# OBJECTION

# TO THE

# MONCUBO WIND FARM PROJECT

## EOL-41-2022

## Second Proposal - Updated Analysis

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On behalf of the Matienzo Caves Project

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# 1. EXECUTIVE SUMMARY

This document presents an updated critical analysis of the Environmental Impact Study (EsIA) and associated documents for the Moncubo wind farm project (second proposal). The project consists of **three wind turbines** of SIEMENS-GAMESA brand, model SG145-5.2 MW, with a unit power of 5,200 kW, hub height of 90 m and rotor diameter of 145 m, resulting in a **total height of 162 metres** per wind turbine and a total installed power of 15.6 MW.

The site is located on 9.5 square kilometres of upland limestone karst on Monte Llusa, a complex and vulnerable ecosystem. Our analysis reveals that:

**1. Violation of Cantabria's pending PROT:** The project directly contravenes the technical directives of Cantabria's pending Regional Spatial Planning Plan (PROT), which specifically identifies karst features as part of the exclusion zones for development, particularly for wind farm installations. The PROT recognizes dolines, shafts, and exposed limestone as features indicating a well-developed karst landscape and a delicate underground ecosystem.

**2. Critical Deficiencies in the EsIA and project description:** Despite its 1,093 pages, the new EsIA still fails to adequately address the unique characteristics of the karst ecosystem. 'Karst' or 'kárstico' **is not mentioned in the 775 pages of the main project document,** demonstrating a concerning lack of consideration for this critical aspect of local geology.

**3. Irreversible Impacts:** The construction of **three platforms** and **9.598 km of new roads** (4.718 km for evacuation trenches), requiring **66,984 m³ of excavation** and **126,133 m³ of fill** (a shortfall of 59,149 m³ that must be imported), will cause irreparable damage to the three-dimensional karst system. Approximately **3,940 truck journeys** will be required for the fill material alone, a fact omitted from the documents.

**4. Underestimated Environmental Sensitivity:** MITECO's classification as a "LOW ENVIRONMENTAL SENSITIVITY ZONE" is incorrect and contradicts scientific publications that demonstrate limestone karst is highly sensitive to both underground and surface disturbance.

**5. Threats to Water Resources:** Multiple catalogued springs around Monte Llusa are at risk. No water tracing studies have been carried out, and there is no drainage plan for roads and platforms. The EsIA dismisses the catalogued springs simply because they are "more than 200 metres from any element of the project," exhibiting a profound misunderstanding of karst terrain and underground water flow.

**6. Destruction of Karst Features:** Wind turbine 2 is located directly over a fenced pond and a wide and deep shaft (#4870). Six karst features (caves and shafts) will be destroyed by the new roads of Alternative 1.

Given the fundamental incompatibility of the project with the karst protection to hopefully be established in Cantabria's PROT, and considering the multiple critical deficiencies identified, **we emphatically recommend the adoption of Alternative Zero**: reject the project and preserve this unique Cantabrian karst ecosystem for future generations.

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# 2. INTRODUCTION

This objection responds to the promoter's second proposal to build the Moncubo wind farm on Monte Llusa. The first proposal had substantial deficiencies in the environmental assessment. Unfortunately, this second proposal repeats many of the same errors and adds new concerns.

### Documents Consulted

This objection is based on a review of:

- EOL-41_2022-Proyecto(117.3.1.1_0).pdf (**Project overview** - 775 pages)
- EOL-41_2022-Proyecto_infraestructuras(117.3.3.2_0).pdf (**Substation** - 437 pages)
- EOL-41_2022-EsIA(117.3.5).pdf (**Environmental Impact Study** - 1,093 pages)
- EOL-41_2022-Cartografia(117.3.6) (A folder of **shapefiles for mapping**)

### Project Context

The Moncubo wind farm project consists of:

- **Number of wind turbines:** 3 turbines
- **Model:** SIEMENS-GAMESA SG145-5.2 MW
- **Technical specifications:**
  - Unit power: 5,200 kW Class: II B
  - Hub height: 90 m
  - Rotor diameter: 145 m
  - **Total height:** 162 metres
- **Total installed power:** 15.6 MW
- **New infrastructure:** 9.598 km of roads (4.718 km for evacuation line trenches)

### The Monte Llusa Karst Ecosystem

The Monte Llusa area contains caves, dolines, shafts, and exposed eroded limestone—all features indicative of a well-developed karst landscape and underground ecosystem. This type of terrain is internationally recognized as highly sensitive and vulnerable to industrial disturbance due to its interconnected three-dimensional nature.

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# 3. DETAILED ANALYSIS

## 3.1 Incompatibility with the Regional Spatial Planning Plan (PROT)

**The Moncubo wind farm project is exactly the type of development that is NOT permitted under Cantabria's pending Regional Spatial Planning Plan (PROT).**

According to the PROT's technical directives, karst features are specifically identified as part of the exclusion zones for development, particularly for wind farm installations. The Monte Llusa area exhibits precisely these features:

- Dolines (closed surface depressions)
- Shafts (vertical pits)
- Exposed eroded limestone (lapiaz or karren)

- Predominantly underground drainage

Although the PROT has yet to be formally implemented by the Cantabrian Government, its technical principles represent scientific consensus on the protection of karst ecosystems. **The fact that the promoter ignores these directives is a serious omission that should disqualify the project.**

## 3.2 Fundamental Deficiencies in the Environmental Impact Study

**Absence of "Karst" in the Main Document**

**The project overview document of 775 pages does not once mention "karst" or "kárstico".** This omission is astonishing given that the project is situated entirely on karst terrain, whether at high or low altitude. The document is full of generalities with little mention of the local karst surface, underground drainage, or biota.

There is no mention of Cantabria's pending PROT, which is partly designed to protect delicate karst ecosystems.

**Flawed Environmental Sensitivity Assessment**

MITECO's "Wind Environmental Zoning" classification as a **"LOW ENVIRONMENTAL SENSITIVITY ZONE"** is completely inappropriate. This designation appears to take no account of numerous scientific publications that demonstrate limestone karst is highly sensitive to both underground and surface disturbance.

The supposed low environmental impact, as indicated in the Environmental Impact Study, takes little account of:

- Extensive local landscape destruction
- Changes to underground ecosystems
- The three-dimensional interconnected nature of karst
- The risk of cave roof collapse from any seismic activity

## 3.3 Inadequate Consideration of Karst

The EsIA's list of environmental factors notably omits any specific consideration of limestone karst with its underground environment of fissures, conduits, and streams. All factors considered focus exclusively on surface conditions, ignoring the three-dimensional nature of karst ecosystems.

This omission suggests that the environmental sensitivity tool developed by the Ministry for Ecological Transition and the Demographic Challenge (MITERD) is fundamentally flawed and incomplete.

**Reliance on Regional Rather Than Local Data**

Throughout the assessment, environmental factors appear to have been extracted from regional sources rather than exhaustive local studies. The wind farm represents a localized intrusion and should be evaluated based on:

- Site-specific geology
- Local geomorphology
- Monte Llusa hydrology
- Slope instability

- Local speleological data

Local speleological surveys indicate numerous caves and karst features in the vicinity that would be directly affected by the project and these have been included as sites at risk.

**Notable Exception:** The bat study is one aspect that has been thoroughly and locally researched. This level of rigor should have been applied to all aspects of the karst study.

## 3.4 Destruction of Landscape and Underground Ecosystems

**Actual Road Widths Much Greater Than Nominal**

The plan on page 76/94 of the project overview shows an additional cyan outline layer indicating that the road widths are much greater than the nominal 6 metres. The apparent width is never less than 10 metres due to cut-and-fill and trench excavation. Some junctions appear to be about 30 metres wide to allow manoeuvring of the blades. This will require extensive cut-and-fill on sloping terrain.

**The shapefile for the actual widths was not supplied in the cartography folder.** This omission prevents accurate analysis of the real impact on the terrain.

**Excavation and Fill Volumes**

According to the EsIA:

**Roads will require:**
Excavation: 52,600 m³
Fill: 65,162 m³

**Platforms will require:**
Excavation: 14,384 m³
Fill: 60,971 m³

**Totals:**

- **Total excavation: 66,984 m³**
- **Total fill required: 126,133 m³**
- **Shortfall: 59,149 m³** that must be brought in (from borrow pits?)

If a truck carries 15 m³, then approximately **3,940 truck journeys** will be required for the additional fill material alone. **This fact is not mentioned in the documents.**

The longitudinal sections show the large amounts of cut-and-fill required for the roads, which will inevitably:

- Fill cracks in the limestone
- Alter drainage patterns
- Threaten underground biota
- Permanently modify karst morphology

**Use of Explosives on Karst Terrain**

The document mentions that **explosives may be used**. **This should not be allowed on karst under any circumstances.**

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All precautions and plans are generic with no mention of karst. The EsIA has no mention of explosives and therefore no mention of any specific mitigating actions to protect:

- Cave systems
- Underground aquifers
- Cavernicolous biota
- Structural stability of karst

Seismic events (even low magnitude caused by blasting) may cause cave roof collapse, endangering wind farm structures and irreversibly altering the underground ecosystem. (See Annexes 2 and 3)

**Land Classification and Inadequate Protection**

All the ground used for the proposed project is one of the following:

- **Suelo Rústico de Protección Ordinaria** (Rural Land of Ordinary Protection)
- **Suelo Rústico de Especial Protección Forestal** (Rural Land of Special Forest Protection)
- **Suelo Rústico de Especial Protección Ecológica** (Rural Land of Special Ecological Protection)
- **Suelo Rústico de Especial Protección de Infraestructuras** (Rural Land of Special Infrastructure Protection)

**These lands are protected for a reason which should not be overridden by industrialization of the rugged karst.**

**Heavy Metal Contamination**

Copper in the earth cabling under the towers could leach into the underground karst system, contaminating aquifers and springs. No mitigation measures are proposed for this.

## 3.5 Underground Water Systems Inadequately Assessed

**Local Hydrology Not Studied**

The hydrological assessment relies on a single water level station at Beranga, providing no meaningful insights into the local hydrology of Monte Llusa.

**Springs at Risk Around Monte Llusa**

Springs documented by the MCP are located around the Monte Llusa hillsides and to the south:

1. Fuente de Villanueva (#5023), Villanueva, Ribamontán al Monte
2. Water source (#5191), Villanueva, Ribamontán al Monte
3. Fuente del Real (#4893), El Rincón, Hazas de Cesto
4. Resurgence (#4894), El Rincón, Hazas de Cesto
5. Wet weather spring (#4892), El Rincón, Hazas de Cesto
6. Wet weather spring (#4867), El Rincón, Hazas de Cesto
7. Wet weather spring (#5187), Hazas de Cesto
8. Resurgence (#3959), Solórzano
9. Cueva del Arroyo de Canastrillas (#4046), Solórzano
10. "Bombeo de Anero", public water supply (#5184), Ribamontán al Monte
11. Flood resurgence (#5192), Ribamontán al Monte
12. Resurgence (#5185), Ribamontán al Monte

Details of these springs are shown in annex 1, and positions on the map are shown on figure 1, below.

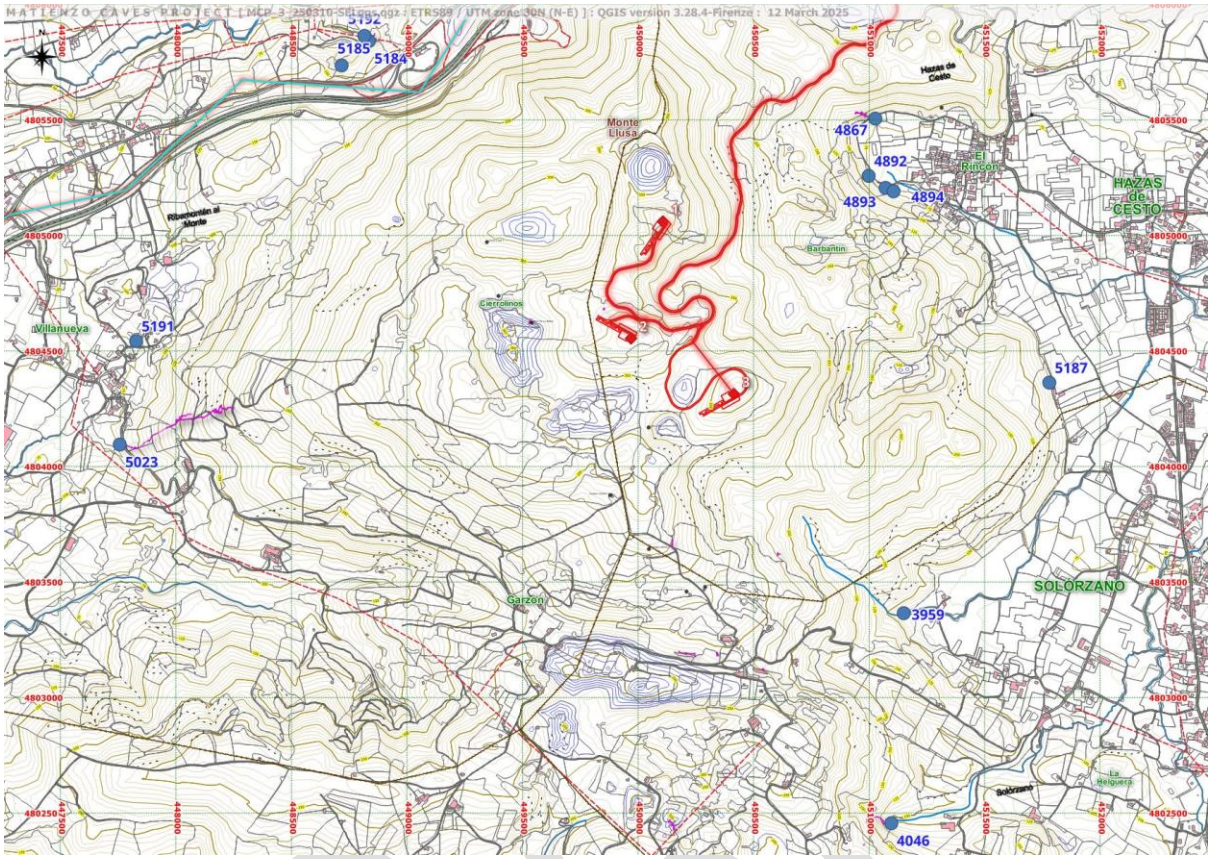


*Figure 1 500m grid. Springs at risk. Note the cave passage extent (purple line) at Villanueva (#5023)*

Although the list of endangered springs in the new EsIA (p207/309) has been updated with information provided by the Matienzo Caves Project, **the data has been "bolted on" with no consequences for the working methods or mitigations**.

The EsIA dismisses the springs because "all of them are located more than 200 metres from any element of the project" (p207/309). **This statement exhibits a deep misunderstanding of karst terrain and underground water flow.** Surface distance is generally irrelevant; underground water can travel kilometres through karst before resurging.

**Absence of Water Tracing Studies**

**No water tracing has been carried out.** As a result, we do not know where the waters from the Monte Llusa area resurge. During normal rainfall, water infiltrates down cracks, following the dip and flowing on sandstone lenses or beds to contribute to underground rivers. During torrential rain, small streams will form on the surface and sink into dolines.

Without water tracing, these waters could resurge at any of the identified springs, or others.
**Filling any dolines will affect underground drainage and biota.**

**Misunderstanding of Karst Hydrological Flow**

The EsIA has sections about the Santander-Camargo and Alisas-Ramales bodies of water without recognizing that water flow from the Monte Llusa area will, most likely, **quickly infiltrate down to resurge in the springs around the hill** - the springs catalogued in the EsIA itself.

There are no surface streams in the vicinity of the three wind turbines. The EsIA mentions only surface rivers at low altitude and the possible effects of earth movement around them. **Subterranean water flow and the known springs are mentioned** (EsIA, p207/309) **but dismissed.**

During flood conditions, water can emerge from different springs as the underground water table alters. The project will alter surface drainage patterns, which may change underground flows and potentially **increase flood risk around one or more springs**.

## 3.6 Insufficient Field Surveys

**Area Not Fully Inspected**

Due to thick vegetation and difficult terrain, a significant part of the project area has not been thoroughly surveyed for cave entrances. There is a high probability that unexplored caves exist containing:

- Wildlife
- Natural drainage patterns
- Archaeological deposits

The archaeological survey itself acknowledges this limitation, noting "The archaeological prospecting of the area for the Moncubo PE could not be carried out as planned due to the presence in some places of a dense vegetation mass composed of scrubland and Cantabrian oak forest, developed over an abrupt karst topography of aged lapiaz." (p. 27 of the archaeology annex).

**Wind Generator 2 Over Karst Features**

**The platform and generator 2 are placed directly over a fenced pond and a fenced deep and wide shaft (#4870).**

Although site 4870 is acknowledged in the new EsIA (and even a sketch from the Matienzo Caves Project website is used), the fact that the large shaft sits under wind turbine 2 appears to be glossed over.

**Has this point actually been visited by the proposer, or is the shapefile mapping wrong?**

Critical unanswered questions:

- Will the platform be moved?
- Will the hole be filled in?
- Will the large shaft be capped?

Again, there appears to be little evidence of local fieldwork and / or local fieldwork informing the documents.

**Karst Features That Will Be Destroyed**

A total of **six karst features** (caves and shafts) will be destroyed as new roads for Alternative 1 are built. Although a reasonable map with caves, dolines and resurgences is shown in the EsIA, **no action is proposed** to avoid their destruction. These sites at risk are shown in figure 2 and details can be found in annex 1.

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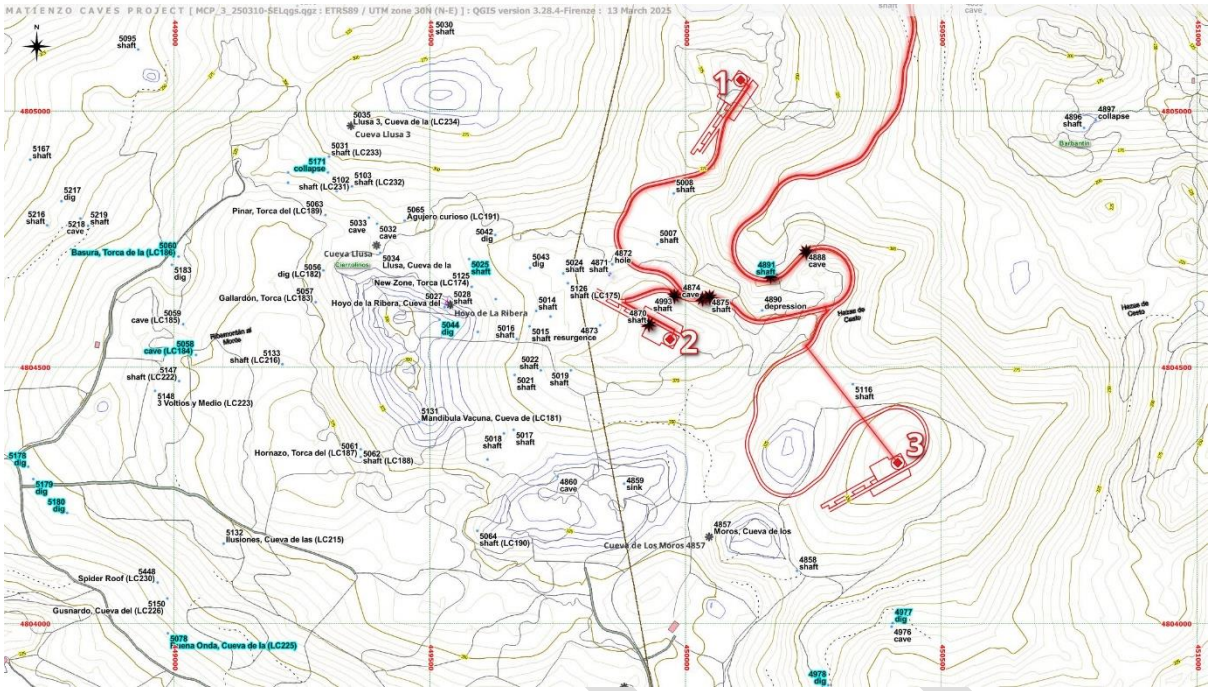


*Figure 2 500m grid. **Six features due to be destroyed by Alternative 1**. Platform 2 is apparently being built over a pond and a wide and deep shaft.*

## 3.7 Disruption of Natural Drainage Patterns

### Absence of Drainage Plan

**There is no drainage plan for the roads and platforms.** Runoff should mimic natural surface infiltration. Providing "ditches 1m wide and 0.5m deep" is not a drainage plan, just as “providing fire extinguishers” is not a fire evacuation plan. There is no mention of how outlets from the drains may mimic natural infiltration.

The construction of access roads (a nominal 6m wide with 60m radius on bends) and their associated drainage systems will significantly alter the area's natural hydrology. Drainage from the project - including roads, generator platforms and work areas - will be directed into depressions with underground connections, thereby disrupting natural drainage patterns.

### Concrete Foundations Not Removed

The EsIA fails to address whether the concrete foundations will be removed during the decommissioning phase. **The foundations for the 3 towers are likely to be left in place and covered.** This raises concerns about permanent alterations to the karst environment:

- Blocking of underground water flows
- Permanent modification of soil and water chemistry
- Impossibility of true restoration

## 3.8 Neglected Underground Biodiversity

**Underground Fauna Ignored**

The EsIA overlooks underground wildlife, apart from the cave-dwelling isopod crustacean **Cantabroniscus**, which is endemic to this region. This species has been documented multiple times in caves around Matienzo, including at least six photographed instances.

Cantabroniscus is mentioned in the document (p224/309), but **no other underground fauna is mentioned or recognized as being at risk**.

This omission exemplifies the document's surface-focused approach that fails to consider the full ecological complexity of karst environments, including:

- Troglobite invertebrates (exclusively adapted to caves)
- Microorganisms in underground water systems
- Specialized fungi and bacteria

**Three-Dimensional Underground Ecosystems Not Recognized**

**Throughout the documents, there is little recognition that limestone karst is a three-dimensional ecosystem.**

The Environmental Impacts table on page 194/309 of the EsIA **fails to take into account that, during the construction and demolition phases, there will be negative impacts on underground ecosystems**, including water flow and quality. Cracks in the limestone will be filled as earth is moved, altering drainage patterns and threatening underground biota.

Therefore, the detailed tables in EsIA Annex 1 are also incorrect.

**Underground ecosystems are not mentioned in any mitigating measures.**

## 3.9 Non-Mitigable Construction Impacts

**Disturbance During All Project Phases**

Page 194/309 in the EsIA has a table of Environmental Impacts that does not adequately recognize that during construction, operation, and decommissioning, there will be negative impacts on:

- Underground ecosystems
- Underground water flow
- Water quality
- Cavernicolous biota
- Structural stability of karst

**Undiscovered Archaeological Deposits**

With respect to archaeology, the EsIA admits (p224/309):

"...it must be considered that, given the area has numerous cavities, sinkholes, and pits, some of them could contain an archaeological deposit that has not been detected to date."

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**The implications are that a wind farm could be built on an incompletely explored area of karst, with new caves and archaeological sites a possibility.** This is an extraordinary acknowledgment of uncertainty that should halt the project until an exhaustive study is completed.

**Cable Leaching**

Copper in the earth cabling under the towers could leach into the underground karst system. No mitigation measures are proposed to prevent aquifer contamination.

## 3.10 Falsehoods About Environmental Restoration

**Impossible-to-Fulfil Restoration Promises**

The usual platitudes about restoration and reinstatement of the landscape are stated:

"The environmental and landscape restoration of the area is mandatory, restoring the initial conditions or improving them."

**This statement is false for several reasons:**

1. **You cannot "improve" on the natural landscape as it is now.** The karst ecosystem has evolved over millions of years. Human intervention can only degrade it.
2. **You certainly cannot restore the initial conditions of the karst landscape and underground ecosystems.** Once cracks are filled, conduits destroyed, and underground water flows altered, these changes are permanent.
3. **The foundations for the 3 towers will be left in place and covered.** This directly contradicts any claim of "restoration" to original conditions.
4. **The table of Environmental Impacts continues the fallacy that karst can be restored.** Therefore, the detailed tables in Annex 1 are also incorrect.

**Decommissioning Phase**

The dismantling phase again raises the fallacies of "environmental restoration" and a return of the "landscape quality". This is simply impossible in a karst ecosystem once large-scale disturbance has occurred.

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# 4. CONCLUSIONS AND RECOMMENDATIONS

## Main Conclusions

1. **PROT Violation:** The Moncubo wind farm project directly violates the technical directives of the Cantabria's pending Regional Spatial Planning Plan (PROT), which explicitly identifies karst as an exclusion zone for wind farm development.
2. **Inadequate Environmental Assessment:** Despite more than 2,300 pages of total published documentation, the project does not adequately highlight:
    - The three-dimensional nature of the karst ecosystem
    - Underground water systems and springs at risk
    - Underground biota including Cantabroniscus
    - The real impacts of road width and earthmoving
    - Archaeological and speleological risks
3. **Irreversible Impacts:** The project will cause permanent and irreversible damage to:
    - Karst landscape morphology
    - Underground drainage systems
    - Cavernicolous ecosystems
    - Springs and local water resources
    - Unique geological features
4. **Falsehoods About Restoration:** Claims that the site can be restored to original conditions are scientifically impossible in karst systems.
5. **Insufficient Scientific Data:** The absence of:
    - Water tracing studies
    - Complete mapping of caves and karst features
    - Local (rather than regional) field studies
    - Adequate drainage plans
    - Underground fauna assessment

## Recommendation

Given the critical deficiencies identified and considering that Spain has many more suitable locations for wind farm development that do not involve sensitive karst, **we emphatically recommend:**

**→ ADOPTION OF ALTERNATIVE ZERO ←**

**Reject the proposed project and preserve this unique Cantabrian karst ecosystem for future generations.**

## Justification for Alternative Zero

1. **Legal Protection:** Compliance with Cantabria's pending PROT directives
2. **Environmental Conservation:** Preservation of a unique three-dimensional karst ecosystem
3. **Water Resource Protection:** Safeguarding of multiple springs and water supplies
4. **Speleological Heritage:** Protection of caves, shafts, and potential archaeological deposits
5. **Biodiversity:** Conservation of endemic species such as Cantabroniscus
6. **Scientific Integrity:** Recognition that certain ecosystems cannot be "restored" after industrialization

## Preferable Alternatives

There are numerous more appropriate locations in Spain for wind energy development:

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- Non-karst areas
- Already industrialized zones
- Regions with lower environmental sensitivity
- Sites that do not threaten water resources

**Renewable energy is crucial for combating climate change, but not building wind farms at the expense of unique and irreplaceable karst ecosystems.**

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# 5. REFERENCES

The following scientific references support the arguments presented in this objection:

**[1] Ford, D., & Williams, P. (2007).** ***Karst Hydrogeology and Geomorphology.*** **John Wiley & Sons.**

**Relevance:** Fundamental text explaining the three-dimensional nature of karst systems and their extreme sensitivity to disturbance. Demonstrates why surface-only assessments are inadequate for karst ecosystems.

**[2] Culver, D. C., & Pipan, T. (2019).** ***The Biology of Caves and Other Subterranean Habitats.*** **Oxford University Press.**

**Relevance:** Documents the unique biodiversity of cavernicolous ecosystems, including endemic crustaceans like Cantabroniscus. Explains why troglobite fauna is extremely vulnerable to environmental changes.

**[3] Goldscheider, N., Chen, Z., Auler, A. S., et al. (2020). "Global distribution of carbonate rocks and karst water resources."** ***Hydrogeology Journal*****, 28(5), 1661-1677.**

**Relevance:** Demonstrates the global importance of karst aquifers and their vulnerability to pollution and alteration. Documents that karst water resources require special protection.

**[4] Palmer, A. N. (2007). "Cave geology and karst hydrology." In** ***Cave Geology*****. Cave Books.**

**Relevance:** Explains how karst drainage systems function fundamentally differently from surface systems. Demonstrates why the EsIA's "200 metres" claim lacks scientific foundation.

**[5] Romero, A. (2009).** ***Cave Biology: Life in Darkness.*** **Cambridge University Press.**

**Relevance:** Documents how underground ecosystems, once disturbed, cannot be restored. Explains the extreme fragility of cavernicolous biotic communities.

**[6] White, W. B. (1988).** ***Geomorphology and Hydrology of Karst Terrains.*** **Oxford University Press.**

**Relevance:** Classic reference on karst geomorphology demonstrating why heavy construction (such as wind turbine foundations) is incompatible with karst terrain. Documents the risks of subsidence and collapse.

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# 6. ANNEXES

## Annex 1- List of affected Karst features (caves, shafts, resurgences) due to Alternative 1

| Alternative | Phase | code | name | area | Ayuntamiento | East | North | Altitude | Feature | Summary | Consequences | web details |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | construction | 4874 | cave | Monte Llusa | Hazas de Cesto | 450033 | 4804634 | 367 | cave | Length 2m; Depth 1m<br>Tiny cave. | **Destroyed / blocked** | https://matienzocaves.org.uk/descrip/4874.htm |
| 1 | construction | 4888 | cave | Monte Llusa | Hazas de Cesto | 450236 | 4804725 | 329 | undercut + scar | Length 3m<br>Undercut and scar. | **Destroyed / blocked** | https://matienzocaves.org.uk/descrip/4888.htm |
| 1 | construction | 4891 | shaft | Monte Llusa | Hazas de Cesto | 450166 | 4804678 | 320 | shaft | Length 4m; Depth 2m<br>Small draughting shaft on footpath. | **Destroyed / blocked** | https://matienzocaves.org.uk/descrip/4891.htm |
| 1 | construction | 4875 | shaft | Monte Llusa | Hazas de Cesto | 450047 | 4804637 | 365 | shaft | Length 10m; Depth 4m<br>Short pitch onto crawl. | **Destroyed / blocked** | https://matienzocaves.org.uk/descrip/4875.htm |
| 1 | construction | 4993 | shaft | Monte Llusa | Hazas de Cesto | 449978 | 4804639 | 377 | shaft | Length m; Depth 2m<br>Small shaft. | **Destroyed / blocked** | https://matienzocaves.org.uk/descrip/4993.htm |
| 1 | construction | 4870 | shaft | Monte Llusa | Hazas de Cesto | 449928 | 4804584 | 383 | shaft + passages | Length 50m; Depth 22m<br>Roomy shaft and chambers. See online sketch. Nearby pond also to be built over. | **Destroyed / blocked** | https://matienzocaves.org.uk/descrip/4870.htm |
| 1, 2, 3 | whole project | 4867 | resurgence | El Rincón | Hazas de Cesto | 451027 | 4805506 | 81 | resurgence with explored cave passage(s) | Length 155m; Height 15m<br>Well-decorated passage ends at sumps. This is a wet-weather resurgence. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/4867.htm |
| 1, 2, 3 | whole project | 5187 | resurgence | Hazas de Cesto (west) | Hazas de Cesto | 451780 | 4804363 | 75 | resurgence with explored | Length 10m; Depth 4m<br>Wet weather resurgence. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/5187.htm |

| Alternative | Phase | code | name | area | Ayuntamiento | East | North | Altitude | Feature | Summary | Consequences | web details |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | cave passage(s) | | | |
| 1, 2, 3 | whole project | 4894 | resurgence | El Rincón | Hazas de Cesto | 451106 | 4805191 | 70 | resurgence | A wet weather resurgence. The farmer says that a lot of water came out during flood conditions . | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/4894.htm |
| 1, 2, 3 | whole project | 4893 | Real, Fuente de la | El Rincón | Hazas de Cesto | 451071 | 4805206 | 70 | resurgence with explored cave passage(s) | Continually flowing, built-over, spring. The main source of the Río Chico. Passages behind this resurgence are likely to act as a conduit for at least some of the water sinking in the area of Alternative 1. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/4893.htm |
| 1, 2, 3 | whole project | 4892 | resurgence | El Rincón | Hazas de Cesto | 450998 | 4805258 | 75 | resurgence | Length 13m; Depth 6m<br>A boulder-filled rift which, the farmer says, emits copious quantities of water in flood conditions. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/4892.htm |
| 1, 2, 3 | whole project | 5184 | resurgence | La Estrada (Anero) | Ribamontán al Monte | 448835 | 4805842 | 53 | resurgence, public water supply | Public water supply. It's possible that at least some of the water comes from the Monte Llusa area. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/5184.htm |
| 1, 2, 3 | whole project | 5185 | cave | La Estrada (Anero) | Ribamontán al Monte | 448717 | 4805736 | 81 | resurgence with explored cave passage(s) | Length 20m; Depth 3m<br>A cave perched above a small resurgence. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/5185.htm |
| 1, 2, 3 | whole project | 5192 | cave | La Estrada (Anero) | Ribamontán al Monte | 448816 | 4805864 | 54 | resurgence with explored | Length 88m; Depth 3m<br>Wet weather resurgence with passages ending too tight. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/5192.htm |

| Alternative | Phase | code | name | area | Ayuntamiento | East | North | Altitude | Feature | Summary | Consequences | web details |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | cave passage(s) | | | |
| 1, 2, 3 | whole project | 5191 | cave | Villanueva | Ribamontán al Monte | 447828 | 4804543 | 75 | resurgence with explored cave passage(s) | Length 5m; Depth m<br>Small resurgence. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/5191.htm |
| 1, 2, 3 | whole project | 5023 | Villanueva, Fuente de | Villanueva | Ribamontán al Monte | 447757 | 4804095 | 81 | resurgence with explored cave passage(s) | Length 915m; Height 18m<br>A major resurgence at the head of a gulley in Villanueva. Passages, with 7 sumps, total nearly 1km in length. The passages head towards Alternative 1 and are likely to act as a conduit for at least some of the water sinking in that area. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/5023.htm |
| 1, 2, 3 | whole project | 4046 | Arroyo de Canastrillas, Cueva del | La Helguera | Solórzano | 451096 | 4802456 | 105 | resurgence with explored cave passage(s) | Length 136m<br>In the mid-July 2014 "lots of water" was seen to flow down the Arroyo de Canastrillas. The cave features a 100m high-level passage leading to a diveable sump, while from the entrance, water can be followed upstream about 40m through two ducks until it intersects the high level. Two sumps have been dived. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/4046.htm |
| 1, 2, 3 | whole project | 3959 | resurgence | Solórzano | Solórzano | 451150 | 4803365 | 85 | resurgence | Small resurgence. | **Altered water flows + pollution** | https://matienzocaves.org.uk/descrip/3959.htm |

## Annex 2: 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) regarding the Sierra de Sel windfarm:
*"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

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## 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)

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**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

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## 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).

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## ANNEX 3: 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) for the Sierra de Sel wind farm:
*"Building a 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 may be 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

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- 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

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**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:

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- 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.

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## ANNEX 4: 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*



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ANNEX 5: 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.

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# Alegación

**Submitted by:**

Juan Corrin (NIE Y5528443-Q)
On behalf of the Matienzo Caves Project

**Date:** 13th February 2025

**Contact:**
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