ALEGACIÓN

Against the Proposed

SIERRA DE SEL WIND FARM

EOL-44-2022

Municipalities of Voto and Ruesga, Cantabria

A Hydrogeological and Environmental Critique
of the Environmental Impact Statement (EsIA) and Supporting Documents

Second Submission – Revised EsIA

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1. EXECUTIVE SUMMARY

This alegación constitutes a formal objection to the proposed Sierra de Sel Wind Farm (EOL-44-2022) in the municipalities of Voto and Ruesga, Cantabria. The proposal seeks to erect ten industrial-scale wind turbines (196 m tall), with associated roads, platforms and substation on high-altitude Cretaceous limestone karst terrain, and a 13.4 km underground 55 kV evacuation line. This is the second submission by the promoter; the main change from the first being a longer underground evacuation line.

Having examined in detail the Environmental Impact Statement (EsIA, 1,330 pages), the Project Overview document (752 pages), the High Voltage Underground Line Modification document (173 pages), and the associated cartography (shapefiles), this alegación finds that the environmental assessment is fundamentally flawed. The EsIA systematically underestimates, ignores or misrepresents the impacts of large-scale industrial construction on karst terrain. The following overarching failures have been identified:

1. The karst environment is not a "Low Environmental Sensitivity" zone. High-altitude karst with well-developed underground drainage, cave systems, endemic biota and distinctive landforms is one of the most sensitive environments in Cantabria.
2. The EsIA fails to treat the surface and underground as an integrated hydrological and ecological system. Underground rivers, conduits, resurgences and their associated biota are barely mentioned and never properly assessed.
3. No water tracing has been conducted (or reported) from the high-altitude construction area to demonstrate where infiltrating water resurges. Without this fundamental data, the claim that the project will have no significant impact on groundwater is unsubstantiated.
4. The claim that karst landscape destruction is "recoverable and reversible" is false. Limestone pavements, dolines, lapiaz and underground features, once destroyed, cannot be restored. The 30-year lifespan of a wind farm does not justify the permanent loss of landforms shaped over millions of years.
5. Approximately 260,954 m³ of fill material must be imported, requiring an estimated 17,400 heavy vehicle journeys. The EsIA barely acknowledges this, and the project document provides no plan for sourcing or managing this material on karst terrain.
6. There are no published drainage plans for the platforms and roads. In a karst environment where natural drainage is primarily via vertical infiltration through fissures, this omission is a critical failing.
7. The proposed use of explosives in karst terrain risks collapsing cave roofs, destabilising underground cavities, and permanently altering subterranean hydrology and biota.
8. The endemic cave isopod Cantabroniscus primitivus, acknowledged by the EsIA as taxonomically and ecologically unique, receives no protective measures whatsoever.
9. The 55 kV underground evacuation line trench passes directly over the known cave Nacimiento del Río Clarín and close to other caves, with a real risk of the trench intersecting underground cavities.
10. Copper leaching from the grounding systems and bentonite injection into fractured karst bedrock pose unassessed risks to underground water quality and aquatic ecosystems.

11. The landscape assessment methodology is reductionist and fundamentally flawed when applied to karst, treating interrelated ecological and geomorphological features as independent variables.
12. The project area is classified as Suelo Rústico de Especial Protección (SREP) – Special Protection Rustic Land – by both Voto and Ruesga municipalities. Industrialisation of this protected land contradicts its designated purpose.
13. The 752-page Project Overview document does not contain a single mention of the word "karst" (or "kárstico"), representing a fundamental failure to acknowledge the nature of the terrain on which the project is to be built.

For these reasons, and as detailed in the comprehensive critique that follows, this alegación concludes that Alternative 0 – not to build – is the only viable and responsible choice. The Sierra de Sel high-altitude karst must be afforded permanent protection from industrial development.

2. INTRODUCTION AND DOCUMENTS CONSULTED

The Sierra de Sel high-altitude karst area, situated between Ogarrio to the south and San Miguel de Aras to the north, is a Cantabrian landscape of outstanding geomorphological and ecological value. It forms part of the Cretaceous limestone region that, in the view of this alegación, should be subject to an indefinite moratorium prohibiting the construction of industrial structures. Building huge industrial complexes on karst ruins the immediate and surrounding areas for decades and beyond.

This alegación deals principally with the effects of constructing a 10-turbine wind farm on well-developed, high-altitude karst, including the effects on landscape, underground environment, underground ecosystems, and the wider hydrological system. It is submitted as a formal response to the second Environmental Impact Statement for the Sierra de Sel project.

Documents Consulted:

A – EOL-44-2022_EiSA(289.3.7).pdf: Environmental Impact Statement, 1,330 pages including 14 annexes.

B – EOL-44-2022_Cartografia(289.3.7.16): Shapefiles, viewed in the QGIS system used by the Matienzo Caves Project.

C – EOL-44-2022_Proyecto_LSAT(289.3.5.03_0).pdf: High Voltage Underground Line Modification, 173 pages.

D – EOL-44-2022_Proyecto(289.3.1.01_0).pdf: Whole Project Overview, 752 pages.

There is considerable overlap between the documents. Where the same issue arises in multiple documents, it is criticised accordingly; if factors are mentioned twice, they can be criticised twice.

Page references in this alegación follow the format p4/14, indicating page 4 from 14 in that particular document or annex, or pp2–10/100 indicating pages 2 to 10 of a 100-page document or annex.

Note: Although the promoter has used some of the information provided by the Matienzo Caves Project after the first version of the EsIA, that information appears to have been "bolted on" rather than integrated into the whole, updated EsIA. There appear to be few, if any, mitigations for karst and the underground ecosystem.

3. COMPREHENSIVE CRITIQUE

3.1 The Fundamental Karst Problem

Industrialising on karst is fundamentally different from building on most other rock types. On non-karst geology, mud, waste materials and water will mainly remain at or near the surface, having limited effect on groundwater and travelling limited distances. On karst terrain, water, mud and other waste will immediately sink underground, using cracks and larger voids to work downward to underground pools, streams and rivers. The underground water flow in karst areas is governed by dip, joints, faults and the overlying and underlying beds. Water sinking from the surface may appear at one or more springs many kilometres distant.

On this high-altitude karst, polluted or contaminated waters can drop down hundreds of metres through the rock and travel through kilometres of river passage to reach resurgences, affecting the underground biota throughout. We are not dealing with localised surface impacts: the effects propagate through an interconnected three-dimensional drainage system.

High-altitude limestone karst is characterised by limestone pavements (clints and grykes), sinkholes (dolines), closed depressions, dry valleys, shafts, extensive cave systems and enlarged fractures. Surface streams are sparse because water rapidly sinks into the rock and flows through underground conduits to springs at lower elevations. Soils are thin and patchy, accumulating mainly in fissures and depressions. Vegetation is sparse on bare rock but denser where deeper soils occur in hollows.

The very first consideration for any proposed development should be: "Will building a wind farm seriously affect the environment?" If the ground is karst, the answer is "Yes", and the developer should look elsewhere.

Since most of Cantabria’s mountains are karst limestone, high-elevation areas with good wind resources are almost inevitably karst. This represents a fundamental conflict between renewable energy targets and the protection of sensitive karst hydrogeology and ecosystems – a conflict that should receive far more scrutiny than it is currently afforded. The Cantabrian government appears to be encouraging wind farms on land that is clearly unsuitable. Other provinces in Spain have much more suitable, non-karst terrain.

This wind farm will have an operational lifespan of approximately 30 years. Houses last for more than 100 years. Ruining a karst landscape with its unique landforms and biota for just 30 years of energy production is profoundly short-sighted. The karst relief, landforms and underground systems have developed over millions of years and cannot be recreated.

3.2 Misleading Statements and False Premises

The EsIA opens with the assertion (p15/330) that renewable energy "contributes to preserving the environment and ensuring sustainable development." This is misleading in context. If, in order to deploy renewable energy, the local high-altitude karst environment must be destroyed and underground ecosystems threatened, with vast quantities of ground material moved, then the wind farm does not "preserve the environment" – it devastates a specific, irreplaceable environment for a generic, global benefit.

The EsIA classifies the wind turbine locations as being within an area of "Low Environmental Sensitivity" (p19/330) according to MITECO's environmental sensitivity mapping for wind energy. This designation is completely wrong for high-altitude karst with well-developed underground drainage, cave systems, endemic fauna and distinctive landforms. The area is an unspoilt, remote sanctuary – both above and below ground. The question must be asked: what does this national sensitivity tool say about karst and its unique underground biota and network of rivers? The answer appears to be: nothing.

The Project Overview document (752 pages) states (p3/93): "Unlike what can happen with conventional energies, wind energy does not produce any type of alteration to aquifers, either through consumption or contamination from waste or discharges." While this may apply to a completed, operational wind farm in non-karst terrain, it ignores the extensive threats to the karst surface and underground ecosystems during the industrialisation of the area – the construction phase, which is the most damaging period.

Critically, the 752-page Project Overview document does not contain a single mention of the word "karst" or "kárstico". "Caliza" (limestone) appears only twice, and never in a landscape context. How can the authorities make an informed decision when the principal project document fails to acknowledge the fundamental nature of the terrain?

The EsIA's own text (p137/330) acknowledges: "In the most exposed areas … the bedrock emerges directly, giving rise to HIC 8210 calcareous outcrops and HIC 8130 active calcareous clays … To these formations, one should add the profusion of caves comparable to HIC 8310; these, as a subterranean manifestation of the described karst relief, must be very well-developed judging by the large number of entrances and sinkholes observed." Having recognised this, the EsIA then fails to address the implications for the proposed construction.

3.3 Hydrogeology, Underground Drainage and Water Tracing

The EsIA states (p118/330) that the wind turbines and roads are located on materials with "Very High" permeability. This admission means that water carrying dissolved and suspended solids from construction activities will quickly reach the underground ecosystem. Yet the EsIA then discusses underground water in terms of large "blocks" (water masses), which is largely irrelevant. In practice, most karst underground water flows in discrete channels, resurging at springs around the base of the hillsides.

No water tracing has been conducted (or reported) from the high-altitude area to demonstrate where sinking water resurges. The springs in Ogarrio and San Miguel de Aras are the ones most likely to be fed by water sinking on the high-altitude karst within the project area. Without water tracing – ideally conducted during rainy conditions – it is impossible to assess the hydrological connectivity or the downstream impacts. It is the promoter's responsibility to demonstrate that construction, operation and dismantling will have no effect on water quality or on the underground environment behind these springs.

The EsIA states (p111/330) that wind farm elements "are not located over watercourses or encroaching on their buffer zone (100 m)." This ignores the karst nature of the project: all high-altitude elements are directly above underground rivers, streams or percolation routes within the rock. The reason there are no permanent surface streams at high altitude is precisely because water sinks into the ground and flows through subterranean passages.

Table 65 (p226/330) lists only a single resurgence that may be affected. This is inadequate. Springs in Ogarrio and San Miguel de Aras are the most likely receptors of water infiltrating from the project area (see Annex 3 for mapped springs).

The EsIA acknowledges (p228/330) the presence of the significant Monticueva Sinkhole near the turbine platforms, with groundwater flowing east to west and passing beneath turbine SS-08. Yet the impact is assessed as merely "moderate" on the grounds of "localised extent." Surface drainage cannot be considered to have "localised extent" on karst, where rock dip, joints and faults can direct underground water many kilometres distant. Is the resurgence for the Monticueva water known? There is some belief that the Monticueva water resurges in Ogarrio – therefore passing under the wind farms. Has water tracing been carried out? These fundamental questions are unanswered.

Other sections of the highlevel karst may drain to the same and / or other resurgences. Water tracing in these other areas will be required.

The EsIA states (p226/330): "the actions proposed during the construction of the project will not reach the depths where this mass is located and, therefore, no impacts will occur on it." Water and contamination from the project may not reach the deep-water mass, but will certainly reach the water table and underground conduits where water generally resurges at springs around the high-altitude area. Any water that subsequently percolates into the deeper mass may also be contaminated. The quoted statement is simply wrong.

The Non-Technical Summary (pp17–18/24) refers to a "geological and hydrogeological study of the geological context of the Alto de Fuente Pico karst area." This appears to be an error – Fuente Pico is a different location. Such errors undermine confidence in the document.

The Environmental Monitoring Plan (Annex XIII, pp7–8/35) proposes monitoring of "the most representative channels" for water quality, but makes no mention of underground water courses under the high-altitude karst, no mention of resurgences, and no mention of water tracing. This is a fundamental omission.

3.4 Underground Biota and Subterranean Ecosystems

The EsIA acknowledges (p156/330) that there is "profound ignorance regarding the distribution and population status of most invertebrate species, which hinders reliable assessment of the need to establish protection measures." This applies with particular force to invertebrates living underground. With such acknowledged ignorance, the precautionary principle demands that these species be better studied and protected, not that development proceed regardless.

The EsIA specifically identifies Cantabroniscus primitivus (p156/330, pp239/330), an endemic cave isopod of the Cantabrian Mountains, the sole species in its genus, which inhabits subterranean aquatic environments in limestone caves and karst systems. The EsIA notes its "taxonomic and ecological uniqueness." Having made this identification, the EsIA then proposes no protective measures whatsoever. Cantabroniscus is highlighted – then forgotten.

The section on fauna impacts (pp207–208/330) refers to the impact on surface and underground water in Table 55, but makes no equivalent separation between surface and below-ground fauna. The fauna impact sections throughout (pp229/330, pp271–272/330) contain no mention of underground biota.

The Preventive Measures section (pp309–310/330, Section 10.1.1.7 Fauna) has no mention of how damage to underground biota can be avoided. The Operation Phase fauna section (pp315–316/330) similarly omits underground biota. The Monitoring Plan (Annex XIII, p22/35) discusses monitoring of amphibians, reptiles and other groups but makes no mention of underground biota or resurgence monitoring.

The Ecological Connectivity Study (Annex IX, pp1–54) contains no mention of "karst" or the underground ecosystem – a major omission given that underground cave passages provide the primary habitat connectivity for subterranean species.

European Union COST Action 620 established that karst aquifers are "particularly vulnerable to contamination" because "contaminants can easily reach the groundwater, where they may be transported rapidly in karst conduits over large distances" with "residence times often short" and "processes of contaminant attenuation therefore often not work[ing] effectively." The EU Water Framework Directive (2000/60/EC) and Groundwater Directive (2006/118/EC) require Member States to protect groundwater against pollution and deterioration, and to prevent significant damage to groundwater-dependent ecosystems. The failure of the EsIA to properly assess impacts on subterranean ecosystems represents a potential breach of these obligations.

3.5 Landscape Destruction and the Myth of "Reversibility"

"Recoverable and reversible" is a phrase used throughout the EsIA and supporting documents to imply that karst destruction can be repaired and original features restored. This is not true. It is the single most misleading claim in the entire assessment.

The EsIA states (p219/330): "although the restoration of part of the surfaces will take place once the works are completed and the trenches are closed, the impact related to earth movements and the opening of trenches is considered to be of high intensity and wide extent, although recoverable and reversible." How can the destruction of a rugged high-altitude karst landscape – with limestone pillars, pavements, grykes and sinkholes – be "recoverable and reversible"? The claim is simply false.

At p221/330, the EsIA states that "much of this loss is temporary, as many of the areas will be restored to their initial condition once the construction phase is completed. Thus, they are considered reversible, temporary, recoverable, and non-synergistic." Clearing and brush cutting on karst inevitably involves destruction of limestone formations as soil and vegetation is removed. The argument that areas "will be restored to their initial condition" is specious.

The Dismantling Phase discussion (pp268–269/330) claims: "The restoration of the area to its conditions prior to the implementation of the project will have a positive impact on the relief." This statement is disingenuous. The karst scenery at high altitudes, including changes in relief, cannot by its very nature be restored to "conditions prior to the implementation of the project." Dolines filled in, limestone pavements broken up, and escarpments cut through are gone permanently.

The Restoration and Landscape Integration draft (Annex XII, p6/13) requires "smoothing slopes and fills, avoiding sharp gradients that contrast with the natural relief of the area." But the natural relief of the high-altitude karst includes limestone pavements, deeper lapiaz, sinkholes, closed depressions, dry valleys and sharp rocky features. Smoothing and filling is the antithesis of restoration – it creates an entirely different, alien surface.

Annex XII contains no mention of "karst" and makes no mention of restoring drainage patterns.

If the wind farm is ever dismantled, the previous karst relief and landforms will never be restored. New roads with their cuttings and embankments will not disappear. The concrete foundations (26 m diameter, up to 3.2 m deep, multiplied by ten) will remain, either visible or buried under fill. In effect, the countryside will have been destroyed in perpetuity.

3.6 Earthworks, Roads and Material Transport

The EsIA (p61/330) provides a table of earthworks quantities.

For roads: 227,573 m³ of material excavated and 305,740 m³ required for levelling.
For platforms: 144,627 m³ excavated and 327,414 m³ required for levelling.
The shortfall is: roads 78,167 m³ + platforms 182,787 m³ = approximately 260,954 m³ of fill material that must be imported.

At 15 m³ per heavy vehicle load, this requires approximately 17,400 truck journeys bringing material from elsewhere. The EsIA (p302/330) states: "if there is surplus material from the excavations after the completion of the works, it will be removed." There is unlikely to be any surplus; the problem is the massive deficit. The Non-Technical Summary (p17/24) similarly refers to "balancing the volume of excavation with that of embankment" without acknowledging the huge shortfall.

The Project Overview (pp85–91/157, section on embankment fill) makes no mention of the quantity of material to be imported. Where are the borrow pits? The document (p24/157) states "the opening of a quarry for the extraction of borrow materials is not planned" for topsoil – but what about the rock and rubble required? These borrow pits could themselves be a significant threat to landscape and karst.

The maps show 13,675 m of new roads, with 58,305 m² of land cleared in total. Road widths measured from the supplied maps are typically 15 m (including cut-and-fill) with junctions up to 27 m wide – substantially wider than the stated 6 m carriageway (see Annex 4). The longitudinal profiles in Document No. 2 of the Project Overview show the massive amount of cut-and-fill required on the roads.

The platform plan diagram (p55/330 EsIA, p36/93 Project Overview) has no scale, making independent verification difficult. Dimensions from the Project Overview (p37/93) show platforms of 185.5 m length and 71.5 m maximum width. The maps provided clearly show platforms removing limestone knolls and filling low areas – wholesale destruction of natural karst geomorphology.

3.7 Use of Explosives on Karst

The Project Overview (pp29–31/157) contains extensive generic instructions for the use of explosives, including blasting plans, vibration studies, safety distances and monitoring. The Evacuation Line document (p12/21) states: "In rocky terrain, the use of explosives or a jackhammer will be essential." The Safety and Health Study (p15/23) refers to the use of explosives with "the corresponding official permit and holding the blasting license."

Yet at p57/157 the Project Overview states: "The use of explosives is completely prohibited, except in those places where it is explicitly specified." This self-contradictory statement demonstrates the incoherence of the documentation.

The use of explosives in karst terrain is extraordinarily dangerous. Blasting can collapse cave roofs, create new fracture pathways for contaminated water, destabilise underground chambers, permanently alter drainage patterns and destroy irreplaceable underground habitats. Vibrations from blasting can travel through limestone for considerable distances, affecting caves and underground features well beyond the immediate blast zone. None of the documents address these karst-specific risks. The blasting instructions are entirely generic – the predominant rock type (fractured limestone karst) and its unique properties, risks and potential for damage are not mentioned.

The Dismantling Phase (Annex 9, p7/16) even proposes using "explosives for concrete" to demolish the foundations during decommissioning, causing yet further damage to the underground environment. (See Annex 5a and Annex 5b for a fuller critique of explosives use on karst.

3.8 Drainage Design – A Critical Absence

In none of the 2,255 pages consulted does there appear to be any drawings or plans for runoff management from the platforms and roads. There are no published plans for the drainage system. This is an extraordinary omission for a project on karst terrain.

In a natural karst region, most rainwater infiltrates the soil and limestone without forming surface streams. During heavy rainfall, temporary streams may form and sink into dolines. The EsIA (p227/330) describes road drainage as "ditches 1 metre wide and 0.50 metres deep" but does not explain where the drainage outlets will be or how the system will "ensure the continuity of the natural water flow." Natural drainage on high-altitude karst begins with rainfall infiltrating directly down through cracks and fissures into subterranean streams. The proposed artificial drainage system will inevitably concentrate runoff and discharge it at unnatural points, potentially altering underground drainage routes.

The Project Overview (pp96–126/157, Chapter IV: Drainage) provides a thorough description of drainage pipes, with testing and storage specifications, but there is no mention of where and how they will be deployed, what the overall drainage system will look like, or how drainage outputs will be distributed to mimic natural drainage.

Runoff from roads and platforms should, at a minimum, be directed to settling ponds before any water is allowed to infiltrate naturally. Clean water from these ponds should be dispersed diffusely to mimic natural rainfall infiltration, not concentrated into the nearest doline where it would alter underground drainage routes.

The position of any "washing basins" (p304/330) for concrete gutter cleaning cannot be evaluated as there are no diagrams of the overall drainage system.

3.9 The 55 kV Underground Evacuation Line

The underground 55 kV evacuation cable is 13,442 m long, buried in a trench 1.6 m deep and 0.65 m wide, with most of its route through limestone with potential karst features. The last 1.5 km appears to run over sandstones.

What is not mentioned is the access required to excavate these trenches. For example, the first 657m (plan map length) of the trench from the Sierra de Sel substation is not on tracks, and is shown as a straight line going down through the karst, dropping 177m. Similar straight-line incursions are indicated on a number of steep hillsides. Lack of access

for machinery and the subsequent building of tracks has not been mentioned in this document.

Splice chambers (for splicing cables) are significant buried structures measuring 7.9 m x 2.4 m x 3.15 m depth, requiring excavation of at least 64 m³ of material each. If excavated into limestone, there will be consequences for underground drainage and ecosystems. There is an inconsistency in the documentation: page 20/38 lists 8 planned splice chambers while page 28/38 states only 4 are necessary. The plans in Document No. 2 also show 8 chambers.

The evacuation line trench passes directly over the cave Nacimiento del Río Clarín (entrance at 457818 4796441, Datum: ETRS89). The trench passes at approximately 457786 4796456 (~PK3135) and there is a real risk that the trench may intersect the cave below. (See Annex 3).

The evacuation route also comes close to other caves known to the Matienzo Caves Project near San Miguel de Aras. The position of Cueva Otero IV is wrongly located in the archaeological report – it is situated at 30T 457227 4800177 (Datum: ETRS89) and is catalogued as #2788 in the Matienzo Caves Project database.

Other sites of speleological interest at risk from the trench are shown in Annex 3.

The surveyed length of Cueva de Cobrante is stated in the EsIA (p45/58 of the archaeological annex) as "about 150 meters." This is wrong. The surveyed length is 472 m (see https://matienzocaves.org.uk/descrip/0110.htm).

Note: The EsIA (p324/330) states the underground 55 kV line length is 26.88 km. This is an error; the correct length is 13.44 km (p66/330).

The 55 kV underground evacuation line travels north and finishes at the SET Las Mazas. The 30 kV underground evacuation line from the proposed Fuente Pico wind farm follows the same route as the northern part of the Sierra de Sel line. There is no documentation in either proposal about sharing trenches or digging 2 trenches or coordinating the excavation of the trenches, etc.

3.10 Electrical Grounding Systems and Chemical Contamination

Each wind turbine has a grounding system beneath its concrete base consisting of a 15 x 15 m copper mesh with bare copper conductor (90 mm² cross-section), completed by four copper-coated steel rods driven 5 m deep. The drill holes are to be filled with bentonite (p40/330).

This raises multiple concerns specific to karst terrain:

Copper leaching: Bare copper conductors will leach copper over time. In karst terrain with thin soils and rapid infiltration, there is minimal attenuation between the grounding system and bedrock. Copper toxicity thresholds for aquatic ecosystems are in the µg/L range – much lower than drinking water standards.

Bentonite in karst: Bentonite swells when hydrated and could migrate into fractures, joints and small conduits. During rod installation, voids may be encountered and bentonite could flow into these features. Bentonite can alter hydraulic conductivity and potentially clog karst drainage pathways. It introduces a fine-grained sealant into a system characterised by open conduits.

Installation risks: Drilling 5 m deep rods in karst risks intersecting epikarst features, vertical fractures, small solution cavities and perched water tables. This could create preferential pathways directly from the grounding system to the saturated zone.

The EsIA contains no assessment of these risks.

3.11 Landscape Assessment Methodology – Fundamental Flaws

The landscape study (Annex IV) applies a methodology that is fundamentally unsuited to karst environments. The study uses a 10 km radius around the wind farm generators and evacuation line, greatly "diluting" the direct impact areas (the high-altitude karst and the narrow corridor for the underground cable) within a much larger, diverse study area.

The study classifies the project area as "Low Mountain" (pp25–26/96). While the terrain has less relief than the Picos de Europa, calling the Sierra de Sel a "Low Mountain" area disguises the significant local height differences: the highest point is approximately 825 m altitude, whereas San Miguel de Aras sits at 50 m and Ogarrio at 125 m.

The study's assessment of landscape fragility and quality is fundamentally flawed when applied to karst. It attempts to separate out vegetation, slope, orientation, diversity and density as independent comparable metrics across different landscapes. On high-altitude karst, these factors are not independent – each depends on the others and all are part of an integrated whole. A patch of dense vegetation in a doline signifies concentrated water and sediment pathways, not merely higher rainfall or gentler slope.

The conclusion on page 36/96 that "the wind turbines of the three proposed project alternatives are located in areas with low landscape fragility" is therefore false. Taken as a whole, the high-altitude karst is highly susceptible to change if wind generators were installed, and would face not merely deterioration but complete destruction. That sentence should read: "The wind turbines of the three proposed project alternatives are located in areas with high or critical landscape fragility."

Treating "water" as a defining landscape factor is inappropriate when most of the high-altitude karst appears dry at the surface. However, the extensive underground water system is the dominant hydrological feature. Furthermore, the Visibility Map (p264/330) indicates the wind farm will be visible from much of the LIG Matienzo Polje and from Relevant Landscapes of Cantabria – 196 m tall structures that are completely out of character with the countryside.

3.12 Archaeological and Heritage Concerns

The archaeological and cultural heritage annex (pp1–58) spends the first 24 pages unnecessarily re-describing the wind farm project before addressing any heritage issues. The satellite photographs used have no scales and no north indicators.

The first north-heading section of the 55 kV underground evacuation line is shown heading in the wrong direction on the maps (p42/58); it should be NNW as shown on page 5 and on all other maps in the total documentation seen. This error is carried through to page 55, Figure 32.

The position of Cueva de Cobrante is unclear on Figure 18 (p44/58) and the nearest point of the evacuation line is incorrectly shown. The surveyed length of Cueva de Cobrante is

472 m, not the "about 150 meters" stated. Cueva Otero IV is wrongly positioned in the report (see Section 3.9 above).

These errors in archaeological and heritage documentation undermine confidence in the accuracy of the entire assessment.

3.13 Decommissioning and Dismantling

The Dismantling Annex (Annex 9) promises "Environmental and landscape restoration of the area is mandatory, restoring the initial conditions or improving them." This is the only document that also mentions the possibility of "replacing the wind turbines with others of greater efficiency" – raising the prospect of indefinite industrialisation.

The decommissioning plan envisages:

• Refurbishment of roads and platforms (further disturbance to karst)

• Demolition of visible foundation parts using explosives for concrete and oxy-fuel cutting

• Leaving the bulk of the foundations in place, covered with 60 cm of fill soil and 20 cm of topsoil

• Either leaving 13.4 km of underground cables in place or reopening all trenches

The foundations will not be fully removed because "extraction of the foundations … will generate a much greater impact on the land than that produced during the construction phase" (p8/16). So, the promoter's own document admits that full restoration would cause more damage. The result is that ten large reinforced concrete structures remain permanently buried in the karst – with signage and locator panels. This is not restoration.

The EsIA's conclusions about the dismantling phase (p270/330) state that "No alterations to the drainage network and surface runoff in the project implementation area are expected during the dismantling phase." This is contradictory: either the drainage network is removed (causing earth movements) or it remains in place (meaning complete restoration is not achieved).

3.14 Planning, Land Use Classification and Legal Framework

Both Voto and Ruesga municipalities classify the wind farm area as Suelo Rústico de Especial Protección (SREP) – Special Protection Rustic Land. It has special protection for a reason. Allowing a 10-generator wind farm with 13 km of new roads is not protecting the land in the slightest.

Annex 8 of the Project Overview relies on Law 7/2013 (Article 6.2), which classifies wind farm installations as "actions of public interest," to override the SREP classification. However, the "public interest" must surely include not allowing the industrialisation of a remote, ecologically valuable area with unique underground features and biota. The SREP maps show the protected areas but make no mention of karst as a special feature. The landscape, with its rock formations, cliffs, scars and underground features, exists precisely because the underlying rocks are slowly soluble limestone. The SREP designation should celebrate and protect these karst qualities.

The EsIA states (p201/330) that the wind turbines are on Non-Urbanizable Land of Special Protection (SREP, Class III, Ecological-Landscape Protection, Zone 2, Moderate Use). How is it possible to build a massive industrial complex on land designated for "ecological-landscape protection" with only "moderate use"?

The vague statements in the Social Impact section (p86/93 of the Project Overview) about "complementary actions" and "new possibilities for future use" imply plans for additional industrialisation (batteries, more substations, more wind farms), with a suggestion that municipal corporations have already signed agreements. These should be fully disclosed.

3.15 Health and Safety on Karst

The Health and Safety Study (Annex 5, Document 1) appears to be a completely generic document without reference to local hazards and risks specific to karst terrain. There is no mention of (for example):

• Slips on exposed limestone

• Falls into concealed shafts, fissures or dolines

• Collapse of ground into underlying cavities

• Risks to workers from open or semi-covered karst features

The EsIA (p286/330) acknowledges that "in the fields of semi-covered lapiaz, there is a rare possibility of some type of collapse or subsidence" but then assigns this "a low level of attention." In reality, deep shafts may be concealed by rocks and/or vegetation, presenting serious hazards to workers and machinery. These risks should be specifically assessed.

The fencing proposed (p5/97, Annex 5) is likely to be erected on natural karst terrain with open or concealed shafts. This additional hazard is not addressed in any risk assessment.

3.16 Alternative 0: The Only Viable Choice

Three alternatives have been proposed (Alternative 1 being the favoured version). This alegación contends that Alternative 0 – not to build – is the only viable and responsible choice for Cantabria’s karst.

There are windy, less sensitive and remote areas of Spain that can accommodate wind farm development without damaging irreplaceable karst environments. If there are not more suitable, non-karst landscapes in Cantabria, then there should not be a rush to industrialise the karst countryside. The perceived urgency of meeting renewable energy targets does not justify permanent environmental destruction.

The EsIA hides behind European, Spanish and Cantabrian rules and directives instead of honestly analysing the specific site for what it is: a unique, sensitive, high-altitude karst environment that is wholly unsuitable for industrial development.

4. KEY CONCLUSIONS AND DEMANDS

Based on the comprehensive analysis above, this alegación presents the following conclusions and demands for the attention of the competent authorities:

1. The project must not proceed.

Alternative 0 (no build) is the only responsible option. The high-altitude karst of Sierra de Sel is an irreplaceable geomorphological and ecological asset. No mitigation measures can compensate for the permanent destruction of karst landforms, underground drainage systems and subterranean ecosystems.

2. The "Low Environmental Sensitivity" classification is wrong.

The MITECO sensitivity mapping tool apparently fails to account for karst environments and their unique underground biota and hydrology. This classification must be challenged and corrected for all karst areas in Cantabria.

3. No water tracing has been conducted.

Without dye-tracing or equivalent studies demonstrating the hydrological connectivity between the construction area and downstream springs, the EsIA's claims of minimal impact on groundwater are without foundation. This must be required before any project on karst terrain can be considered.

4. The underground ecosystem has been ignored.

The EsIA acknowledges the presence of endemic cave fauna including Cantabroniscus primitivus but proposes no protective measures. A full subterranean biological survey should be required, with protective measures commensurate with the findings.

5. "Recoverable and reversible" claims are false.

Karst landscape restoration to original condition is physically impossible. The authorities should reject any impact assessment that claims otherwise.

6. The drainage design is absent.

No plans exist for managing runoff from platforms and roads on karst terrain. This is a fundamental deficiency that, on its own, should be grounds for rejecting the EsIA.

7. Explosives must not be used on karst.

The documented plans for using explosives during construction and decommissioning pose unacceptable risks to cave systems, underground drainage and subterranean biota. Alternative excavation methods must be mandated, or the project abandoned.

8. The 260,954 m³ material shortfall is unaddressed.

The massive volume of fill material to be imported, requiring approximately 17,400 heavy vehicle journeys, is not acknowledged in the project documents. The source, transport route and environmental impact of this material movement must be fully assessed.

9. The 55 kV evacuation line threatens known caves.

The trench route passes directly over Nacimiento del Río Clarín and close to other known caves. The risk of intersecting cave passages is real and has not been adequately assessed.

10. The Project Overview does not mention "karst".

The 752-page principal project document's complete omission of karst terminology demonstrates a fundamental failure to address the nature of the terrain. This document cannot form the basis of an informed planning decision.

11. The SREP designation must be respected.

Both municipalities classify this land as Special Protection Rustic Land. Overriding this protection for wind farm construction makes a mockery of the land-use planning system.

12. Consult speleological expertise.

The Federación Cántabra de Espeleología (http://www.espeleocantabria.net/) and the Matienzo Caves Project should be formally consulted. The EsIA relies on inadequate data sources and appears mainly to be a desktop exercise rather than the product of proper field investigation.

13. Cumulative impacts must be assessed.

The Study of Synergies (Annex X) shows potential for additional wind farm development at La Rasa, Fuente Pico and Moncubo, threatening further karst destruction. Cumulative impacts on the karst environment must be properly evaluated.

14. The flood risk assessment is inadequate.

Altering high-altitude drainage patterns may divert more water, more quickly, to particular resurgences, increasing flood risk at lower altitudes in Ogarrio, San Miguel de Aras and surrounding areas.

5. REFERENCES

The following references support the position that constructing wind farms on karst terrain is highly destructive and that karst aquifers require special protection:

1. Valente, A., Catani, V., Esposito, L., Leone, G., Pagnozzi, M. & Fiorillo, F. (2022). "Groundwater Resources in a Complex Karst Environment Involved by Wind Power Farm Construction." Sustainability, 14(19), 11975. Available at: https://www.mdpi.com/2071-1050/14/19/11975

2. Johnson, K.S., Bangsund, W.J. & Hines, N.A. (2013). "Gypsum karst and potential risk in siting wind turbines in Blaine County, Oklahoma." Proceedings of the Thirteenth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst (NCKRI Symposium 2), pp.151–159. Available at: https://digitalcommons.usf.edu/kip_talks/63/

3. Zwahlen, F. (Ed.) (2004). COST Action 620: Vulnerability and Risk Mapping for the Protection of Carbonate (Karst) Aquifers – Final Report. European Commission, Publications Office of the EU. Available at: https://op.europa.eu/en/publication-detail/-/publication/be3c99bf-1a0a-4213-b35d-c3faffcd355b

4. Vias, J.M. et al. (2006). "Karst groundwater protection: First application of a Pan-European Approach to vulnerability, hazard and risk mapping in the Sierra de Líbar (Southern Spain)." Science of the Total Environment, 357(1–3), 54–73. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0048969705003761

5. Drew, D. & Hötzl, H. (1999). Karst Hydrogeology and Human Activities: Impacts, Consequences and Implications. IAH International Contributions to Hydrogeology, Volume 20. Balkema, Rotterdam. [Standard reference work on human impacts on karst environments.]

6. Langer, W.H. (2001). "Potential Environmental Impacts of Quarrying Stone in Karst – A Literature Review." U.S. Geological Survey Open-File Report 01-0484. Available at: https://pubs.usgs.gov/of/2001/ofr-01-0484/ofr-01-0484po.pdf

Additional legal framework: EU Water Framework Directive (2000/60/EC); EU Groundwater Directive (2006/118/EC); EU Habitats Directive (92/43/EEC), particularly Annex I habitat type 8310 (Caves not open to the public); Spanish Water Law (Ley de Aguas); Cantabrian Law 7/2013 on Wind Farms; Legislative Decree 1/2023 on Land Use Planning.

The first Matienzo Caves Project alegación against this wind farm can be consulted at
https://www.matienzocaves.org.uk/Windfarms2025/SierraDeSel/SierradeSel-Critique.pdf (English)
https://www.matienzocaves.org.uk/Windfarms2025/SierraDeSel/SierradeSel-Critique-es.pdf (Castellano)

ANNEX I: DETAILED QUOTES AND COMMENTARY

This annex presents, in the order of the EsIA and supporting documents, the translated quotes from the original documents (*in italics*) together with commentary. Where the same issue arises in the Project Overview (Document D) or Evacuation Line document (Document C), these are cross-referenced. Page references follow the format described in Section 2.

Not included in the English version

ANNEX 2: ADDITIONAL IMPACTS

-1 Impacto negativo teniendo en cuenta los ecosistemas kársticos superficiales y subterráneos

-1 Un posible impacto negativo, teniendo en cuenta los ecosistemas kársticos superficiales y subterráneos.

X Los resultados positivos propuestos no se producirán con los ecosistemas kársticos.

MATRIZ DE IDENTIFICACIÓN DE IMPACTOS (-1) Impactos negativos (+1) Impactos positivos		ATMÓSFERA Y AMBIENTE SONORO					CAMBIO CLIMÁTICO	GEOLOGÍA Y GEOMORFOLOGÍA		EDAFOLOGÍA		HIDROLOGÍA E HIDROGEOLOGÍA			FLORA Y VEGETACIÓN		FAUNA				FIGURAS DE PROTECCIÓN			FACTORES SOCIALES Y ECONÓMICOS			PATRIMONIO CULTURAL Y ARQUEOLÓGICO	PAISAJE	
		Calidad del aire	Contaminación lumínica	Contaminación electromagnética	Contaminación acústica	Olores	Huella de carbono	Características geológicas	Cambios en el relieve	Pérdida de suelo	Compactación, erosión y contaminación	Alteración de la calidad de las aguas superficiales	Alteración de la calidad de las aguas subterráneas	Alteración del drenaje, caudal y escorrentía superficial	Abundancia, densidad y diversidad	Afectación a especies protegidas e HICs	Aislamiento de poblaciones	Abundancia y diversidad	Mortalidad directa o indirecta	Afectación a especies protegidas o singulares	Red d Espacios Protegidos	Red Natura 2000	Otros espacios de interés	Variación modo de vida (cambios uso suelo, linfraestructuras, etc)	Economía local	Salud pública y seguridad	Afectación al patrimonio cultural y arqueológico	Alteración de la calidad paisajística	Visibilidad
FASE DE CONSTRUCCIÓN	Construcción y adecuación de viales	-1			-1			-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1			-1	-1			-1	-1	
	Montaje de instalaciones auxiliares y acopio de materiales								-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1				-1				-1	-1
	Tráfico de maquinaria y personal	-1			-1		-1	-1			-1	-1	-1		-1	-1			-1	-1				-1		-1			
	Despeje y desbroce	-1			-1		-1			-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1			-1					-1	
	Movimientos de tierra y apertura de zanjas	-1			-1			-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1			-1	-1		-1	-1	-1	
	Cimentaciones y montaje de elementos permanentes		-1					-1			-1	-1	-1	-1										-1				-1	-1
	Generación y gestión de residuos										-1	-1	-1					-1	-1							-1			
	Mano de obra y actividades económicas asociadas																								1				
FASE DE OPERACIÓN	Presencia del proyecto		-1	-1	-1						-1						-1	-1	-1	-1		-1				-1	-1	-1	-1
	Generación de energía	1					1																		1				
	Mantenimiento de la instalación				-1						-1							-1	-1										
	Generación y gestión de residuos										-1	-1	-1													-1			
	Mano de obra y actividades económicas asociadas																								1				
FASE DE DESMANTELAMIENTO	Desmantelamiento y retirada de los elementos del proyecto		-1				-1	-1				-1	-1	-1			X	X	X	X		1	1		-1	1		X	X
	Desmontaje de obra civil y restauración ambiental				-1				X			-1	-1	-1	1	1	-1	-1	-1	-1			1					X	1
	Tráfico de maquinaria y personal	-1			-1		-1	-1			-1	-1	-1		-1	-1			-1	-1				-1		-1			
	Generación y gestión de residuos										-1	-1	-1					-1	-1							-1			
	Mano de obra y actividades económicas asociadas																								1				

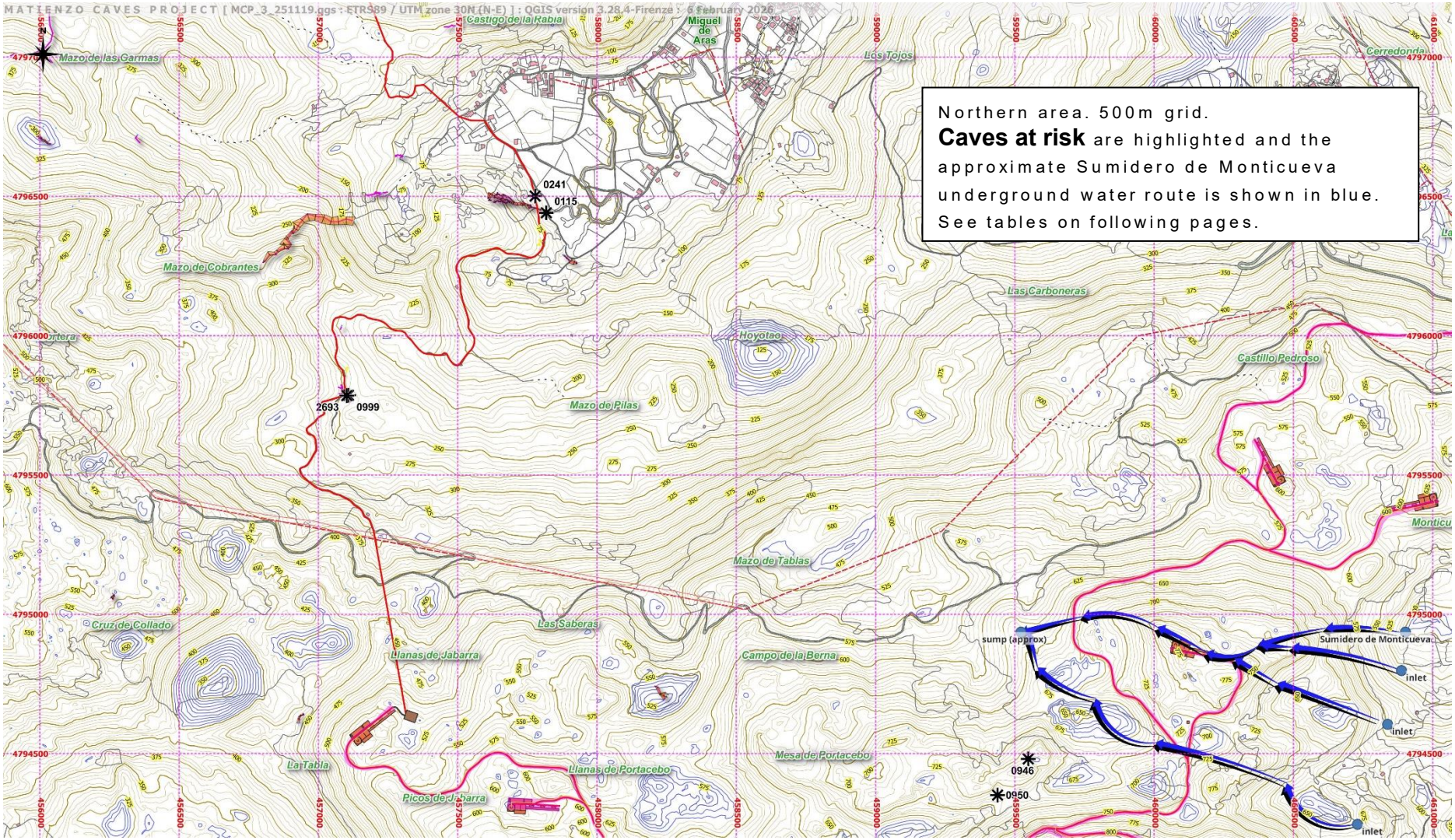
Ver página siguiente
See following page

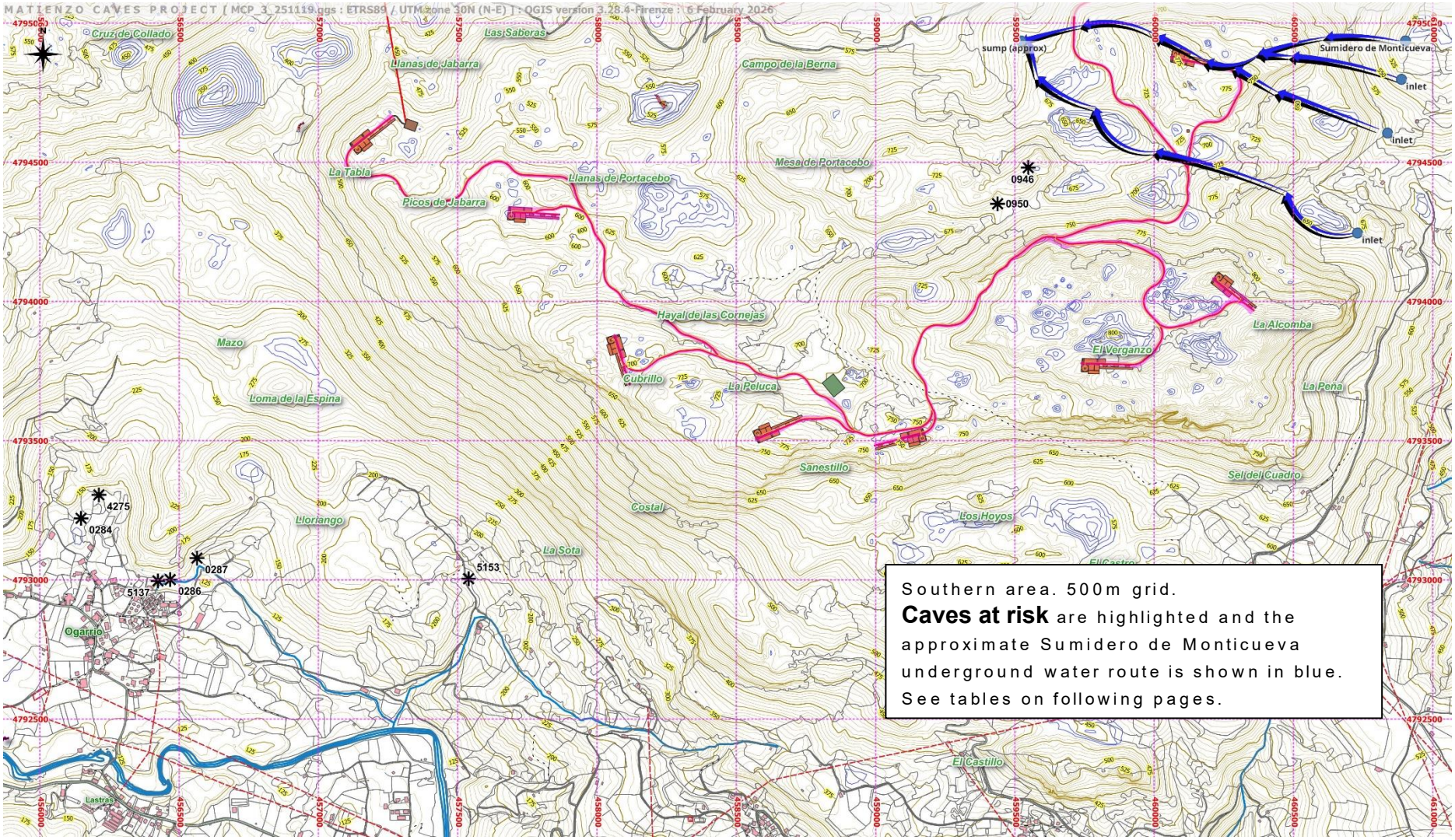
A B D G N O P Q

Notas sobre la matriz de Identificación de Impactos (EsIA página 212)
Notes regarding the Identification of Impacts matrix (EsIA page 212)

A	La construcción de carreteras generará barro, limo y otros desechos, algunos de los cuales se infiltrarán al ecosistema subterráneo.	The construction of roads will generate mud, silt and other debris, some of which will infiltrate to the underground ecosystem.
B	El área de recolección de 3390 m² es un terreno rectangular inclinado (65 x 52 m) con árboles y piedra caliza. ¿Es esta la zona correcta? ¿Se requieren caminos? Cualquier movimiento de tierra o piedra caliza tendrá un impacto negativo, como se muestra.	Collection area of 3390m² is a sloping, rectangular (65 x 52m) site in trees and limestone. Is this the correct area? Road(s) required? Any earth / limestone movement will have a negative impact as shown.
D	Habrá efectos subterráneos dependiendo de qué tan severa sea la limpieza.	There will be effects underground depending on how harsh the clearance is.
G	Cualquier escorrentía de desechos se infiltrará al subsuelo.	Any runoff from the waste will infiltrate to the underground.
N	La maquinaria pesada utilizada para el desmantelamiento alterará el drenaje y la escorrentía superficial. (-1) Desde el punto de vista de la fauna subterránea, no habrá un impacto positivo al eliminar elementos del proyecto. Las bases de hormigón aún serán visibles.	Heavy machinery used for dismantling will alter the drainage and surface runoff. (-1) From the point-of-view of underground fauna, there will not be a positive impact by removing project elements. The concrete bases will still be visible.
O	El desmantelamiento de las obras civiles y la restauración ambiental no funcionarán. Es imposible restaurar el accidentado paisaje kárstico. Si se intenta retirar las plataformas de hormigón y allanar la zona, esta tendrá un aspecto totalmente artificial. Cualquier restauración afectará los ecosistemas subterráneos con escorrentías, barro, etc. No habrá un impacto positivo en la calidad del campo, sólo un impacto negativo diferente.	The dismantling of civil works and environmental restoration will not work. There is no way in which the rugged karst landscape can be restored. If an attempt is made to remove the concrete platforms and smooth off the area it will look totally artificial. Any restoration will affect the underground ecosystems with runoff, mud, etc. There won't be a positive impact on the countryside quality, just a different negative impact.
P	Barro extra producido por el tráfico, contaminando cualquier escorrentía.	Extra mud produced by traffic. polluting any runoff.
Q	Cualquier escorrentía de desechos se infiltrará al subsuelo.	Any runoff from the waste will infiltrate to the underground.

ANNEX 3: CAVES at RISK



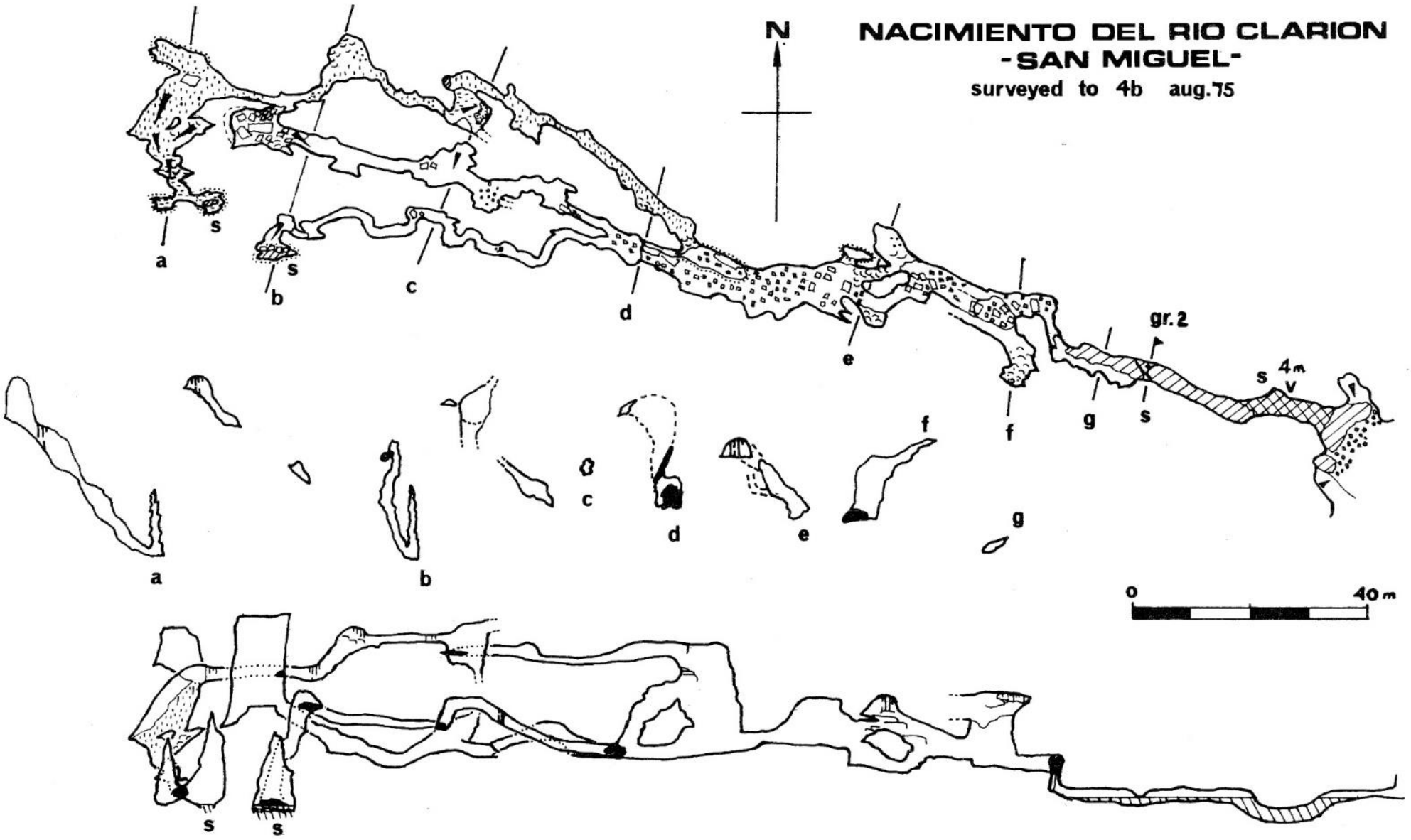

MATIENZO CAVES PROJECT [MCP_3_251119.qgs : ETRS89 / UTM zone 30N (N-E)] : QGIS version 3.28.4-Firenze : 6 February 2026
Cruz de Collado
Las Saberas
Llanas de Jabarra
Campo de la Berna
sump (approx)
Sumidero de Monticueva
inlet
inlet
inlet
La Tabla
Llanas de Portacebo
Mesa de Portacebo
Picos de Jabarra
0946
0950
Hayal de las Cornejas
La Alcomba
El Verganzo
Mazo
Cubrillo
La Peluca
La Peña
Loma de la Espina
Sanestillo
Sel del Cuadro
Costal
Llos Hoyos
Lloriango
La Sota
4275
0284
0287
0286
5137
5153
Ogarrio
El Castillo
Lastras
Southern area. 500m grid.
Caves at risk are highlighted and the approximate Sumidero de Monticueva underground water route is shown in blue.
See tables on following pages.

Annex 3 continued … Caves at Risk

Note: There will be many more sites of speleological interest not shown on the map which are currently unknown to the Matienzo Caves Project

Phase	code	name	area	Ayuntamiento	East	North	Altitude	Feature	Summary	Consequences	web details
all	5153	Lluriangos, Fuente de	Ogarrio	Ruesga	457539	4793004	163	cave passages with water	Impenetrable resurgence.	**altered water flows + pollution**	https://matienzocaves.org.uk/descrip/5153.htm
all	0287	Campuvijo, Cueva de	Ogarrio	Ruesga	456564	4793078	123	resurgence cave + passages	Length 925m Water is thought to come from the Sumidero de Monticueva to east of the project area.	**altered water flows + pollution**	https://matienzocaves.org.uk/descrip/0287.htm
all	0286	Mazo 5, Cueva del	Ogarrio	Ruesga	456468	4793001	127	resurgence cave + passages	Part of the resurgence complex in this area.	**altered water flows + pollution**	https://matienzocaves.org.uk/descrip/0286.htm
all	5137	Coverón, Surgencia del	Ogarrio	Ruesga	456424	4792996	120	resurgence cave + passages	Part of the resurgence complex in this area.	**altered water flows + pollution**	https://matienzocaves.org.uk/descrip/5137.htm
all	0284	caves	Ogarrio	Ruesga	456148	4793221	130	resurgence caves (incompletely documented)	Length 90m A group of 4 caves.	**altered water flows + pollution**	https://matienzocaves.org.uk/descrip/0284.htm
all	4275	resurgence	Ogarrio	Ruesga	456212	4793305	133	resurgence		**altered water flows + pollution**	https://matienzocaves.org.uk/descrip/4275.htm
all	2693	shaft	Caburrao	Voto	457102	4795785	220	shaft with cave	Length 114m; Depth 23m Leads into a chamber well decorated with helictites. There are inaccuracies in placing the track line, the cave survey and the entrance position but the following points should be noted: The roof of the known cave passage under the track is at a depth of about 14m. Heavy vehicle traffic vibrations will may destroy the delicate helictites and other formations. There may be unknown passages that come much closer to the surface.	at risk	https://matienzocaves.org.uk/descrip/2693.htm
construction	0999	cave (AD-60)	Caburrao	Voto	457108	4795786	245	cave	Length 25m; Depth 3m - A small cave with old bottles.	at risk	https://matienzocaves.org.uk/descrip/0999.htm

Phase	code	name	area	Ayuntamiento	East	North	Altitude	Feature	Summary	Consequences	web details
construction	0241	cave	San Miguel	Voto	457778	4796501	60	cave	Length 3m Small cave chamber.	**Destroyed / blocked.**	https://matienzocaves.org.uk/descrip/0241.htm
all	0115	Nacimiento del Rio Clarin	San Miguel	Voto	457818	4796441	55	resurgence with explored cave passage(s)	Length 577m; Depth 4m - Resurgence which we believe is a drinking water supply. The entrance pool has been dived and the cave passage beyond explored on various levels. Some of the passages (and possibly unexplored routes) come close to the surface. Heavy vehicles could collapse the roof, potentially harming operators and damage the water supply.	**Possible danger to life. Cave survey (p34); depth of cave passage; weight of traffic all need considering as the track passes over the cave.**	https://matienzocaves.org.uk/descrip/0115.htm
all	-	Sumidero de Monticueva	Monticueva	Voto / Ruesga	460902	4794936	498	Extensive and deep cave system.	Will feed a major resurgence, either #0115 at San Miguel or #0287 at Ogarrio. The cave passes under the wind farm project.	**altered water flows + pollution**	See https://matienzocaves.org.uk/descrip/0287.htm
construction	0946	shaft	Monticueva area	Voto	459548	4794481	733	Shaft; position uncertain	Shaft; position uncertain	**altered water flows + pollution**	https://matienzocaves.org.uk/descrip/0946.htm
construction	0950	shaft	Monticueva area	Ruesga	459438	4794351	715	Shaft; position uncertain	Shaft; position uncertain	**altered water flows + pollution**	https://matienzocaves.org.uk/descrip/0950.htm
construction	3699	Cave / dig	Secadura	Voto	457178	4801398	206	Dig into cave	Cave with water heard below. (Not on map)	**altered water flows + pollution**	https://matienzocaves.org.uk/descrip/3699.htm


NACIMIENTO DEL RIO CLARION
-SAN MIGUEL-
surveyed to 4b aug.75
N
a
s
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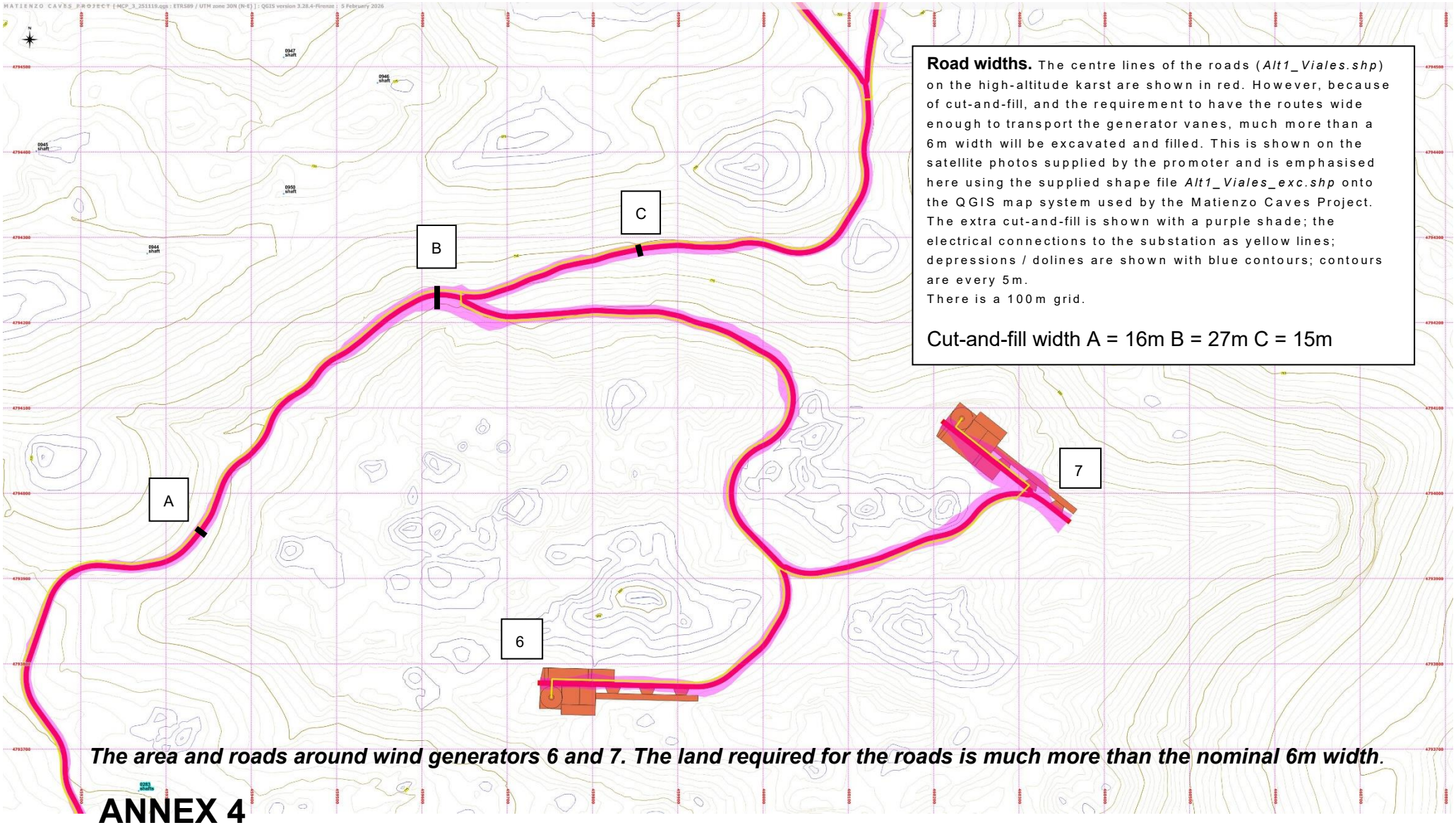
gr. 2
4m
0
40 m

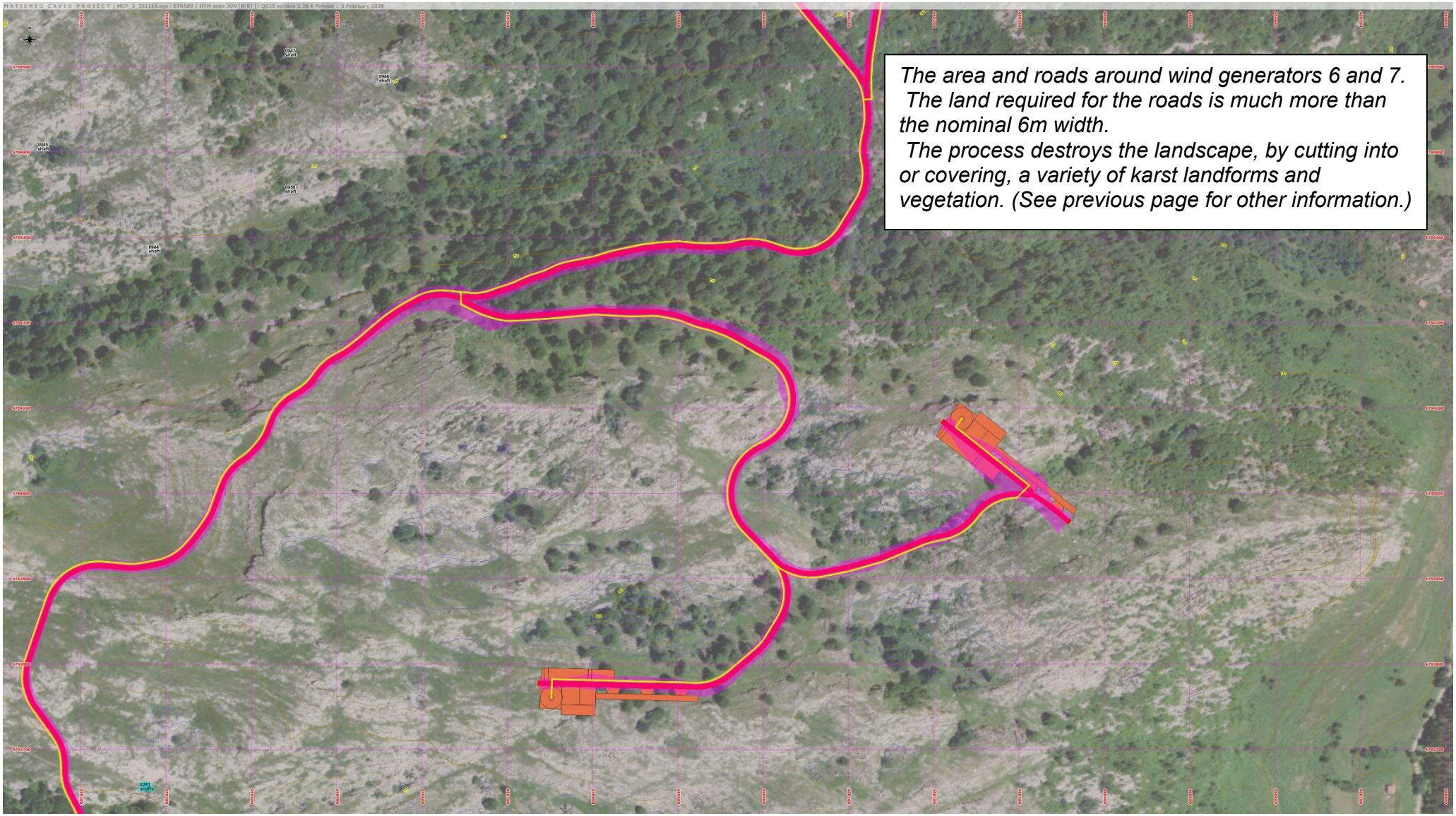


Road widths. The centre lines of the roads (*Alt1_Viales.shp*) on the high-altitude karst are shown in red. However, because of cut-and-fill, and the requirement to have the routes wide enough to transport the generator vanes, much more than a 6m width will be excavated and filled. This is shown on the satellite photos supplied by the promoter and is emphasised here using the supplied shape file *Alt1_Viales_exc.shp* onto the QGIS map system used by the Matienzo Caves Project. The extra cut-and-fill is shown with a purple shade; the electrical connections to the substation as yellow lines; depressions / dolines are shown with blue contours; contours are every 5m.
There is a 100m grid.

Cut-and-fill width A = 16m B = 27m C = 15m

The area and roads around wind generators 6 and 7. The land required for the roads is much more than the nominal 6m width.

ANNEX 4



The area and roads around wind generators 6 and 7.
The land required for the roads is much more than the nominal 6m width.
The process destroys the landscape, by cutting into or covering, a variety of karst landforms and vegetation. (See previous page for other information.)

ANNEX 5a: EXPLOSIVES USE ON KARST (larger scale)

Concerned with the use of explosives in a karst area, the following prompt was put to Claude AI (Sonnet 4.5):

"Please critique this extract [1.5.10.2 USE OF EXPLOSIVES from "DOCUMENT No. 3 – SPECIFIC TECHNICAL REQUIREMENTS in EOL-44-2022_Proyecto(289.3.1.01_0).pdf"] and give me a proper method of working within a limestone karst area, including recommendations as to whether explosives should be used - and possible alternatives."

Critique of Generic Explosives Specification for Limestone Karst Terrain

Critical Deficiencies

You're absolutely correct—this specification is **dangerously generic** for limestone karst terrain. It reads like a standard highway construction document and completely fails to address the unique geological hazards of karst environments.

Major Omissions:

1. **No karst-specific geological investigation requirements**
   - No cavity detection surveys (Ground Penetrating Radar, electrical resistivity, seismic refraction)
   - No groundwater tracing or dye studies
   - No speleological assessment
   - No evaluation of rock mass discontinuities and solution-enlarged fractures
2. **Complete ignorance of groundwater vulnerability**
   - Karst aquifers are among the most vulnerable to contamination
   - Explosives residues (nitrates, ammonia, fuel oils) can rapidly contaminate entire watershed systems
   - No consideration of protected springs, wells, or underground water supplies
   - No mention of Environmental Protection Zone designations common in karst areas
3. **Generic vibration criteria are inadequate**
   - DIN 4150 addresses building damage, not cave roof stability
   - Underground voids can collapse at much lower vibration thresholds
   - No consideration of thin rock bridges, natural arches, or delicate geological features
   - Slope stability in fractured karst limestone is highly sensitive to vibration
4. **No recognition of blast-induced fracturing risks**
   - New fractures can interconnect existing voids, causing catastrophic collapse
   - Blast damage zones in fractured karst can extend 10-20x farther than in competent rock
   - Progressive failure can occur days/weeks after blasting
5. **Assumes blasting is acceptable** rather than evaluating whether it should be avoided entirely

---

Proper Method for Working in Limestone Karst

Phase 1: Comprehensive Pre-Construction Investigation

Geological & Hydrogeological Studies:

- Multi-method cavity detection (GPR, ERT, microgravity, seismic)
- Core drilling with downhole camera inspection (NOT percussion drilling)
- Identify all caves, voids, solution features within 100m of each turbine
- Groundwater tracing to map subsurface drainage
- Rock Quality Designation (RQD) and rock mass classification
- Identify "no-go" zones where caves/voids preclude development

Environmental Baseline:

- Inventory springs, wells, and surface water sinking points within 2km

- Baseline water quality monitoring
- Cave fauna surveys (many karst species are endangered)
- Establish vibration monitoring points in sensitive areas

Phase 2: Foundation Design Adapted to Karst

For 196m turbines on sloping karst:

- Consider drilled pier foundations extending through weathered zone to competent rock
- Cavity grouting may be required before foundation construction
- Each turbine location may require unique foundation design
- Pad foundations are typically unsuitable in karst—too sensitive to differential settlement

Phase 3: Excavation Strategy (Minimize or Eliminate Blasting)

RECOMMENDATION: AVOID EXPLOSIVES ENTIRELY

Primary Alternative Methods:

1. **Mechanical Excavation with Rock Breakers**
    - Hydraulic hammer attachments on excavators
    - Controlled, low-vibration removal
    - Allows inspection during excavation to detect voids
    - **Best option for karst environments**
2. **Non-Explosive Demolition Agents (NEDA)**
    - Expansive grouts (e.g., Dexpan, Betonamit)
    - Drill holes, fill with expanding agent, wait 24-48 hours
    - Zero vibration, zero flyrock, silent
    - Slower but much safer in karst
    - Ideal for rock with RQD < 50%
3. **Diamond Wire Sawing**
    - For creating precise cuts in competent rock
    - Vibration-free
    - Expensive but appropriate for sensitive locations
4. **Hydraulic Rock Splitters**
    - Wedge-type splitting systems
    - Controlled fracturing along predetermined planes
    - Low vibration
5. **Roadheader or Tunnel Boring**
    - For access road cuts in very difficult terrain
    - Continuous mechanical cutting
    - Allows immediate support installation

IF Explosives Must Be Used (Last Resort):

Restricted Blasting Protocol for Karst

Pre-Blast Requirements:

- 3D mapping of all voids within 200m
- Trial blast monitoring at each new location
- Peak Particle Velocity limits: **< 50 mm/s near voids**, < 25 mm/s for delicate features
- Frequency analysis (low-frequency waves travel farther in karst)

Controlled Blasting Techniques:

- **Microblasting only**: Maximum 5-10 kg per delay
- Pre-splitting or smooth blasting to create damage control boundaries
- Electronic detonators for precise timing

- Deck charges (small charges separated by stemming)
- Never use ANFO in fractured rock (coupling is poor, energy dissipation excessive)
- Use emulsion explosives with lower detonation velocity

Specific Karst Restrictions:

- No blasting within 50m of known voids
- No blasting within 100m of cave entrances
- Drilling pattern must avoid intersecting solution channels
- All blast holes inspected with downhole camera before charging
- If void intersected, hole abandoned and grouted
- Continuous seismic monitoring during blasting operations

Phase 4: Access Road Construction in Karst

Critical Considerations:

- Roads on sloping karst are especially problematic (drainage, stability)
- Minimize cut-and-fill (use elevated viaduct sections where necessary)
- Never route drainage into sinkholes without engineered treatment
- Road drainage must be managed to prevent sinkhole formation
- Expect significant variation in excavation depth to reach competent rock
- Retaining walls may require rock anchors drilled into competent limestone

Construction Sequence:

1. Clear vegetation minimally (roots stabilize epikarst)
2. Map all surface karst features along alignment
3. Excavate in short sections with continuous geological supervision
4. If cavity encountered, stop, assess, grout or reroute
5. Never backfill over ungrouted voids

Phase 5: Monitoring & Contingency

Real-Time Monitoring:

- Seismographs at sensitive locations during any blasting
- Water quality monitoring before, during, and after construction
- Settlement monitoring if working near known voids
- Cave atmosphere monitoring if working near cave systems

Contingency Plans:

- Emergency void grouting materials on-site
- Alternative foundation designs prepared
- Sinkhole collapse response protocol
- Groundwater contamination response plan

Summary Recommendation

For a wind farm on **rugged, sloping limestone karst** with **196m turbines**, I strongly recommend:

1. ✅ **AVOID EXPLOSIVES** - Use mechanical methods (rock breakers, NEDA)
2. ✅ **Invest heavily in pre-construction investigation** - 3-5% of project cost
3. ✅ **Expect site-specific solutions** - No two turbine locations will be identical

4. ✅ **Engage karst specialist geotechnical engineer** and hydrogeologist
5. ✅ **Plan for 20-30% longer construction time** compared to non-karst sites
6. ✅ **Budget for cavity grouting** - likely needed at multiple locations

The current specification should be rejected and replaced with one written specifically for karst conditions, preferably by someone with experience in karst geotechnical engineering.

The cheapest approach initially (blasting everything) will likely be the most expensive ultimately (foundation failures, sinkholes, litigation, environmental damage).

ANNEX 5b: EXPLOSIVES USE ON KARST (trenches)

Concerned with the use of explosives in a karst area, the following prompt was put to Claude AI (Sonnet 4.5):

"Building a 13.4km trench to take a 55kV 3 phase line from a wind farm to a distribution substation. The trench dimensions are 1.6m deep and 0.65m wide. Along the length there are to be 8 prefabricated splicing chambers built (each 7.9m x 2.4m x 3.15m depth). This trench is going to run through limestone karst (with some interleaved sandstone beds). The working methods could involve jack hammer and explosives.
Please give a full analysis of this situation, especially the possible damage to nearby cave chamber roofs. Is there any other methods to sensibly remove limestone in a trench?"

Comprehensive Analysis: Trenching Through Limestone Karst

Primary Concerns with Cave Chamber Damage

Critical Risks:

1. **Unknown cavity locations** - Karst topography features unpredictable void spaces ranging from small cavities to large chambers
2. **Roof collapse potential** - Disturbance from above can destabilize naturally-formed chamber roofs, especially if:
    - Roof thickness is minimal (< 2-3m above cavity)
    - Rock is weathered or fractured
    - Natural support pillars are compromised
3. **Cascading failures** - One collapse can trigger adjacent failures in interconnected systems

Working Method Analysis

Jack Hammers/Pneumatic Breakers:

- **Vibration level:** Moderate (localized)
- **Risk:** Medium - Can cause progressive fracturing of roof rock, especially in thin or weathered zones
- **Concern:** Repeated impact stress may propagate cracks into cave roofs

Explosives:

- **Vibration level:** HIGH (far-reaching)
- **Risk:** VERY HIGH in karst
- **Specific dangers:**
    - Ground shock waves travel efficiently through limestone
    - Can destabilize chambers 50-100m+ from blast site
    - May trigger delayed collapses (hours to weeks later)
    - Difficult to control in fractured/bedded limestone
    - **NOT RECOMMENDED in known/suspected cave areas**

Safer Alternative Excavation Methods

1. Rock Trenchers/Chain Trenchers:

- Continuous cutting action with minimal vibration
- Can handle medium-strength limestone
- More predictable than impact methods

- Better for maintaining trench stability

2. Hydraulic Rock Breakers with Damping:

- Lower frequency, less ground transmission than pneumatic
- Can be fitted with vibration-dampening mounts
- More controlled energy application

3. Controlled Rock Sawing:

- Diamond wire or chain saws
- Minimal vibration
- Very precise cutting
- Expensive but safest for sensitive areas
- Good for sandstone beds

4. Hydraulic Splitting/Bursting:

- Near-zero vibration
- Uses hydraulic expansion in drilled holes
- Slow but extremely cave-friendly
- Ideal for confirmed sensitive zones

5. Chemical Rock Splitting (Expansive Agents):

- Zero vibration/shock
- Drill holes, insert expanding cement/compound
- Slow (12-48 hours per cycle)
- Very expensive but safest option
- Examples: Dexpan, Bristar

Essential Pre-Construction Investigations

1. Geophysical Surveys:

- Ground Penetrating Radar (GPR) - limited depth but good for shallow voids
- Electrical Resistivity Tomography (ERT) - detects air/water-filled cavities
- Seismic refraction - identifies velocity contrasts (rock vs void)
- Microgravity - can detect larger voids

2. Borehole Investigation:

- Rotary drilling with careful logging
- Downhole camera/CCTV inspection
- Acoustic televiewer logging
- Note: Boreholes can themselves break into chambers - requires experienced drillers

3. Cave Registry Research:

- Check with local caving organizations
- Survey records may show known cave passages near route
- Speleological societies often have invaluable data

4. Desktop Study:

- Geological maps for limestone types/bedding
- Sinkhole/depression mapping
- Spring locations (indicate active flow systems)
- Historical records of subsidence

Risk Mitigation Strategies

Design Phase:

1. **Route optimization** - Avoid known cave areas even if longer
2. **Depth reduction** - Consider shallower trench where ground investigation permits
3. **Trench width** - Your 0.65m is relatively narrow (good)
4. **Splicing chamber locations** - These deeper excavations (3.15m) are highest risk

Construction Phase:

1. **Continuous monitoring:**
    - Vibration sensors (geophones) at intervals along route
    - Set trigger thresholds (typically <10 mm/s PPV for sensitive structures)
    - Visual inspection ahead and behind excavation face
2. **Adaptive methodology:**
    - Have equipment for multiple excavation methods on standby
    - Switch to lower-impact methods when anomalies detected
    - Geologist/karst specialist on-site during excavation
3. **Grouting program:**
    - Pre-treat detected voids with controlled low-strength grout
    - Stabilize loose roof rock before excavation
    - Create temporary support for chamber roofs
4. **Support installation:**
    - Immediate trench support system (sheeting, hydraulic shores)
    - Don't leave excavations open longer than necessary
    - Rock bolting if roof rock exposed
5. **Excavation sequence:**
    - Work in shorter sections (50-100m)
    - Allow rock mass to "relax" between sections
    - Monitor for ground movement/settlement

Specific Concerns for Your Project

Splicing Chambers (7.9m x 2.4m x 3.15m deep):

- These represent **significant risk** - much larger excavation
- Depth increase from 1.6m to 3.15m nearly doubles rock stress redistribution
- Consider:
    - Pre-excavation ground treatment
    - Alternative designs (shaft access with horizontal gallery?)
    - Prefabricated caissons that minimize excavation volume
    - Spacing away from highest-risk karst zones

Sandstone Interbeds:

- Often more competent than limestone
- May act as natural roof protection for caves below
- But can also create perched water tables
- Excavate carefully - can be load-bearing layer

Environmental/Legal Considerations

1. **Cave protection legislation** - Many jurisdictions protect caves as natural heritage
2. **Water resource protection** - Karst aquifers are vulnerable
3. **Bat habitat** - Caves may have protected species
4. **Archaeological sites** - Caves often contain artifacts
5. **Insurance** - Notify insurers of karst ground conditions

Recommended Approach

Minimum Standard:

1. **Comprehensive geophysical survey** of entire route
2. **Trial excavations** in representative geology (5-10 locations)
3. **Exclusion zones** around any detected significant voids (minimum 10m radius)
4. **Primary method:** Rock trencher with hydraulic breaker backup
5. **AVOID explosives entirely** unless route can be confirmed cave-free
6. **Grouting program** for any voids intersected
7. **Real-time monitoring** during all excavation

Gold Standard:

1. All of the above PLUS:
2. **Speleological survey** of known cave systems near route
3. **3D ground model** integrating all survey data
4. **Karst specialist** on project team throughout
5. **Contingency budget** for dealing with unexpected voids (20-30% of excavation cost)

Final Recommendation

Do NOT use explosives for this project. The risk to cave systems is too high and the potential consequences (catastrophic roof collapse, injury, environmental damage, project delays, legal liability) far outweigh any cost savings.

Invest in proper ground investigation and use mechanical excavation with vibration monitoring. The upfront cost is higher but the risk reduction is substantial.

ANNEX 6: CANTABRONISCUS

A request for information to Claude AI about this crustacean came back with the information below. (6/2/2026)

Cantabroniscus primitivus is a fascinating cave-dwelling isopod crustacean endemic to the Cantabrian Mountains in northern Spain, where it has been documented in caves within the Matienzo depression.

Biology and Classification

- It belongs to the family Trichoniscidae within the suborder Oniscidea (terrestrial isopods or woodlice)
- It's considered a relict species with primitive characteristics, reflected in its species name "primitivus"
- It's the only species in its genus (Cantabroniscus)

Habitat and Distribution

- Found exclusively in limestone caves of the Cantabrian Mountains in northern Spain
- Inhabits subterranean aquatic environments, particularly in karst systems
- Has been specifically documented in caves such as Orillonzuco (#1162) and Cueva de Fresnedo 2 (#0841) in the Matienzo area
- Restricted to a very limited geographical range, making it extremely endemic

Adaptations

- Like many cave organisms, it displays troglomorphic adaptations including:
    - Lack of pigmentation (typically appearing whitish or translucent)
    - Reduced or absent eyes
    - Elongated appendages for sensing its environment
    - Slow metabolism adapted to the resource-limited cave environment

Conservation Status and Threats

- Due to its extremely limited range and specialized habitat requirements, it's considered vulnerable to environmental changes
- Threats include groundwater pollution, disturbance of cave systems, and climate change impacts on karst hydrology
- **Current threats**: Recent environmental impact assessments acknowledge "profound ignorance regarding the distribution and population status of most invertebrate species" in the region, particularly those living underground
- Proposed wind farm developments in the Cantabrian karst present potential risks to Cantabroniscus habitat through surface disturbance to karst recharge zones and impacts on underground water systems

This species represents an important example of specialized evolution in subterranean environments and is of significant interest to biospeleologists studying the unique cave fauna of the Basque-Cantabrian region.

Cantabroniscus has been photographed at least 6 times in different caves in and around Matienzo.



Above: Cantabroniscus in Orillonzuco (#1162)
Photo: Juan Corrin

Below: Cantabroniscus in Cueva de Fresnedo 2 (#0841)
Photo: Simon Cornhill



ANNEX 7: MATIENZO CAVES PROJECT

El Proyecto de Cuevas de Matienzo

El Proyecto de Cuevas de Matienzo es una iniciativa de larga trayectoria dedicada a explorar, documentar y preservar los extensos sistemas de cuevas en y alrededor de la depresión de Matienzo en el norte de España desde la década de 1960. Operando con permisos oficiales del Gobierno de Cantabria, el proyecto realiza expediciones sistemáticas que han documentado miles de cuevas, creando un archivo digital y físico integral de topografías, fotografías, descripciones de cuevas y datos geológicos.

El proyecto sirve como un centro de colaboración internacional donde espeleólogos experimentados y novatos trabajan juntos para ampliar el conocimiento de estas formaciones kársticas únicas, promoviendo la conservación de cuevas y apoyando la investigación científica en campos como la arqueología, hidrología, biología y cambio climático.

A través de su sitio web interactivo, el Proyecto de Cuevas de Matienzo hace sus hallazgos accesibles al público, permitiendo a investigadores y entusiastas de todo el mundo beneficiarse de sus sesenta y cinco años de exploración espeleológica, mientras crea conciencia sobre la importancia de proteger estos frágiles ecosistemas subterráneos.

The Matienzo Caves Project

The Matienzo Caves Project is a long-standing initiative dedicated to exploring, documenting, and preserving the extensive cave systems in and around the Matienzo depression of northern Spain since the 1960s. Operating with official permits from the Cantabrian Government, the project conducts systematic expeditions that have documented thousands of caves, creating a comprehensive digital and physical archive of surveys, photographs, cave descriptions and geological data.

The project serves as an international collaborative hub where experienced and novice cavers work together to expand knowledge of these unique karst formations while promoting cave conservation and supporting scientific research in fields such as archaeology, hydrology, biology and climate change.

Through its interactive website, the Matienzo Caves Project makes its findings publicly accessible, allowing researchers and enthusiasts worldwide to benefit from its sixty-five years of speleological exploration while raising awareness about the importance of protecting these fragile underground ecosystems.

END OF OBJECTION DOCUMENT

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On behalf of Matienzo Caves Project

Signature

[12th February 2026]
