Fig. 3.26 Wetland observed during the field investigations

areas in the south. The extended study perimeter also includes zones that can be characterised as humid. The habitat quality is heterogeneous, ranging from very low to high. The space occupied by the surface site can be split in two halves: an area of low and an area of high habitat quality. The half that is closer to the autoroute exhibits the higher value.

Site PL in Challex in France is located in a rural context. The site and the larger study perimeter spanning 100 ha include agricultural fields, wasteland, bushes, and trees around houses that are on the surface site. The herbaceous spaces carry characteristics of wetlands. The agricultural constructed spaces with trees and gardens currently have a low to very low habitat quality. The humid prairies in the vicinity, but not on the surface site, have an average habitat quality.

Wetlands Wetlands provide numerous services for ecosystems, particularly in terms of regulation, water storage, and conservation of biodiversity. In the context of this study, investigations were carried out on the presence of wetlands in areas potentially affected by the surface sites. The study of wetlands is important environmentally and also a regulatory requirement under French law. This study aims to assist in decision-making for the location of sites and their optimisation according to the avoid-reduce-compensate approach. In France, in the case of the destruction of a wetland, the regulations impose compensatory measures with a ratio that can reach 1.5 to 2 times the wetland area impacted. Measures can include the improvement of partially degraded wetland functions and monitoring over a defined period to evaluate their effectiveness.

The study of wetlands was carried out in the same way for Swiss and French territories to obtain comparable and coherent data. In Switzerland, only wetlands listed in the federal inventories of low marshes, riparian zones, OROEM, RAMSAR sites, and amphibian breeding sites are potentially protected. In the absence of a direct equivalent of wetlands in Swiss legislation, this study was inspired by the definition of wetlands given in French legislation. According to Article L211-1 of the French Environment Code [85], *"Wetlands are understood as areas, used or not, usually flooded or saturated with freshwater, saltwater, or brackish water, permanently or temporarily; vegetation, when present, is dominated by hygrophilous plants for at least part of the year"*. Article R211-108 of the Environment Code specifies that: *"The criteria to be retained for the definition of wetlands [...] relate to the soil morphology linked to the prolonged presence of water of natural origin and the possible presence of hygrophilous plants. These are defined based on lists established by biogeographical regions. In the absence of hygrophilous vegetation, the morphology of the soils is enough to define a wetland."* Thus, French legislation defines wetlands based on floristic and/or pedological criteria.

The delineation of wetlands on surfaces concerned by the potential site locations was based on departmental/cantonal, Swiss, and French inventories, floristic criteria, and pedological inventories. Government inventories

of the departments of Ain and Haute-Savoie allowed a first delineation of the known wetlands currently present on surface sites. Inventories of flora allowing a second delineation of wetlands were carried out during the flowering period in spring 2023 and by an expert company to identify and delimit the types of habitats potentially present on the immediate and extended perimeters around each site. These inventories also highlighted 'pro parte' surfaces, i.e., surfaces where the habitat identified was not systematically or entirely characteristic of wetlands. Finally, pedological inventories were conducted by another expert company in 2023 and 2024. These inventories identified soils characteristic of wetlands for surfaces where the presence of wetland characteristics was eventually determined to be actually present or not in 2024 using shallow subsurface investigations (12 to 90 cm deep).

At the border of site PA in Ferney-Voltaire, two wetlands are known with a total size of 6.3 ha. The site does not directly impact the zone. The concept for the site has a rewilding project to improve the quality of this area and to make it a permanent and protected natural habitat with recreational characteristics. There are zones that are comparable to the French definition of wetlands in the vicinity of site PB in Presinge. None of these is in the immediate perimeter of the site, and the site will not impact any of these protection zones. The conceptual plan for the surface site includes the integration of one part of the nearby creek's area to rewild the space used for agricultural purposes today and to make it a fully protected habitat.

Three wetlands zones can be found in the extended perimeter of site PD in Nangy, separated from the site by an autoroute. The site does not affect any of these wetlands. A number of wetland zones can be found in the immediate vicinity of site PF in Éteaux. The field investigations revealed that the zone is larger than registered in the regional inventory. The site does not impact these zones. However, the conceptual plan for the site concept includes the creation of a green buffer that includes one of the zones currently used for agricultural purposes to rewild it and to make it a protected habitat. There are also several wetland zones in the forest in the vicinity of site PG in Charvonnex and Groisy. The shape of the site has been adapted to avoid potential negative effects on these zones. A wetland zone exists in the forest at the northern border of site PH in Cercier and Marlioz and cuts through the site towards the south. Out of 16 ha about 0.8 ha are in the perimeter of the currently indicated site boundary. Consequently, the site will be further optimised during a subsequent design phase to either exclude significant effects on the wetland zone or to develop appropriate compensatory measures where the effect cannot be avoided. For example, a nearby area of land which has very poor biodiversity and habitat value has been identified and it can serve as an optional space in case the surface site equipment does not fit within the reduced surface site geometry.

The vicinity of site PJ, in particular close to the autoroute, is characterised by extended wetland zones, covering 13.6 ha. 1.6 ha are on an agriculturally exploited area of the surface site. The subsequent site design phase will take in account the presence of this zone to establish avoidance and reduction measures, including the possibility of creating an annex further in the north on land that is not affected. Compensation measures may have to be developed for the part that cannot be entirely avoided. Wetland zones also exist at some distance from site PL in Challex, in the forest. The site does not affect them.

Summing up, none of the sites is directly affected by wetland induced constraints. The restoration of an ecological compensation zone in the immediate vicinity of site PA provides an opportunity to increase the value of the zone and thus compensate for the loss of space by fostering the development of a natural habitat and the increase of biodiversity opportunities. Sites PH and PJ deserve particular attention during the further development of surface site designs due to zones that have characteristics of wetlands entering partially the site perimeters. Care also needs to be taken during the optimisation of the perimeter of site PG to ensure the avoidance of potential wetland-like areas outside the site limits.

Flora On-site field visits were conducted in 2023 to validate bibliographic data and inventory the species present at the surface sites. These investigations aimed to confirm the presence of remarkable flora and invasive species and provide insights into local ecological contexts. "Remarkable flora" refers to plants that are notable or extraordinary due to their unique characteristics, ecological importance, rarity, or cultural significance. These plants often stand out because of their striking appearance, unusual adaptations, or the critical roles they play in their ecosystems. The term can apply to native, endemic, or even cultivated plants. Invasive plants are non-native species that are introduced to a particular ecosystem, where they spread rapidly and often outcompete native plants. These plants typically lack natural predators, diseases, or other controls in their new environment, allowing them to thrive unchecked. As a result, they can disrupt local ecosystems, reduce biodiversity, and cause environmental and economic harm.

For this study, remarkable species are those with legal protection status (national, regional, or departmental) in one of the two Host States and those listed as "near-threatened" (NT) and those that appear in regional and national red lists.

Special attention was given to invasive species, since soil that hosts invasive species must not be simply transferred to land compensation areas in order to avoid spreading of such species. Risk levels established at regional and national criteria were considered to determine the sensitivity of areas with respect to invasive species.

Fig. 3.27 Military orchid *(Orchis Militaris)* observed during field investigations, providing valuable data on local wildlife presence and ecosystem dynamics

Fig. 3.28 Glutinous sage *(Salvia glutinosa)* observed during field investigations, providing valuable data on local wildlife presence and ecosystem dynamics

The habitats and floral compositions in the study area of site PA in Ferney-Voltaire, France are dominated by the agricultural space. During the field inventory, no remarkable species were observed. However, the municipal species list for Ferney-Voltaire identifies 3 noteworthy species that could in principle be encountered in the enlarged study area around the site. Complementary studies will be required during a project preparatory phase to confirm or exclude the presence in all areas that would potentially be affected by the surface site. Several species of invasive plants were observed in the PA study area that need to be considered when developing agricultural space compensation plans.

The habitats and composition in the Presinge study area in Switzerland concerning site PB are mainly agricultural. Woodland exists at a further distance and close to the Nant de Paradis creek, plants typical of wetlands (wetlands, riverside vegetation) are found. During the field visits, two remarkable species, protected at the cantonal and national level, were observed. Apart from these exceptions, no other important species listed in the bibliography were recorded. Several invasive species exist in the surroundings, and there are even some exotic ones. The agricultural space is free from remarkable and invasive species.

Fig. 3.29 Common toad *(Bufo bufo)* observed during field investigations, providing valuable data on local wildlife presence and ecosystem dynamics

Applying the municipal catalogue of remarkable species for site PD in Nangy, France does not lead to any significant sensitivity of the site. During the field inventory, no noteworthy species were found. However, several invasive species were observed that may negatively affect agricultural cultivation. Therefore, it remains to be studied if the soil can be transported for compensation purposes as is or if particular measures to eliminate those species will be required.

No remarkable species were recorded during the field inventory of the site PF in Éteaux in France. Three noteworthy species listed in the bibliography may, in principle, occur in the enlarged study area including wet meadows and wooded areas, outside of the surface site perimeter.

The municipal species catalogue of Groisy and Charvonnex applicable to site PG in France mentions three remarkable species that could be present in the study area. None of them were identified during the field inventory and no other remarkable species from the bibliography were observed either. A few invasive species have been recorded in the study area and topsoil that is removed should be cleared of those species.

The list of flora species of the communes of Cercier and Marlioz applicable to site PH in France includes a considerable number of remarkable species, but none of them is present in the study area, and no remarkable species were observed during the field visit.

None of the remarkable species listed in the bibliography for Dingy-en-Vuache and Vulbens for site PJ in France occur in the study area and no remarkable species were observed during the field visits. Some remarkable species listed in the communal lists could, however, be potentially present in the area that exhibit sufficient characteristics to support those species. They concern mainly humid zones at the edges of the surface site candidate perimeter.

For site PL in Challex, France, four species are highlighted as noteworthy in the bibliography. Tow out of them may potentially occur in the area of the PL site. However, none of them were observed during the field visits. On the contrary, two invasive species were inventoried in the study area, which should be taken into account in the case of reuse of agricultural topsoil.

Summing up, no particular sensitivity of any surface site candidate could be established with respect to remarkable flora. However, some sites will require attention with respect to the treatment of invasive species before the topsoil can be re-used for compensation measures. The PB surface site design requires attention due to two remarkable species observed during the field visit and the large number of potentially present species listed in the bibliography in the larger area. This site is, therefore, still considered to have a strong sensitivity at its edges. No outstanding flora species were inventoried at the PA, PG, PH, PJ, PL and PF sites, but these areas require complementary studies during a preparatory project phase to confirm the state and to plan for the construction site activities. So in general, additional field visits are required to reliably assess the environmental impacts. The sensitivity of site PF is also considered strong due to potential remarkable flora at the very edges of the site. Attention will need to be paid to invasive species present in several locations, and this will need to be taken into account when considering the reuse of agricultural soil in other locations.

Fauna

Amphibians For some groups of amphibians, identification down to the species level cannot be carried out without genetic analysis due to the strong hybridisation within these groups. However, an inventory based on bibliographical data and field investigations was established not only on the sites, but also for the perimeters in the vicinity of the site. Investigations were done during the day and the night for several months. Amphibians are frequently found in the vicinity of water spaces, creeks, rivers, and wetland zones.

Amphibians were observed in the vicinity of site PA in Ferney-Voltaire across the French and Swiss territories. Some of them are considered endangered in Switzerland. No amphibians are present on the surface site location. In

Fig. 3.30 Reed warbler *(Acrocephalus scirpaceus)* observed during field investigations, providing valuable data on local wildlife presence and ecosystem dynamics

the immediate vicinity of site PB in Presinge the bibliographic inventory was confirmed by the field investigations and the issue[9] is big, and therefore the river zone will be entirely avoided by the project. The integration of a rewilding project in the site will help to raise the protection level of that zone further. The area is currently partially used as agricultural space. Site PD in Nangy and its vicinity have a low stake concerning amphibians. Although the site PF in Éteaux is not directly concerned, the immediate vicinity revealed species with a high stake. At site PG in Charvonnex and Groisy several amphibians are confirmed in the vicinity and few on the site. The stake concerning amphibians is also high in the vicinity of site PF. On the site, no issues could be identified. Some amphibians were observed in the vicinity of site PJ, but the site did not reveal particular issues. Some amphibians were observed in the larger area around site PL in Challex, including Switzerland. Some of them are listed as endangered and protected. The site does not host amphibians.

Summing up, the zones in the vicinity of sites PA and PD feature a few habitats that would give them a high value. For sites PF and PJ, the availability of habitats also seems relatively limited, but the forest/hedge environment and the presence of streams give them a higher value. The vicinity of site PB, meanwhile, has the particularity of being partly located on an amphibian reproduction site, that increases its value level, despite the lack of direct observation of high-valued species. The sites PG, PH, and PL have high values due to a high density of aquatic habitats and the observation of a large number of high-value species in their vicinities.

Birds Ornithological surveys were conducted using sound recorders and visually with binoculars and cameras. The survey period spanned 2023 and 2024. An inventory was carried out for the 8 surface site locations over several seasons. Five ornithologists took part in the surveys. The inventories were conducted under suitable weather conditions (no rain and little/no wind). Field observations were recorded on-site using computer equipment. Observation intensity varied depending on the seasons. Increased observation intensity was applied to the spring inventories due to the sensitive period for breeding birds. A matrix was established using European guidelines for endangered species that is only applicable to the French territory. For Switzerland, the cantonal and federal protection lists were used to analyse the risks.

Birds find living space in the vicinity of site PA in Ferney-Voltaire, mainly in trees, bushes, and hedges. Some noteworthy species have been found in the vicinity. Birds are also prevalent in the vicinity of the agricultural space in site PB in Presinge and next to the small creeks and rivers. Protected and endangered species were found in the extended zone around the site. Areas and trees in the vicinity of site PD in Nangy provide protection spaces for birds. Some noteworthy species have been found on the surface site location. The surface site PF in Éteaux today includes several bushes that serve birds to find food and rest during the migration. Some noteworthy species have been found on the site. The forest on site PG in Charvonnex and Groisy provides living space for a variety of birds, and the bushes around serve as a retreat and reproduction space. Some noteworthy species have been found in the vicinity of the site. Also the forest on site PH in Cercier and Marlioz provides space for birds. Some heritage species were found on the site. Site PJ is surrounded by bushes and hedges that serve birds as living and reproduction space and for rest during migration. Some heritage species were found on the site and in the immediate vicinity. Also the hedges nearby site PL provide protection for birds and noteworthy species were found there.

[9]Environmental issues mentioned here and in the following sections may also be referred to as ‘stakes’ - an alternative translation of the French ‘enjeux’.

Fig. 3.31 European kestrel *(Falco tinnunculus)* observed during field investigations, providing valuable data on local wildlife presence and ecosystem dynamics

Fig. 3.32 Red fox *(Vulpes vulpes)* observed during field investigations, providing valuable data on local wildlife presence and ecosystem dynamics

A full database of species observed was established, and it has been integrated into a project-wide geographical information system. The bird observations have limited validity and must be continued if a decision to advance with a project design is taken.

In summary, the sites PD, PL, and PJ in France, as well as PB in Switzerland and their surroundings, contain hedgerows and open areas that support nesting species of high conservation value. The sites PF, PG, and PH in France feature hedges and forests adjacent to extensive pastures, which are crucial habitats for uncommon species throughout the year. Site PA in France consists primarily of conventional agricultural land that becomes waterlogged in winter, serving as an important stopover site for waders.

To mitigate the environmental impact, dedicated measures will be implemented during the design phase to recreate bird nesting and living areas comparable to those lost, either within the green buffers of the sites or in their immediate vicinity. These efforts will be integrated into rewilding projects associated with the development.

Mammals Data on terrestrial mammals was collected during all naturalist assessments of other groups on the surface sites. Therefore, data on terrestrial mammals were collected both day and night at all surface sites throughout four seasons. Terrestrial mammal species were recorded visually or through indicators such as tracks, faeces, burrows, etc. The particular attention given to weather conditions for other groups was also applied during the assessments of terrestrial mammals. All observations were geolocalised and recorded in the project-wide geographical information system.

The PA site in Ferney-Voltaire has been the subject of infrequent observations of terrestrial mammals during naturalist investigations. They include the European roe deer, wild boar, European badger, European hare, brown rat, and greater white-toothed shrew. In the wider surrounding bibliographic data also revealed the presence of species of medium concern, such as for instance the hedgehog and beaver.

In the vicinity of site PB in Presinge, two species with a high conservation priority in Switzerland were observed: the beaver and the hare. Other species with a low priority that were encountered are the roe deer, badger and fox.

Fig. 3.33 Bat detectors used to detect the presence of bats by converting their echolocation ultrasound signals

Bibliographic data also provided information about species with a very high priority: the harvest mouse, polecat, weasel, wolf and the dormouse. Two species with a medium priority are the hedgehog and the stoat. However, these species were not observed.

The observations on site PD in Nangy of medium importance are the beaver and hedgehog. A species with lower importance, the fox was also observed. Bibliographic data also reports on the wildcat, the polecat, the black rat, but they were not observed.

Several observations have been recorded at the PF site at Éteaux: the hedgehog, with medium importance, and the fox and the badger, with very low importance. Bibliographic data details the presence of four species of medium conservation concern, including the Alpine Ibex, European beaver, European rabbit and the wildcat.

Observations at the PG site in Charvonnex and Groisy ranging from very low to low importance are: European roe deer, fox, squirrel, wild boar, European hare, chamois. In the surroundings, the bibliography also reports species with high importance: European otter, polecat. The following species with medium importance are reported: hedgehog and wildcat. However, these species were not observed.

At the PH site in Cercier and Marlioz the presence of species with medium importance such as the beaver and the squirrel were recorded. Species of lower importance concern the red deer, roe deer, wild boar and fox. The bibliography also mentions the presence of species with very high concern such as the grey wolf, otter and medium concern such as the wildcat and the hedgehog. These species were, however, not confirmed.

At the PJ site in Dingy-en-Vuache and Vulbens several observations of mammals with medium importance were made, such as the European beaver and the wildcat. Species with lower importance are the squirrel and with even lower importance the red deer, roe deer, hare, wild boar, badger, fox and the greater white-toothed shrew. The bibliography also mentions the presence of the lynx and the otter with very high importance and the rabbit with medium importance, but they were not observed.

Observations on site PL in Challex with a very low importance include the badger, fox, roe deer and hare. The analysis of the bibliography highlights four species with medium concern: wildcat, beaver, rabbit, and hedgehog. The polecat is cited with high importance and the lynx with very high importance. These species have, however, not been observed.

Summing up the bibliographic and field investigations of mammals carried out on all surface site candidates and in extended perimeter around the sites shows that overall a strong sensitivity exists for all sites although on none of the sites direct observations of relevant species were confirmed. The reason is that mammals were observed in the vicinities and extended surroundings of the sites and they can traverse the sites today, but they will face limitations during construction periods and when the sites are constructed. However, no protected or endangered species would be affected directly by the surface sites. A subsequent preparatory project phase needs to consider the mammals in the surroundings of the site in the design of the construction sites and the surface sites. Ecological corridors need to be considered and preserved. Where possible, green buffers and sites that can be traversed by mammals can preserve their current behaviour. Embedding the presence of animals in general in the concepts of surface sites can also help to improve their habitats and eventually even support the increase of biodiversity and conditions for them.

Chiropters Chiropters (bats) are mammals. The name chiroptera comes from the Greek words cheir (hand) and pteron (wing), meaning 'hand-wing'. This reflects the unique structure of their wings, where elongated fingers are covered by a thin membrane of skin that allows them to fly. Chiropters are in the focus of environmental studies due to their ecological importance, vulnerability to habitat changes, and the legal protections they enjoy in France and Switzerland through national laws, as well as in the frame of the EU habitats directive, the 'EUROBATS'

agreement, the 'Bern Convention' and 'Natura 2000 site'. Violating protections of bats in France can result in significant penalties consisting of high fines and prison sentences.

This study comprised dedicated field investigations applying different techniques which included echolocation detectors (see Fig. 3.33),to establish an inventory of bats on and in the vicinity of candidate surface site locations to permit developing avoidance, reduction, compensation, and accompanying measures during a subsequent project design and preparatory phase.

Bibliographic analysis could unfortunately not be carried out since it requires a detailed description of the areas to be investigated, and the surface site locations were not sufficiently defined at the time of making such inquiries for data, which are time-consuming processes with different data owners. Therefore, indirect (e.g., passive and active acoustic searches with ultrasound detectors and microphones, search for traces) searches were immediately carried out at the larger candidate surface site zones.

On site PA in Ferney-Voltaire, France, the existence of an ecological corridor renders the passing of chiropters likely in a band at the southern end of the surface site and outside that zone. 12 species were recorded in the larger area around the surface site location, in particular in the neighbouring woodlands and groves. There were no sightings on the site itself, probably due to it being an open space currently subject to light pollution during nighttime.

On site PB in Presinge, Switzerland, the zones at the borders of the surface site towards the Nant de Paradis creek represent an area of interest for chiropters for hunting. The same applies for individual bushes, the Seymaz zone and woodlands in the vicinity and garden areas in the Avenir hamlet. 2 species have been observed at houses that would be removed for the construction of the site and 18 species were found in the larger area. 7 of them have a preservation status. This makes the area sensitive and calls for measures to preserve the habitats and avoid and reduce light pollution as far as reasonably possible.

On site PD in Nangy, France, the larger zone is of interest for Chiropters for hunting where bushes, trees and houses exist. 3 species were observed on the site and 8 in the extended investigation area. They have protection status. As with site PB, the larger area is sensitive and calls for measures to preserve the habitats and avoid and reduce additional light pollution as far as reasonably possible.

On site PF in Éteaux, France, the neighbouring areas are of interest for chiropters, in particular zones with hedges and woodland. This concerns for instance the boundaries of the surface site, houses and gardens along the national road and the wetland zones. 13 species were observed on the larger area and some of them on the site close to trees. 3 enjoy a protection status. The larger area represents an interest for this species and calls for measures to preserve the habitats and avoid and reduce additional light pollution as far as reasonably possible.

On site PG in Groisy and Charvonnex, France, the woodland is of interest for chiropters. It extends to the autoroute zone in the north. 18 species have been observed in the larger area and 13 species were found in some locations on the surface site, primarily in the forest. 8 enjoy a protection status. The strong presence of chiropters in the forest calls for a minimisation of the impact on those zones during the design phase and envisages compensation and accompanying measures.

On site PH in Cercier and Marlioz, France, chiropters find hunting areas and a corridor in and between the woodlands. 13 species have been observed within the site perimeter in the woodland. 5 species enjoy a very high protection status and two are highly protected. The density and diversity diminishes as one approaches the road on the eastern side of the site. These findings call for further optimisation of the site, reduction, compensation and accompanying measures in the subsequent phase.

On site PJ in Dingy-en-Vuache and Vulbens, France, the woodlands at the creeks and the hedges at the limits of the surface site are interesting spaces for chiropters. Ten species were found on the border of the site and 16 in the larger area around the site. Some enjoy a particular protection status. The density and diversity are higher around hedges and trees close to the motorway. This location will need some attention during the subsequent site design with respect to avoidance, reduction, compensation and accompanying. Artificial light pollution is one issue to be considered in this area.

On site PL in Challex, France, chiropters find suitable locations in the woods, hedges, hamlets and individual houses, their gardens and the nearby vineyards. Two species with medium to low protection status were recorded at the houses that would have to be removed to construct the surface site.

Summing up, the stakes with respect to chiropters directly on the surface sites are low in PA, PB, PD and PL. PJ has no particular sensitivity on the entire site, but a small sector that is close to the woodlands requires particular attention. The stakes are average for PF, high for PG and very high for PH. The limitations of impacts on chiropters, the preservation and, where possible, the improvement of their habitats have to be included in the eco-design approach to be implemented in the subsequent phase.

Reptiles Field investigations on the candidate surface site locations focused on identifying reptile populations (like the wall lizard shown in Fig. 3.34) in environments that are known to be favourable habitats for them. They include for example semi-open areas, forest boundary zones, cavities and stone or woodpiles as well as constructed areas. These inventories were carried out during the reptile's primary activity periods from May to June and from

Fig. 3.34 Common wall lizard *(Podarcis muralis)* observed during field investigations, providing valuable data on local wildlife presence and ecosystem dynamics

September to October. Each observation was geolocated. No intrusive methods were used to avoid disturbance to the species. Several methodological limitations, an unfavourable rainy spring and an exceptionally hot summer as well as access limitations set limits on the quality and reliability of the results. This concerns mainly the data for snakes that are more difficult to observe than other reptiles. For a preparatory phase project and a comprehensive environmental impact assessment, the initial state of reptiles has to be updated with complementary studies.

The natural habitats investigated for reptiles varied across the sites, leading to different levels of suitability for living spaces and ecological corridors.

At site PA in Ferney-Voltaire, France, the forest edges and wood strips were identified as high-value habitats. Isolated trees and cultivated areas had a lower interest. Only one species with a low conservation value, the common wall lizard, was observed on the annex site south of LHC point 8. Bibliographic data do not indicate the presence of species with high stakes.

At site PB in Presinge, Switzerland, the zones with vegetation at the nearby creek Nant de Paradis, gardens in the Avenir hamlet and small woods in the vicinity are of interest to reptiles, but not the surface site location. Only a single species was found in the larger area around the site. No species were found on the perimeter of the site.

At site PD in Nangy, France, interesting locations for reptiles are at the southern end of the site in the hedges and the borders of the autoroute, but not the surface site. Three species were found in the larger area around the site and at the extreme edge in the south, outside the site.

At site PF in Éteaux, France, the hedges at the border of the surface site are of interest for reptiles. Only a single species was found in the larger environment around the site. No observations could be confirmed on the site or in the immediate vicinity.

At site PG in Groisy and Charvonnex, France, the forest zone and the limits of the woodlands are of interest for reptiles. Also, areas close to the highway can be relevant spots. 2 species were found in the larger area around the site, but no observations could be confirmed on the site directly.

At site PH in Cercier and Marlioz, France, the entire forest occupied by the surface site location is of interest for reptiles. 2 species were found in the area around the site, sometimes entering the perimeter of the site. However, no clear pattern of presence or movement could be determined that would permit drawing sound conclusions on the permanent presence of reptiles on the site.

At site PJ in Dingy-en-Vuache and Vulbens in France, areas in the vicinity of the creeks, bushes, groves and trees including the zone close to the motorway are of interest for reptiles. 7 species were found in the larger area around the site, leading also to the conclusion that at the edges of the site, species could be present.

At site PL in Challex, France, gardens, bushes, and trees are of interest for reptiles but not the majority of the surface site. Only one species could be found at a distance of the site, close to the forest in the north. No observations on the site could be confirmed.

Summing up, only very low sensitivity with respect to reptiles exists for sites PA, PB, PD and PL. In the vicinity of PF some care needs to be taken to preserve the living spaces of reptiles. For PG and PH sensitivity may exist in some parts of the forest and the project design needs to respect this condition. An update of the initial state with complementary field investigations is required to optimise the integration of the surface site, applying avoidance and reduction measures. The architectural designs of the surface site constructions should integrate concepts that favour the creation of habitats and thus help to increase the presence of reptiles.

Insects Bibliographic research and field investigations of the sites and their vicinities by specialised companies were used to identify the issues with respect to insects. Field investigations were carried out for several months

Fig. 3.35 Butterfly black-veined white *(Aporia crataegi)* observed during field investigations, providing valuable data on local wildlife presence and ecosystem dynamics

Fig. 3.36 Golden-ringed dragonfly *(Cordulegaster boltonii)* observed during field investigations, providing valuable data on local wildlife presence and ecosystem dynamics

during good weather conditions, low wind and during both day and night identifying insects like those in Fig. 3.35, Fig. 3.36 and Fig. 3.37.

Despite the highly urbanised environment, a strong population of insects was observed in the surroundings of site PA in Ferney-Voltaire due to the favourable living and breeding spaces. The site itself, an agricultural area is not subject to a strong presence of insects and thus, therefore, has only a very low sensitivity. The vicinity of the border between France and Switzerland towards the Geneva airport may require the consideration of a cross-border impact since some species observed in this zone outside the site perimeter are protected in Switzerland. Complementary field investigations are required during a project preparatory phase to reveal any such potential case.

The surroundings of site PB in Presinge feature an important population of insects, mainly those relating to aquatic habitats. Some species observed in this area outside the site perimeter enjoy particular protection status in Switzerland. The site itself is an agricultural space with low stakes apart from the areas that are close to the nearby creek.

The surroundings of site PD in Nangy are characterised by a few insect species. The site is an agricultural space and has low stakes with respect to insects. No species with protection status were observed. The extended surroundings of site PF in Éteaux are attractive for insects. However, on the site and in the immediate vicinity, no relevant species were identified, and the sensitivity is low.

The forest at and around site PG in Charvonnex and Groisy is moderately attractive for insects, as are the surrounding hedges. The site itself does not show particular issues with respect to insects. Also, the woodland spaces did not reveal the presence of relevant insects.

The forest spaces at and around site PH in Cercier and Marlioz provide, in principle, a favourable habitat for insects. However, only little presence of insects was revealed within the candidate site perimeter. Due to some observations at the border of the site, the site has a medium level sensitivity.

Fig. 3.37 Italian locust *(Calliptamus italicus)* observed during field investigations, providing valuable data on local wildlife presence and ecosystem dynamics

Fig. 3.38 Stream photographed during the field investigations

Site PJ in Dingy-en-Vuache and Vulbens, in principle, offers favourable conditions due to the trees and hedges around it. The stakes are high in the extended surroundings, but they are low on the site itself.

The hedges and bushes around site PL in Challex also, in principle, provide a favourable habitat for insects. However, the site shows only low-level issues with respect to insects, though a presence cannot be entirely excluded. Some species are protected in the nearby Swiss territory. A preparatory project phase will have to make complementary field investigations to consider potential cross-border impacts.

Summing up, none of the surface site candidates exhibits particular sensitivity with respect to insect presence. The surroundings of site PB present a habitat with high sensitivity. The wider surroundings of site PF present, in principle, some sensitivity. For sites PG and PH, despite being woodland, the favourable habitat for insects turns out to be less favourable than expected. The presence of some relevant species in the surroundings raises the sensitivity of the areas that are in the vicinity of the site. There were observations of some species with medium sensitivity in the surroundings of site PJ, suggesting that they might also be present on the site.

Aquatic Fauna in the aquatic context has been analysed based on cartographic and orthophoto information. Systematic investigations and water analysis for all aquatic aspects were not carried out at this stage. They are planned to be done if a design phase is launched. However, nearby surface water, like the stream in Fig. 3.38, in

Fig. 3.39 Trees in the woodland photographed during the field investigations

the vicinity of sites PF, PG, PH and PJ was analysed. The stake concerning macroinvertebrates is often high in the extended surroundings around surface sites. Aquatic benthic macroinvertebrates are insects in their nymph and larval stages, snails, worms, crayfish, and clams that spend at least part of their lives in water. Fireflies are another important species that are sometimes encountered in the wider perimeters of the sites.

Although the site PA and its immediate surroundings are not subject to aquatic fauna presence, the wider environment is known to be a habitat for vulnerable and endangered species. Protected and endangered species are close to site PB, although the site does not affect their habitats. Sites PD and PF and their surroundings are not concerned by aquatic fauna. The vicinity of site PG is characterised by important aquatic habitats with vulnerable and endangered species that the project will avoid and aim not to affect. The site perimeter has already been adjusted as a result of various stakes identified during the initial state analysis. Although site PH lies in the forest and close to a creek the presence of noteworthy aquatic species is low and the site itself is not affected. Sites PJ and PL and their surroundings also have no issues with respect to aquatic fauna.

Summing up, the PJ site does not present any observations of benthic macroinvertebrates. The wider surroundings of the PD, PF, and PL sites show a few habitats favourable to the development of benthic macroinvertebrates, but only a few taxa are present. Also, the PH site does not present any taxa with significance; however, the habitats are varied and the taxonomic diversity is high near the site, although with very low significance. The PG site hosts taxa with 'medium' significance, but the habitats are varied and taxonomic diversity is high near the site border. The wider PA site surroundings are subject to an observation with 'high' significance, but the habitats are poor and have little interest for the benthic macrofauna. The PB wider site surroundings have several observations of taxa with 'very high' significance. No surface site has any relation with fish although some sites (PB, PF, PG, PH, PJ) are in the vicinity of small creeks.

Forest During this study, expert companies and forest evaluation consultants have made a comprehensive and detailed forest quality and value analysis. This included the potential loss of biodiversity, habitat and economic income over a sustained period of several decades. The results are also integrated into the comprehensive, wider socio-economic assessment. The French 'Indice de biodiversité potentielle' (IBP) methodology was applied [86, 87]. The project will not affect any existing forest spaces in Switzerland. Forests like the woodland shown in Fig. 3.39 are in the vicinities of sites PA, PB, PD, PF, PG, PJ and PL. Only sites PG and PH will require clearings.

The forest that would be affected by site PG has quite a diverse character. The xeric woodlands located in the southeast mainly consist of small-diameter oak woods, showing a strong to weak stake depending on the area. The ravine woodlands in the west feature a composition of large and very large trees rich in dendro-microhabitats, potentially hosting a rich and diverse biodiversity. The central area of the forest presents a character more easily exploitable for forest owners. This leads to more or less diverse stands depending on the plots. The presence of large dead wood is less important overall. The challenge in terms of biodiversity varies from strong to weak depending on the age of the trees. Consequently, the surface site has been adapted to reduce the affected forest as much as possible and to select an area for the access shaft locations that has a lower quality than the surroundings. In total about 2.4 ha of forest may be affected by the surface site development.

The forest at PH features relatively young woodlands resulting from agricultural abandonment, thereby having few dendro-microhabitats. The woodlands located on the northern fringe of the site are the oldest and there is presence of a temporary watercourse. Medium wood is less conducive to supporting forest biodiversity than large and very large wood. In total, up to 10 ha of forest may be affected in the communes of Cercier and Marlioz. Further surface site designs are needed to determine the exact surface requirements, taking into consideration all the environmental issues that have been identified.

Summary Detailed data are included in specific paragraphs of the biodiversity section. To the east of the PA are wetlands that serve as a migratory stopover for bird species, and to the south, near LHCb Pt8, is a forest of

ecological value due to the presence of bats and insects. Some agricultural patches near the site with isolated trees also play a valuable role for birds. The PA surface sites have low ecological stakes, however the future construction must carefully consider the surrounding elements to maintain the key habitats and species.

The PB surface site presents low to moderate ecological stakes, however the presence of diverse bird species, aquatic insects and protected plants along the Nant du Paradis stream highlights the ecological value of the site's nearby areas. The future construction must take into account the ecological sensitivity of these places to ensure the preservation of biodiversity and habitats.

The site PD is entirely covered by agricultural land which represents low-level stakes. Small areas of high ecological importance are located further north of the site. These include hedges and old trees that provide habitat for birds and bats of low or moderate concern. Future construction in this area has to take into consideration small fauna species that might be present on or crossing the site.

The PF site is used as an agricultural meadow and presents moderate ecological states. However, the site is located within the ecological corridor for wildlife movement, near the wetland area and forest with the stream providing habitats for a range of species, including birds, bats, and amphibians. The site layout must be carefully planned to avoid disrupting the sensitive ecosystems and ensure good functionality of the fauna corridor.

The main PG surface site is partly in a forest area, which represents high stakes, and partly in pasture land with low stakes. The annex site to the north, located near the highway, shows low ecological stakes. The main constraint rPG site is the valuable forests that hosts fauna and flora species, therefore the effort has to be put into limiting deforestation and maintaining the current habitats.

The PH surface site is located in the forest with small clearings and wetland area. Part of the PF surface site shows very high stakes, mainly in the north, due to the presence of bird species, including those of high conservation concern, bat species with their ecological corridor as well as small fauna. Stakes of strong character, with parts of medium and low are located in the southwestern part of the site. Limiting the use of areas with high stakes will be necessary to preserve its biodiversity and ecological value.

Most of the PJ surface site presents low stakes, excluding an inventoried small wetland and hedgerow that are considered as strong stake. The current layout of the site already foresees the space for an ecological corridor and grassy meadows in order to maintain connectivity between natural areas for wildlife and to keep areas for birds to hunt.

The major part of the PL surface site is located on the agricultural land presenting low stakes. Some hedges within the site and in the vicinity of the site play an important role for bird species and must be preserved whenever possible.

To ensure responsible development of the areas, site construction must be carefully planned to minimise habitat disturbance, maintain ecological corridors, and preserve biodiversity. By integrating these considerations into project design plans at the early stage, it is possible to balance infrastructure needs with the preservation of local biodiversity and ecological integrity.

3.3.6 Ecological functionality

In France, the ecological network, known as the 'Trame verte et bleue' (Green and Blue Framework), is a component of the national and regional planning framework. It integrates terrestrial and aquatic ecological continuity. This network comprises biodiversity reservoirs, ecological corridors, permeable terrestrial and aquatic spaces, and large agricultural areas. These elements collectively support species movement, lifecycle completion, and biodiversity preservation. In Switzerland, the ecological network identifies essential zones for nature and their connections. The REN's (Réseau écologique national) framework includes nodal zones (vital habitats for species lifecycle completion), extension zones (lower-quality or smaller zones), continua (interconnected areas such as forests and wetlands), and development zones (partial habitats). The network also features ecological corridors linking key areas.

The difference in both countries lies in implementation and structure. In France, the ecological network emphasises integrating green and blue corridors at a national scale under regional governance. In contrast, Switzerland's REN adopts a more localised approach, focusing on specific ecological zones and their physical connectivity. Additionally, the French framework includes significant agricultural spaces and functions of water bodies while the Swiss REN categorises its zones with a greater focus on inter-zonal ecological dynamics.

The site PA and nearby area are permeable agricultural spaces that represent only limited interest in terms of ecological functionality. A regionally important ecological corridor was identified south of the surface site. Wetlands in the vicinity of the surface site contribute to the ecological functionality in the context of the blue network. According to the local urban development plan, three isolated trees located to the east of the main surface site and trees to the south-east are considered a landscape element to be preserved. The layout and design of the surface site constructions will need to ensure that the ecological continuity is maintained.

Site PB is located on large agricultural land with some extensive areas and a continuum of dry grasslands. However, these areas which are conducive to biodiversity are not located within the surface site. There are two locally important movement corridors for large fauna, one of which passes west to the surface site without crossing

it and the other through the eastern part of the surface site area, near the hedgerows, which should be taken into account in the design phase. The PB surface site lies in the immediate vicinity of the blue continuum, which follows the hedgerow line to the north-east. However, the location of the site does not directly interrupt the functionality of this network.

The area of PD surface site is located on the permeable relay agricultural land. South of the PD surface, under RD903, a secondary corridor of medium fauna that is to be considered in the design phase was identified. The surface site does not encroach on any element related to wetlands or water areas and therefore does not affect the functionality of the region's blue network. According to the Nangy local urban plan, no element of biodiversity reservoirs or ecological corridors is present in the study area.

The PF surface site is located within permeable agricultural spaces and a forest ecological corridor connecting the areas located to the north-west and south-west of the site. It is a remote area used by large fauna. The surface site is close to two wetland areas of the blue network, the functionality of which has not yet been analysed. This aspect must be taken into account in the design phase of the surface site. It will also be necessary to ensure the functionality of ecological corridors and large fauna movement routes between the forest areas to the north and south of the site surface, as required by the Éteaux commune's local urban plan.

To the north of the PG surface site, across the highway, there are two forested corridors, while to the south there is a linear corridor, also forested. The PG area with its annex is located in permeable spaces, partly on agricultural and forest land, however the PG surface area is not located in any ecological corridor and no biodiversity reservoir has been inventoried. The surface site does not concern any element of the blue network. According to the Groisy local urban plan, the surface site and the possible access road are located on classified forested areas - Espaces Boisés Classés - which results in preservation or appropriate reforestation in the case of felling, depending on the agreed compensation method, therefore construction in the forested area will be limited to the minimum necessary.

The PH surface site is concerned only with permeable relay spaces and does not cross any ecological corridors or biodiversity reservoirs. The surface site's proximity to the Tabassé stream, which joins the Usses watercourse, is one of the main elements of the blue network of the area. During the field visits, the wetland was inventoried on the perimeter of the surface site, but it does not seem to represent a major functional role in the blue structure. The local urban development plan of Val des Usses and Cercier also mentions a sector of ecological interest related to the watercourse to the north, which will be taken into account when designing the layout of the infrastructure.

The PJ surface site is located on agricultural land with permeable relay spaces, as well as an ecological corridor connecting forested biodiversity reservoirs between the north and the south, which connects with another ecological corridor in the further part. There are two small streams, west and east of the PJ site, and a wetland has been inventoried on the site itself, but its functionality has not yet been analysed. In accordance with the local urban plans of two municipalities concerned, the surface site is located between wooded area ensuring the ecological continuity, and contains two lines of protected hedges. The preservation of ecological continuity and the ecological corridor will be taken into account during the design phase.

The PL surface site is located on the relay permeable spaces and agricultural spaces. A regional wetland from departmental inventories and a corridor for the movement of large fauna are located to the north of the site, however, these structures do not cross the site. According to the local urban plan of the municipality of Challex, small hedges that are within the surface site perimeter and in close vicinity are considered natural structures and are to be preserved for ecological reasons.

In summary, the PA site includes a regional ecological corridor with wetlands and hedges that need preservation to maintain ecological continuity. The PB site is near two fauna movement corridors and the blue network along the eastern side. Though the site does not directly impact the blue structure, the surface site layout has to take it into consideration. The PD site consists of agricultural spaces with a secondary fauna corridor in the south, near the RD903 but does not encroach on wetlands or biodiversity reservoirs. The PF site is located near two wetlands and within an ecological corridor, which will have to be taken into account in the design phase. Part of the PG site includes a classified forest area, and wood cutting should be minimised. The design of the site will have to ensure that the functionality of nearby ecological corridor and biodiversity reservoir is maintained. The PH site is close to the stream, and a larger watercourse is to be considered during the layout design. It also has some wetlands present but these play a minor functional role. The PJ site lies in a large ecological corridor, including an area of wetlands and hedgerows of ecological value. Lastly, the PL site consists of agricultural land with hedges that need preservation, while a regional wetland and fauna corridor further to the north remains unaffected. Overall, ecological continuity and protected elements must be carefully considered during the design phase to ensure their functionality.

3.3.7 Urbanism

The urbanism aspects comprise all local and regional policies and plans for territorial developments. All land plots are subject to such plans, and they are regularly reviewed and updated at the municipality level and at the local and regional public administration levels.

Table 3.12 Summary of urbanism issues

Topic	Extended perimeter around site	Description of stakes
Strong urbanism stakes	PA, PB, PD, PF, PG, PH, PJ, PL	Nature and agriculture protection zones, humid zones.
Other urbanism stakes	PA, PB, PD, PF, PG, PJ, PL	Protected or valuable architecture in the vicinity, sport facilities, agriculture, roads, highways.
Public utility servitude	PB, PF, PH	Pipelines, electricity lines and protection buffers around those infrastructures.
Urban environment and applicable regulations	PA, PB, PD, PG, PF, PJ, PL	Co-visibility, requirement for integration in the urban context, topographic constraints.

Table 3.13 Summary of urbanism topics by site

Site	Stakes	Urbanism topics
PA	High	Protected agriculture zone, gas pipeline at the site border
PB	High	Protected agriculture zone (SDA), ecological corridor, landscape integration
PD	Low	Agricultural space, road development project
PF	Low	Agricultural space
PG	Low	Agricultural space, nature zone (forest)
PH	High	Agricultural space, nature zone (forest), pipeline at the northern site limit
PJ	High	Agricultural zone, wetland zone, protected agricultural space, ecological corridor
PL	Medium	Protected agricultural zone, nature protection zone

The urban aspects of the perimeters of the surface sites, enlarged and extended zones of several kilometres around the surface sites have been analysed based on the relevant regional and local urban plans in France and in Switzerland. In addition, field visits permitted the publicly available information to be complemented and enriched with the up-to-date situation. This survey permits all regulatory constraints with respect to the territorial development to be compiled and anticipating the planned evolution of the territory from an environmental point of view, considering all of the applicable laws and regulations. The relevant documents and associated geographical information systems and maps comprise PLU, PLUi, PLUIh, PADD, SCoT in France and PDCn and PDCm of the canton in Geneva in Switzerland.

Table 3.12 shows that all extended or enlarged perimeters around the surface sites are subject to strong or other urbanistic and territorial development issues. These issues have to be taken into account during the detailed project plan development.

Table 3.13 shows that half of the sites are directly affected by urban constraints that need to be considered during the site design development and that require particular attention during the project authorisation process.

3.3.8 Mobility

Data about the public transport infrastructures and road traffic as well as soft mobility and multi-modal mobility within the perimeter of the project have been collected and analysed. Figure 3.40 presents a schematic representation of the travel flows in Grand Genève.

Public transport The PA Site is well served by the Geneva public transport system (TPG) which operates across the Swiss/French border and serves the entire zone. The bus connection is direct, and there is a tramway connection within a reasonable distance. Site PB in Switzerland is also served by the TPG network with a bus station in the immediate vicinity and a tramway connection at a reasonable distance. The PD Site in France is well served by regional French bus lines, including a park+ride facility connecting to Geneva. The presence of the large hospital (CHAL) ensures that the connections are maintained and potentially further developed. The location of site PF is poorly served by public transport. However, 2 km away, La Roche-sur-Foron train station is an important multi-modal transport pole including a connection to Geneva via the Léman Express. The PG site is not served by public transport. However, the Groisy train station is 2 km away and provides regular connections to Annecy and Geneva via the Léman Express line. The PH site is not served by public transport and no public transport exists in the vicinity. Site PJ is not served by public transport, but 2 km away, a Swiss TPG bus line connects to Vulbens

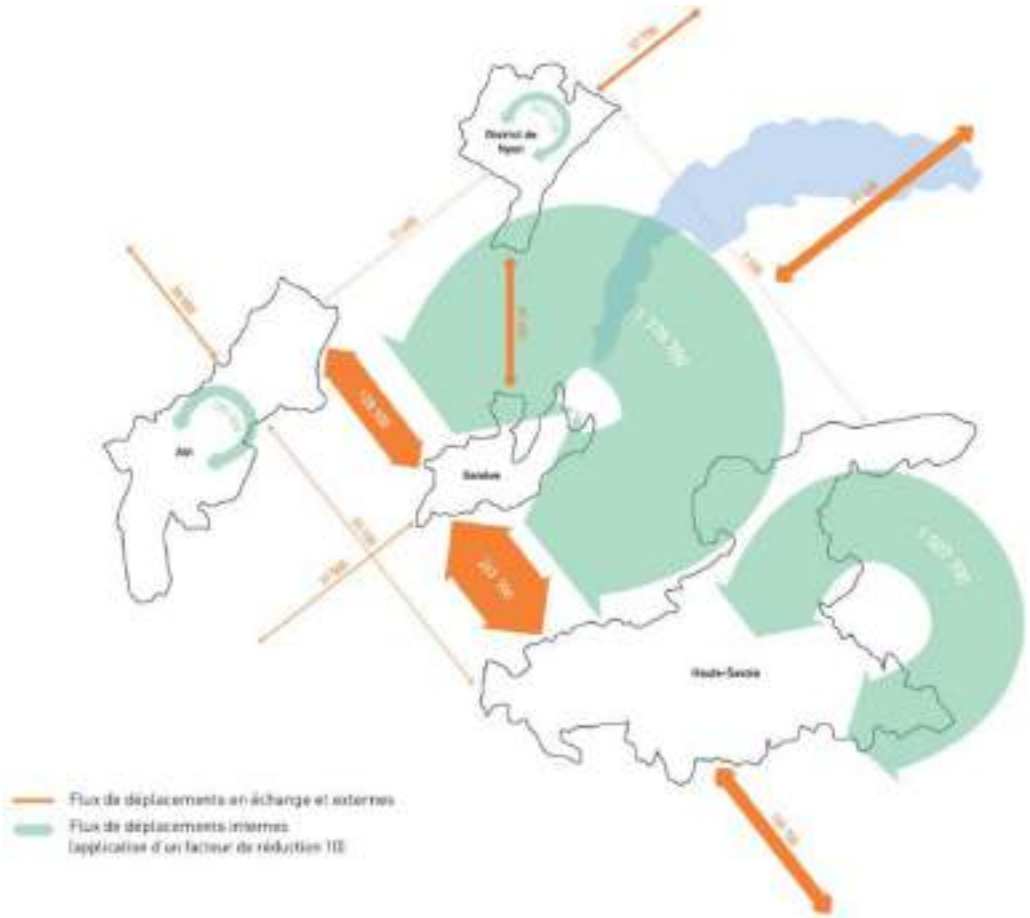

Fig. 3.40 Daily travel flows (all modes combined) in Grand Geneve (Source Grand-Genève [88], based on MRMT – EDGT 2015 - 2016) Although Geneva remains a central hub, the analysis of flows reveals a more multipolar organisation, with a majority of internal travel within the large territories (Geneva, French Geneva, Nyon district)

and in Valleiry, there is a train station on the line between Bellegarde and Evian via Annemasse. Although there are Swiss TPG bus stops in Challex in the vicinity of site PL, the frequency is modest. Better connections exist in nearby Dardagny in Switzerland. At a distance of 4 km in La Pleine, there are very good connections to bus and train lines.

Summing up, the experiment sites PA and PD are well served by public transport and the experiment sites PG and PJ are reasonably connected at some distance. The technical sites PB, PF, PH and PL are not well served by public transport. An analysis of the demand from these sites would be required if further development of the public transport system is considered in relation to the FCC project. It could be in the mutual interest of the project and the local stakeholders to develop public transport around the PG and PJ experiment sites at least.

Road network The experiment sites PA, PD, PG and PJ are in the immediate vicinity of major roads and would profit from direct access to the autoroute infrastructure for construction and installation purposes. This would eliminate any potential residual local traffic challenges around the sites during these phases. The PA site is also well-connected to the CERN Prévessin and Meyrin sites via a major departmental road. In addition, the PL technical site is in the vicinity of a major departmental road and is also well-connected to the existing CERN sites. The PB Site is directly on a good road, but the traffic situation through Geneva and to nearby Annemasse in France is challenging. Technical site PF is also well-connected via a major departmental road. Although site PH is directly located on a departmental road, it is isolated and is distant from major transport routes. The closest autoroute access is at a distance of 10 km in Allonzier-la-Caille. Installation of bulky equipment at this site needs to be carefully studied, developed and planned.

Other transport modes The study also included the analysis of dedicated bicycle tracks in France and Switzerland. Dedicated lanes and tracks have recently been constructed in the vicinity of site PA and these are expected to

Fig. 3.41 Current and potential future extension of the Leman Express

be further developed. These spans the Franco-Swiss border. A dedicated bicycle track is also being constructed directly at the PB site. Sites PD and PF are not equipped for soft mobility. No dedicated bicycle lanes exist around site PG, but the road to Groisy is well-adapted for cyclists. Site PH has no soft mobility infrastructures. The surroundings of site PJ are being developed with a view to strengthening soft mobility, aiming to link the nearby municipalities Vulbens and Valleiry. The creation of access to site PJ also permits the connection of Dingy-en-Vuache to this system. PL is not particularly equipped for soft mobility. Although walking and biking are easy in the commune, there are no dedicated links to other municipalities in France and Switzerland.

Foreseeable evolution The Grand Genève area is developing a multi-modal transport plan that aims to improve further the transport infrastructure across the Franco/Swiss border. The continued housing development and demographic evolution of about +1.2% per year in the neighbouring French departments of Ain and Haute-Savoie, which is unrelated to CERN's activities, calls for such developments. There are about 1.2 million journeys today within the perimeter of the project, but about 4.2 million per day are expected by 2040. As will be described later, the activities relating to the construction, installation, and operation of the project are insignificant compared to the existing and future mobility in the region.

The extension of the Swiss railway system continues to increase its daily train capacity, mainly due to the Léman Express lines (see Fig. 3.41). This also includes an improvement of the services to the Arve valley (La Roche-sur-Forton), Groisy and Annecy for completion in 2030. In the longer term, developments are planned for increasing the service to La Plaine and beyond to Bellegarde. Autoroute extension projects in Switzerland have been planned, but were recently put on hold. A project to connect both sides of Lake Geneva sides by a tunnel under the lake has been studied, but any potential implementation before 2050 is unlikely and therefore the project is not included in specific plans. In France, an autoroute is planned to connect the A40 (Arve valley) to the A412(Thônon) via a wide departmental road (RD903) connecting to the A40 in Nangy. Bus line developments between major agglomerations and the hospital next to the PD site are likely.

Project induced traffic Project induced traffic refers to the following types:

1. Workers commuting to and from the construction sites during an approximately ten-year-long construction phase.

2. Evacuation of excavated materials from construction sites. While all sites require the evacuation of materials during the first two years, only four sites will see relevant transport of excavated materials during another 6 to 8 years due to the deployment of tunnel boring machines.
3. Transport construction materials to the construction sites. All sites will see a moderate inflow of construction materials during the first two years, but only four sites will continue to have relevant construction materials inflow during the period when the tunnel boring machines are deployed. Construction materials also need to be brought in when the surface site buildings are constructed.
4. Transport of accelerator equipment during the six to eight-year installation phase that overlaps partially with the civil construction activities.
5. Transport of the experiment detector equipment during experiment installation that overlaps with accelerator installation and testing phases.
6. Commute of engineers and scientists during the installation and testing phases.
7. Commute of engineers and scientists during the operation phase.
8. Commute of engineers and scientists during regular maintenance periods and in the frame of repair activities.
9. Traffic induced by visitors to experiment sites during the operation and shutdown phases.

The main project-induced traffic is linked to the evacuation of the excavated materials. It will be confined to major transport routes. The inflow of construction materials represents a minor additional contribution to this traffic. Commute of workers is intended to be organised centrally, as is best practice for construction sites. The installation of equipment for the particle accelerator represents a minimal contribution to the traffic. The same is true for the transport of the experiment detector equipment. For this case, some isolated, exceptional loads may be required due to the size of pieces manufactured off-site. Once operational, only a few scientists and engineers commute daily to experiment sites. Technical sites are predominantly operated remotely and will see very little traffic for maintenance and repair. The traffic of an estimated total number of 25,000 visitors per year to an experiment site during the operation phase can be compared to the traffic induced by a typical museum or archaeological site such as the Grottes de Cerdon in the region (about 50,000 visitors per year[10]) or the Château Voltaire in Ferney-Voltare (about 50,000 visitors per year [89][11]). This traffic of individual visitors can be managed with appropriate directions to the site and through support by public transport. Visitors in groups arrive in buses, presenting a minimal amount of additional traffic.

More information about the quantities and the additional traffic induced can be found in sections Sect. 2.7.2 and Sect. 2.7.12. A first quantitative traffic analysis has been carried out to confirm that the traffic is manageable and that with respect to the nearby major transport routes, it represents only a minor addition.

3.3.9 Human activities

Human activities The analysis of the environmental state established the situation concerning human activities around the surface sites. The environment around site PA in Ferney-Voltaire is dominated by commercial activities (like the commercial centre shown in Fig. 3.42), the LHC Pt8 surface sites and the airport. The presence of a surface site does not add to these activities. The environment around PB in Presinge is rural and characterised by small hamlets. The Geneva Landscape and Architecture School (HEPIA) is an academic activity zone in the vicinity. Towards the west, the zone starts to be dominated by urban activities. The environment of site PD in Nangy is characterised by a mix of agricultural, commercial and industrial activities, residential zones and a major hospital (CHAL).)Due to this mixed environment and the major transport routes available, the location is advantageous for an experiment site with a permanent presence of scientists and engineers. PF in Éteaux is located on a main transport route with dispersed residential areas, small businesses and artisans and a major public works company opposite the site. PG in Groisy and Charvonnex does not have major human activities. The vicinity of Groisy, with schools and potential for local development, is an opportunity to develop a main experiment site with the presence of scientists and engineers. Site PH in Cercier is very rural, with agricultural activities (fruit production) and some small hamlets. No major human activities are carried out in this area. The environment around the PJ site in Dingy-en-Vuache and Vulbens is agricultural with commercial activities to the north-east in Valleiry. PL in Challex is in an agricultural zone with low-density residential areas. Commercial activities take place at a distance in La Plaine, Switzerland, which is not directly linked to the site.

Poplulation The population density around the eight surface sites varies significantly. Around PA, the area is moderately populated with about 34,000 inhabitants within a perimeter of 2 km. The major communes are Ferney-Voltaire, Prévessin-Moens in France, Meyrin and Grand-Saconnex in Switzerland. The population growth

[10] https://www.ain.cci.fr/sites/g/files/mwbcuj1466/files/2024-02/Chiffres%20cles%202024%20AIN_.pdf.

[11] https://www.lemanbleu.ch/fr/Actualite/Archives/Le-chateau-de-Voltaire-entierement-renove.html.

Fig. 3.42 Commercial district near the PA site photographed during the field investigations

Fig. 3.43 Residential district photographed during the field investigations

in this area is 2.4% per year but this is unrelated to CERN's activities. Around PB the environment is sparsely populated, at most 6000 inhabitants can be counted in a perimeter of 2 km. The main communes are Presinge, Pupling, Choulex, Meinier, Jussy in Switzerland and Ville-La-Grand in France. There is no annual population growth in Switzerland (between −0.3 and +0.3%). In neighbouring France, the annual growth is modest (+1.1%), comparable to the average in Haute-Savoie. Site PD is located in a moderately dense environment with about 4000 inhabitants in a perimeter of 2 km, the majority located in Nangy and Contamine-sur-Arve and Fillinges. The annual population growths in these communes are highly diverse, ranging from negative 0.5% in Nangy to +3% in Contamine-sur-Arve. The PF site is located in a moderately populated zone with about 4000 inhabitants in a 2 km radius with the majority of people in Éteaux and La Roche-sur-Foron. The population evolution is stable, ranging between −0.6% and +1.0% per year. PG is located in a sparsely populated area with around 4000 inhabitants in a perimeter of 2 km, mainly in Charvonnex and Groisy. However, the two communes see an annual population growth of between 2.2 and 3.2%. The environment around the PH site is very weakly populated. There are only 1500 inhabitants in a perimeter of 2 km in Cercier, Choisy and Marlioz. The population growth is around 1.5% per year. The area around PJ is also sparsely populated with about 6000 inhabitants in a perimeter of 2 km in Vulbens and Dingy-en-Vuache. Valleiry is a more densely populated commune nearby. The annual population growth is 2 to 3.5%, higher than the average in Haute-Savoie. PL in Challex is in a sparsely populated area with only about 3000 inhabitants in a perimeter of 2 km including Challex in France and Dardagny in Switzerland. Both communes experience an annual population growth of about 3% per year.

Housing As with the population, the housing situation also varies significantly amongst the surface site areas. In the immediate environment around PA, the housing sector is dominated by apartment buildings (like those shown in Fig. 3.43). Prévessin is dominated by individual houses. The housing sector around PB is mixed with individual houses in the closer vicinity and residential buildings further away. The communes in the vicinity of the site are not dominated by individual houses, but see a mix of houses and residential buildings. The area around PD is dominated by individual houses. Individual houses are also predominantly found around site PF. The entire area around PG is dominated by individual houses, as is the case with sites PH and PJ. Only Valleiry is an exception with a significant number of residential buildings and apartments. The surroundings of site PL have a highly contrasting housing sector. Mainly individual houses are found in the French communes of Challex, Péron, Saint-Jean-de-Gonville. Residential buildings are predominant in the Swiss communes of Avully and Dardagny.

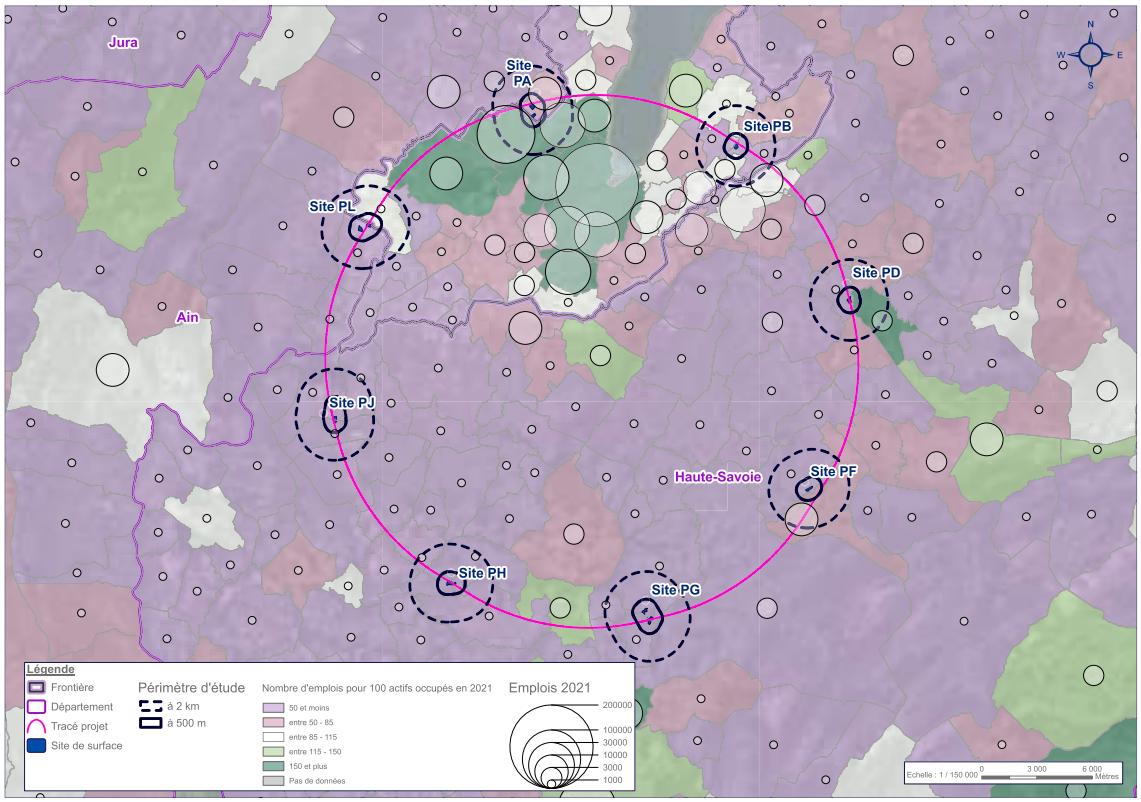

Fig. 3.44 Overview of the employment opportunities in the perimeter of the FCC reference scenario

Employment At a general level, the employment sector in the northern sectors of the FCC is dominated by Geneva and its surroundings on French territory (see also Fig. 3.44). The southern zone in Haute-Savoie is characterised by significantly fewer job opportunities and an overcapacity of available workforce. Depending on the region, the tertiary sector is only weakly developed. The secondary sector (industrial activities) offers opportunities in selected locations. Like Geneva, the Department of Ain in France has many more employment opportunities than the Haute-Savoie department.

Around PA, employment opportunities are mainly found in the tertiary sector. In the Swiss territory, the secondary (industrial) sector is also a major source of employment opportunities. Employment around PB is dominated by the primary sector (agriculture) and there is a slightly smaller number of job opportunities than people seeking work. PD has employment opportunities in the industrial sector and the health sector (CHAL hospital), although the job opportunities are limited. The area around PF offers few employment opportunities and those that exist are distributed between the secondary and tertiary sectors. The primary sector (agriculture) is rather weak in this area. There are fewer job offers than the available workforce. Also around PG there are fewer job opportunities than available workforce. In particular, the tertiary sector is only weakly developed. The same is true for site PH in which the primary sector (agriculture) is the main employer for almost one-third of the population. Also the area around PJ sees more job seekers than job offers. The main employment sector is agriculture. Around PL the situation is mixed: residents find their employment in France and in Switzerland.

Agriculture The area used for agriculture in the Pays de Gex (e.g., Fig. 3.45) between the site PL in Challex and PA in Ferney-Voltaire has been stable over the last 30 years. The evolution of plot ownership and agricultural exploitations in the 1990 s led to fewer but larger farms. The typical size of a single exploitation today is about 90 ha per farm, covering a total of about 3600 ha. The main product remains milk, although this sector is decreasing. Cereals represent a minor contribution. Free trade zones between France and Switzerland in this sector facilitate goods exchange, from which the sector for milk and milk-derived products profits mainly. Out of the 23 million litres produced in the Pays de Gex, 14 million are sold to cooperatives in Geneva. The volume of the milk production in the area is larger than the entire volume in Switzerland. The cereals produced by about 90 producers are almost entirely sold in Switzerland. The production of cereals saw a constant increase with a growth of more than 60% between 2000 and 2010.

Milk production is also an important agricultural sector in Haute-Savoie. Major, globally acting firms and groups (e.g., Société Laitière des Hauts de Savoie / Lactalis) are important economic players in the region who

Fig. 3.45 Agricultural land photographed during the field investigations

also produce milk derived products, in particular Reblochon and Abondance cheese. Green spaces for feeding the cattle are important for this industry. Growing urbanisation puts this branch of the economy under pressure, although the economic potential is high. Production and sales of hay as cattle food is a related main economic branch.

The agriculture sector around PB in Switzerland is dominated by the production of cereals. Recently, following the construction of glass houses, different types of agriculture are fostering the local production of various products. Local agriculture is one of the economic pillars of the canton, although the sizes of the individual operators are much smaller than in France (typically less than 50 ha). Vineyards are another relevant part of the cantonal agricultural sector. Land consumption creates pressure on the agricultural sector: about 20 ha of agricultural space is lost every year.

The sector around PD in Haute-Savoie experiences different climatic conditions than the northern sector. The countryside is more mountainous and the agricultural activities are more diversified, although the main product is hay and grass related to milk production. Almost 5000 ha are exploited in this area for milk and cheese production. 17 million litres of milk are processed by a firm in Fillinges alone.

Moving further south (sites PF and PG) shows that the importance of agricultural activities has decreased over recent decades and small farms dominate. The activities are diverse, including cereals, cattle farming, meat production, hay production, vegetables, poultry and some local wine production. Dairy production remains the dominant branch.

Towards the south-east (PH) the activities are still milk and cheese production with a total area of more than 12,000 ha devoted to it. Other important activities are fruit (apples and pears) and cereals (including maize) production. The entire zone processes per year about 45 million litres of milk. The eastern sector (PD) processes about 12 million litres of milk yearly and also sees dairy product industries (e.g., Baiko). Cattle farming for meat production is a related activity in the sector.

Forestry Forestry is mainly important in the French Haute-Savoie department. About 150,000 ha are utilised in the area. 70% of the forests are privately owned. Wood production comprises a variety of different tree types, both deciduous and conifer trees. Forestry in the French department of Ain is also well-developed, mainly supplying wood for carpentry and construction works.

The project scenario only affects forestry in a very limited way in PG (Groisy) and PH (Cercier and Marlioz) in the Haute-Savoie department in France. The economic loss has been quantified, and the potential effects on habitat and biodiversity have been analysed. Mitigation measures can be developed in a subsequent design phase based on this analysis.

Viticulture Vineyards (like the one shown in Fig. 3.46) are present in the Ain and Haute-Savoie departments in France, as well as in the canton of Geneva. However, the implementation scenario does not affect any of them. Wine production exists in the vicinity of the PL site in Challex, on both the French and Swiss sides. Wine production also exists at some distance from the surface site PB in Switzerland.

Tourism Tourism is already a major economic factor in Geneva and the immediate vicinity of CERN because of its Science Gateway visitor centre and the numerous exhibitions and guided tours that CERN offers. Every year more than 400,000 people visit CERN either individually or as part of groups. The economic impact due to local spending

Fig. 3.46 Vineyards photographed during the field investigations

that creates indirect, direct and induced jobs is significant, since people typically combine their visit with other activities in the region, on average for a stay of four days. For instance Ferney-Voltaire (PA site) is known for the Château Voltiare, its typical weekly market and numerous tourist attractions in the immediate vicinity (e.g., the Jura mountains in France and Coppet and Nyon in Switzerland). Geneva and its numerous tourist attractions are not exhaustively listed here. However, the United Nations, the International Red Cross Organisation, the old town, the Jet d'Eau, the watch museums, the cathedral are some examples. The economic benefits in this area today have been recorded and estimations for the effects to be expected with a future collider projects have been estimated and are reported in the section on socio-economic impact (see Section sustainability:results). With the increase of CERN's activities in the region, high-quality science tourism is expected to expand into the Haute-Savoie region, contributing to the tourism development there as well.

Concerning the new sites, PB in Presinge features a number of small, but relevant, tourist attractions that invite pedestrian and bicycle tourists, extending their excursions through the vineyards to the lake or towards France to the Arve valley.

The area around the PD site in Nangy in France is mostly known for its bicycle tracks that will be significantly extended by 2030. A track from the lake to Mont-Blanc is planned.

The surroundings of the PF site in Éteaux do not yet feature dedicated tourist attractions. However, several opportunities exist for discovering local cheese products between sites PD and PF. Together with a visitor centre at PG in Charvonnex and Groisy the entire zone could profit from a well-planned development of high-quality tourism that links the lake through the Arve valley with the Annecy area, which is highly developed in terms of tourism. Numerous mountain walking tours can be included in this programme.

The area around site PH in Cercier and Marlioz is not currently developed touristically and does not have noteworthy infrastructures.

The zone close to the Vuache next to site PD in Dingy-en-Vuache and Vulbens, on the contrary features, numerous bicycle paths (including ViaRhôna) that are inviting for tourists interested in nature.

The site PL in Challex is embedded in a regional nature and bicycle tourism area, linking the Jura mountains with the Rhône valley. It features hiking paths and trails through the vineyards. The area around the Swiss commune Dardagny is known as one of the most beautiful in Switzerland and is therefore particularly protected along with the landscape that surrounds it.

Economic development projects Development projects potentially relevant for the FCC scenario are included in the Geneva cantonal master plan (Plan Directeur Cantonal, PDCn) and concern the period to 2030. A project for new apartments on about 180 ha in the vicinity of the airport, involving major construction works and the employment of about 5700 workers, is potentially relevant for site PA in France. Also, about 1300 apartments are planned to be constructed in nearby Grand-Saconnex, involving up to 2400 workers. No development projects are registered in the vicinity of sites PL in Challex and PB in Presinge on the Swiss side.

In France, the potential main developments are in the vicinity of site PA in Ferney-Voltaire. A future commercial activity zone (ZAC) on about 65 ha and the creation of an additional 2500 apartments and educational facilities are planned for the period up to 2030.

In the vicinity of site PD in Nangy a new road widening project (RD903) and the intersection with the A40 autoroute are scheduled to be implemented before 2030.

Scientific activities The main scientific project in the region is the upgrade of the Large Hadron Collider, known as the High-Luminosity Large Hadron Collider (HL-LHC). It guarantees the continuation of the presence of scientists and engineers at today's level until the 2040 s. The FCC implementation scenario builds on this activity, leveraging the existing LHC Pt8 for the creation of surface site PA and hosting the injector on the CERN Prévessin site. Also site PL in Challex profits from being in the vicinity of CERN Meyrin.

Fig. 3.47 Architectural heritage photographed during the field investigations

For site at PB, the presence of the Geneva Architecture and Landscape School (HEPIA) in Lullier may be relevant. This facility is close to the site and potentially provides services that the surface site can leverage to reduce its own requirements. HEPIA could also potentially profit from common developments in different areas around the FCC, including agricultural studies and technical infrastructures. A collaboration already exists between the study, CERN and HEPIA to work on the re-use of excavated materials and agricultural aspects.

The national milk and meat industry school can be found in the vicinity of the PF site in Éteaux in La Roche-sur-Foron. The infrastructure also hosts a technical and scientific high-school. The school is active in scientific partnerships with INRAE, CNRS, universities and national research centres. Potential synergies can, for example, be found in the development of water and heat re-use.

3.3.10 Heritage

The analyses carried out in the frame of this study related to cultural, architectural and archaeological heritage first took into account all noteworthy elements that could be identified in a perimeter of 500 m around the surface sites. An example of architectural heritage is shown in Fig. 3.47. A subsequent, more detailed assessment focused on the elements in the immediate vicinity of the surface site candidate locations. This choice of perimeter was established in order to understand the richness of each surface site which, subsequently, would need to be considered in the designs and territorial integration of the sites.

Bibliographic analyses did not reveal any registered archaeological sites or interest in archaeological relevance at and in close proximity to the surface sites. There are no buildings or monuments of historical importance on the surface sites or directly affected by potential surface site constructions due to visibility or co-visibility. There are a few buildings of historical significance in the wider perimeters of some of the surface sites.

The sensitivity of the area of PA in Ferney-Voltaire, France with respect to heritage is low, particularly at the surface site itself. The site would be located on protected agricultural land. To the west of the study area, there is the protected woodland, Bois de la Mouille, also classified as wetland. To the northeast, in the vicinity of the site, there are a few isolated protected trees and a wetland with low functionality. Nevertheless, the implementation of a surface site avoids these classified and protected areas, despite the fact that some of them are on agricultural land.

The area around the site PB in Presinge, Switzerland has a strong heritage, architectural, cultural and landscape character. The surface site is relatively far from heritage sites but it remains partially visible from the hamlets to the north as well as those to the south. The existing wooded strips partially protect the views towards the villages of Choulex, Puplinge and Presinge, but remain open towards the communes of Jussy and Meinier. In order to preserve the rural character of the area, it is advisable to consider good landscape integration, such as a semi-buried surface site so that visibility from nearby hamlets is limited.

The heritage sensitivity within the study area of the PD site in Nangy, France, is considered medium to very high depending on the part of the site. The presence of the Château de Pierres and a classified wood located to the north and west, 180 to 300 m from the surface site induced this rating. In the area directly concerned by the site, the sensitivity is very low. The site is in the immediate vicinity of an autoroute and a departmental road which will be reorganised to improve traffic flow. No relevant visibility issues are recorded in an area that is dominated by high traffic, a hospital, or industrial and commercial facilities.

Sensitivity to heritage in the area of the PF surface site in Éteaux in France is low. Very high issues are noted in the wider vicinity of the site to the south and the southeast due to a woodland around a creek that is classified and protected. To the north-west, at a distance of about 400 m, there is a notable building, constructed in 1923, which formerly housed a cheese factory. There are also several groups of isolated trees that are witnesses to the history of agriculture. However, the implementation of the surface site avoids all sensitive spaces and stays close to the departmental road, directly opposite a public works construction company.

Fig. 3.48 Mountainous landscape with agricultural fields documented during field investigations, highlighting the interaction between natural and cultivated environments

The sensitivity related to heritage at site PG in Groisy and Charvonnex in France is considered to be low. Some areas in the south of the main site are remarkable due to the presence of areas with wetland characteristics and unclassified but high-quality woodlands. There are a few old buildings linked to the networks of old mills located in the surrounding larger study area. The surface site does not directly affect any heritage elements.

Heritage sensitivity in the immediate area of the PF surface site in Cercier and Marlioz, France is considered very low. This assessment is linked to the presence of the large forest (Grand Bois) and the Tabassé creek to the north of the surface site. Both present ecological interests, but are not considered heritage sites.

The heritage sensitivity of the PJ surface site in Dingy-en-Vuache and Vulbens in France is considered medium to high due to the location of the site in an area classified as a protected agricultural area and an ecological corridor protection zone. The entire zone is of agricultural character. In the south-west, in the immediate vicinity, some areas exhibit very high sensitivity due to the presence of classified woodlands along small creeks. The current shape of the surface site respects the integrity of the constraints. Still, particular attention will have to be paid for the specific design and integration of the surface site to maintain the registered ecological corridor, ensuring the free movement of fauna in the area.

The heritage sensitivity for the PL surface site in Challex, France is considered to be medium to high. The area around the site consists largely of protected agricultural and, further away, natural lands. There are several groups of isolated trees and alignments that bear witness to the history of agriculture. The site itself is located in a protected agricultural area and borders a protected ecological corridor registered in the municipal urban plan. The main issue is the visibility of the site from several locations in nearby villages. Therefore, care has to be taken for the specific design and landscape integration of the surface site.

In summary, the main heritage constraints are mostly related to the rural and agricultural character of the areas, with the presence of historical buildings at some distance from the sites. Particular attention related to heritage has be paid during site design and landscape integration at the site locations PB, PJ and PL.

3.3.11 Landscape

The initial state analysis included a detailed landscape analysis that was carried out with expert companies during field visits over an entire year. An example of the landscape considered is shown in Fig. 3.48. The landscape analysis extended up to 5 km around the surface sites, since the visibility of the sites depends significantly on the topography, urban and vegetation environment. Detailed landscape analysis and maps were developed that show the topography, the views from and to the sites and the visibility issues. They will serve as input for subsequent architectural design works and landscape integration concepts.

The site PA and its surroundings in Ferney-Voltaire (France) are dominated by agricultural areas, Geneva airport, highly urbanised commercial surroundings and an ecological corridor between the residual forests that occupy the buffer along the Franco-Swiss border. The area is in an open landscape with a view towards the Alps and Mont Blanc that has to be considered during the architectural design of the surface site. The nearby LHC site Pt8 (LHCb) and its planned extension provide an excellent opportunity to reduce the PA site footprint as much as possible to preserve the view and the ecological corridor that also stretches across the border.

The site PB in Presinge (Switzerland) is located in open countryside with valuable views towards the Alps and the Salève mountain. The landscape continuity is remarkable and the views from nearby hills over the landscape and its cultural and landscape heritage are highly valued. Much care must be taken in the architectural designs of the site, ideally integrating the site in the landscape as much as possible, taking care that the view from the nearby villages towards the mountains remains unobstructed.

The PD site in Nangy (France) is located in a mixed urban, agricultural and industrial environment that is dominated by major transport routes. Direct views to the sites are limited.

Table 3.14 Typical noise levels with practical examples

Noise	dB(A)	Level	Conversation
Jet plane takeoff	< **130**	Above pain threshold	**Impossible**
Jackhammer at 1 m	< **110**	Supportable for a short moment	
Motorcycle at 2 m	< **90**	Annoying	**Possible when shouting**
Heavy road traffic	< **80**	Very noisy	**Difficult without shouting**
Dwelling close to an autoroute	<**70**	Noisy	**Possible when speaking loud**
Working on a computer	< **60**	Moderate	**Possible with normal voice**
Noise level in a city during the day	< **50**	Rather quiet	
Construction noise at 100 to 200 m distance from a surface site	**40 - 45**	-	
Noise level in the countryside during the day	< **40**	Quiet	**Possible with quiet voice**
Noise level in the countryside during the night without wind	< **30**	Very quiet	
Snow falling in the mountains, recording studio	< **15**	Silent	

The PF site in Éteaux (France) is located in a natural environment, directly on highly frequented transport routes and commercial premises. No direct visibility from La-Roche-sur-Foron exists. However, the mountain views towards the Alps need to be considered when developing the architectural design of the site.

The site PG in Charvonnex and Groisy (France) is located in a highly natural environment, partially forested and with grass fields. The mountain views from the site are highly valued. A direct, but limited view of the site only exists from the Olières plateau.

The PH site in Cercier and Marlioz (France) is located in a rural environment with a forest. Some hamlets exist in the vicinity, but due to the forest and the topography, no direct view of the site exists.

The PJ site in Dingy-en-Vuache and in Vulbens (France) is located in a mixed natural and agricultural environment. The landscape is open and the view from Vulbens must be taken into consideration during the architectural design.

The site PL in Challex (France) is located in an agricultural/vineyard environment with views to the Jura mountain, the Rhône valley and the Alps. The open views require careful landscape integration, considering in particular the site's visibility from the nearby hamlets.

3.3.12 Noise

Noise, is considered to be unpleasant or annoying and is an environmental aspect that is relevant during the construction of the surface and subsurface structures and during the operation of the particle collider. The regulations concerning noise protection differ significantly between France and Switzerland. However, in all cases the impact due to noise depends on the presence of people and animals that would be affected by the noise. The relevant indicators are not only frequency and amplitude, but also the time during which an exposure to noise occurs and the duration of the exposure: during ordinary working hours, during the night, on non-working days, the typical presence of people in their homes, the age, health and other social conditions of the potentially affected people (e.g., noise in the vicinity of a hospital, a school or a retirement home). Typically, noise generated by machinery is considered to have noteworthy health effects from 40 dB(A) and higher. Noise up to 30 dB(A) is a level that is generally experienced by persons in a typical living environment (see Table 3.14).

Therefore, the first step required is to establish the existing background noise in the vicinity of the candidate surface sites using devices like those shown in Fig. 3.49 and Fig. 3.50. This activity is followed by estimations of noise generation without protection measures. This identifies sensitive areas. An eco-design is subsequently applied to reduce the noise where potential impacts on the environment are expected. The approach is to first work on low-noise designs. This also includes the relocation of noise-generating devices on the surface sites. Where this process turns out to be insufficient, noise protection measures to reduce the impacts are studied. Relocation of noise-generating equipment or adjustment of an entire surface site is an option that is considered if no adequate mitigation measures can be identified.

The background noise was established by first consulting national noise emission databases and then completing the data with field measurements. The measurements were carried out by expert companies on various days in 2024 at a selection of different locations and at different distances from the surface sites. Detailed analysis of the