor can cool off and sunbathe.



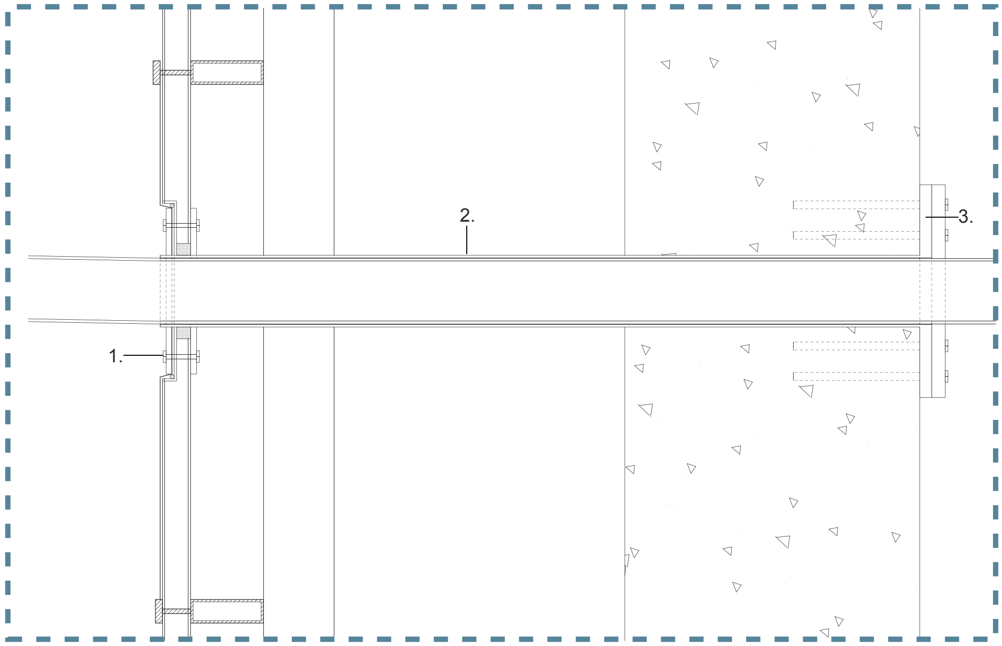
1. Sun Deck 2. Elevator 3. Treatment 4. Access Stair 5. Pipe Path 6. Platform

Bath Sixth Floor Plan.



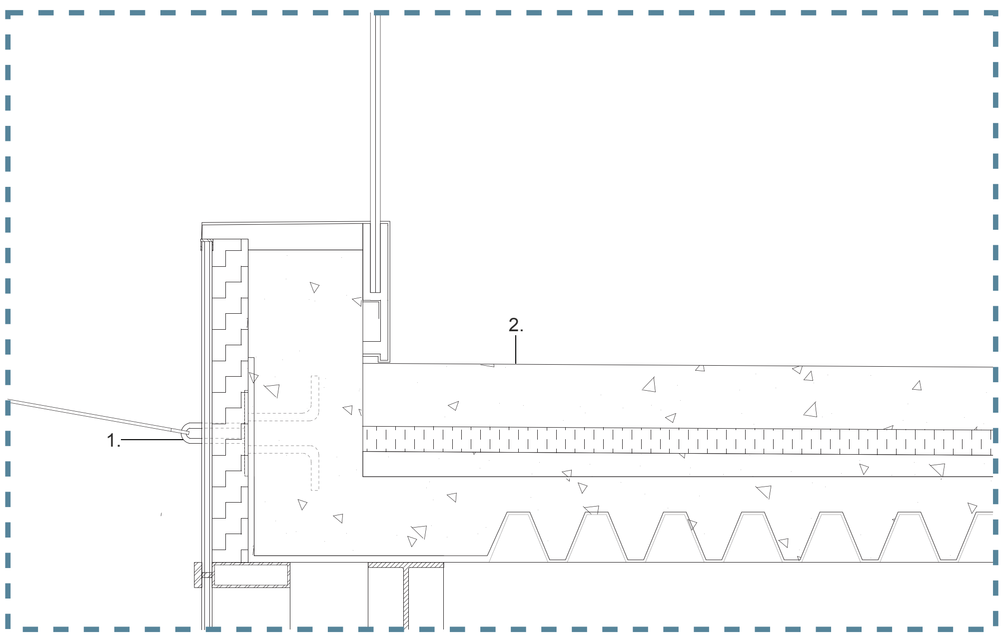
1. aluminum flashing
   lam. safety glass
2. conc. w sealing layer
   50mm expanded poly ins.
   leveling layer
3. tension cable (bow truss syst.)
   steel cable hook
   welded steel angle
   angle anchor bolts
4. toughened fritted glass
   curtain wall
5. powder coated steel sleeve
   inset aluminum spandrel panel
6. water pipe (bow truss syst.)
7. powder coated steel sleeve
   anchored into conc. elevator
   shaft
8. elevator hoistway
9. water storage and treatment

Bath Sixth Floor Trestle Connection Detail. It was important to keep the deck open for circulation.



1. powder coated sleeve cap plate
   aluminum flashing (caulked at seams)
   reinforced aluminum spandrel panel
   TR poly expansion wring
   sleeve bottom plate

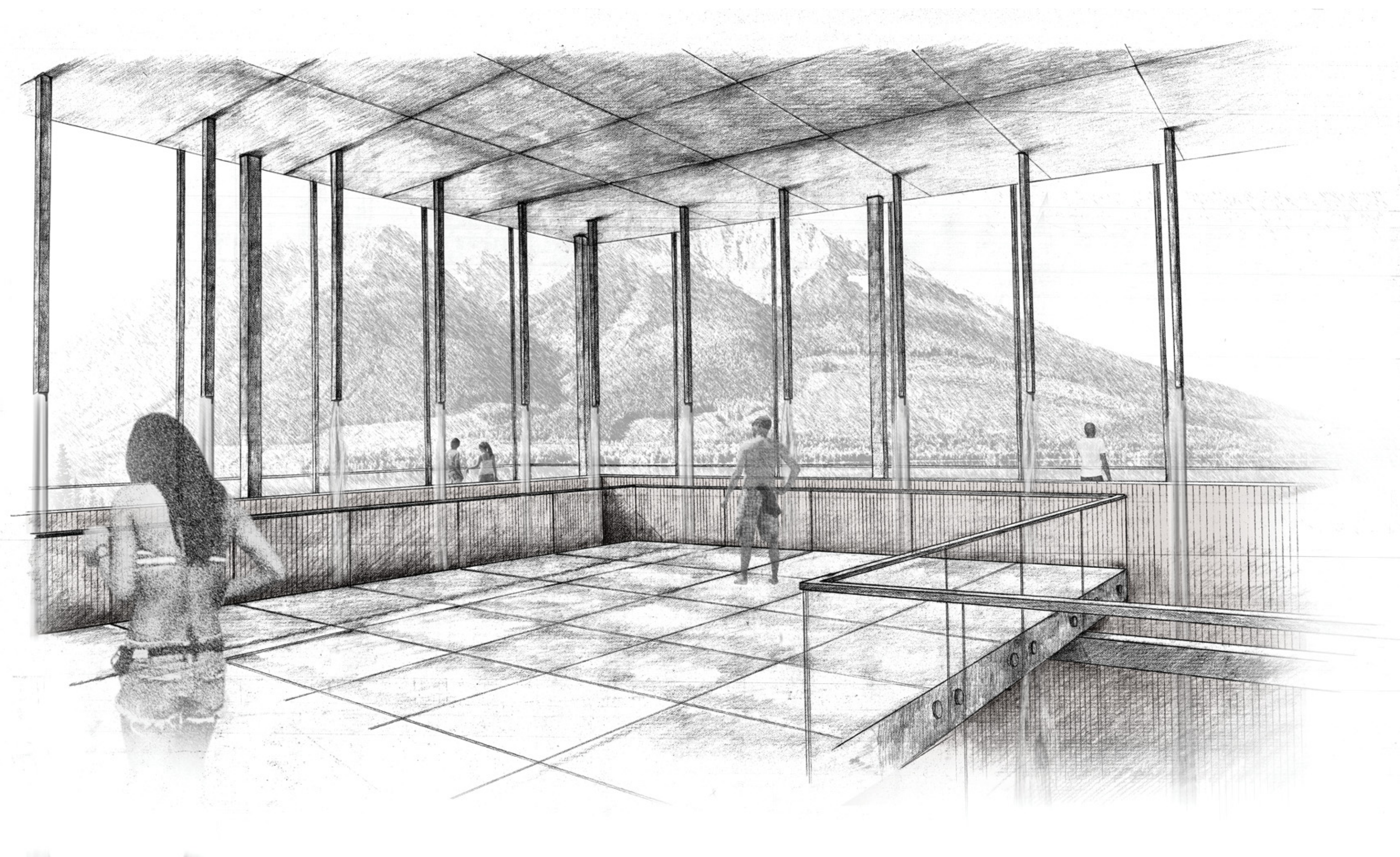
2. powder coated steel sleeve
   steel water transportation pipe
3. powder coated sleeve anchor plate



1. aluminum spandrel panel (curtain wall)
   expanded poly ins.
   welded stainless steel anchor plate
   anchor bolt

2. conc. w sealing layer
   50mm expanded poly ins.
   leveling layer
   conc deck, steel decking

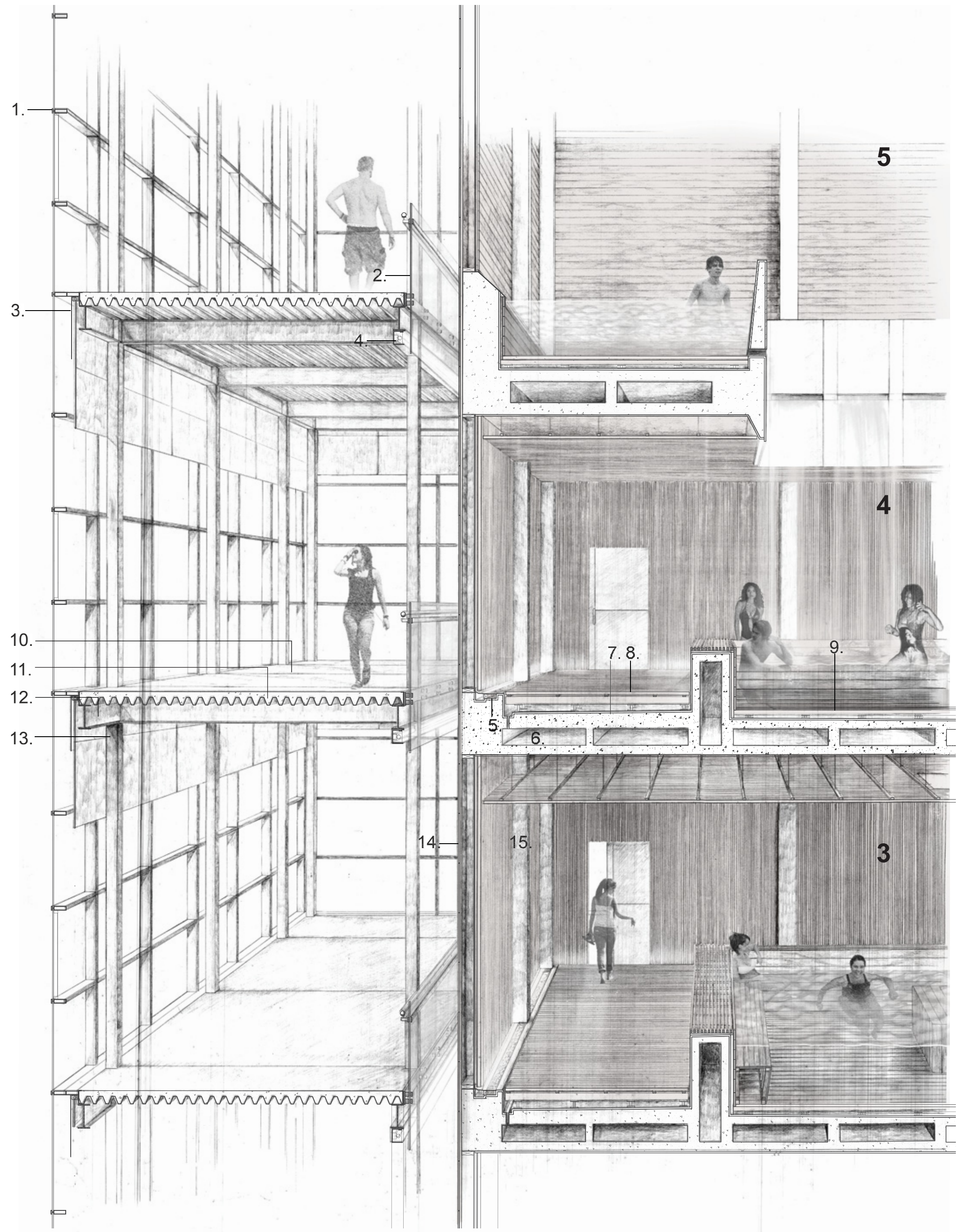
Bath Sixth Floor Trestle Connection Detail.



Bath Sixth Floor (Cloud Room) Vignette. Notice the pipes pouring the thermal water into the cedar box.

Material Detail

Conceptually the bathing environment was to be a wooden construction inserted into a steel and glass wrapping. However, after much research into water towers and mining equipment, it began to be very apparent that a wood framed totemic structure in the heart of the building would be very difficult. The extreme mass of water did not lend itself well to wood construction. Furthermore, structural problems related to rot were very apparent. Therefore, a concrete structure became the most obvious choice. However, a wood wrapper would be fastened to the structure to carry the material concept throughout the entire design of the site. The building would be held up by concrete columns, revealed on the inside of the baths, as warm stones with a wood slat infill. The actual baths took influence from Japanese ‘ofuros’ (cedar tubs) and like the ‘ofuros’ the inside of the baths were lined with elevated cedar planks; creating an environment of warmth wood and water. On the outside wall of the bath, a continuous local cedar paneling system would wrap both the wood infill and concrete columns, giving the visitor the impression of a unified wooden totem rising up through the heart of the building.



1. toughened fritted glass
   curtain wall
2. GRS wet glaze railing system
3. retractable curtain system
4. inset incandescent arch. lighting
5. river stone fill wall drain
   recessed LED accent lighting
6. mechanical plenum
7. 20mm conc. sealing layer
8. cedar planking
   cedar battens
   raised cedar supports
   raised rubber battens
9. cedar tub liner
10. polished concrete
11. corregated steel deck
12. steel I beam
13. steel column
14. cedar panelling
    plywood sheating
    wood stud infill wall
    plywood sheating
    water barrier
    cedar shims
    cedar sheating layer
    cedar planking
15. concrete column

Bath Material Detail. Third (rain room), fourth (fall room) and fifth (river room) floors represented.

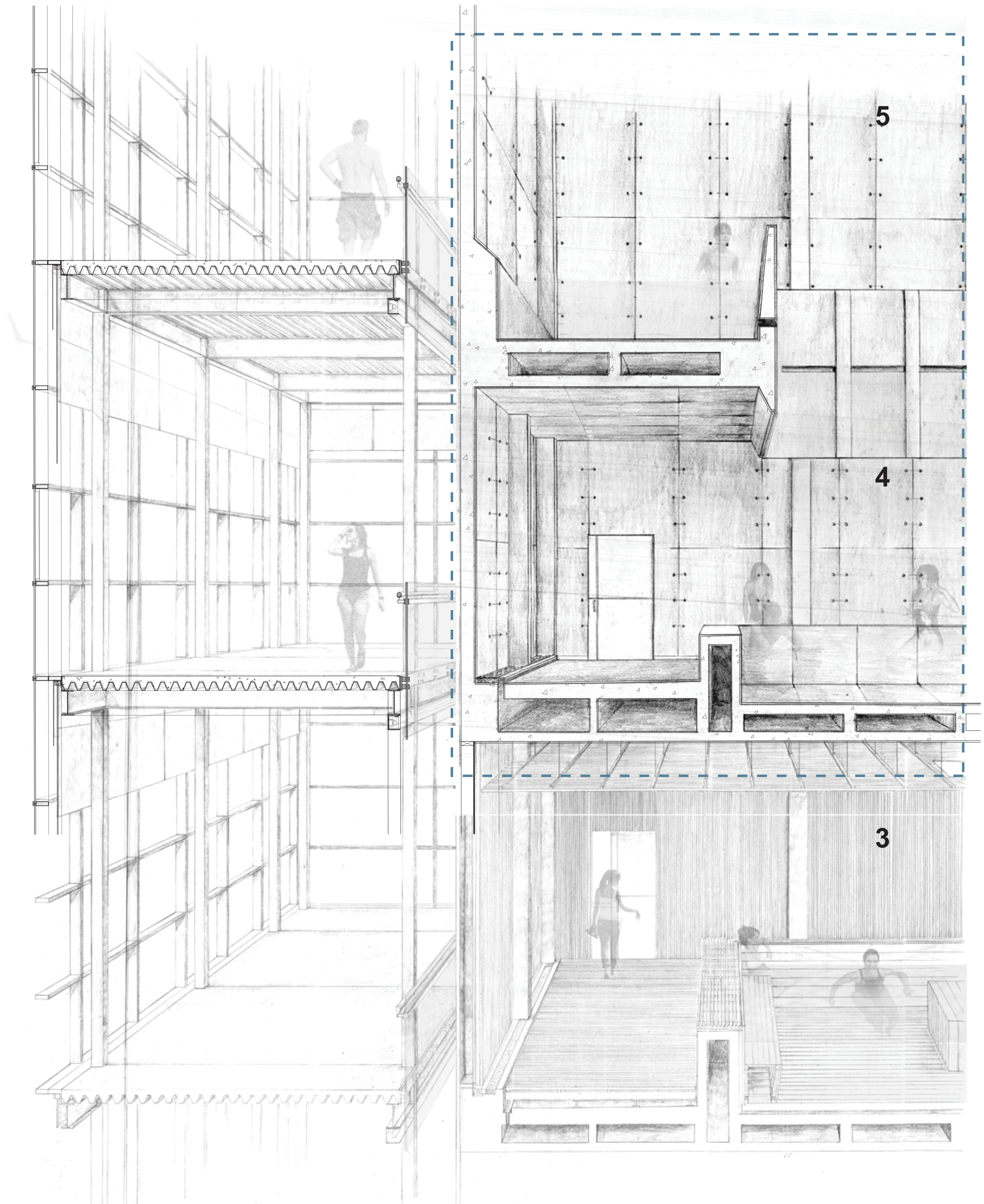
CHAPTER 3: CONCLUSION

The design used a strict material strategy to inform choices on the site. The material strategy may have been limiting in its severity. This is clear in the bath material detail discussed at the end of the design section. Indeed, in an attempt to keep a unified material language throughout all of the buildings' on the site, the bathing area may have became less focussed and refined. However, this strategy was a great strength in keeping a design focus within the many buildings on site. Indeed, it was successful in creating a unified resort destination with a clear architectural relationship between programs.

Throughout this thesis the design objective has employed architecture as a framework in the exploration of a geothermal resource. Though the large scale of the project may not be probable for the development occurring currently in Valemount, the design has aimed to inspire ideas about making the production of geothermal power a public event. By combining the process of power generation with bathing, this thesis designs a place where people can enjoy the effluent of the power process, while learning about an alternative to a historically destructive human relationship with nature. By means of public opinion and perception, architecture has the opportunity to influence the way in which our electrical power is produced. Making geothermal energy attractive through thoughtfully designed public programs and refined architecture, will increase demand for this green resource into the future.

APPENDIX: REVISED MATERIAL DETAIL

After designing the concrete and wood structural system discussed previously, and deliberating on the integrity of the design solution, another strategy became apparent. Concrete is usually a cold material and is notoriously difficult to insulate. The obvious benefits of having a concrete structure first entirely enclosed by a steel and glass wrapping, and second in constant contact with thermal water, made concrete a prime choice for material inside of the bath. Therefore I designed a stripped down version of the original ‘cedar’ version of the bathing environment. The simplicity of the concrete design was a definite positive. Fasteners, water barriers, flashing all became non issues. Furthermore, problems related to rot and drainage no longer had to be addressed. Indeed, while not conforming to my site based material strategy of steel and wood, in the case of the Bathing Center, the concrete design may be the more elegant design solution.



Bath Material Detail (concrete). The fourth and fifth floors have the cedar wall infill, flooring and tub lining removed. The concrete structure is revealed creating rooms of singular materiality.

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