

Reference implementation scenario PA31

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(CERN)

Disclaimer:
All locations shown are work in progress and subject to further adjustments in the course of the micro-optimisation of scenario PA31-1.0, which is documented in <https://doi.org/10.5281/zenodo.7614421>

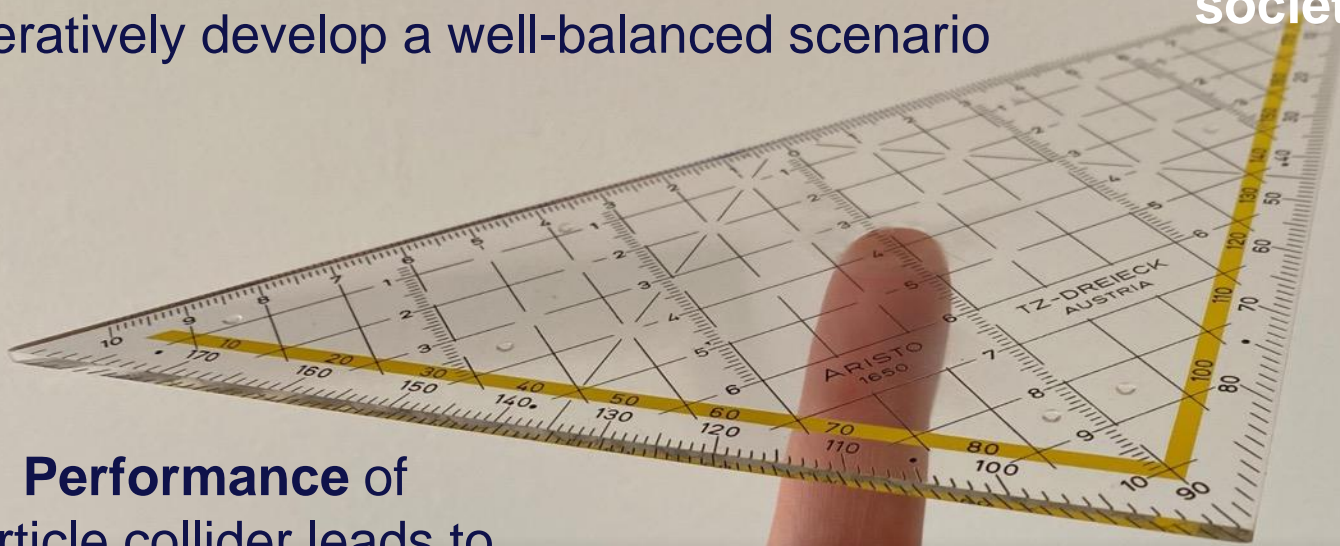
A balance of stakes

« Avoid-Reduce-Compensate » approach
to iteratively develop a well-balanced scenario

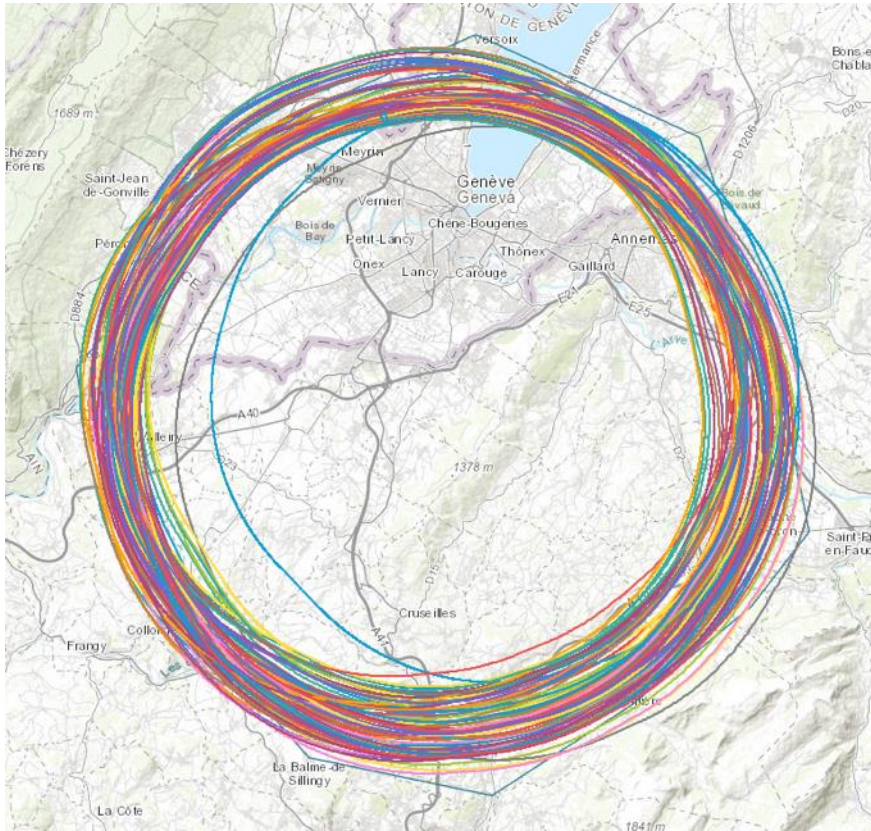
**Territorial impact
limitation leads to
societal acceptance**

**Performance of
particle collider leads to
scientific excellence**

**Technical feasibility and
cost control lead to
acceptable project risks**



More than 100 scenarios developed & analysed



Multi-criteria approach covering 37 aspects

Legal and administrative aspects – 5 criteria

Connectivity – 2 criteria

Availability of services – 2 criteria

Accessibility of infrastructures – 6 criteria

Land plot related aspects – 9 criteria

Environnement – 8 criteria

Accelerator configuration – 3 criteria

Cost of construction

Risks linked to the construction

Reference layout

Straight section @IP: 1 400 m

Straight technical section: 2 032 m

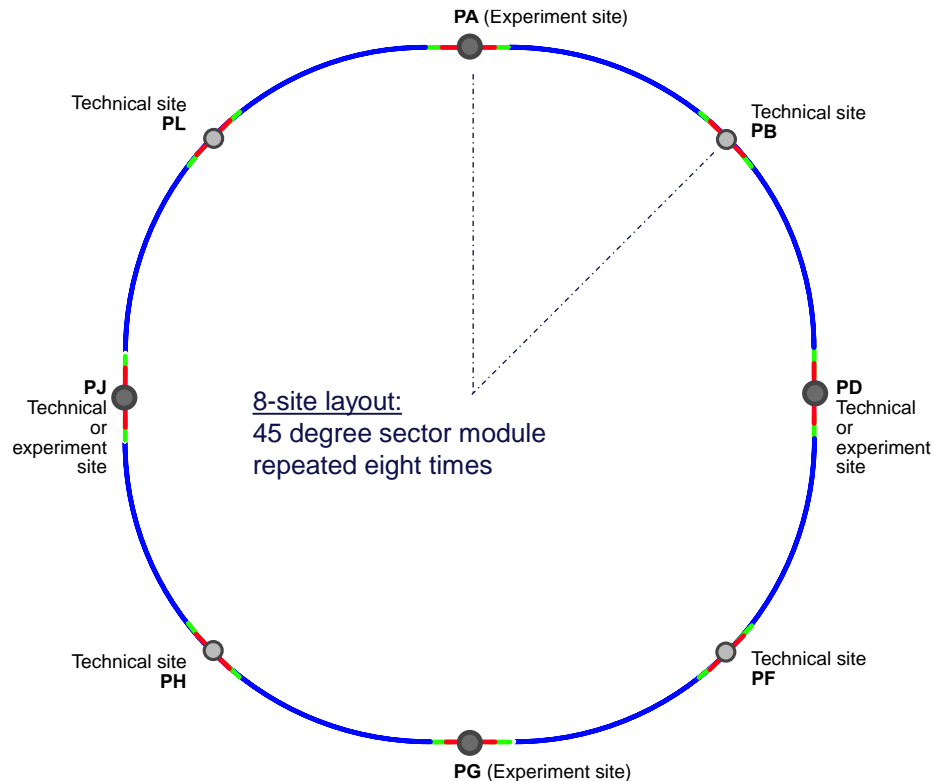
Sum of arcs: 76 929.609 m

FCC-hh RF required circumference: 90 657.4 m

Total circumference: 90 658.828 m
(1.428 m longer than the FCC-hh circumference)

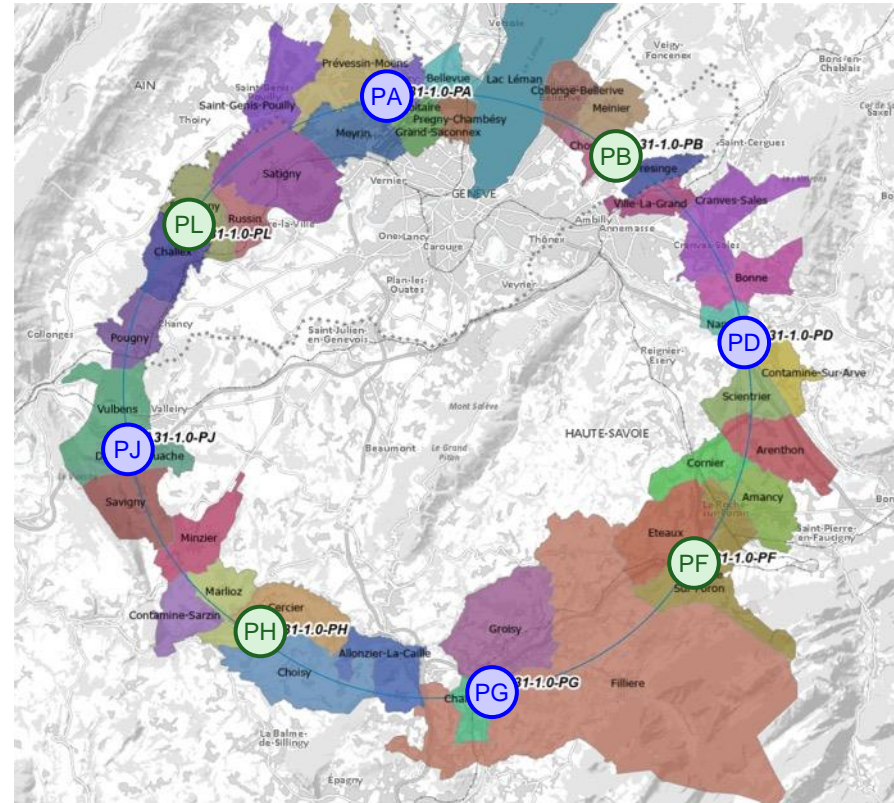
Therefore some further minor adjustment of the trace is currently taking place to produce an ee/hh integrated trace that meets both requirements and reduces the necessary the tunnel widening on both sides of the IPs.

Inclination: 0.5% (about line PD-PJ with PA moving up and PG down, subject to optimisation after subsurface investigation results are available)

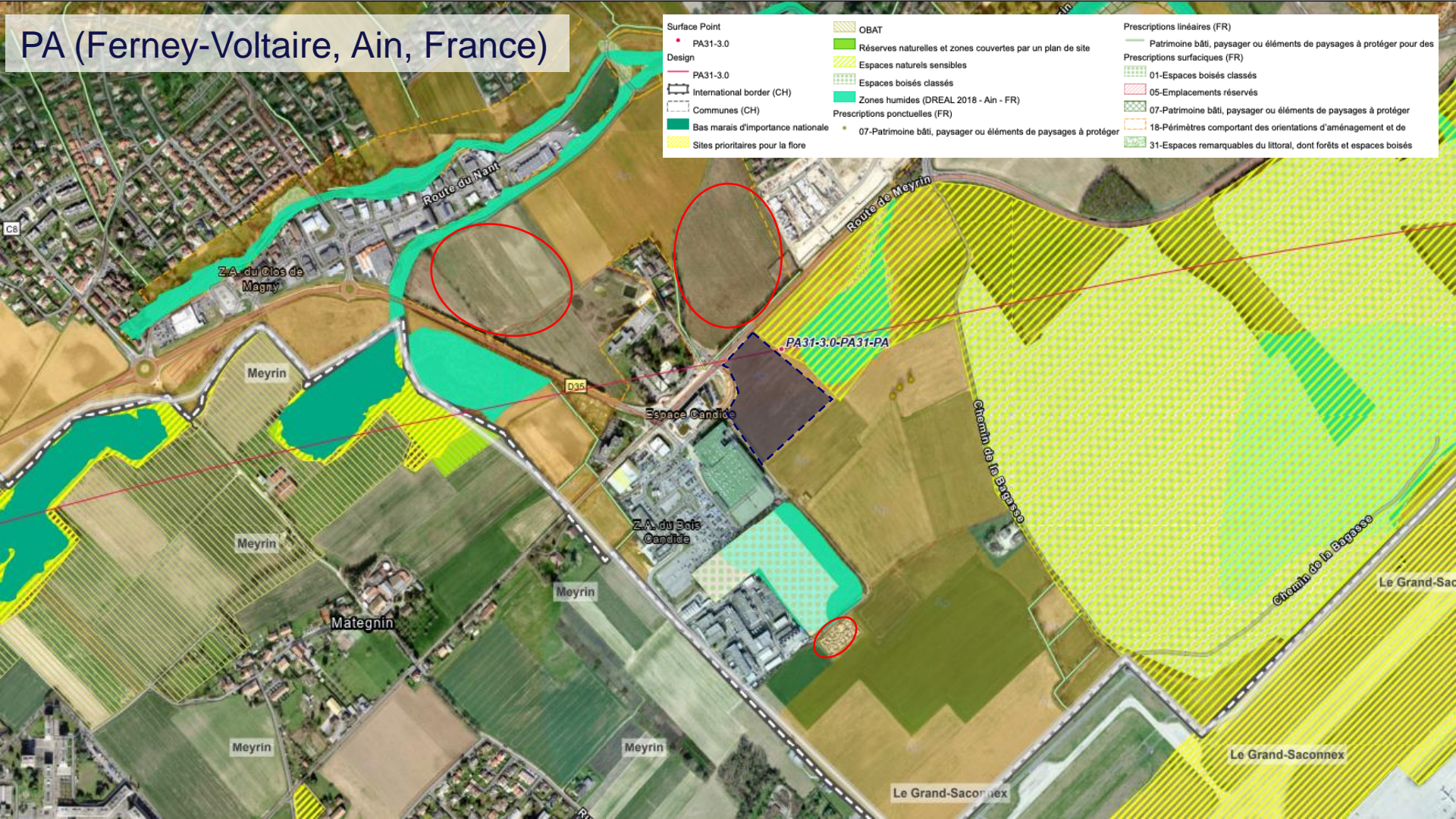


Surface site locations

1. **PA** – Ferney Voltaire (FR, 01) – experiment
2. **PB** – Choulex (CH) – technical
3. **PD** – Nangy (FR, 74) – experiment
4. **PF** – Etaux/La Roche-sur-Foron (FR, 74) - technical
5. **PG** – Charvonnex/Groisy (FR, 74) - experiment
6. **PH** – Cercier/Marlioz (FR, 74) – technical, RF
7. **PJ** – Vulbens/Dingy en Vuache (FR, 74) – experiment
8. **PL** – Challex (FR, 01) – technical, booster RF



PA (Ferney-Voltaire, Ain, France)



| | | |
|---|--|---|
| <p>Surface Point</p> <ul style="list-style-type: none"> • PA31-3.0 <p>Design</p> <ul style="list-style-type: none"> PA31-3.0 International border (CH) Communes (CH) Bas marais d'importance nationale Sites prioritaires pour la flore | <ul style="list-style-type: none"> OBAT Réserves naturelles et zones couvertes par un plan de site Espaces naturels sensibles Espaces boisés classés Zones humides (DREAL 2018 - Ain - FR) Prescriptions ponctuelles (FR) 07-Patrimoine bâti, paysager ou éléments de paysages à protéger | <p>Prescriptions linéaires (FR)</p> <ul style="list-style-type: none"> Patrimoine bâti, paysager ou éléments de paysages à protéger pour des <p>Prescriptions surfaciques (FR)</p> <ul style="list-style-type: none"> 01-Espaces boisés classés 05-Emplacements réservés 07-Patrimoine bâti, paysager ou éléments de paysages à protéger 18-Périmètres comportant des orientations d'aménagement et de 31-Espaces remarquables du littoral, dont forêts et espaces boisés |
|---|--|---|

Main site:

minimal occupancy with assembly hall and shaft head building for transport and ventilation only.

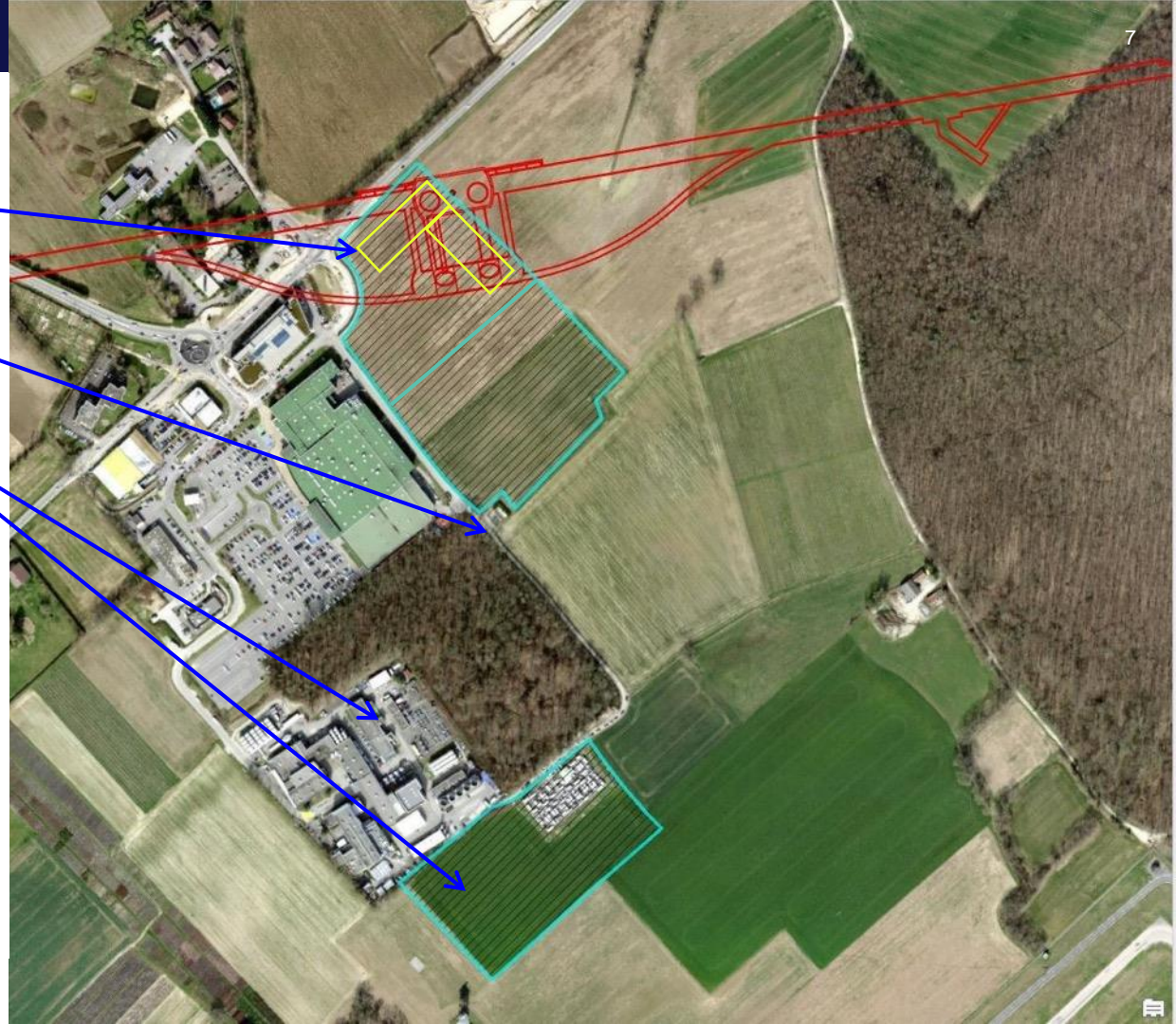
Public road links the 2 sites

LHC Pt8 and extension:

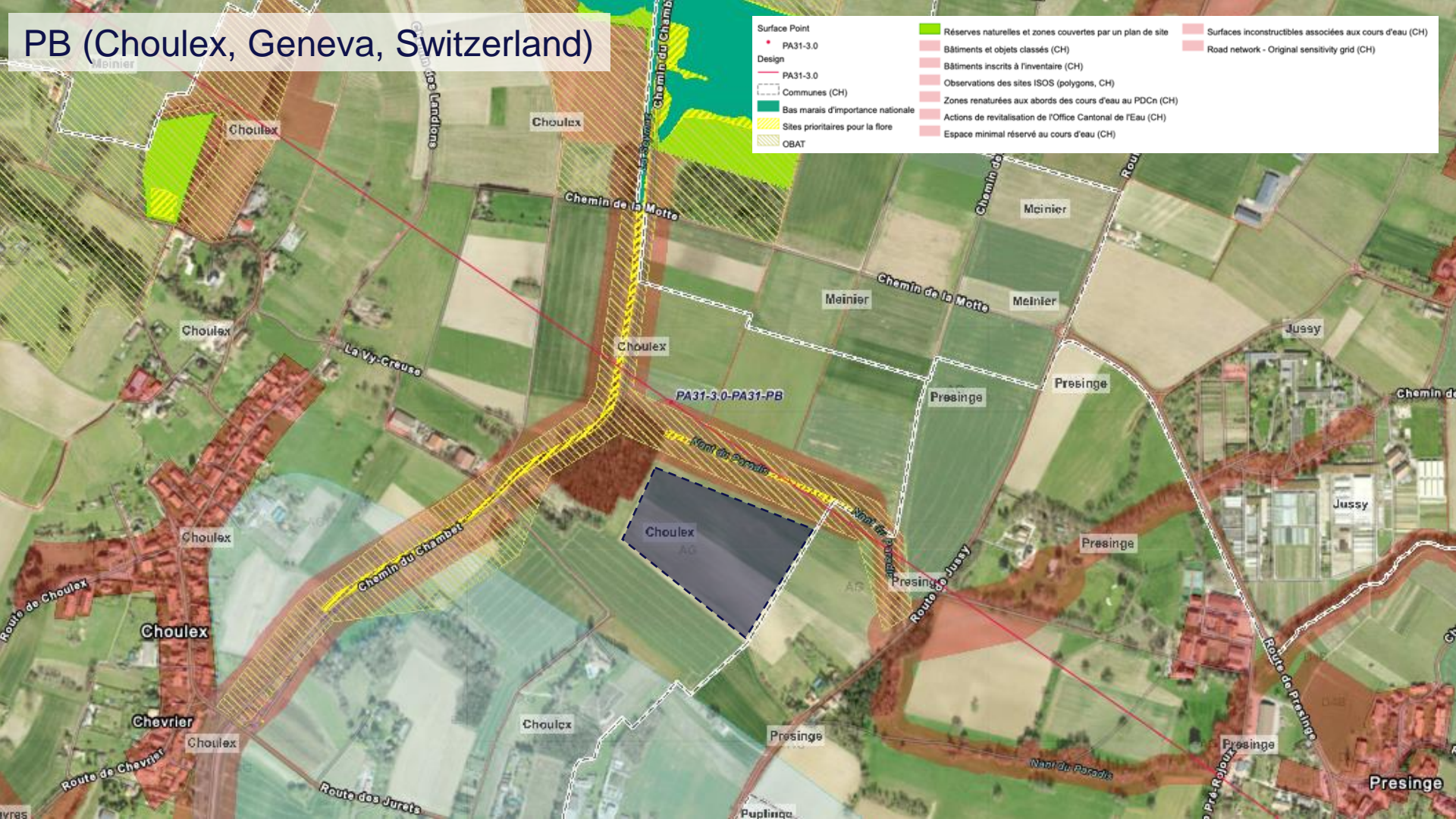
to host all other site relevant technical infrastructures and offices.

Opportunities:

- Electricity via CERN
- Waste heat supply
- Water supply for wetland
- Re-naturalisation and biodiversity improvement
- Excavated materials re-use
- Visitor centre
- Local services



PB (Choulex, Geneva, Switzerland)

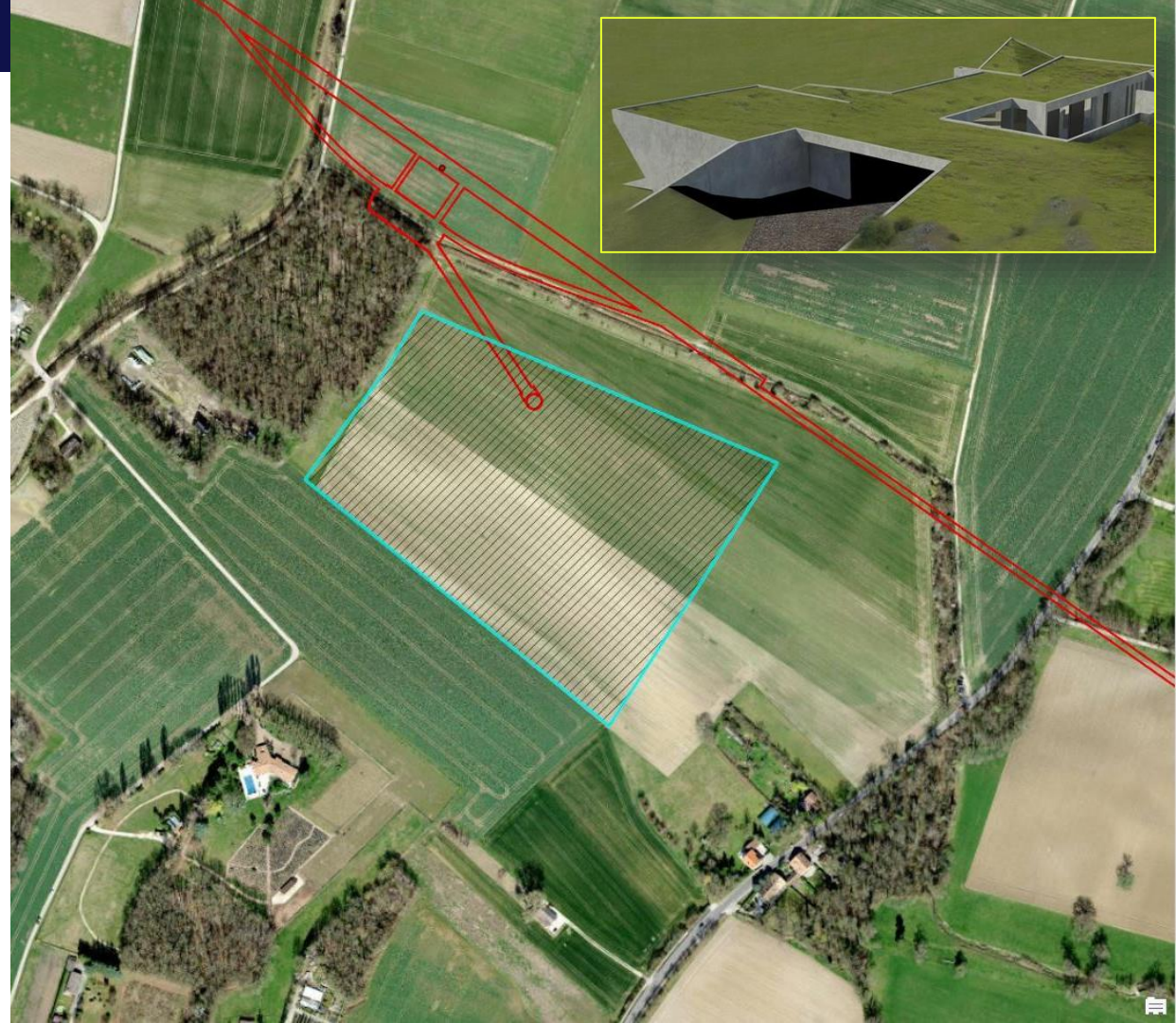


Main site:

- Plot owned by state of Geneva
- Requires zone modification instrument developed at federal level
- Access to be developed with cantonal services
- Must keep footprint as small as possible
- Must integrate well in landscape, considering also half-buried structures and re-forestation

Opportunities:

- “Traversé du rade” project
- Waste heat supply
- Water supply for wet zone and agriculture
- Re-naturalisation and biodiversity and habitat protection improvement
- Excavated materials re-use



Intent coted in 2016 with majority in Geneva
Project cost: ~ 5 billion Chf



GENÈVE

Publié 24 février 2023, 11:19

Sept ans après, la traversée du lac refait surface

La Confédération a décidé de déterrer le dossier de l'immense projet genevois, mis aux oubliettes depuis la votation en 2016.

PD (Nangy, Haute-Savoie, France)

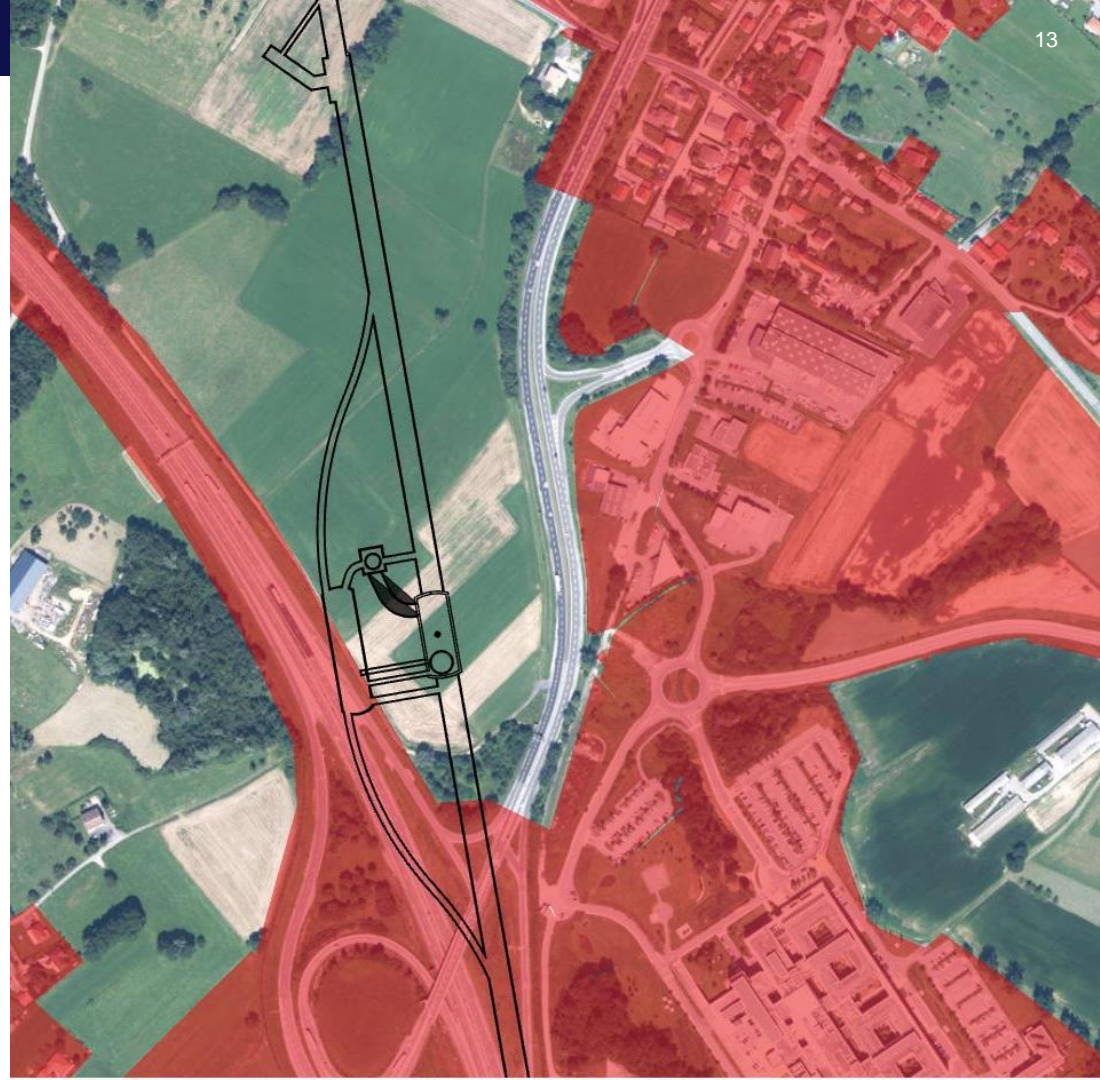


Main site:

- Requires creation of access
- Needs to be integrated in the slope
- Large space permits major experiment site with additional infrastructures for hosting people

Opportunities:

- Hospital across the road provides several synergies
- Visitor centre
- Industrial and commercial zone
- Waste heat supply for heating and food processing
- Water intake from Arve
- Water supply for agriculture or return to Arve
- Connection to highway for excavated materials and good transport
- Local suppliers and services



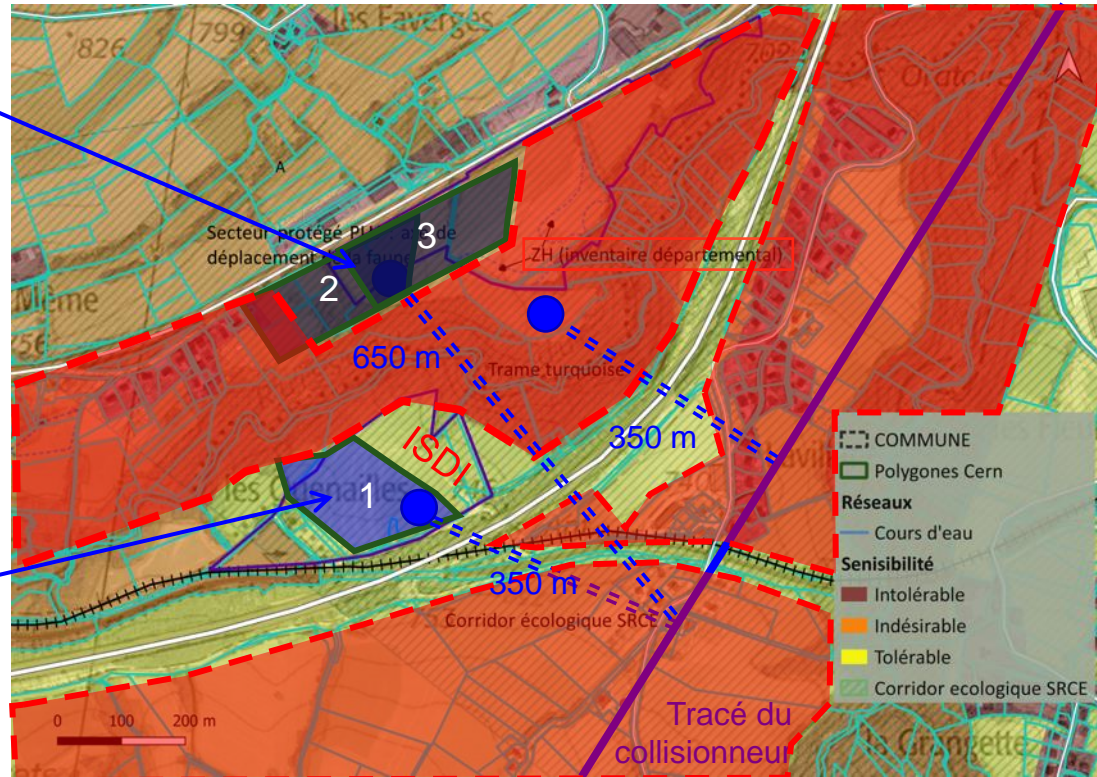
PF (Eteaux or La Roche-sur-Foron, Haute-Savoie, France)

Options 2 et 3 (Eteaux):

- X** Shaft depth **380 m** and horizontal access tunnel between **350 et 650 m**.
- X** **Adjacent environmental constraints (ZH).**
- X** **Site visible**
- +** **Easy access** via RN 203/D1203 existing
- +** **General infrastructures available**
- +** **Several synergies possible in vicinity**

Option 1 (La Roche-sur-Foron):

- X** **Very difficult and long (2.2 km) access to be created**
- X** Requires acquisition of isolated house
- X** Negligible synergies identified so far
- +** Shaft depth **400 m** and horizontal access tunnel of **350 m**.
- +** Ecological value of plot less than option 2 and 3
- +** **Site hidden**

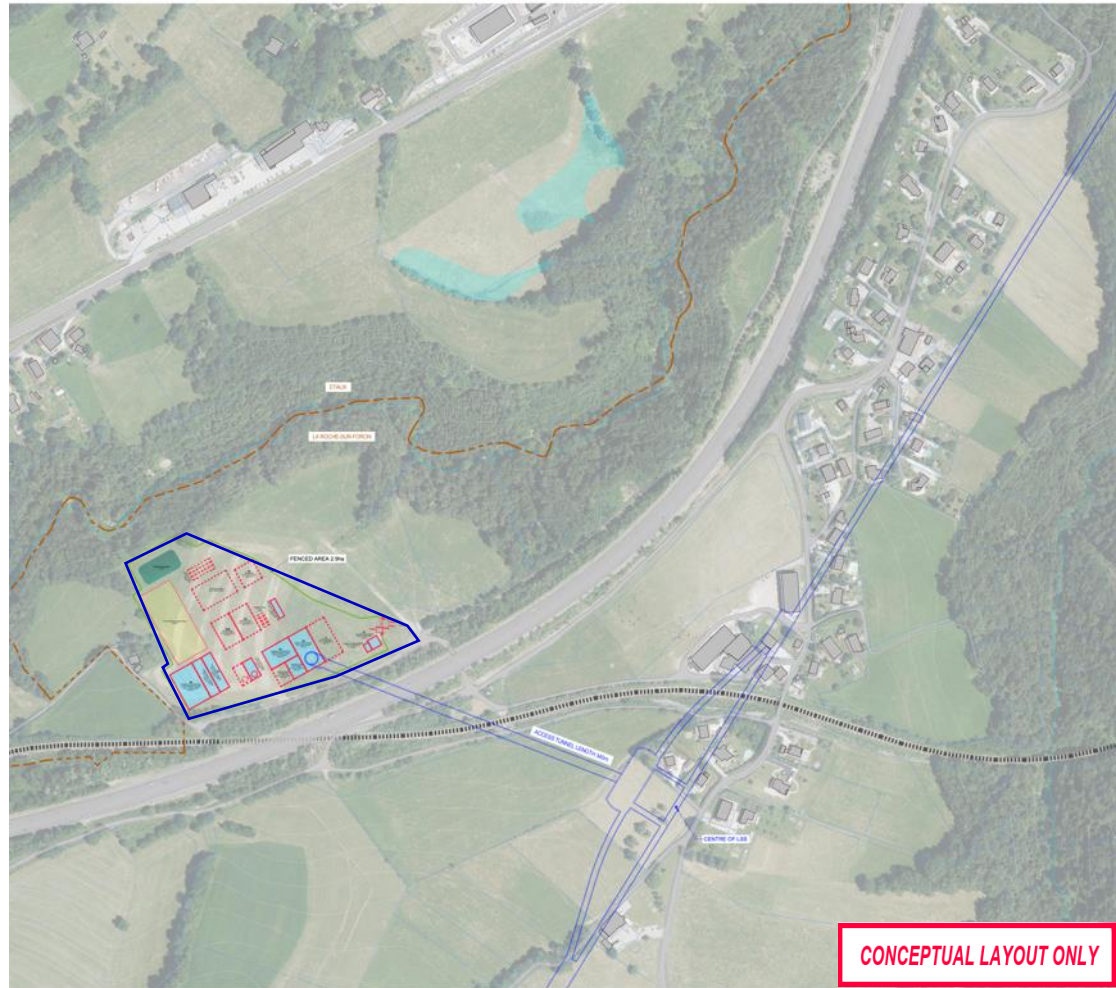


Proposed scenario for compatibility on southern plot:

Technical site within 3 ha on the area foreseen for ISDI phase 2.

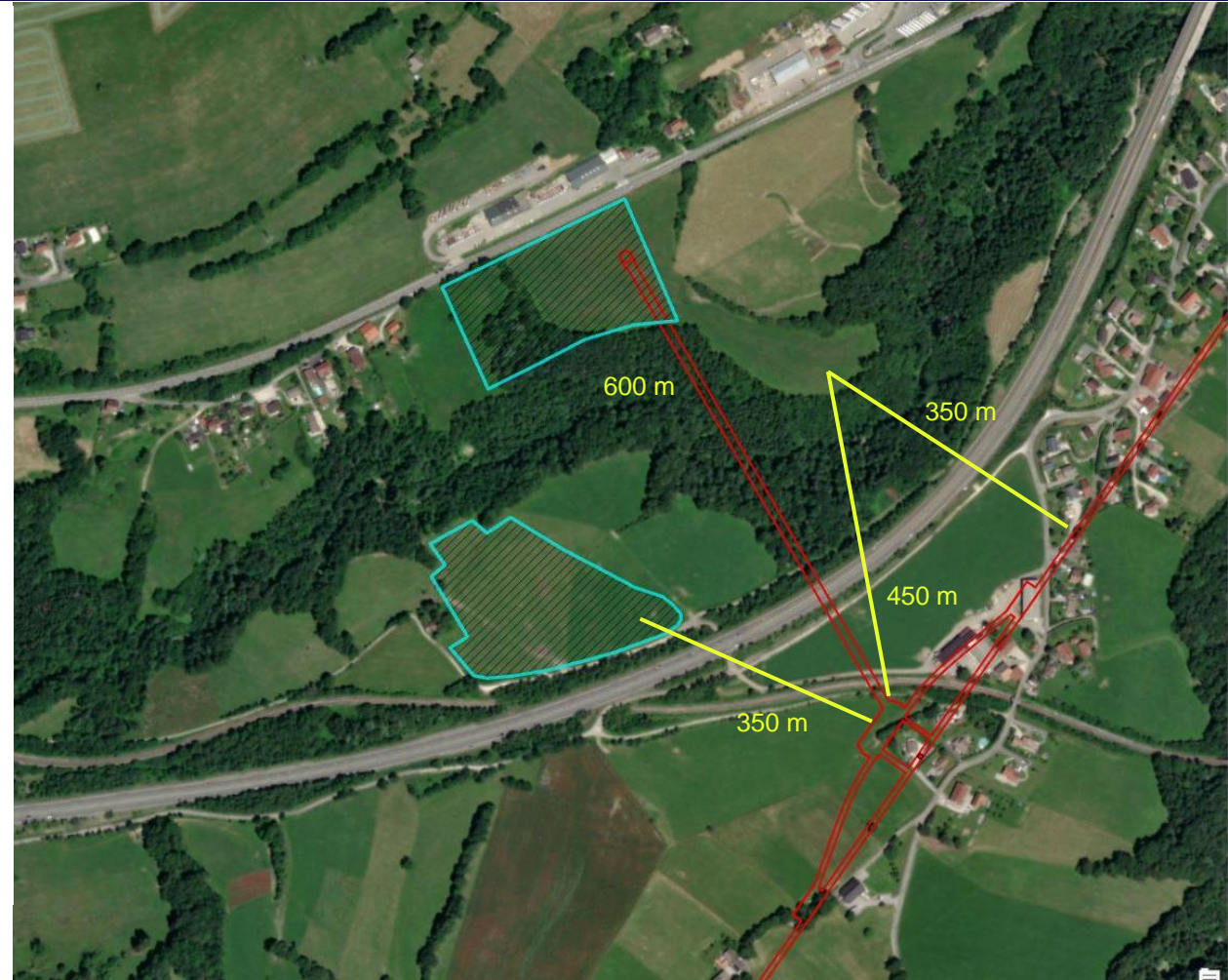
Conclusions after exchanges:

- The ISDI authorization can neither be refused nor be postponed.
- A request to modify/adjust the ISDI project cannot be justified.
- There is no committed intent of CERN for an FCC that would grant a public administration a legal basis for taking any action in favor of the request.
- Commune confirmed suitability of northern plot for a surface site.
- Presented a reduced surface site scenario to be compatible with the ISDI.
- For the southern option, therefore, a negotiation would need to take place between the ISDI operator and the land plot owners by 2026 on the progress on phase 2 of the installation.

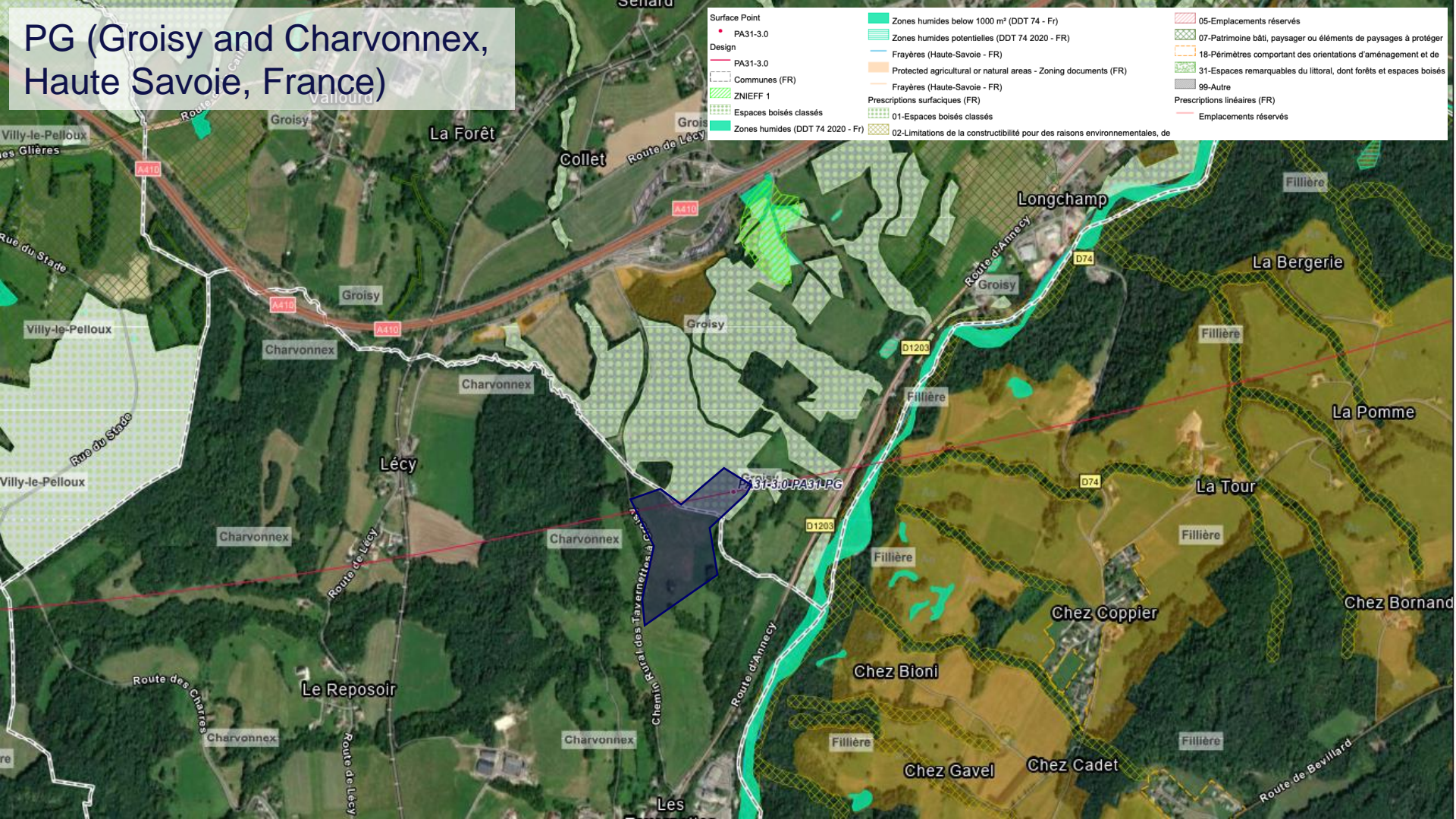


Opportunities:

- Waste heat supply for heating and food processing
- Water supply for wet zone, to improve creek and agriculture
- Re-naturalisation and biodiversity and habitat protection improvement
- Excavated materials re-use for agriculture and reforestation
- Highway access for excavated materials and goods transport
- Local services



PG (Groisy and Charvonnex, Haute Savoie, France)



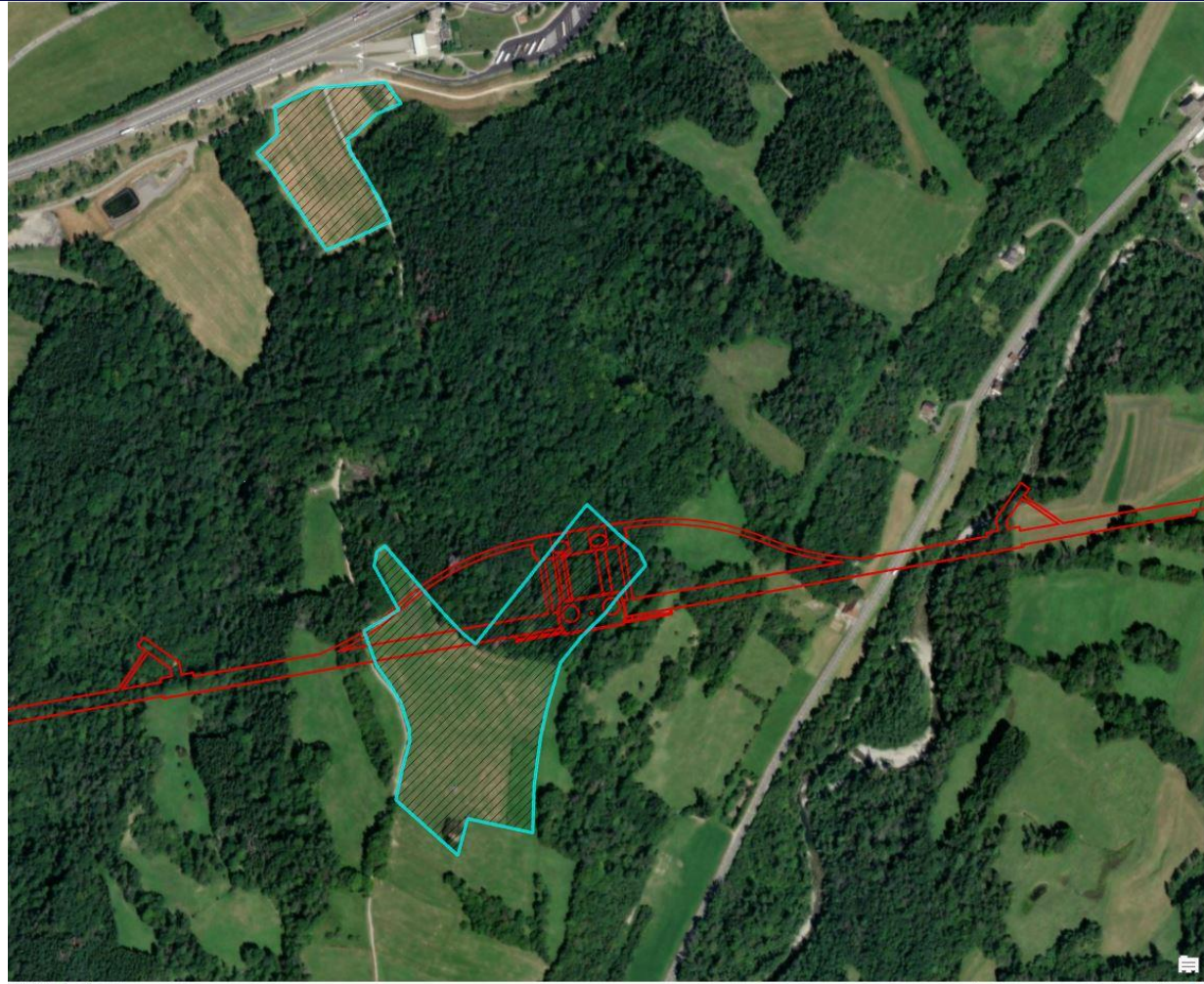
| | | |
|--|---|---|
| <ul style="list-style-type: none"> Surface Point • PA31-3.0 Design — PA31-3.0 --- Communes (FR) --- ZNIEFF 1 --- Espaces boisés classés --- Zones humides (DDT 74 2020 - Fr) | <ul style="list-style-type: none"> Zones humides below 1000 m² (DDT 74 - Fr) Zones humides potentielles (DDT 74 2020 - FR) Fraysères (Haute-Savoie - FR) Protected agricultural or natural areas - Zoning documents (FR) Fraysères (Haute-Savoie - FR) Prescriptions surfaciques (FR) 01-Espaces boisés classés 02-Limitations de la constructibilité pour des raisons environnementales, de | <ul style="list-style-type: none"> 05-Emplacements réservés 07-Patrimoine bâti, paysager ou éléments de paysages à protéger 18-Périmètres comportant des orientations d'aménagement et de 31-Espaces remarquables du littoral, dont forêts et espaces boisés 99-Autre Prescriptions linéaires (FR) Emplacements réservés |
|--|---|---|

Main site:

- Exact location (balance between forest and field) to be optimised
- 800 m existing access through forest to be improved
- Loss of 1.5 ha of forest to be compensated, e.g. by reforestation of existing wastelands

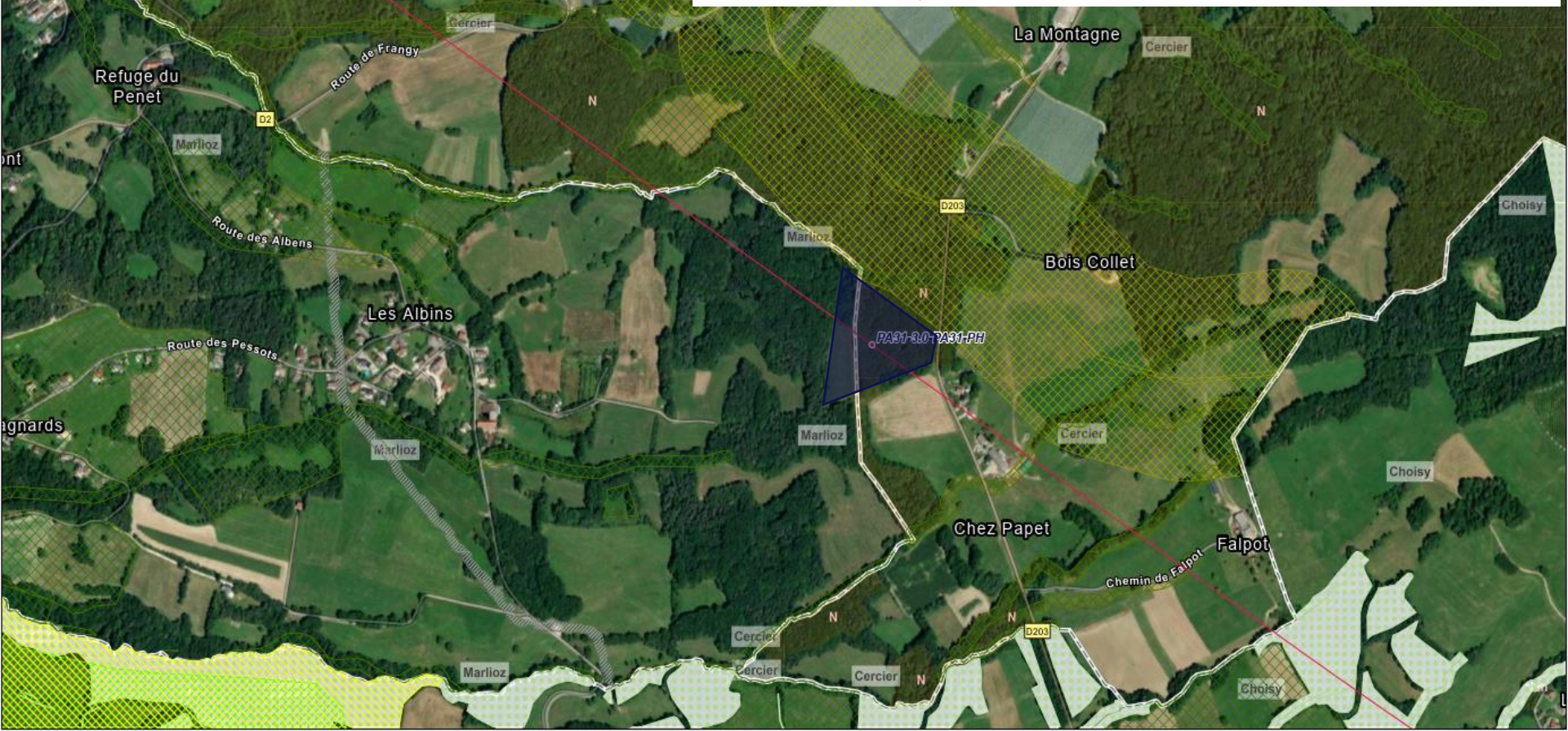
Opportunities:

- Visitor centre
- Waste heat supply for heating
- Water supply for agriculture or return to creek
- Temporary storage of materials
- Connection to highway for excavated materials and good transport
- Vicinity of CNRS/IN2P3/LAPP



PH (Cercier and Marlioz, Haute Savoie, France)

| | | |
|---------------------------------|---|--|
| Surface Point | — Frayères (Haute-Savoie - FR) | 02-Limitations de la constructibilité pour des raisons environnementales, de |
| • PA31-3.0 | Prescriptions ponctuelles (FR) | 05-Emplacements réservés |
| Design | • 07-Patrimoine bâti, paysager ou éléments de paysages à protéger | 07-Patrimoine bâti, paysager ou éléments de paysages à protéger |
| PA31-3.0 | Prescriptions linéaires (FR) | 99-Autre |
| Arrêts de protection de biotope | — Emplacements réservés | Protected agricultural or natural areas - Zoning documents (FR) |
| ZNIEFF 1 | — Patrimoine bâti, paysager ou éléments de paysages à protéger pour des | Communes (FR) |
| Espaces boisés classés | Prescriptions surfaciques (FR) | |
| | 01-Espaces boisés classés | |

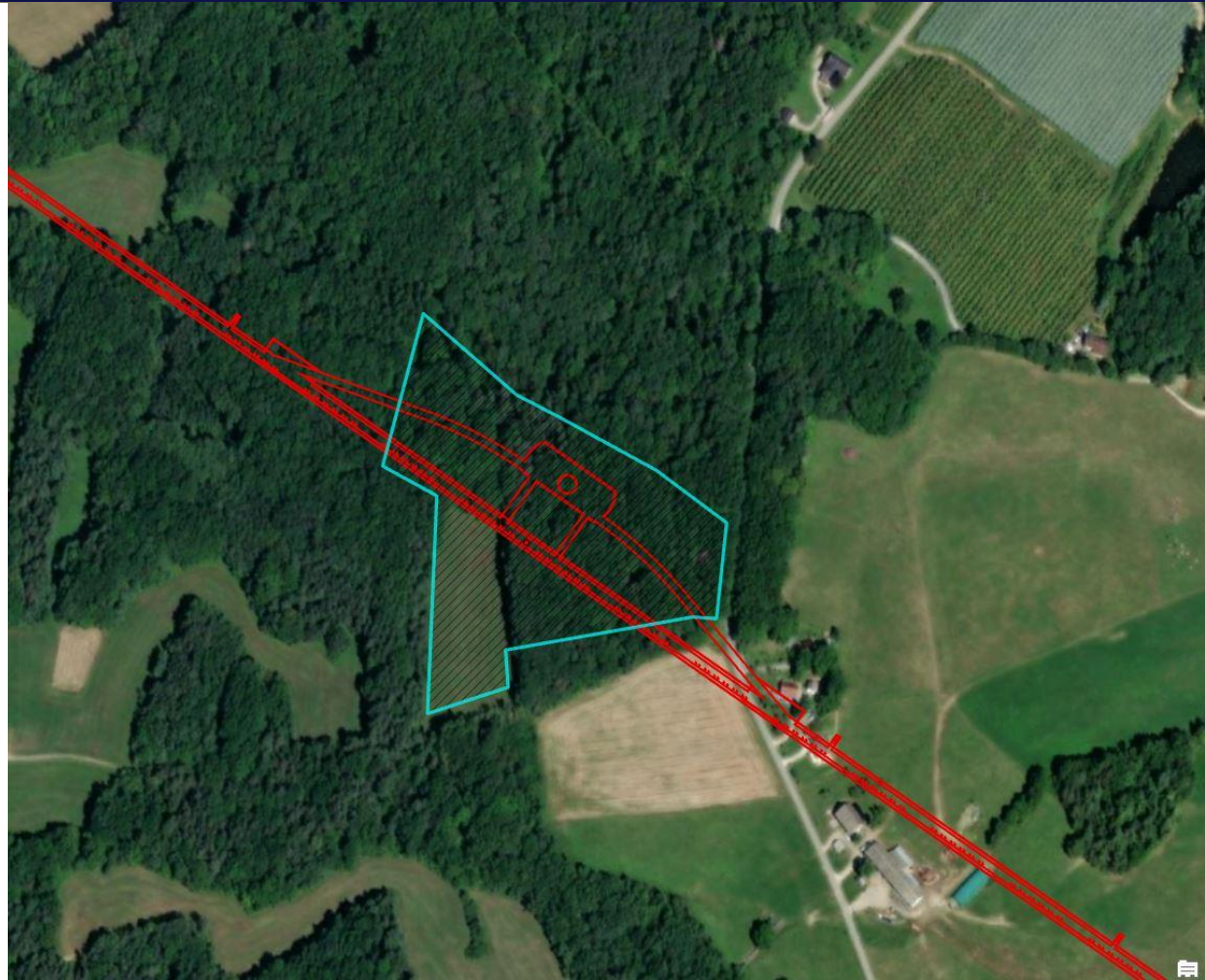


Main RF site:

- Access existing, but road is long and winding from CERN and from LAPP
- Directly at the road in the forest
- Compensation measures to be developed
- Waste heat supply opportunities remain to be studied

Opportunities:

- Connection to 400 kV grid
- Water supply for agriculture



PJ (Dingy-en-Vuache and Vulbens, Haute-Savoie, France)

| | | |
|--|--|--|
| Surface Point <ul style="list-style-type: none"> PA31-3.0 | Prescriptions linéaires (FR) <ul style="list-style-type: none"> Patrimoine bâti, paysager ou éléments de paysages à protéger pour des Autre | <ul style="list-style-type: none"> 07-Patrimoine bâti, paysager ou éléments de paysages à protéger 18-Périmètres comportant des orientations d'aménagement et de 99-Autre <all other values> Protected agricultural or natural areas - Zoning documents (FR) Communes (FR) |
| Design <ul style="list-style-type: none"> PA31-3.0 | Prescriptions surfaciques (FR) <ul style="list-style-type: none"> 01-Espaces boisés classés 02-Limitations de la constructibilité pour des raisons environnementales, de 05-Emplacements réservés | |
| <ul style="list-style-type: none"> Espaces boisés classés | | |
| Prescriptions ponctuelles (FR) <ul style="list-style-type: none"> 07-Patrimoine bâti, paysager ou éléments de paysages à protéger | | |

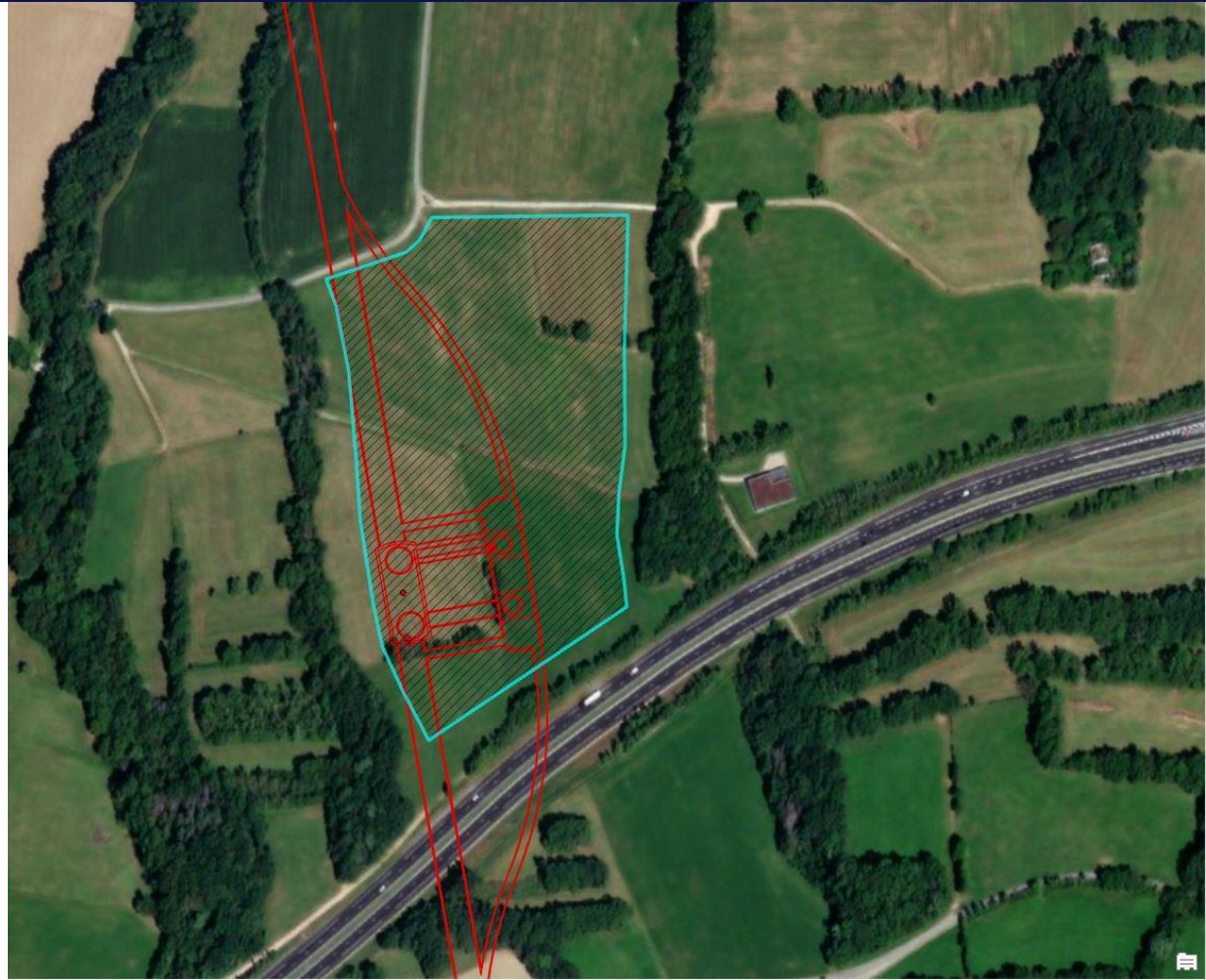


Main site:

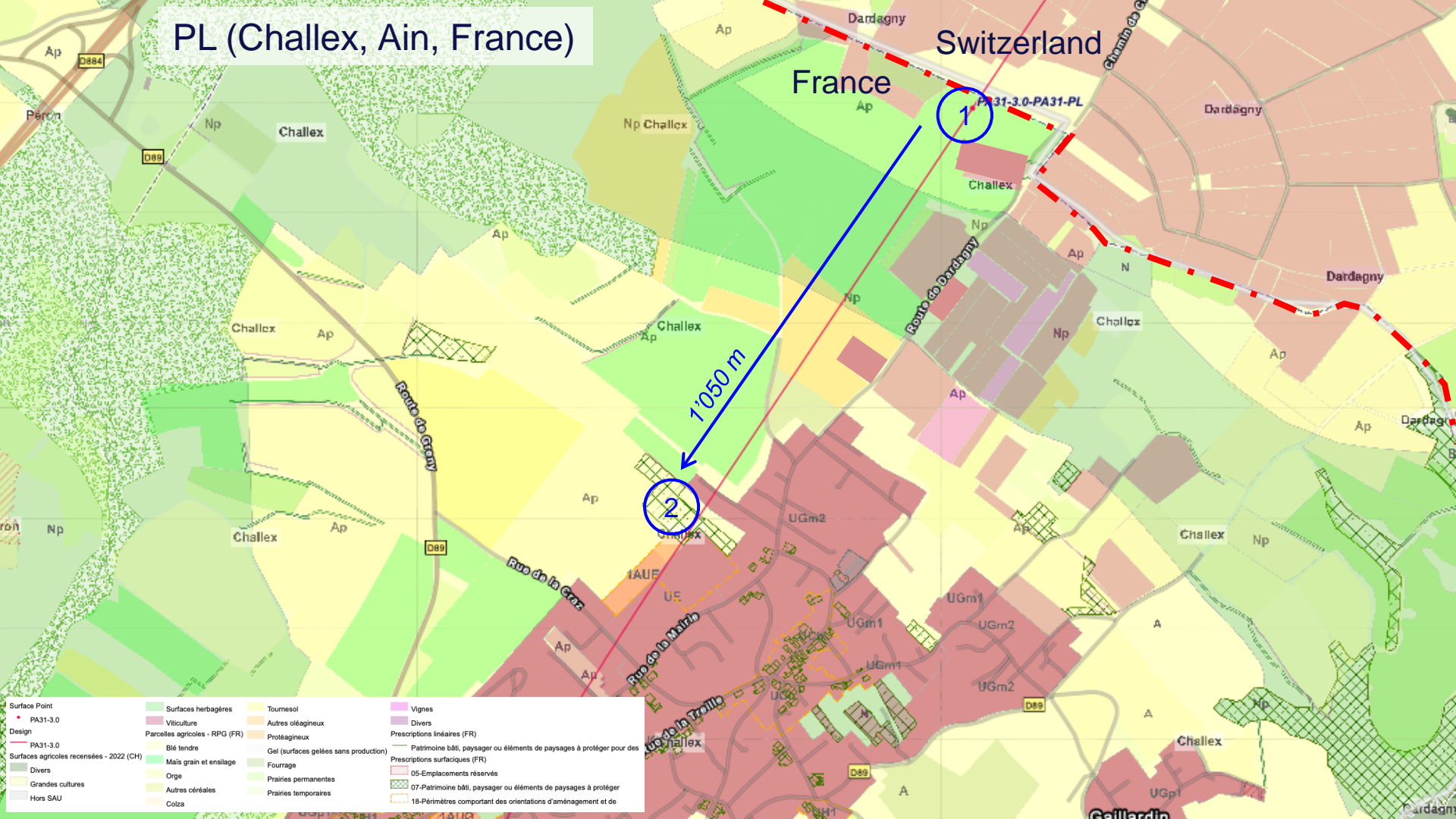
- Integration of experiment site in the slope
- Integration into planned transport concept Vubens-Dingy-Valleiry
- Space and infrastructures enable a large experiment site with on-site presence
- Fauna corridor and natural habitats can be improved

Opportunities:

- Visitor centre
- Integration with schools
- Local services
- Waste heat supply for heating
- Water supply for agriculture or return to creek
- Temporary storage of materials
- Connection to highway for excavated materials and good transport



PL (Challex, Ain, France)



| | | | |
|--|--------------------------------|---------------------------------------|---|
| Surface Point | Surfaces herbagères | Tournefol | Vignes |
| • PA31-3.0 | Viticulture | Autres oléagineux | Divers |
| Design | Parcelles agricoles - RPG (FR) | Protéagineux | Prescriptions linéaires (FR) |
| PA31-3.0 | Blé tendre | Gel (surfaces gelées sans production) | Patrimoine bâti, paysager ou éléments de paysages à protéger pour des |
| Surfaces agricoles recensées - 2022 (CH) | Mais grain et ensilage | Fourrage | Prescriptions surfaciques (FR) |
| Divers | Orge | Prairies permanentes | 05-Emplacements réservés |
| Grandes cultures | Autres céréales | Prairies temporaires | 07-Patrimoine bâti, paysager ou éléments de paysages à protéger |
| Hors SAU | Colza | | 18-Périmètres comportant des orientations d'aménagement et de |

Main booster RF site:

- Nominal location difficult to reach.
- Creation of 1.5 km long access through sensitive zones would be required.
- Water bearing layer at -25 m probable with potential transnational impacts.
- Isolated houses in immediate vicinity would require acquisition.

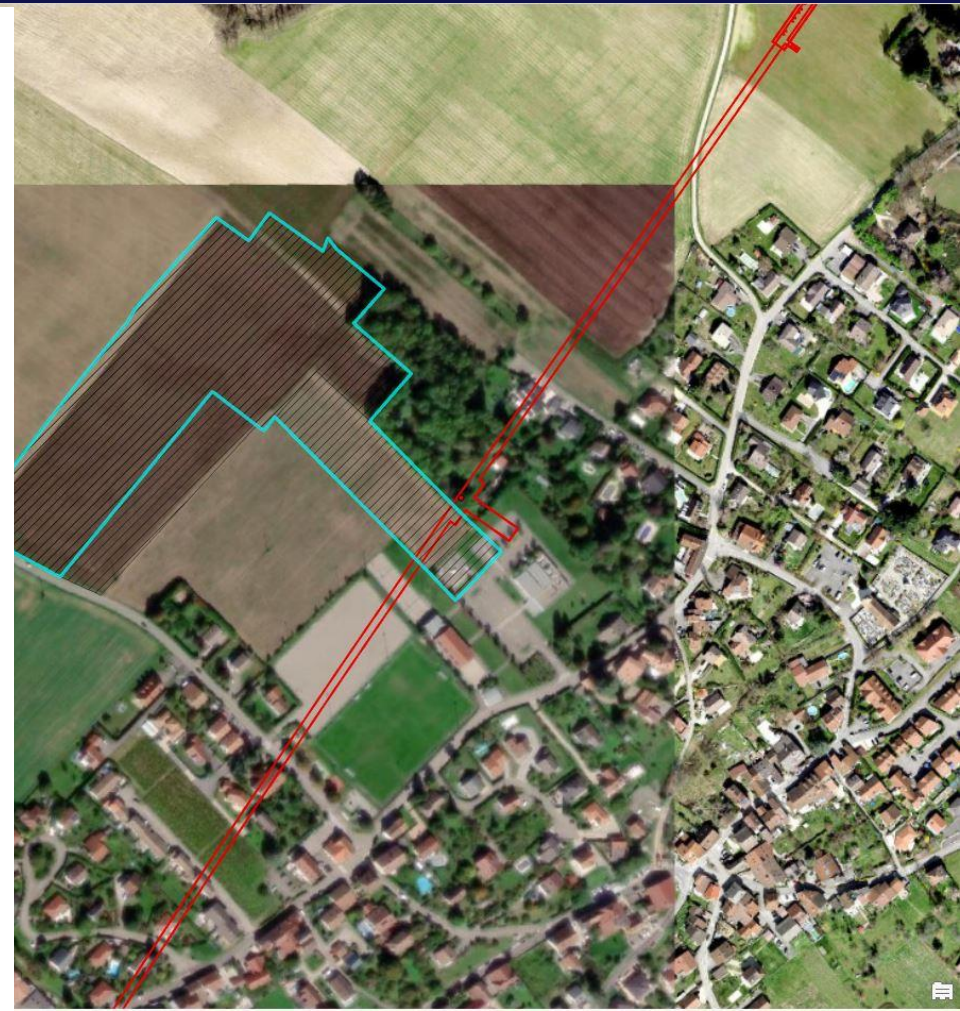


Displaced site:

- Outside commune avoids nuisances
- Access directly at road existing
- Requires shaft outside the ring and 200 m underground horizontal access tunnel
- Large space available

Opportunities:

- Vicinity of CERN via 4 lane road
- Vicinity of railroad access opportunity at 9 km distance
- Waste heat supply for commercial zone
- Water supply for creeks and agriculture as well as natural habitats
- Excavated materials re-use



Implementation scenario documentation

- **With the definition of a “reference implementation scenario”, FCC entered a new phase**
- **Engagement of national actors has started in late 2022 and is ongoing**
 - Communes
 - Notified bodies
 - Host state government representatives
 - Associations
- **This requires a managed and single source of information about the studied facility to be sure that national stakeholders are provided with reliable, trustworthy and managed updates of information relevant to them in their language from a single source.**
- The single reference documentation is FCCIS deliverable 3, currently titled ***“Synthèse des contraintes et opportunités d’implantation”***.
- The document is made **available via the Zenodo Open Access platform.**
- The document and the data sets associated with it are **properly versioned and undergo a quality management process.**
- **Geolocalised information is kept in an FCC Environmental Information System, which has been put in place between 2022 and 2023 (to be gradually opened).**



FCC

Futur Collisionneur Circulaire

RAPPORT LIVRABLE

SYNTHÈSE DES CONTRAINTES ET OPPORTUNITÉS D'IMPLANTATION

| | |
|-------------------------|---|
| Identifiant du document | FCC-2107150900_Synthese_implantation_territoriale_V0100.docx |
| Autre identifiant | 10.5281/zenodo.7614421 |
| Date de la version | 07/02/2023 |
| Groupe de travail | FCCIS – WP3 Intégrer l'Europe |
| Organisation | Cerema - CERN |
| Version | V 1.1 |
| Statut | Version publiée |
| Domaine | Implémentation |
| Mots clés | FCC, implémentation, impacts environnementaux, opportunités territoriales |

<https://doi.org/10.5281/zenodo.7614421>

- **Deliverable** document on the development and feasibility of placement scenarios prepared in the frame of the **EU co-funded H2020 project FCCIS** by CERN, Cerema and Latitude Durable
- One scenario (PA31-1.0) is standing out from all the others
- First version of the documentation released for work with host states and as project-internal reference
- Micro-optimisations with stakeholders
 - **1.0 – published** as reference in February 2023
 - 2.x – various trials to improve the siting for CE
 - 3.0 – adjustment of circumference after RF review
 - **4.0 – result of the optimisation with communes and CE to be openly published in autumn 2023**

Complementary studies

Carried out

Mining the Future – technologies for innovative excavated materials re-use

Access to French highway infrastructure

Renewable energy source supply feasibility

Job creation

Regional impact on high-tech suppliers

Training value for students and post-docs

Tourism effects

Open ICT development impacts

Common good value

Ongoing or planned

Access to the French national electricity grid

Local electricity connection

Excavated materials local re-use

Excavated materials deposit

Access to railroad infrastructure

Waste heat supply feasibility & socio-economy

Water intake

Supply of residual water

Conclusions

Reference scenario exists.

Scenario **has been verified with communes** that host surface sites.

No showstopper found.

Engagement is overall positive.

Development of synergy potentials with communes has **started**.

Micro-optimisation is taking place with host state technical services and communes.

Environmental aspect analysis ongoing.

Managed documentation exists.

Environmental Information System rolled out.

The **territory is continuously evolving**. No obvious alternative scenario potentials have been identified.

Dedicated support and contributions from government services in both countries are required to advance on the validation of the scenario and the territorial optimisation for local excavated materials re-use.

Land plot reservation for study purposes has started with the French authorities and land plot reservation with Swiss authorities will be engaged with update of placement report in autumn 2023.