

**material in
transition**
The fragile
mountain

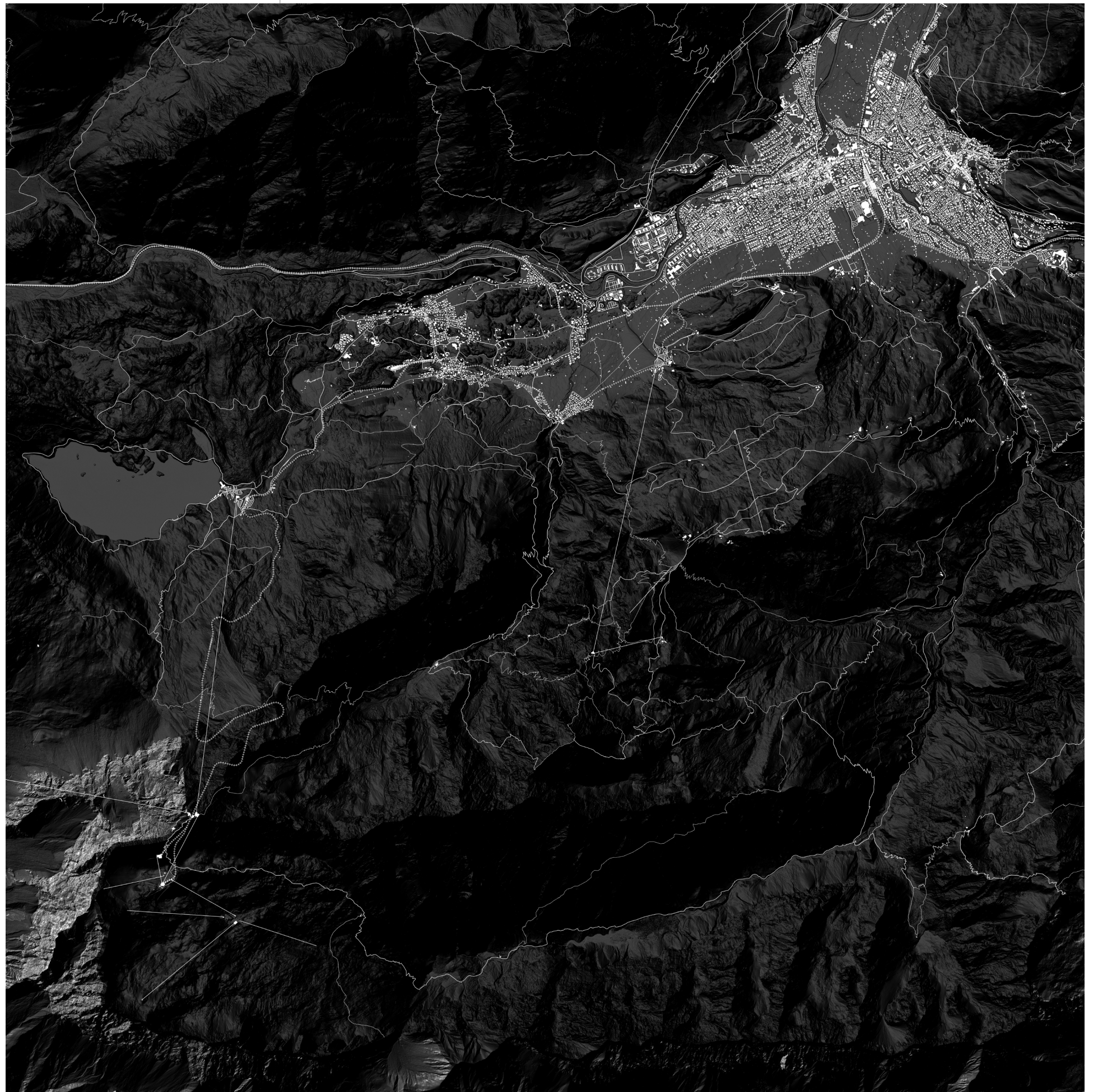
author
Maximilian
Loeschke

07.03.2025



fragile infrastructure

network of transportation routes

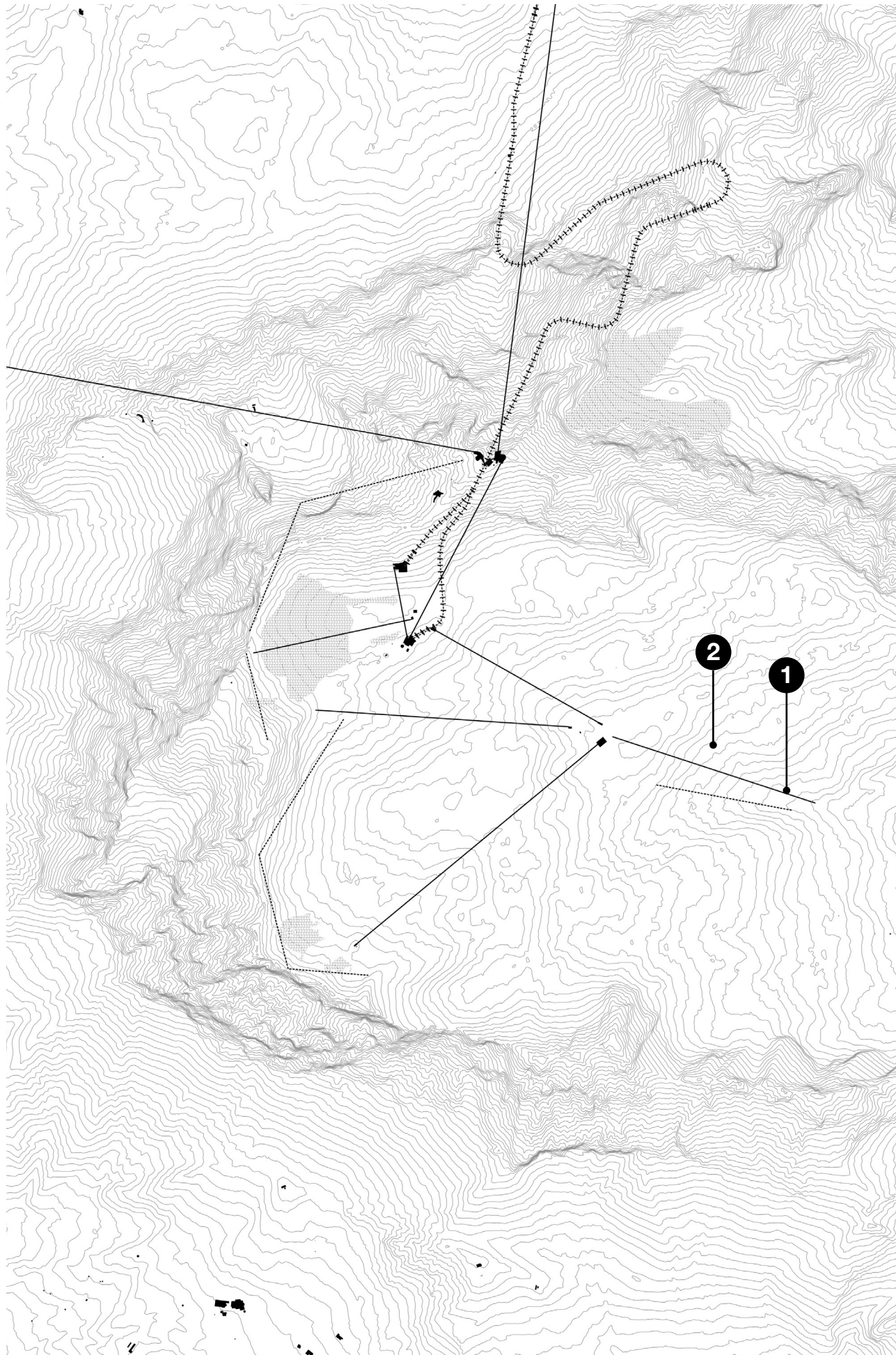


field journal

The ongoing dynamic of erosion in the mountains, accelerated through climate change has implications on human built infrastructure. On top of the Zugspitzplateau, tourism has led to the development of a landscape of metal, glass and concrete. To understand the interrelation of erosion dynamics and built infrastructure, I hike from the lowest point of the ski-area towards the summit.



transportation to the Zugspitz-plateau
via cable car or cog-railway



1 Joachim Götz and Lothar Schrott, eds., Das Reintal - Geomorphologischer Lehrpfad am Fuße der Zugspitze: Eine Wanderung durch Raum und Zeit mit einem Einblick in moderne geowissenschaftliche Arbeitsweisen, 1., Aufl (München: Pfeil, 2010), 12.

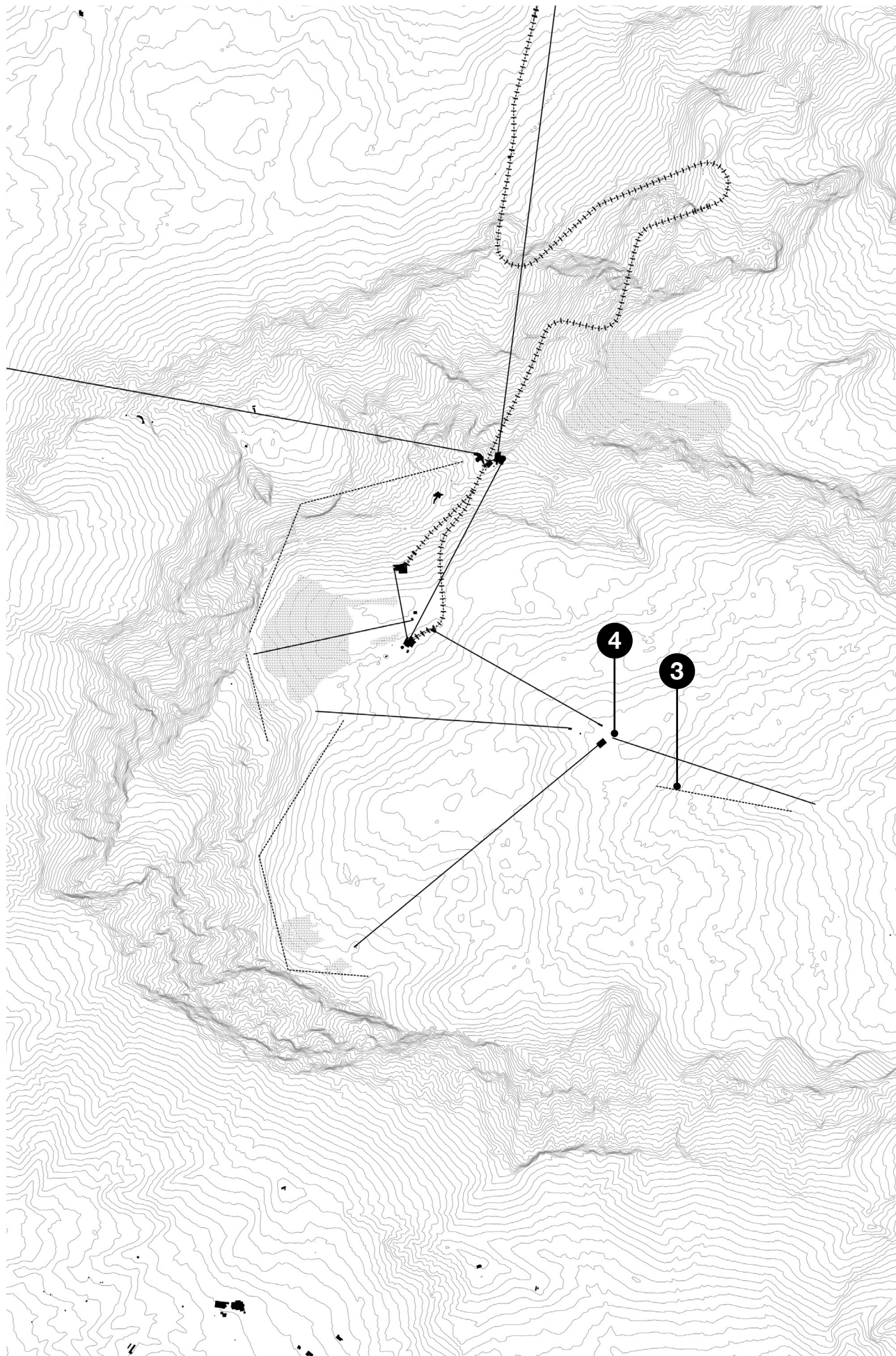
2 Florian Neukirchen, The Formation of Mountains, 1st ed (Cham: Springer International Publishing AG, 2022), 69.

Post-Glacial Landscape. The Zugspitze plateau, with its distinctive horseshoe shape, was sculpted by the immense forces of ice and water during the last glacial period. These natural processes carved the terrain we see today, leaving behind a stark and rugged landscape.¹ In contrast, the ski poles scattered across the plateau appear fragile, a reminder of humanity's short-lived presence amidst the timeless power of nature.



Sinkholes. The characteristic karst landscape is shaped by water dissolving particles of calcareous rock and carrying them away. Over time, water seeps deeper into the rock, creating vast underground cave systems. When one of these caves collapses, the overlying material follows, leaving distinctive depressions on the surface known as sinkholes.²

2.040 m
2.106 m

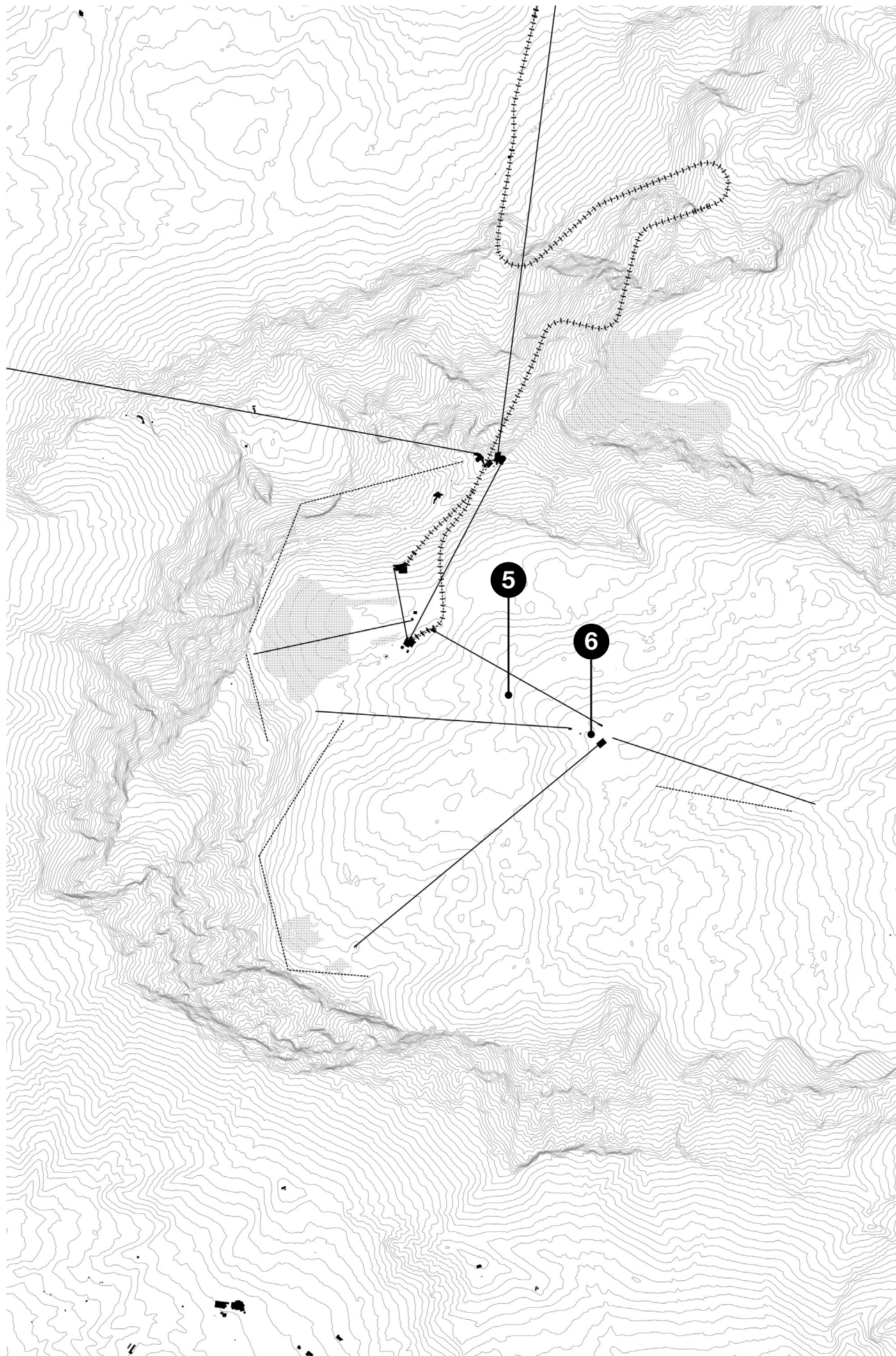


Avalanche blasting. As the plateau is used as a Ski-area, it is highly controlled. Small lift-like structures are positioned above ski slopes on exposed terrain, where explosives are deployed to trigger small, controlled avalanches. This practice helps prevent the formation of large, uncontrolled avalanches, ensuring the safety of skiers.



Ski Slope. Without its snowy cover, the ski slope reveals the underlying terrain. Gravel is accumulated and leveled to smooth over the harsh rock surface. While natural processes relentlessly wear down the rock, human ambition counters with reshaping and maintenance.

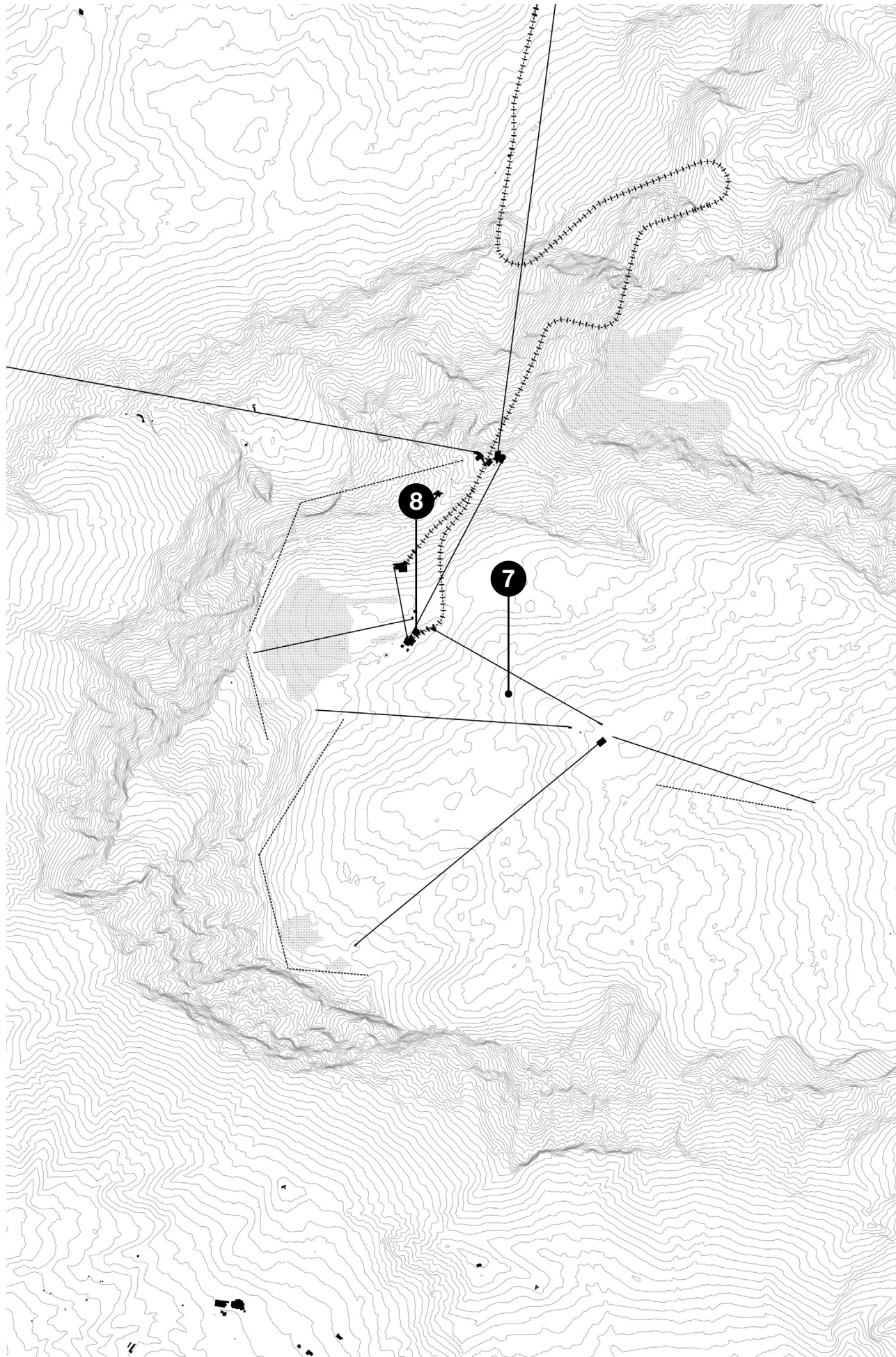
3 2.115 m
4 2.296 m



Snow farming. Snow Farming. To start the ski season as early as possible, snow from higher elevations in the ski area is shaped into a piste. This creates a glacier-like tongue that advances downward, not through natural forces, but by human intervention. Upon closer inspection, the melted runoff water has left visible marks in the gravel terrain below, revealing an interplay between natural and engineered processes.



Construction dump. Gravel and metal profiles are piled next to the slope, likely stored for future repair work or left over from dismantled and replaced lift structures. These materials hint at the ongoing maintenance and adaptation required in this engineered landscape.

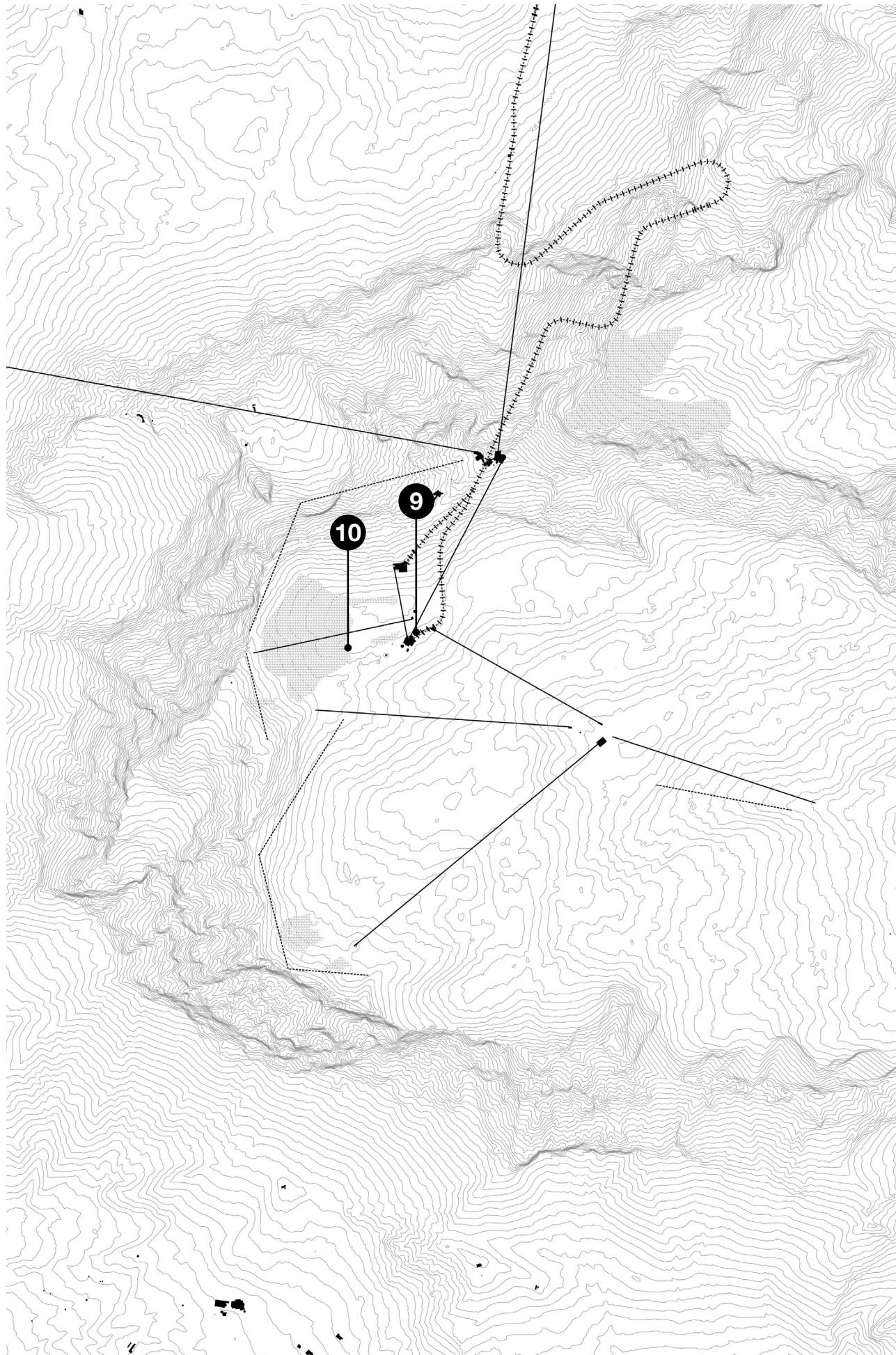


Ski-lifts at the bottom. As gravitational force pulls material downwards, these bottom end lift station are more exposed to avalanches and rockfall. This site is not just an agglomeration of structures but also a storage area for snow, which is compacted into piles to preserve it through the summer months.



Buildings on a hilltop. To protect these structures from avalanches or rockfall, they seem to have been built compactly on an elevated area just below the Schneeferner Glacier. This site is accessible directly from Garmisch-Partenkirchen via the cog railway.

7 2.405 m
8 2.585 m



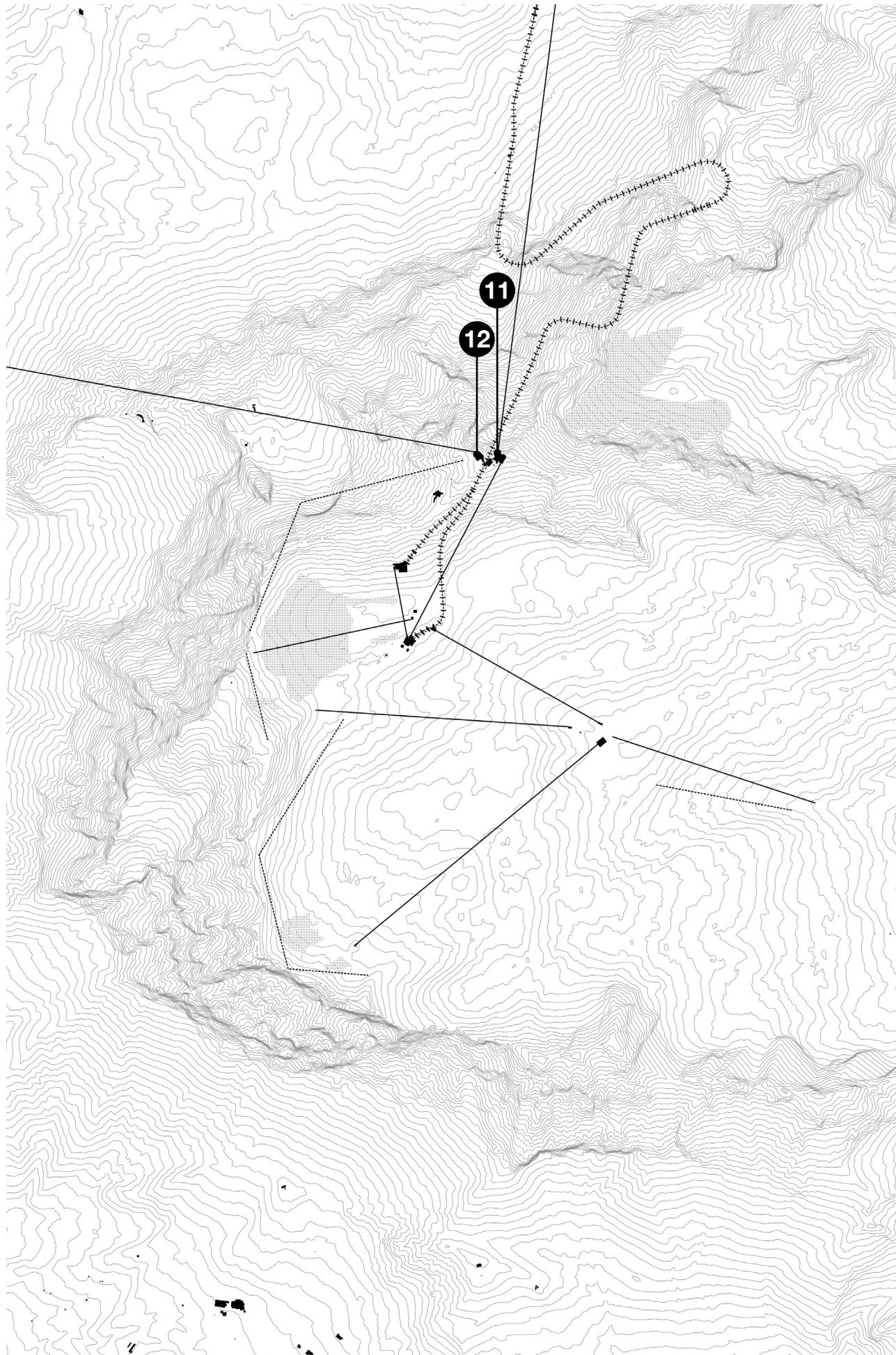
Cog-railway. This railway provides easy access to the glacier directly from the Garmisch-Partenkirchen train station. Its construction involved carving through a 19-meter-wide, ice-filled sinkhole and incorporating insulation to prevent the surrounding permafrost from thawing.³



Glacier. The northern Schneeferner Glacier is one of the last four remaining glaciers in Germany. It is predicted to lose its status as a glacier by 2040. In 2022, the southern Schneeferner Glacier lost its official status, and its remnants are now referred to as „dead ice.“⁴

3 Roland Ulrich and Lorenz King, 'Influence of Mountain Permafrost on Construction in the Zugspitze Mountains, Bavarian Alps, Germany' (6th Int. Conf. on Permafrost, Beijing, 1993), 629.

4 Lui Knoll, Martin Breitkopf, and Günther Rehm, 'Zugspitze-Gletscher: Es Kommt Zum Abschmelzen – Auf Jeden Fall', Bayerischer Rundfunk, 28 June 2023, <https://www.br.de/nachrichten/bayern/zugspitze-gletscher-es-kommt-zum-abschmelzen-auf-jeden-fall>.



Foundation on permafrost. The cable car station and other buildings at the mountaintop are anchored in permafrost. The frozen rock provides structural support to both the rock itself and the buildings. However, due to climate change, this permafrost is expected to thaw over time, which is why researchers from TU Munich are continuously monitoring the structural integrity of the mountain.⁵



Eibsee rock avalanche. The Eibsee, known for its blue color, was likely shaped around 3,750 years ago by a massive rock avalanche that displaced 200 million cubic meters of material. The resulting depression and islands eventually filled with water. Due to thawing permafrost, researchers argue that, while not as dramatic, rockfall events may become more frequent in the future.⁶

5 'Permafrost at the Zugspitze', Munich Alpine Hazards and Mitigation Cluster, accessed 19 January 2025, <https://www.cee.ed.tum.de/alphaz/research/projects/article/permafrost-at-the-zugspitze/>.

6 Ulrich Teipel, 'Geologische Karte von Bayern 1:25000. Erläuterungen Zu Den Blättern 8531/8631 Und 8532/8632' (Bayerisches Landesamt für Umwelt, October 2017), 93.

conclusions

Melting permafrost destabilizes the ground upon which infrastructure is built, avalanche paths intersect with ski lift poles, and entire lifts are situated on glaciers that are rapidly melting. If predictions prove correct, and both the glaciers and permafrost are thawed by 2040, infrastructure will need to be reimagined. Will we need to retreat from high-altitude areas? While there is no definitive answer, one thing is certain: a lift on a melting glacier has no future and will eventually need to be dismantled. This changing material reality of eroded human infrastructure raises questions about its afterlife. Consequently, the most exposed infrastructure, the ski lifts, are collected in a future material bank.

