From Nature or Housing to Nature and Housing?

A report about the current state, the effects, and the possibilities of housing in the WA Hoeve

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Picture on front page of heather at WA Hoeve, made by Annelinde Dingemanse.

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General introduction

The Netherlands is currently dealing with two crises at once: a housing crisis, as well as a more global environmental crisis. The obvious solution to the first crisis – more housing – can often seem at odds with the goals that have been set up to tackle the second crisis. This is especially the case in a densely populated province like Utrecht, which with 923 residents per km^2 is the third most densely populated province of the Netherlands (CBS, 2022). Housing takes up space – but which spaces can we use to create new residential areas without further exacerbating the environmental crisis?

This is an important question, but the way it is often phrased implies that nature and living are mutually exclusive: where people live, nature cannot. However, this need not be the case. We are learning more and more about how to live in harmony with nature, rather than in conflict. Where ecologists first thought it best to create large spaces for animals separate from residential areas – the so-called 'island approach' – some now think that it is better to focus on connectivity and harmony – called the 'social-ecological approach' (Palomo et al. 2014; see section '4.1 Approach to nature conservation'). Building in nature might change nature, but change is not always harmful. Nature is dynamic, and people can be dynamic too.

In this report, we, six Wageningen University students educated in Biology and Forest & Nature Conservation, analyse the pitfalls and opportunities of building at the Willem Arntsz Hoeve, located in the municipality of Zeist. This analysis is the result of an Academic Consultancy Training project of 8 weeks. This project was commissioned by the Vrienden van de Willem Arntsz Hoeve, a working group ('werkgroep') with the aim of protecting the nature of the Willem Arntsz Hoeve from potential negative impacts caused by the residential area that is to be developed there. To help our commissioner mitigate these potential impacts, our own aim with this report is threefold:

The first goal is to summarise the current situation: to get an idea of the ecological value of the WA Hoeve, the relevant legislation, and the stakeholders involved. This is done in section '1. Current state of the WA Hoeve', section '2. Building plans', and section '3. Stakeholder analysis'.

The second goal is to analyse the effect of the planned housing construction on the area and see how this may conflict with existing legislation. This is done in section '4. Effects of building plans'.

The third goal is to give advice on how to minimize the negative effect of the building plans on the ecological value of the area. For this, we consider an alternative plan proposed by the commissioner, as well as our own recommendation. We also give more general advice that can be taken into account in any scenario. All this is done throughout the sections and summarised in section '5. Conclusion'.

We hope to provide our commissioner the tools to enter a fruitful dialogue with the municipality of Zeist, so that together we can create a space in which people can live in harmony with nature, taking one step further in solving the housing and environmental crises.

1. Current state of the WA Hoeve

This chapter provides a broad description of the current state of the WA Hoeve and its uses. First, an introduction is given on the origin of the area, its uses, and services that the environment can provide. In addition, explanations are provided about the natural reserves, the Nature Network of the Netherlands, and the forest strategies applied in the WA Hoeve. Finally, an analysis is presented concerning the occurrence of protected species that were found during the quickscan and in the database NDFF, and how the legislations for these species work in practise.

1.1 Area description

1.1.1 History

The Willem Arntsz Hoeve (WA Hoeve) is a unique historical and natural area in the north-eastern part of Den Dolder, the Netherlands. It is located on the northern part of the 'Utrechtse Heuvelrug', approximately 5 m above NAP ('Normaal Amsterdams Peil'; Amsterdam Ordinance Datum), and the area is considered a glacial moraine. The relief of this area was formed during the Saale Glaciation (ice age), about 370,000 to 130,000 before Christ (BC). During the last glacial period, Weichselien (115,000 to 10,000 BC), vast amounts of drifting sand were deposited around the Utrechtste Heuvelrug, transforming the area into a moraine. Ever since this transformation, the geological properties have been mostly consistent throughout the Holocene era (10,000 BC to present). The soil consists of mostly a dry, acidic, and nutrient-poor sandy soil, which can be categorized under field podzol soils ('veldpodzolgronden') and dune soils ('duinvaaggronden'). During the Holocene era the landscape consisted of mainly deciduous forests until the late medieval period, in which the human population expanded considerably and altered the landscape by deforestation for agricultural practices (Muhren et al., 2005). Throughout the 19th century the environment mainly consisted of fragmented forests, wet heathlands, and several plots were used for small-scale agriculture by local farmers. It was not until 1896 that a soap factory was built in the neighbourhood. This ensured the construction of more residential houses and various facilities (*e.g.* postal office), and thus establishing the origin of the village Den Dolder (Muhren et al., 2005).

The area of the WA Hoeve was bought in 1905 by the foundation of Willem Arntsz, with the intention to establish a psychiatric healthcare institution within a natural area. At that time the area consisted of only one building, the so-called lake house ('het meerhuisje'). The foundation started with the construction of a farm and vegetable gardens in which the patients were treated in the form of occupational therapy, and the natural area surrounding the WA Hoeve was thought to be beneficial for the rehabilitation of its patients. Soon the development continued, and new pavilions and service houses needed to be built to provide enough room for the growing number of patients and their caregivers. The construction of multiple buildings in the historical central part ('Historische Middenas'; HMA) date back to before the second world war. This includes buildings that are known as the direction building, auditorium and management building, which are marked as a national- or municipal monument (Rijksmonumenten Den Dolder, n.d.). Only after the second world war did development of the area continue, especially in the 1960s when the demand for housing began to increase tremendously. In the 1980s and 1990s the development further continued to the north and south parts of the HMA (Gemeente Zeist, 2021c).

1.1.2 Area usage

The area of the WA Hoeve is located to the north-east of Den Dolder. The area is separated from Den Dolder by the provincial road Dolderseweg (N238) and the train tracks from Utrecht to Amersfoort. A train station is located right at the south of the WA Hoeve. Part of the WA Hoeve is already occupied by buildings used by Altrecht and Fivoor, two healthcare institutions. These built-up areas are surrounded by forests and heather (Figure 1. The area of the WA Hoeve. Left: white and grey are built-up areas, green is forest, and purple is heather (Kadaster, 2022). Right: satellite photo of the area (Google Maps, 2022).Figure 1).

Figure 1. The area of the WA Hoeve. Left: white and grey are built-up areas, green is forest, and purple is heather (Kadaster, 2022). Right: satellite photo of the area (Google Maps, 2022).

The area and surrounding of the WA Hoeve are currently owned by four organisations (Figure 2): (1) Bouwfonds Property Development (BPD), the project developer in charge of the building plans, (2) Altrecht, a healthcare institution planning to sell to BPD by 2027 (Altrecht, 2020), (3) Reinaerde, another healthcare institution with its own development plans, and (4) Utrechts Landschap, the manager of many nature areas in the province of Utrecht. These and other stakeholders are analysed more in-depth in the stakeholder analysis (section '3. Stakeholder analysis').

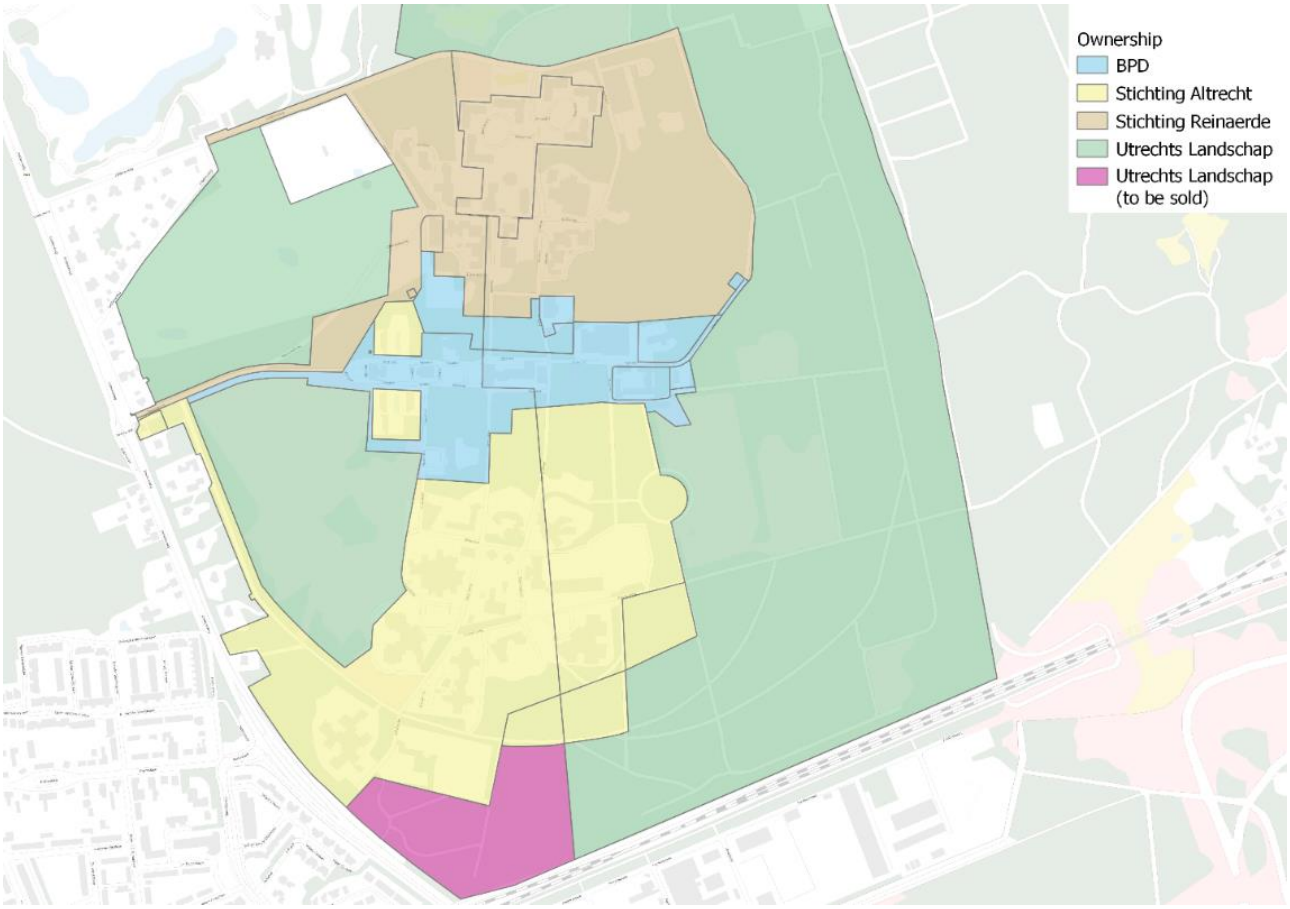

Figure 2. Ownership of the terrain surrounding the WA Hoeve (Beheer PDOK, 2022).

The Historische Middenas was previously owned by Altrecht, but has already been sold to the project developer BPD. BPD (9.3 ha), Altrecht (27.2 ha), and Utrechts Landschap (4.9 ha) make up the area that is being developed as 'Bosch and Hei'. For this purpose, the purple area (Figure 2) is being sold to BPD by Utrechts Landschap.

1.1.3 Ecosystem services

The natural environment of the WA Hoeve provides multiple different ecosystem services (Bolund & Hunhammar, 1999). These services can be divided into four main categories: regulating services, cultural services, production services, and supporting services (Melman et al., 2010). Should the ecosystem that provides these services be lost or damaged, these services are also lost.

Firstly, there are regulating services, which are services that provide a benefit by regulating natural processes. Examples within the WA Hoeve include:

- Natural areas in and around the WA Hoeve provide habitats for insects, which may pollinate crops.
- A variety of natural areas increase the biodiversity, and thereby increasing pest suppression. Higher amounts of species within an area increase the chance that one of them is effectively able to predate on pest species, preventing outbreaks from occurring.

- Natural soil allows water to infiltrate into the ground, rather than falling on the paved roads which increases the burden of the local sewer system.
- Forests have a purifying effect on air, increasing the air quality (Powe & Willis, 2004).
- The forest creates a microclimate which is generally milder than the surrounding areas.

Secondly, there are cultural services, which are the benefits humans assign to nature. Examples within the WA Hoeve include:

- Given the history of the area, the nature and the buildings of the WA Hoeve have a strong cultural-historical value (see section '1.1.1 History') (Gemeente Zeist et al., 2021)
- The area provides a recreation opportunity for people to relax or exercise, which can improve their quality of life and increase their overall wellbeing of people.
- The area provides value for tourists, making local commercial accommodations like the Ernst-Sillem Hoeve Hotel or The Pool House more attractive.

Thirdly, there are production services, which provide a benefit through directly supplying resources. The WA-Hoeve only really delivers one of these:

- The harvesting of wood from the forest.

Finally, there are supporting services, which are services which are required for other ecosystem services to function properly. Three important supporting services are provided within the WA Hoeve:

- The forest takes up CO_2 when they grow, helping to reduce the enhanced greenhouse effect.
- The forests may catch dry nitrogen deposition and the plants can then absorb this nitrogen. While this may prevent the nitrogen from ending up in systems sensitive to nutrient enrichment, the WA Hoeve has some of these areas itself where this could endanger the local habitat type.
- The forest and heather provides a habitat for multiple species and maintains the biodiversity of the surrounding area.

1.2 Environmental legislation of the province of Utrecht

Legislations in the Netherlands are currently transitioning into a new environmental law called the 'Omgevingswet,' which is scheduled to take effect on July 1 2023 (although this date has been consistently postponed since 2017). The province of Utrecht deemed it necessary to construct their own interim environmental regulation called the 'Interim Omgevingsverordening,' that takes the plans and ambitions of the newly developed environmental legislation into account. They plan to work with the interim environmental regulation, until the official Omgevingswet is released. Interim environmental regulation is formulated to contain the rules needed to implement the environmental vision of Utrecht ('Omgevingsvisie'). This vision provides clarity on the policies that new development projects, within the province of Utrecht, should comply with. Issues such as handling with natural areas, the continuing need for housing and the accessibility of the area must all be taken into account. The slogan for the environmental vision of the province of Utrecht is: "Room for development, conserving quality". Their vision contains seven policies that aim to conserve and provide a healthy and safe living environment, including; 'future-proof nature and agriculture', 'urban and environmental health', 'climate and water resistance', 'sustainable energy', 'vital cities & villages', 'sustainability, health and safe accessibility', and 'living landscape, heritage and culture'.

1.3 NNN

The nature network of the Netherlands ('Natuurnetwerk Nederland'; NNN), previously called the ecological main structure ('Ecologische Hoofdstructuur'; EHS), is the name for the network of nature areas in the Netherlands (Provincie Utrecht, 2022h). The idea behind this network is that the stronger the connectedness is, the more species get the possibility to migrate between their habitats. Then, if pressure on one area increases (due to droughts, climate change, etc.), species can adapt by spreading throughout the network. For species that require a large habitat, NNN ensures that they can use a large area because of the connection between different nature patches. This is especially important in a densely populated country like the Netherlands, where there are many cities, roads, and train tracks that form barriers in the landscape.

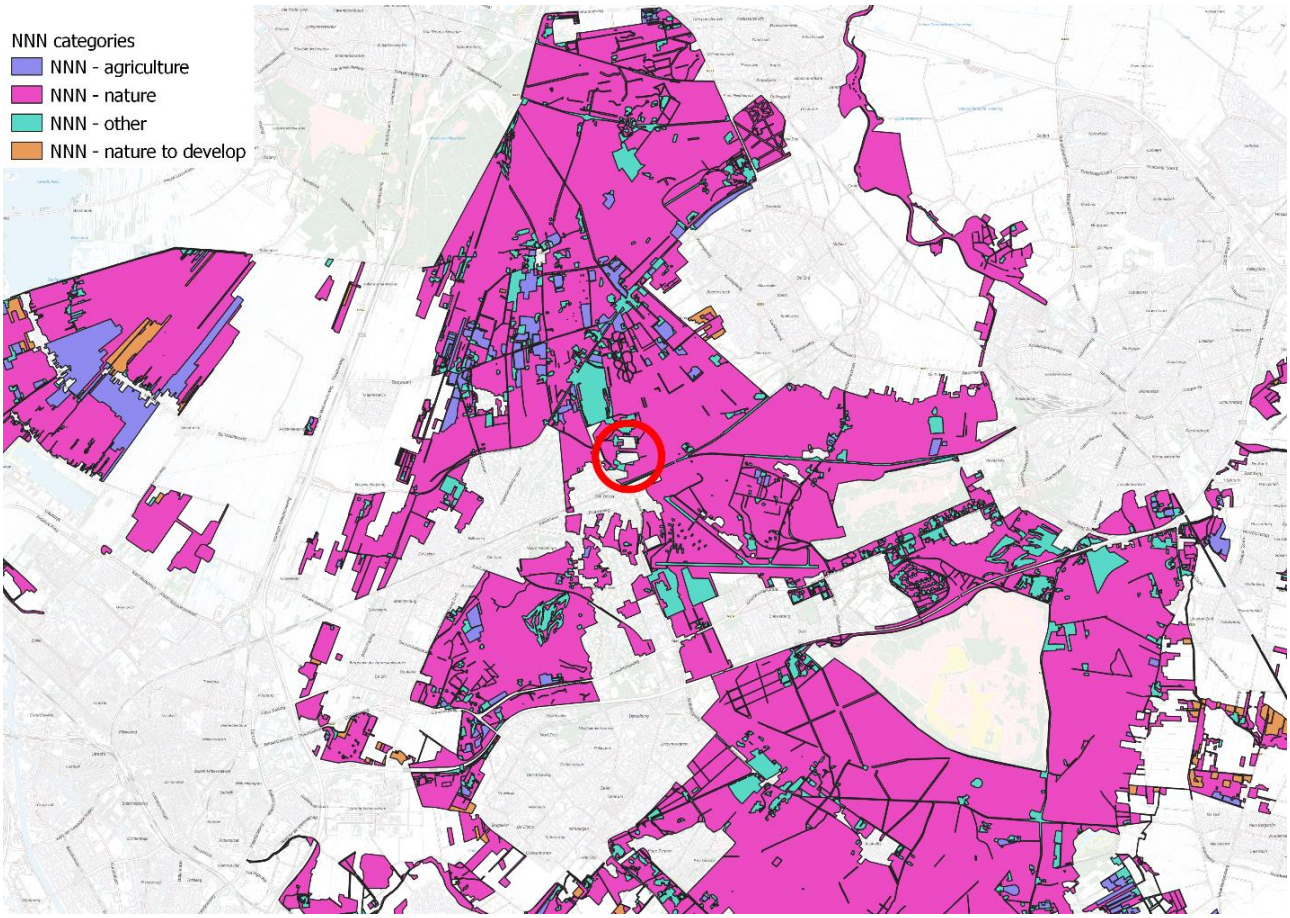

Figure 3. NNN areas in the Utrechtse Heuvelrug. The WA Hoeve is circled in red. (Provincie Utrecht, 2022d).

Figure 3 shows the position of the WA Hoeve within the larger NNN. It is part of a connection between the south-eastern part and the north-western part of the Utrechtse Heuvelrug. The province of Utrecht has about 30,000 hectares of NNN.

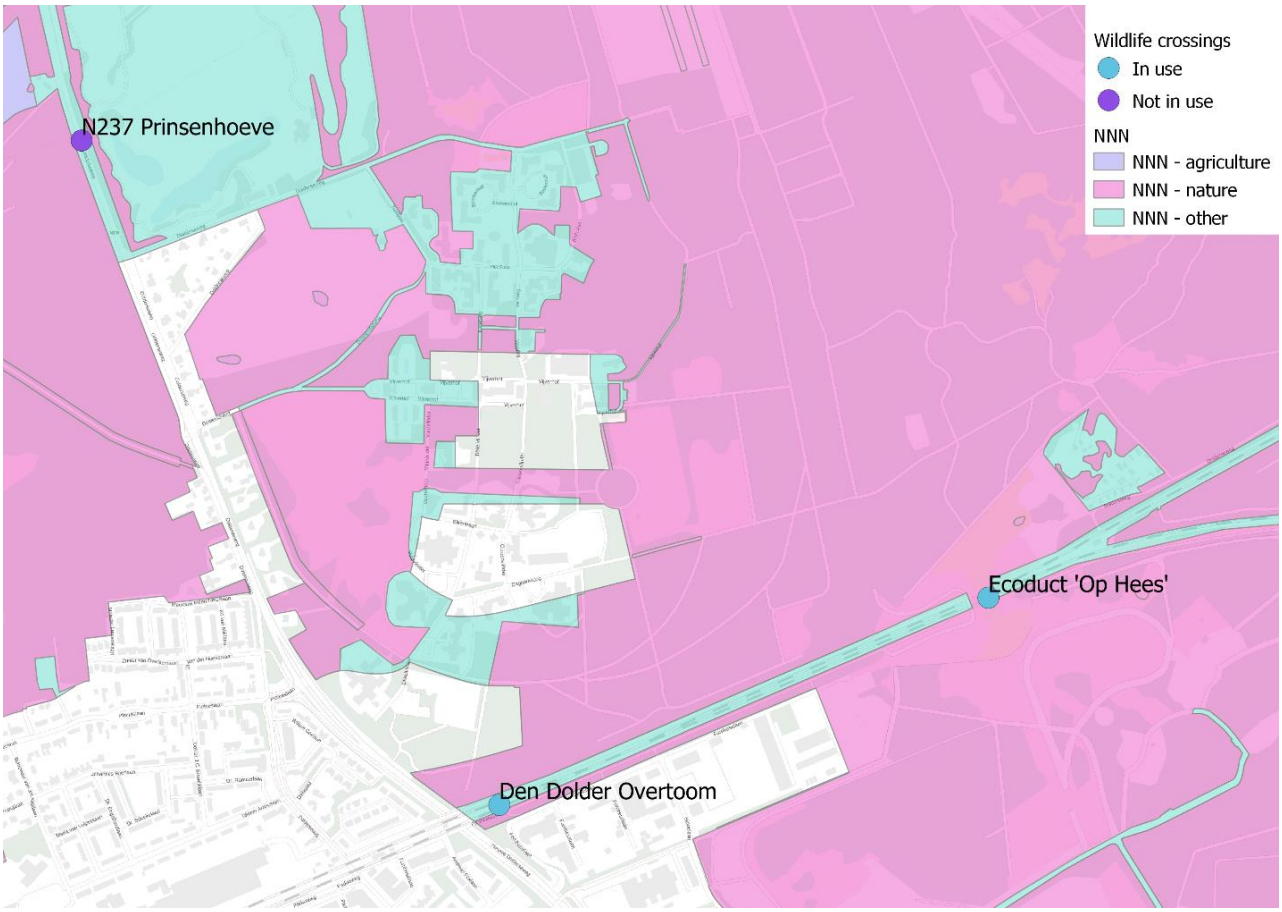

Figure 4. NNN areas around the WA Hoeve, along with wildlife passages in the area (Provincie Utrecht, 2022c).

Figure 4 shows the NNN areas around the WA Hoeve as well as the wildlife crossings present in the area. Most of the WA Hoeve is part of the NNN, with the exception of three parts which are marked as areas that are part of the development plans. We will discuss why these areas are not part of the NNN in section '1.3.2 Change in NNN'. There are also three wildlife crossings in the area, the largest of which is the ecoduct 'Op Hees', a large bridge with vegetation on top going over the local railway. A smaller wildlife passage is located to the west along the same railway. Another wildlife passage is located along the N237 highway to the north, but this one is currently not in use for unknown reasons.

1.3.1 Legislation

To be able to build in a NNN area, a project developer has to pass a "no, unless" test ('"nee, tenzij"-toets') that proves that the buildings will not affect the NNN. According to article 6.3(1) of the Interim Omgevingsverordening of the province of Utrecht (Provincie Utrecht, 2021), this can be done in one of three ways:

1. The development is of great public importance, for which there are no realistic alternatives that do not affect the NNN or affect it less.
2. The developments that do affect the NNN, are being compensated within an area connected to the affected area in question, in such a way that the net value of the NNN is demonstrably increased (in terms of quality, surface area, or connectedness) within 10 years.

3. The development has a limited effect on the NNN, and any changes made are necessary to conserve the current purpose of the area.

Existing buildings, properties and surrounding terrain, or other concrete (hard) surfaces in principle do not belong to the NNN (article 6.3(2)). Furthermore, any negative changes to the NNN should be limited as much as possible, and be compensated for in a timely manner (article 6.3(3)).

1.3.2 Change in NNN

Before the Interim Omgevingsverordening went into effect on March 2021, the whole area of the WA Hoeve was included in the NNN data (Figure 5). Since then, certain areas of the WA Hoeve have been removed from the network (Figure 4). These areas correspond to the zoning areas that are a part of the building plans (see section '2. Building plans'). This change happened because the Omgevingsvisie – and its corresponding legislation the Interim Omgevingsverordening and Omgevingswet – has replaced the previous provincial plans called the 'Provinciale Ruimtelijke Structuurvisie 2013-2028 (PRS)' (Provinciale Staten van Utrecht, 2017). These plans were originally supposed to last until 2028, but the Omgevingsvisie and Omgevingswet are now planned to fully go into effect from July 1 2023 (see section '1.2 Environmental legislation of the province of Utrecht').

Figure 5. The archived NNN dataset of the province of Utrecht, valid until March 2021 (Provincie Utrecht, 2020).

The PRS lists a set of rules – similar to the legislation as outlined in the Interim Omgevingsverordening – that have to be adhered to when removing NNN areas. These rules would normally not allow the areas in the WA Hoeve to be removed. However, Dennendal (the area owned by Reinaerde) and the WA Hoeve are not subject to these rules: the PRS explicitly states that the NNN-borders of these areas will

be adjusted as soon as the municipality of Zeist has made zoning plans that adhere to the agreements made in the context of the program 'Hart van de Heuvelrug' (Provinciale Staten van Utrecht, 2017). In this program, the province of Utrecht works together with the municipalities of Soest and Zeist, as well as stichting Utrechts Landschap, to create space for living, recreation, and to enhance and connect nature on the area of the Heuvelrug (Hart van de Heuvelrug, n.d.). The goal of this program is to create and maintain a balance (in surface area) between "red" (non-nature) and "green" (nature) areas: nature can only make way for residential areas if the nature is compensated for elsewhere. However, this does not mean that every time new building plans are made in green areas, new green areas should be created elsewhere as compensation; rather, there can only be built in nature if the green side of the balance is positive. The PRS states that (at the time) there is enough green to compensate for the WA Hoeve, but that at the time, this compensation had not yet been translated into the removal of these areas from the NNN. The removal of these areas is therefore in accordance with provincial policy (Provinciale Staten van Utrecht, 2017).

Nevertheless, the building plans still affect the NNN. In section '4.3.1 Effects on NNN', we will discuss how these effects are taken into account.

1.4 Dry heather

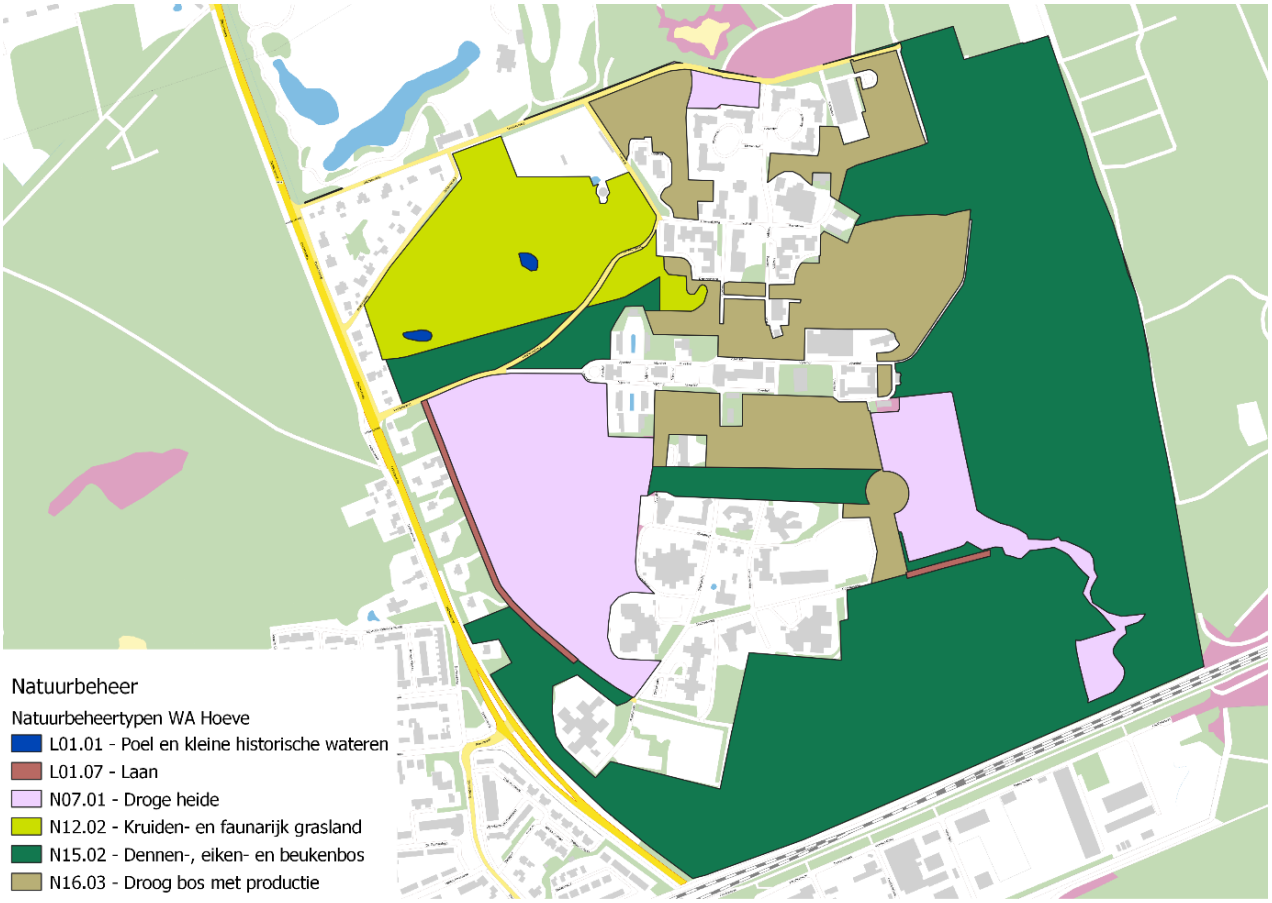

Figure 6. Nature management types around the WA Hoeve (Provincie Utrecht, 2022a).

Nature in the Netherlands is divided into 17 nature types, each with their own specific management requirements. At the WA Hoeve, the three main management types are dry heather (N07.01), pine, oak

and beech forest (N15.02), and dry production forest (N16.03) (Figure 6). The name of the building project – 'Bosch & Hei' – refers to these management types. Because heather is most vulnerable to changing abiotic factors, we will first focus our analysis on this management type.

1.4.1 Preliminary analysis

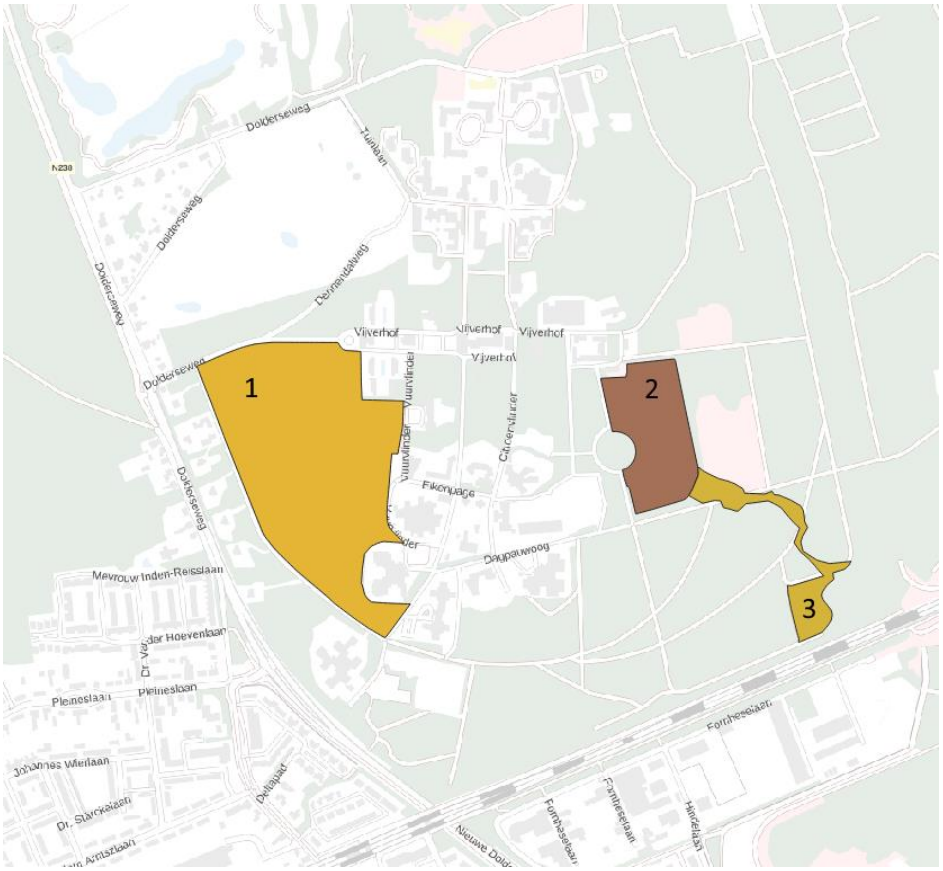

Figure 7. Three heather fields (management type N07.01 'droge heide') at WA Hoeve (Provincie Utrecht, 2022a).

Within the area and surroundings of the WA Hoeve, there are three fields that are designated as nature management type 'N07.01 droge heide' – dry heather (Figure 7). Field 1 is in the western part of the WA Hoeve. Field 2 is in the eastern part, and is connected to field 3 by a small strip of heather. All three fields are managed by Utrechts Landschap. Field 2 has a surface area of about 3 ha, and field 3 is roughly 1.5 ha. Field 1 is around 11.3 ha.

Dry heather fields are characterised and usually dominated by common heather (*Calluna vulgaris*; struikhei). However, due to nitrogen deposition purple moor-grass (*Molinia caerulea*; pijpenstrootje) often takes over, decreasing the biodiversity of the heather (Figure 8). When visiting the area of the WA Hoeve, we found that field 1 was dominated by purple moor-grass, and that there was little common heather present (Figure 9). We only found common heather in the north of field 1, outside of the fence that surrounds it, next to the street 'Vijverhof' that runs towards the Historische Middenas.

Figure 8. The relatively nitrogen-rich grass purple moor-grass (left) and the indicative heather species common heather (right).

Figure 9. Near the entrance of field 1: trees and grass, but not a lot of heather.

We further noticed that on field 1, at the end of November, there were still some Drenthe Heath Sheep (*Ovis aries*; Drents Heideschaap). These are sheep primarily raised for vegetation management. They eat relatively nitrogen-rich plants like purple moor-grass that, in areas with too much nitrogen deposition, outcompete plants like common heather. Currently, Utrechts Landschap has about a dozen sheep permanently present on the heather for 8 months (Dick Schippers, personal communication, December 2, 2022). Management of heather using sheep is most effective at night, when the sheep can defecate in a different area. That way, the nitrogen that is in the plants they consume during the day, is not put back into the same area (Bakker et al., 1983). As is currently already the case, the sheep should be taken away in winter to prevent too much grazing pressure on the heather. Possible other measures for reducing the effects of nitrogen deposition include mowing, 'chopperen' (Dutch term for removing the vegetation and part of the humus layer), and sod cutting (Jansen et al., 2016).

In contrast with field 1, field 2 and 3 are more dominated by common heather (Figure 10). There is a small stroke of common heather connecting the two fields, which has been recently designated by the province of Utrecht as an area suitable for dry heather (Provincie Utrecht, 2022g). Field 2 is also managed using sheep, but instead of a permanent presence, a herd of roughly 200 sheep is allowed to graze for a day after which they are removed again (Dick Schippers, personal communication, December 2, 2022).

Figure 10. Heather fields 2 (left) and 3 (right), both dominated by common heather (Calluna vulgaris; struikhei).

1.4.2 Quality of dry heather

There are a few elements of dry heather that determine the quality of this management type (BIJ12, 2022). For each element, there are three levels of quality: high, middle, and low.

The first element is its structure: different species require different types of covering. A dry heather field therefore does not only have to consist of common heather. For example, purple moor-grass, the nitrogen-rich grass mentioned earlier, is not a totally unwelcome species, but should not exceed more than 20% of the surface area. We have done a preliminary analysis of the structure of the heather fields of the WA Hoeve, but to better determine the quality, we recommend a more in-depth analysis of the structure according to the monitoring guidelines of BIJ12 (2022).

The other elements are the flora & fauna, nitrogen deposition, and the connectedness of the heather to other fields of the same management type. Based on these three elements, we determine the quality of the three heather fields below.

1.4.2.1 Flora & fauna

Dry heather has some qualifying species that can be used to determine the quality of the ecosystem: mostly plants, and some birds, butterflies, and grasshoppers. Based on the presence of these qualifying species, there are three levels of quality (BIJ12, 2022):

- High: when at least 12 qualifying species have been found, of which at minimum seven on more than 15% of the surface area, and there is at least one qualifying species of plant, one species of bird, and one species of butterfly or grasshopper.
- Middle: when 8-12 qualifying species have been found, but the requirements of 'high' quality have not been met.
- Low: when the requirements of neither 'high' nor 'middle' have been met.

An extra 2 IUCN Red List species that are endangered, critically endangered or extinct, can be added to the number of qualifying species.

We used the Nationale Databank Flora & Fauna (National Database Flora & Fauna), or NDFF for short. Because monitoring of dry heather is done every 6 years (BIJ12, 2022), we considered observations made as of 01-01-2017.

In field 1, we found the following qualifying vascular plants: mat-grass (*Nardus stricta*; borstelgras), grey hair-grass (*Corynephorus canescens*; buntgras), small cudweed (*Logfia minima*; dwergviltkruid), common juniper (*Juniperus communis*; jeneverbes) and petty whin (*Genista anglica*; stekelbrem). There are also observations of three qualifying species of butterfly: grayling (*Hipparchia semele*; heivlinder), small heath (*Coenonympha pamphilus*; hooibeestje), and silver-spotted skipper (*Hesperia comma*; kommavlinder). There is one qualifying species of grasshopper: lesser mottled grasshopper (*Stenobothrus stigmaticus*; schavertje). Finally, the Red List endangered species delicate reindeer lichen (*Cladonia ciliata*; sierlijk rendiermos) and small skipper (*Thymelicus sylvestris*; geelsprietdikkopje) have been spotted in the field.

In total, there have been nine qualifying species and two extra Red List species found in field 1 since 2017. According to these findings, field 1 is of 'middle' quality.

In field 2, no qualifying vascular plants have been observed. There are two qualifying species of butterfly: grayling and small heath. There is one qualifying species of grasshopper, lesser mottled grasshopper. Finally, some Red List endangered fungi could occur in the area, like matt knight (*Tricholoma imbricatum*; fijnschubbige ridderzwam) and cedarwood waxcap (*Hygrocybe russocoriacea*; geurende wasplaat), but these have not specifically been found in this field.

In total, there have been three qualifying species found in field 2 since 2017. According to these findings, field 2 is of 'low' quality.

In field 3, no qualifying vascular plants have been found, but common gorse (*Ulex europaeus*; gaspeldoorn) and blue bonnets (*Jasione montana*; zandblauwtje) have been observed nearby, at the other side of the ecoduct Op Hees, which connects the area surrounding the WA Hoeve to the nature area 'Vliegbasis Soesterberg' (Figure 11). In the field, there have been observations of three qualifying butterfly species – grayling, small heath, and small skipper – as well as one qualifying species of grasshopper, lesser mottled grasshopper. Similar to field 2, some Red List endangered fungi could occur in the area, but have not specifically been sighted in field 3.

In total, there have been four qualifying species found in field 3 since 2017. According to these findings, field 3 is of 'low' quality. The qualifying species that have been observed in field 3 have also been found in field 2, so even put together, the quality of the fields remains 'low'. However, given their proximity to the ecoduct Op Hees, fields 2 and 3 have the potential for visitors from the nature-rich area Vliegbasis Soesterberg.

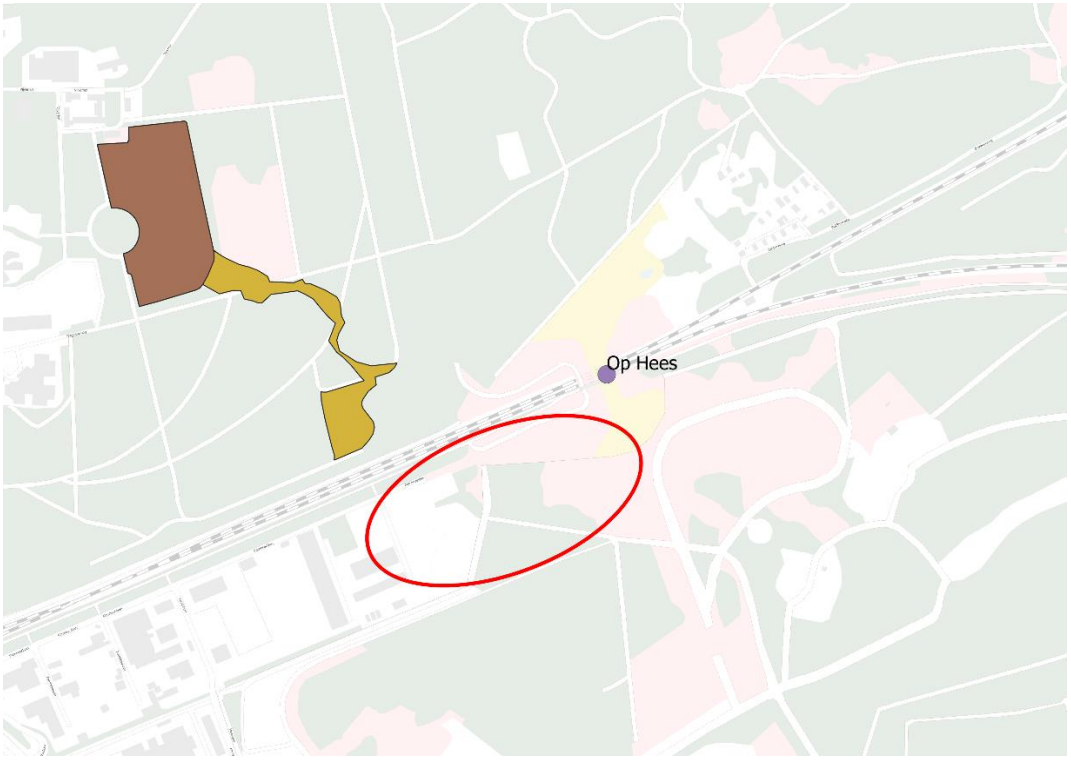

Figure 11. The red circle shows the location where common gorse (Ulex europaeus; gaspeldoorn) and blue bonnets (Jasione montana; zandblauwtje) have been observed, near ecoduct 'Op Hees', and close to heather field 2 and 3 (Provincie Utrecht, 2022c).

1.4.2.2 Nitrogen deposition

On a 'high' quality dry heath, less than 15 kg nitrogen per hectare per year is deposited. On a 'middle' quality dry heath, nitrogen deposition lies between 15 and 30 kg (1070 – 2130 mol) per hectare per year. A 'low' quality dry heather has more than 30 kg (2130 mol) nitrogen per hectare per year (BIJ12, 2022). The nitrogen deposition in the area of the WA Hoeve is around 1700 mol (RIVM, 2021). According to this metric, all three heather fields could therefore be considered of middle quality. An increased nitrogen load would push this further towards low quality dry heather.

It should be noted that nitrogen deposition in an area is not just influenced by nearby traffic and agriculture, but that it is calculated based on a combination of sources both nearby and further away, forming a blanket of nitrogen that covers the Netherlands. The model used by the RIVM takes into account both the general blanket deposition and deposition from local sources.

1.4.2.3 Connectedness

The quality indicators of dry heather based on connectedness depend both on the surface area and on the proximity to other supporting management types (BIJ12, 2022): raised bogs (N06.03), wet heaths (N06.04), sand drifts (N07.02), dry nutrient-poor grasslands (N11.01), and fens (N06.05 and N06.06).

Dry heather that is connected to supporting management types within 30 m distance are of ‘high’ quality if it is larger than 10 ha, and of ‘middle’ quality if it is smaller than 10 ha. Dry heather that is within 1 km of supporting management types is of ‘middle’ quality if it is between 10 and 50 ha, of ‘high’ quality if it is larger than 50 ha, and of ‘low’ quality if it is smaller than 10 ha.

Figure 12. The dry heather fields of the WA Hoeve (red circle) and the nearby supporting management types (Provincie Utrecht, 2022a).

With a surface area of 11.3 ha, field 1 is the only field that is larger than 10 ha. Both field 1, field 2 and 3 are within 1 km proximity of other dry heather fields, sand drifts, or dry nutrient-poor grasslands (Figure 12). Because field 1 is between 10 and 50 ha, it is of ‘middle’ quality.

Taken together, field 2 and 3 are only 4.5 ha, and are therefore of ‘low’ quality. However, field 2 and 3 are closely connected to each other, and also to the dry heather and nutrient-poor grasslands on and near the ecoduct ‘Op Hees’ (Figure 11 & Figure 12). This connection is likely an important source of species not only for field 2 and 3, but by extension also for field 1.

1.4.3 Conclusion

According to BIJ12’s monitoring requirements, the three dry heather fields at the WA Hoeve are of low to middle quality, with field 1 being of the highest quality. However, a preliminary analysis has shown a lack of common heather (*Calluna vulgaris*; struikhei) at field 1, and an excess of purple moor-grass (*Molinia caerulea*; pijpenstrootje). Furthermore, the dry heather of field 2 and 3 might form an important bridge between field 1 and the dry heather and dry nutrient-poor grassland on and near the

ecoduct ‘Op Hees’. On the northern, southern, and western side, field 1 is enclosed by roads and train tracks.

1.5 Forest strategy

1.5.1 Current state

The forest area of the WA Hoeve can be divided into two vegetation types: leucobryum moss – pine forest (‘kussentjesmos – dennenbos’, veg. type 41A3), and birch – oak forest (‘berken – eikenbos’, veg. type 42A1) (Feijen, n.d.). The first vegetation type consists mainly of Scots pine (*Pinus sylvestris*; grove den), Douglas fir (*Pseudotsuga menziesii*; douglasspar*),* and Corsican pine (*Pinus nigra subsp. laricio*; corsicaanse den). The deciduous trees in the area are mainly (exotic) oak species (*Quercus spp.*; eik), Birch species (*Betula spp.*; berk), some European beech (*Fagus sylvatica*; beuk), sycamore species (*Acer spp.*; esdoorn), and Rowan (*Sorbus aucuparia*; gewone lijsterbes) (Feijen, n.d.; Dick Schippers, personal communication, December 2, 2022).

To the north-east of the WA Hoeve, on the EwijcksHoeve, there is an ‘old growth forest area’ (‘oude bosgroeiplaats’), which is a nature type for areas containing native deciduous trees that has been forest since the 19th century. In these areas, soil was able to develop undisturbed, which resulted in a high number of flora and fauna related to these soils (Figure 13). These forests act as a source for organisms that can spread to surrounding forests. The area close to WA Hoeve dates back to 1832, and consists of oak, beech and birch species. (Bijlsma & Koop, 2022) The forests of WA Hoeve are directly connected to this old growth forest area.

Figure 13. Old growth forest area (Provincie Utrecht, 2014).

1.5.2 Legislation and policy

The forest strategy ('bossenstrategie') of the province of Utrecht focusses on protection of existing forests and expansion of the forest area. In the document 'Strategisch bosbeleid' of the province (Provincie Utrecht, 2022e), it is acknowledged that the space needed for expansion is hard to find, because other aspects such as housing and agricultural areas are also of importance for the province. In the forest strategy of 2020 ('Bos voor de toekomst') (Ministerie van Landbouw, Natuur en Voedselkwaliteit, 2021), it has been decided that the forest area must be expanded with 10% by 2030. Applied to the province of Utrecht, this means an increase of 1500 ha by 2040, of which 500 ha would be classified NNN area (Provincie Utrecht, 2022d). Currently, the forested area in the province of Utrecht is 18.000 hectares. A large part of the WA Hoeve is part of the NNN. The strategic forest policy has not yet been included in concrete rules for nature. General rules for forest expansion include 600,000 extra trees to be planted (next to compensation for tree fellings) following the action plan for trees ('Bomen Actieplan'), and more trees to be planted in NNN areas (Provincie Utrecht, 2022e; p. 8). This Bomen Actieplan contains 38 projects, of which the WA Hoeve is not a part (Natuur en Milieufederatie Utrecht, 2020).

1.5.2.1 Kamp van Zeist

On November 1, 2022, the province of Utrecht became the owner of the area 'Kamp van Zeist', which is a former military location close to Soesterberg (Hart van de Heuvelrug, n.d.). An area of 29 ha of Kamp van Zeist has the status of 'nature' in the destination plans of the province. Of these 29 ha, 18 ha is not yet nature, but contains of buildings and roads (Feijen, 2019). These 18 ha will be developed into nature. The area will act as nature compensation for the building of the program Hart van de Heuvelrug (Provincie Utrecht, 2022b). In a report of 2017, this was planned to be realised by 2025 (Feijen, 2019). This date was shifted to 2030 (Hart van de Heuvelrug, n.d.), which is after the start of the building activities on the WA Hoeve.

In the program 'Hart van de Heuvelrug' (see also section '1.3.2 Change in NNN'), it is stated that the area Kamp van Zeist will be given to Stichting Utrechts Landschap when the realization of nature is finished (Hart van de Heuvelrug, n.d.). However, there are no clear plans concerning the realisation of new nature on Kamp van Zeist. The 2019 draft plan shows that priority is given to the realisation of (nutrient-poor) grassland and heathland; because of the connection with the nearby Leusderheide, realising forest has the least priority (Feijen, 2019, p. 17-18). This is not yet in line with the forest strategy of the province, which focuses on expanding the forest area. The forest strategy implies that at the end of the line, with compensation of nature on Kamp van Zeist, more forest should be realised than will be lost because of the building projects.

1.5.3 Climate change and CO_2

The forests on the Utrechtse Heuvelrug are situated on sandy soils, where trees depend on retained water ('hangwater'). The groundwater level in most of the areas in the WA Hoeve are classified as groundwater level VII (highest average level 80-140 cm, lowest average level >120 cm), except for one area in the west of the WA Hoeve just below the golf course, which is classified as groundwater level III (highest average level <40 cm, lowest average level 80-120 cm) (Feijen, n.d.). With an expected increase in annual temperatures, trees are expected to experience heat stress during hot and dry summer periods, especially on sandy soils with low groundwater levels. This results in trees dying and growth stagnating. The coniferous trees on the WA Hoeve have a drought tolerance of 3-4 on a scale of 5 (1: not

tolerant, 5: tolerant). Of the deciduous trees, birch, beech and rowan have a low tolerance (2), and sycamore and oak species have an intermediate tolerance (3) to drought (Lerink et al., 2021).

Forests can store CO_2 both above and below ground. On average, a Dutch forest stores around 400 tonnes CO_2 per hectare, the forest soil contains 350 tonnes CO_2 per hectare extra (Probos, 2020). Forests account for 60% of the total storage of CO_2 in the Netherlands (Probos, 2020). Based on rough calculations of the existing forest on the WA Hoeve (Figure 14, red and green together), and the area of forest that will be removed based on the building plans of BPD, a calculation can be made of the expected CO_2 if these plans will be executed. The present CO_2 storage on the WA Hoeve is around 7560 tonnes in the trees itself, plus an additional 6615 tonnes CO_2 in the forest soil. The forest area that will be removed is around 5.7 ha, which is approximately 2280 tonnes CO_2 in the trees, and 1995 tonnes CO_2 in the forest soil (Probos, 2020). However, more CO_2 is stored in a clay soil than in sand soil, and since the WA Hoeve is on a sandy soil, the amount of CO_2 lost in the soil will likely be lower. Also, the stored CO_2 in the woody parts can still be stored when this wood is used in durable and long term applications, such as landscape furniture.

Figure 14. Total forest area (green and red together) and area of forest to be removed when building plans will be executed. Made in QGIS from a combination of zoning data from the municipality of Zeist (2021d) and forest data from the province of Utrecht (2022).

1.6 Species/Quickscan summary and analysis

In 2021, a quickscan was performed by Royal HaskoningDHV, commissioned by BPD (Maas & Wortel, 2021). During the quickscan, an ecologist made an assessment concerning the flora and fauna of the WA

Hoeve in the context of the 'Wet Natuurbescherming' (Wnb). Because BPD is aiming to develop part of the WA Hoeve into a residential area, a quickscan was necessary to outline the possible risks on violating the prohibitions mentioned in Wnb. We will now provide a summarizing overview of the quickscan, including some critical remarks.

1.6.1 Species protection

The quickscan was carried out using data from the NDFF database and by an orienting site visit.

Four protected species of ground-bound mammals were included in this research:

- Badger (*Meles meles;* das): old burrow is likely present, badgers may visit area occasionally.
- Pine marten (*Martes martes;* boommarter): has been sighted.
- Red squirrel (*Sciurus vulgaris;* Europese rode eekhoorn): occurrence likely, no roosts found.
- Beech marten (*Martes foina;* steenmarter): occurrence unlikely but cannot be ruled out.

Multiple other mammal species are present, but they are less relevant for the building plans. Badgers and pine martens have been observed regularly by Dick Schippers (personal communication, December 2, 2022) and Margriet Hartman (personal communication, December 5, 2022). During our own field visit to the WA Hoeve, we also got a very strong impression that these two species reside in the area. An exemption for building plans is necessary when presence of badger or pine marten is indeed confirmed. This confirmation would have to be made in future research, which BPD is legally obliged to have someone carry out before they can start building (legislation is explained in section '1.6.4 Legislation')

Various bat species have been observed in the area. Observations have been made of common pipistrelle (*Pipistrellus pipistrellus*; gewone dwergvleermuis), common long-eared bat (*Plecotus austriacus*; grijze grootoorvleermuis), serotine bat (*Eptesicus serotinus*; laatvlieger) noctule bat (*Nyctalus noctule*; rosse vleermuis), and nathusius' pipistrelle (*Pipistrellus nathusii*; ruige dwergvleermuis) . If bats have been present in at least one building and possibly in trees. Further research is needed to confirm bat habitats (which again, BPD is legally obliged to have carried out before they can start building); if so, an application for exemption or dispensation is required.

There are some birds with year-round protected nest sites in the area as well. The presence of common buzzard (*Buteo buteo*; buizerd) and Northern goshawk (*Accipiter gentilis*; havik) has been confirmed. If nests are present, exemption and fitting mitigation or compensating measures are necessary.

There are also various species of common breeding birds present. Construction work is also legally required take place outside of the breeding season (between 15 March and 15 July) to avoid disrupting these species.

Reptiles: four species of reptile were also observed on various occasions.

- The sand lizard (*Lacerta agilis*; zandhagedis) and viviparous lizard (*Zootoca vivipara*; levendbarende hagedis) occur on the heather Southeast of the HMA.
- The slow worm (*Anguis fragilis;* hazelworm) has a large range which includes the WA Hoeve.
- The grass snake (*Natrix natrix*; ringslang), including juveniles. There have even been efforts to create nesting sites (Dick Schippers, personal communication, December 2, 2022).
- The building plans can affect both lizard species and to a lesser extent slow worm and grass snake.

There is one protected invertebrate species present according to the quickscan: The silver-spotted skipper. However, there is only one observation. According to our knowledge, there are more rare protected invertebrate species occurring in the WA Hoeve, like rhinoceros beetle (*Oryctes nasicornis*; neushoornkever) found in the compost heap near the eastern heather (Dick Schippers, personal communication, December 2, 2022).

Fungi and lichen are not taken into account in the quickscan. Fish, amphibians and vascular plants are present but from these groups no protected species were found.

For all protected species: if they are present and will be lost due to the development plans, it is necessary for BPD to apply for an exemption or dispensation for violation of the prohibitions. This process can take at least up to six months. Additional research on the occurrence of these species is obligatory. It is most recommended for:

- Bat species
- Reptile species
- Year-round protected nests in trees
- Pine marten
- Red squirrel

1.6.2 Natuurtoets

Following up on the quickscan, a 'natuurtoets' (nature test) has been carried out by Royal HasKoningDHV, commissioned by BPD. This natuurtoets was only concerning the HMA; corresponding research will also have to be done for the NOV and ZOV. The results of this natuurtoets show that indeed a number of the species discussed in the quickscan, were actually observed on the HMA. The mammals include wood mouse (*Apodemus sylvaticus*; bosmuis), hare (*Lepus europaeus*; haas), red fox (*Vulpes vulpes*; vos), roe deer (*Capreolus capreolus*; ree), squirrel and badger, as well as five bat species. Concerning reptiles, grass snake and slow worm were observed. For more details on these results, it is advised to read the natuurtoets (Maas et al, 2021), which can be found in appendix 2.

1.6.3 Protected species overview

In addition to the findings in the quickscan, we have created an overview of the protected and red-listed species in the WA Hoeve (Table 1). The overview is composed of NDFF data from the past 5 years. It only shows the number of species; an overview of all protected and red-listed species observed in the WA Hoeve in the past 5 years can be found in Appendix 3.

Table 1: The number of protected and red list-certified species observed in the WA Hoeve in the past 5 years.

Species group	Number of species	Protected by Wet Natuur-bescherming	Red list
Mosses	2	0	2
Insects - Butterflies	5	1	5
Insects - Wasps, Bees and Ants	1	0	1
Lichen	7	0	7
Reptiles	3	3	2
Fungi	2	0	2
Vessel plants	8	0	8
Birds	71	71	14
Mammals - ground bound	12	12	2
Mammals - Bats	4	4	1

Of the 12 ground bound mammals, three species are also subject to protection by the province of Utrecht. These species are pine marten, badger and red squirrel. These species are confirmed to at least make use of the WA Hoeve. Recent occurrence of these three species is also proven by the camera trap footage from Margriet Hartman, shown in Figure 15 (Margriet Hartman, personal communication, December 5, 2022).

Figure 15: Observations of pine marten (top left), squirrel (top right) and badger (bottom left) on the WA Hoeve by Margriet Hertman (personal communication, December 5, 2022) using camera traps. The locations of the photos are in the map on the top right: badger was photographed in this instant at WAM, pine marten and squirrel at WAZ.

1.6.4 Legislation

In the Netherlands, we are legally obliged to take care of flora and fauna. The protection of the species is controlled through the Wet natuurbescherming (Wnb) (Wet natuurbescherming, 2021). This legislation, in combination with European directives, was developed to protect species by prohibiting disturbance, picking of plants, habitat degradation, trade, and restrictions of hunting. Everyone must officially comply with these rules, and it is up to an initiator to take the appropriate measures to ensure that prohibitions under the Wnb are not exceeded. However, the Wnb also allows for dispensation or exemptions from these prohibitions, provided that the effects of the planned activities are avoided or adequately mitigated/compensated (no, unless principle ['nee, tenzij']). So, this does not mean that if a protected or rare species is present within a developing area, planned constructions cannot continue. What it does describe is what can be done to ensure that the conservation status of the species will not deteriorate any further, as a consequence of the development.

The Wnb starts with the so-called 'duty to care' ('zorgplicht'), which applies to all native species. In theory, this duty to care requires initiators to be conscious of which protected species make use of their properties. Naturally, this is generally not feasible because most institutions do not have ecological departments to continuously monitor the species that make use of their property. But it does ensure that specialists, such as ecologists, are hired to make an assessment of all protected and rare species.

In addition to knowledge of which (protected) species occur in the area, it is also essential that the function of the area is known. Only when both occurrence and function are known, an impact assessment can be made, defining which species are expected to be harmed by development measures. These assessments require a considerable degree of ecological knowledge. In order to determine whether a dispensation or exemption is needed and can be granted, it is necessary to make a proper assessment of the potential negative effects of the developing plans. Additionally, for all protected species, it is necessary to consider under which 'legal interest' the project falls. The necessity for a project may in fact be assessed differently by authorities, for reasons such as social interests or public health. Alternatives that might mitigate the effects should always be considered beforehand.

Such assessments generally start with the performance of a quickscan of the area. During a quickscan, a specialist estimates where bottlenecks can be expected and how the project developer should deal with them. A brief assessment is made about which protected species could potentially occur in the area and which of these species are expected to be disturbed by the project. A quickscan may conclude that additional research is needed for non-exempt species, because it may need to be demonstrated whether a species is actually present in the project area. If additional research ('nader onderzoek') is needed for one or more species, this has to be conducted according to certain protocols for the species group in their appropriate season. Unfortunately, for some species no protocol has been developed yet. In that case, the additional research should be determined by a specialised ecologist.

After the results of this research are known, further action might be needed. This may include applying for exemptions, modifying the project plan, determining compensation and mitigation measures, or preparing an ecological work protocol. Mitigation measures are intended to minimalize damage to protected species and preferably prevent damage altogether. If an exemption is granted, these mitigation measures can act an important role for the condition of approval.

If the functionality of a permanent habitat cannot be maintained, it must be compensated. Compensation can take place within or outside the project area, for example by strengthening another population of the same species, thus ensuring the favourable conservation status of that species. If, for example, the functional habitat is so degraded that species can no longer occur in the original habitat and measures within the original habitat are not possible, measures should be taken elsewhere in the population. These are then compensatory measures, for which an exemption is mandatory.

Mitigation or compensation measures should always be implemented before work is started (Wet natuurbescherming, 2021). Finally, it is important to mention that there are legal obligations that project developers must comply with in order to take care of local flora and fauna. However, the project developers are not legally obliged to investigate the effectiveness of the ultimately used mitigation and/or compensation measurements.

2. Building plans

The general plans for construction of the residential area on the WA Hoeve are proposed in the document 'Beeldkwaliteitsplan', written by the municipality of Zeist, BPD, architectural firm Braaksma & Roos, and studio Loos van Vliet, and were presented on 12 October 2021 (Gemeente Zeist et al., 2021). This plan serves as a source of inspiration and as a framework for assessment. Besides, the 'Gebiedsvisie' (Gemeente Zeist, 2017) shows general ideas about the design of the area. Information in this chapter is retrieved from the beeldkwaliteitsplan of Gemeente Zeist et al. (2021), unless otherwise stated. All plans described in this chapter can still change in the process of building, because the execution of construction will find place in 2027.

WA Hoeve is part of the program Hart van de Heuvelrug, which ensures that the balance between red and green areas is maintained. Red areas in the program contain all non-green areas, including water, infrastructure, gardens, and buildings. WA Hoeve already consists of 20.8 ha of red area, and because of the program of Hart van de Heuvelrug, another 3.3 ha will be added, which adds up to 24.1 ha. However, the new building plans only accommodate for 22.02 ha, which is within the limit (Gemeente Zeist, 2021a).

General building agreements state that no more than 25 homes can be built per hectare. This corresponds to 33 houses on the NOV and 142 houses on the ZOV, which together accounts for a maximum of 175 houses. For the 'Zorgkern' 160 houses (Gemeente Zeist, 2021b), and for HMA a maximum of 65 houses can be anticipated (Hendrik Visser, personal communication, December 7, 2022). However, the zoning regulations state that the maximum number of houses on the HMA should be 75, divided over existing buildings and 12 new houses (Gemeente Zeist, 2021a).

The vision on housing of the municipality is focused on housing for every segment of the population. Villas and more expensive houses will be located in the NOV, the cheaper houses and social rental homes will be placed in the ZOV. Monumental buildings will possibly be renovated into houses, but thus far it is not known how many. This is because not all monumental buildings are allowed to be converted into homes (Hendrik Visser, personal communication, December 7, 2022).

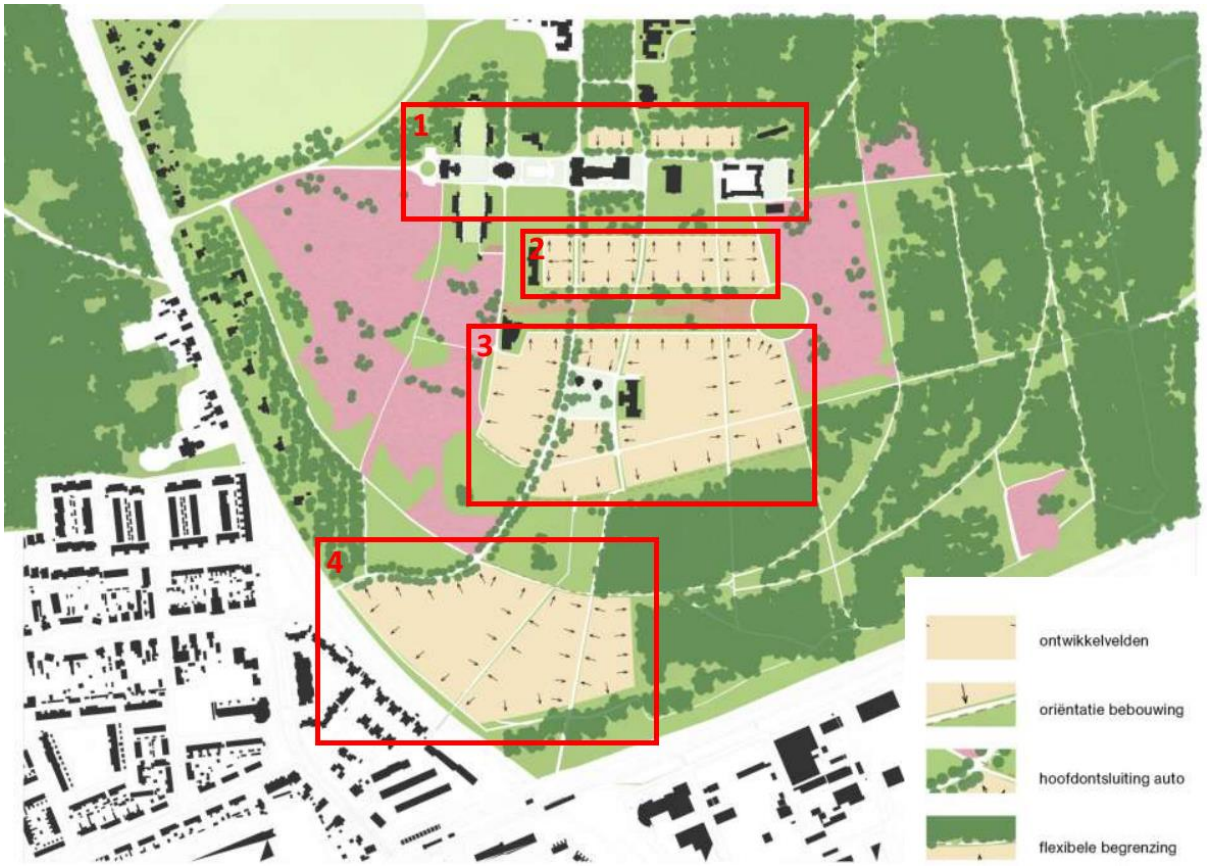

Figure 16. Distribution of building areas. 1: Historische middenas (HMA), 2: Noordelijk ontwikkelingsveld (NOV), 3: Zorgkern, 4: Zuidelijk ontwikkelingsveld (ZOV). Based on the 'Gebiedsvisie 2017' of Gemeente Zeist (2021).

The municipality of Zeist has made development plans for the area of the WA Hoeve, divided between the HMA and the NOV & ZOV. Between the HMA and the NOV, the development plans show a zoning of forests (Figure 18). In the beeldkwaliteitsplan, the plans show that this forest will not only be forest but on the edges there will be park-like areas. The gebiedsvisie of the municipality states that two official eco-corridors will be realised. These corridors are between the NOV and the Zorgkern, and the Zorgkern and the ZOV (Figure 17). The eco-corridors are said to be at least 50 m (Gemeente Zeist, 2017). However, this might be not enough for mobile mammals such as roe deer and badgers. Dick Schippers (personal communication, December 2, 2022) says that roe deer need a corridor of at least 100 to 150 m in width.

The Zorgkern is not included in the beeldkwaliteitsplan, because the developer has not bought it yet. However, there are already general building plans for this area. Buildings on the Zorgkern will be removed, and the plan is to build new houses in the previously built-up area. In the southern part of the Zorgkern, no buildings will be placed back in this plan, but on this area a nutrient-poor field will be created which enhances the width of the nature corridor between the eastern and western heather field (Hendrik Visser, personal communication, December 7, 2022).

The roads between the ZOV and the Zorgkern will be one-directional. The first part of the left road that connects the area will be two-way, but from where the nature corridor starts, it will change to one direction. This prohibits the road from being broadened, which could have a negative effect on nature

next to the roads, but it would also create a bigger boundary for wildlife to cross. By creating two one-way roads, these boundaries will be smaller for wildlife and therefore easier to pass (Bruinderink et al., 2010) (Hendrik Visser, personal communication, December 7, 2022).

Figure 17. Green corridors (Gemeente Zeist, 2017)

2.1 Historische Middenas (HMA)

The plan describes different aspects of housing and landscape elements. The main focus at the historical central part of the WA Hoeve ('Historische Middenas'; HMA) is on the landmark buildings and making a relationship between old and new buildings. In the original plans of Poggenbeek (former architect of the area) there was an avenue structure with trees. This will be restored, but this will be done when the present trees 'have reached the end of their lifetime'. These possibilities will be further investigated in the development plan. The plan focuses on green border fencing in the area around residential functions as well as around catering functions and parking facilities. A park-like structure will be created between the surrounding forest and the buildings on the HMA, with the idea that transition zones between forests and urban areas can have high nature values. The buildings will be placed in the red-dotted lined areas (Figure 19). For five areas on the HMA, a total forest area of 1.1 ha will be cut down (Figure 14) (Royal Haskoning DHV, 2021b). Valuable trees and the relief have the highest priority in these park-like landscapes, which means that the buildings will be placed in a way that needs the fewest interventions. A proposed tree effect analysis still needs to be executed.

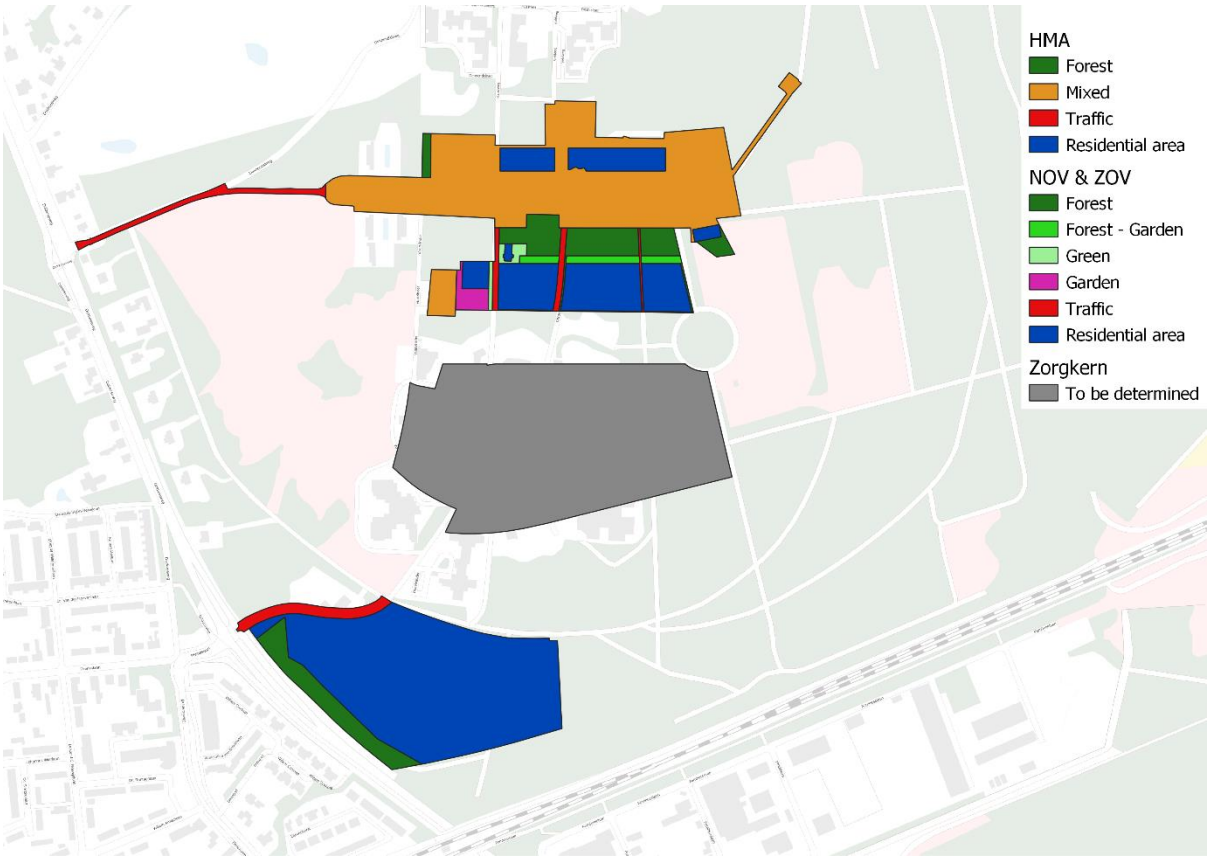

Figure 18. Zoning plans of the municipality of Zeist, for the WA Hoeve. The zoning of the Zorgkern has yet to be determined. (Gemeente Zeist, 2021d).

In the plans there is space for nature-inclusive building with attention to the species that are present in the area. It is mentioned that artificial light should be lowered especially close to the heather fields, because of the European nightjar (*Caprimulgus europaeus*; nachtzwaluw) that use that area (NDFF, 2022).

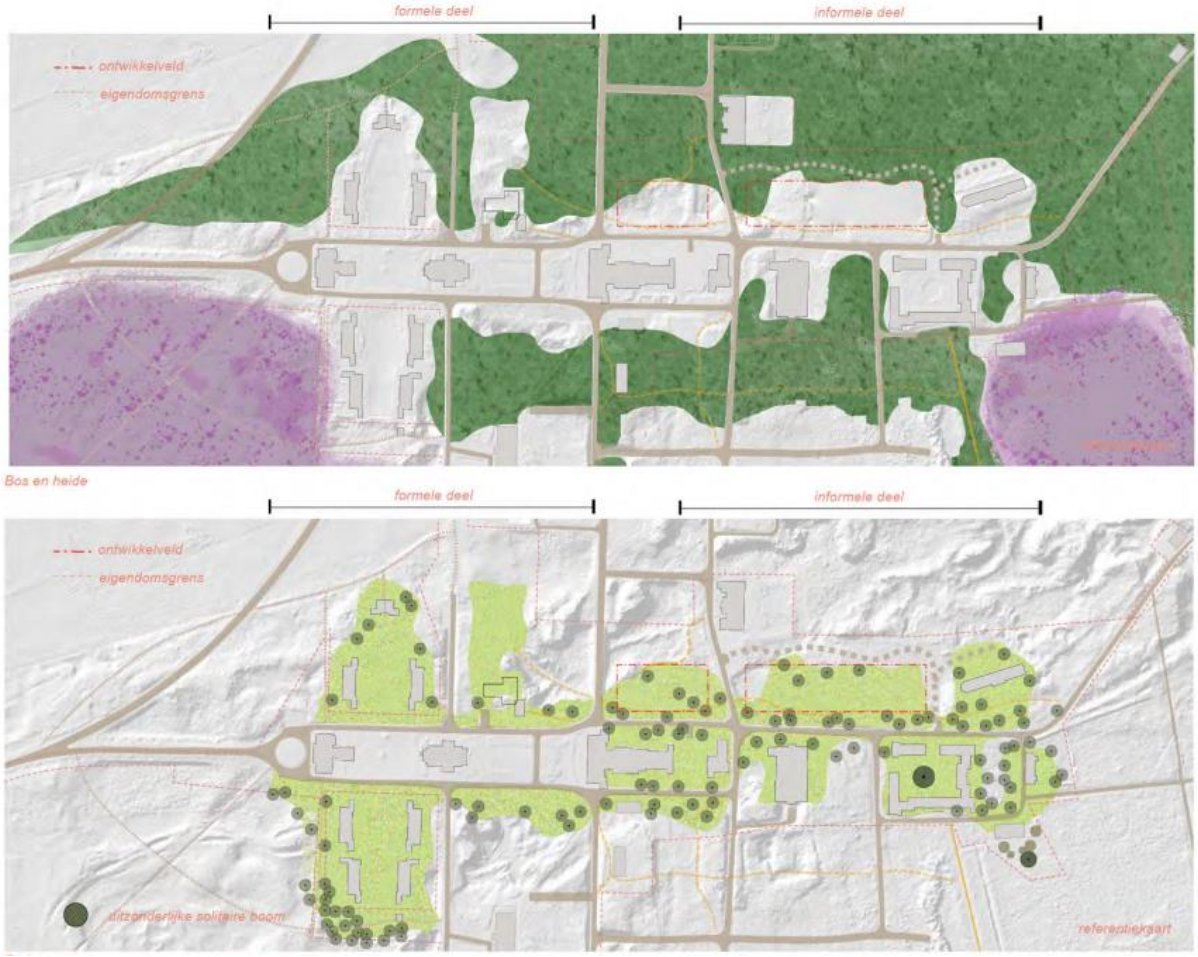

Figure 19. Park-like transition zones (below) will be realised between the buildings and the surrounding forest and heather fields (above). In the red-dotted lined areas, buildings will be realised.

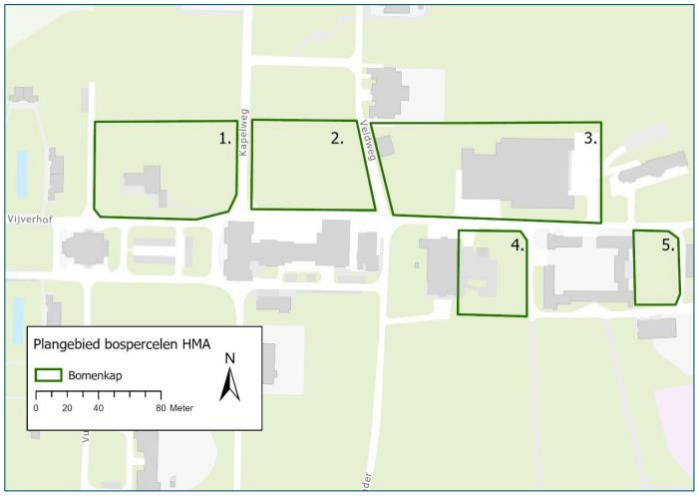

Figure 20. For 5 different parts of the HMA, a total area of 1.1 hectares of forest will be removed.

2.2 Noordelijk Ontwikkelingsveld (NOV)

The northern development field (‘noordelijk ontwikkelingsveld’; NOV) is divided into two parts, Spinoza on the western side and a collection of detached or semi-detached houses in a wooded area (Figure 21). Around the Spinoza monument lies a garden that will be preserved as a collective garden, and the monument will be expanded with new buildings. The NOV will be realised because of the connection it creates between the HMA and the Zorgkern (Hendrik Visser, personal communication, December 7, 2022). On this area, the theme is living in the forest. Attention is paid to preserving trees that are valuable, and the soil relief is taken into account when building the houses. To assess whether trees need to be preserved, a tree effect analysis will be done. To be able to build in the NOV, at least 1.9 ha of forest will be cut down (Gemeente Zeist, 2021b). Houses will be build solitary, as well as in pairs or several together, spread over the area. The design takes into account the negative effects of artificial light on nocturnal birds, and the design will be climate-adaptive and nature-inclusive.

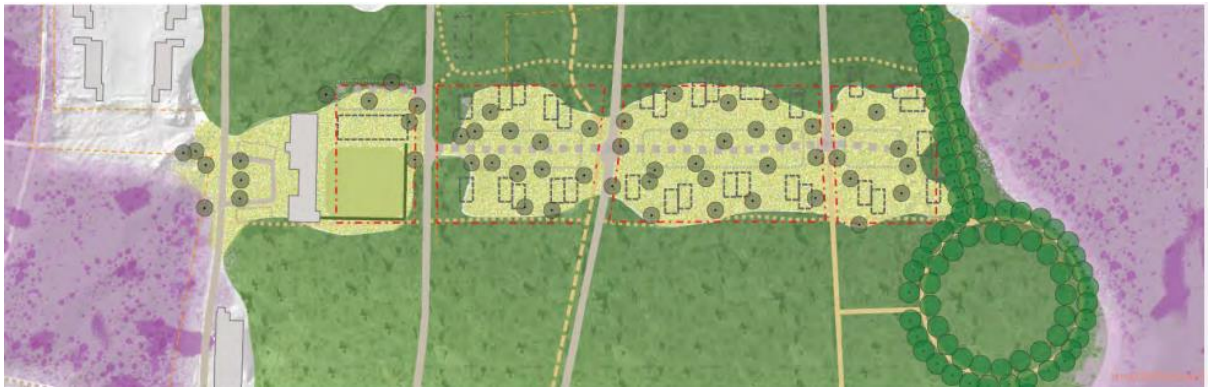

Figure 21. Noordelijk ontwikkelingsveld (NOV). Park-like transition zones, surrounded by forest.

Figure 22. Zuidelijk Ontwikkelingsveld (ZOV). Two zones with buildings; the north side with two main areas, and the south side where houses will be built in more solitary units. Between the ZOV and the Zorgkern, the western and eastern heather field will be connected.

2.3 Zuidelijk Ontwikkelingsveld (ZOV)

Between the southern development field ('Zuidelijk Ontwikkelingsveld; ZOV) and the Zorgkern, there are plans to connect the eastern and western heather field, by creating heather in the zone (Figure 22). Avenue trees will be planted along the road that connects the WA Hoeve with the provincial road. Within the WA Hoeve, the maximum speed will remain 30 km/h. At the end of the road that connects the WA Hoeve with the provincial road, the maximum speed will be 50 km/h, to make the connection more smooth.

Trees that are present in the area are mostly valuable, but houses will be built mostly in the areas where there are the least valuable trees. Also, in this part a tree effect analysis will be made. In order to build in this area, 3 ha of forest must be cleared (Gemeente Zeist, 2021b). There are two zones with buildings, one in the north side, consisting of two centres that are placed in areas where there are less valuable trees. The other zone is on the south side, where more solitary building units will be placed. Attention is paid to buffering rainwater for dry periods, and the infiltration of rainwater on private plots, which means that the paving and drainage allow water to infiltrate in the area itself. Attention will also be paid to facilities for animals, but these plan have not been worked out yet (Gemeente Zeist et al., 2021).

2.4 Outdoor space

Parking spaces have a green infiltrating pavement. Tree species that are already present in the area will be used to place along the avenues, which will be mainly northern red oak (*Quercus rubra*; Amerikaanse eik) (Gemeente Zeist et al., 2021). The beeldkwaliteitsplan does not speak about using native tree species in the area, but focuses on using species that are already present to increase coherence. One reason it can be better to use native tree species and autochthonous plant material (which means that the tree seeds come from the Dutch climate), is because this is beneficial for related insects that depend, for example, on leaf emergence at the right time in spring to lay their eggs. When non-autochthonous material is used, leaf emergence is often out of sync with the insects (Van Kemenade et al., 2021). Northern red oak is associated with only 12 insect species in the Netherlands, while the sessile oak (*Quercus petraea;* wintereik) has over 400 related insect species (Leerink et al., 2021). It is also recommended to mainly use native tree species in the park forest, for the same reason. However, in section '4.3.5.5 Pets and garden plants' we explain that non-native species do not always have to be a problem for the biodiversity, but can actually contribute to it.

When planting tree species, climate adaptability and climate mitigation should also be taken into account, especially because there is sandy soil in this area, which increases the likelihood of extreme drought during dry summers. The planting of new trees offers opportunities to make nature climate adaptive. In order to guarantee CO_2 storage in the existing trees as much as possible, and to use the felled wood, it is possible to use this wood locally, for example in new outdoor furniture and fences within the area. This wood can also be used in nature trails and playgrounds.

3. Stakeholder analysis

There are ten main stakeholders involved in the redevelopment of the WA Hoeve. Between these stakeholders, there is a difference in power and interest. Herein, stakeholders are categorized into four categories: high power, high interest; high power, low interest; low power, high interest; and low power, low interest (Table 2). Figure 23 illustrates the stakeholder analysis.

Table 2. The power and interest of the stakeholders in the WA Hoeve

High Power and Interest	High Power, low interest	Low power, high interest	Low power and interest
Provincie Utrecht	Altrecht	Vrienden van WA Hoeve	Reinaerde
Gemeente Zeist		Stichting Mileuzorg Zeist	Belangenvereniging Den Dolder
BPD		Stichting beter Zeist	
Utrechts Landschap			

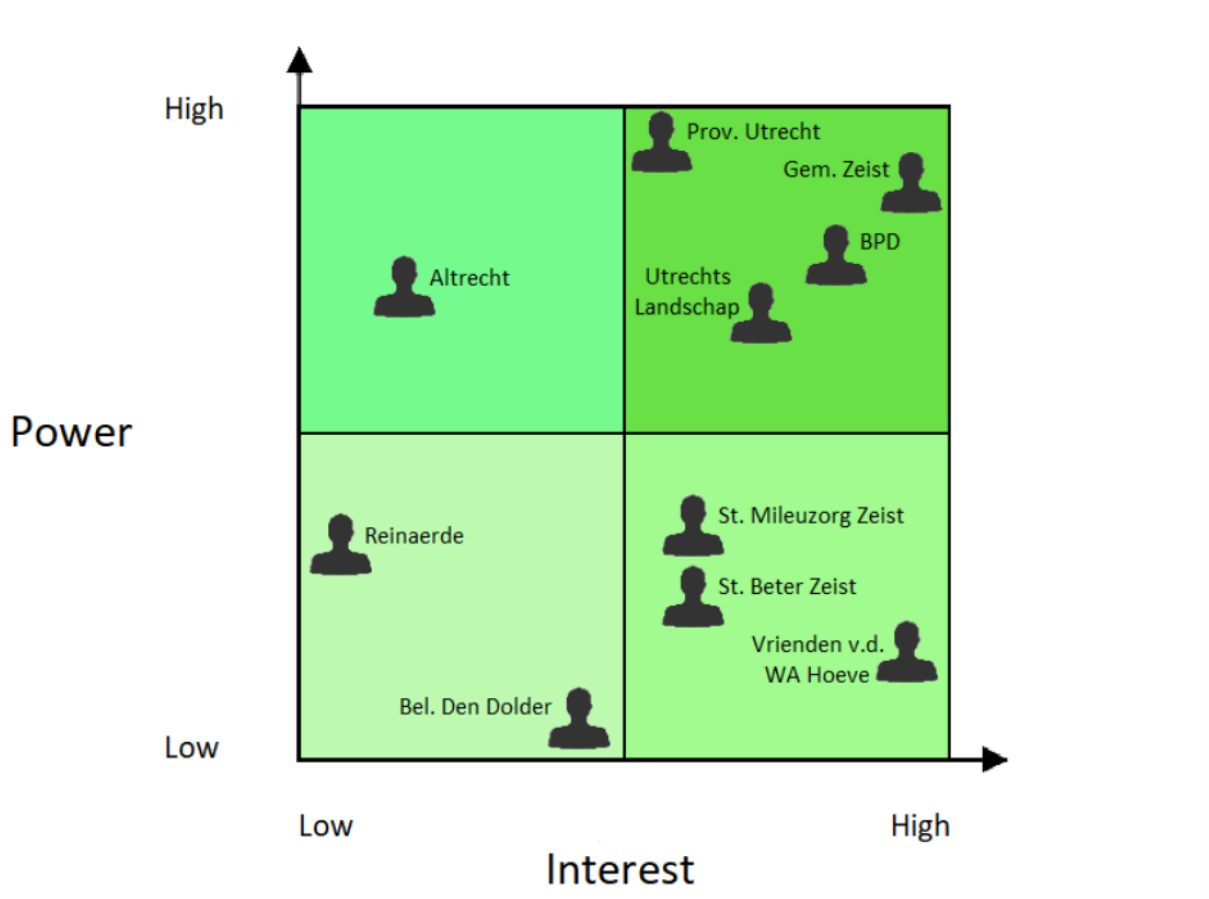

Figure 23. Stakeholder analysis

Furthermore, the comprehensive description is divided into Foundations & associations, Institutions & Funds, and government institutions. Hereby, each heading contains a general description of what the organizational form entails.

We have three recommendations regarding the stakeholder analysis. The first recommendation is that we recommend working together with the other associations and foundations to come up with one alternative plan. Right now, every association has his own proposal about the redevelopment of the WA Hoeve. The result is that the municipality of Zeist must look at many different proposals. This also means that every association and foundation individually has less influence on the redevelopment plans because fewer people are behind the proposal. When the associations and foundations all work together, they can have more influence on the redevelopment plan of the WA Hoeve. This is because many people will support the plan.

The second recommendation is to not put all hope on the Province of Utrecht but to also look for other ways to preserve the nature values in the area. The province of Utrecht is the most powerful stakeholder in the redevelopment of the WA Hoeve. They can stop the building plans of the municipality of Zeist. However, the province of Utrecht works together with the municipality of Zeist and Utrechts Landschap through the program of 'Hart van de Heuvelrug'. Hereby, they have decided to change the NNN borders so the building plans can continue. It can still be possible to convince the province of Utrecht that the building plans contradict the province's goals, but because they initially approved of the plans, they are not likely to go along with such lines of reasoning. Because of this, we recommend shifting your focus to discussing with the municipality what is possible to preserve the natural values of the area as much as possible.

The third and most important recommendation is to not only look at obstacles but also look at the possibilities. We noticed that in the redevelopment of the WA Hoeve the focus is on where the housing should be located and whether or not it harms nature. However, we also noticed that no stakeholder is explicitly against the building plans. It can be a good starting point to first look at the common ground with all the other stakeholders. Knowing the common ground makes it easier to discuss what the obstacles are. By taking this approach we believe that it allows you to stay more involved in the long term in further developments of the WA Hoeve.

3.1 Foundations & Associations

Foundations and associations are organizational forms established by citizens. These civic initiatives have an intangible purpose, which originates from a philosophical, charitable, idealistic, or artistic nature. Because foundations and associations are civic initiatives, the main method through which they can have influence is through their voice. This allows them to transmit their knowledge and skills and to convey what most citizens think about particular issues. Because of this, they have relatively little power compared to stakeholders who can influence through position, function, money, and prestige. Related foundations and associations are: 'de Vrienden van de WA Hoeve', 'Belangenvereniging Den Dolder', 'Stichting Milieuzorg Zeist', and 'Stichting Beter Zeist'. When a foundation or association grows larger, they can exert more influence through position, function, money and prestige. The foundation that relates to this the most is Utrechts Landschap.

3.1.1 Vrienden van de WA Hoeve

The Vrienden van de WA Hoeve is a working group ('werkgroep') with the goal of preserving the historic landscape heritage and preserving and restoring nature in the area (Vrienden van de WA Hoeve, n.d.). The working group does not oppose the redevelopment plans to develop housing in the WA Hoeve but opposes the plans of the environmental vision of the municipality of Zeist ('Zeist Omgevingsvisie'), to develop the housing in predestined areas. They advocate that the developments need to take place in the areas that are already built upon (the HMA and the Zorgkern) (van der Ende & van den Boer, 2022).

The Vrienden van de WA Hoeve is placed in the category 'low power, high interest' because the working group can only have influence through their voice but care much about the area. Furthermore, the group is placed lower in power compared to the foundations Milieuzorg Zeist and Beter Zeist, because we think they have more knowledge and skills. We base this on the size of the foundations, how long the foundations have existed, and previous conflicts in the municipality of Zeist in which the foundations were involved. The group is placed higher in interest compared to the foundations because the group was created purely for the WA Hoeve and the foundations were created for the municipality Zeist.

3.1.2 Belangenvereniging Den Dolder

The interest association of Den Dolder ('Belangenvereniging Den Dolder') is an association founded by the residents of the village of Den Dolder. The purpose of the association is to represent a common interest of the residents and the village (Belangenvereniging Den Dolder, n.d.). As a community, the association is in favour of Altrecht moving out of the area, because residents no longer felt safe after the Anna Faber incident (RTV Utrecht, 2017). The association is in favour of the new development plans in the WA Hoeve on the condition that small-scale construction (a maximum of 250 houses) will be realised, the village character will be preserved, facilities will be provided in the area and the natural and cultural values of the area will be preserved (Beekman, 2022).

The interest association is placed in the category 'low power, low interest' because they have little knowledge and skills, and they can only influence through their voice. Furthermore, they do not explicitly express themselves on the building plans except for one vision for the future (toekomstvisie).

3.1.3 Stichting Milieuzorg Zeist

Stichting Milieuzorg Zeist was founded by residents of the municipality of Zeist, who are concerned about the nature that occurs in the municipality. The goal of the foundation is to "keep Zeist and its surroundings liveable for people, animals and plants" (Stichting Milieuzorg Zeist, 2020). Regarding the new development plans in the WA Hoeve, the foundation does not oppose the redevelopment in the HMA, but they do oppose the development of the NOV and ZOV (Greeven & de Wolf, 2022a; Greeven & de Wolf, 2022b).

The foundation is placed in the category 'low power, high interest' because the foundation can only have influence through their voice, and they care for the environment of the municipality Zeist.

3.1.4 Stichting Beter Zeist

Stichting Beter Zeist was founded by residents of the municipality of Zeist to promote the quality of living, working and life in Zeist (Stichting Beter Zeist, 2022). In doing so, the foundation aims to improve the policies of Zeist by making their voices heard through information, advice, actions, etc. (Stichting Beter Zeist. 2022). The foundation strongly values the importance of keeping existing nature connected and avoiding fragmentation. Therefore, they are in favour of placing all new housing in the ZOV and taking away the NOV, since there is a lot of precious nature there. Furthermore, they think it is important to have a connection between the two heathlands, with the corridor itself also consisting of heathland (Visscher, 2022).

The foundation is placed in the category 'low power, high interest' because the foundation can only have influence through their voice, and they care for the environment of the municipality Zeist.

3.1.5 Utrechts Landschap

Utrechts Landschap is a foundation that falls under the umbrella organisation LandschappenNL, which represents the interests of the provincial Landscapes and provincial foundations Landscape Management (Stichting LandschappenNL, n.d.). The goal of Utrechts Landschap is "to strengthen a robust and diverse Utrecht network of nature and heritage with the support of Utrecht society by actively acquiring nature and heritage in ownership and deploying our expertise" (Utrechts Landschap, n.d.). In doing so, they have five core values that the foundation promotes (Utrechts Landschap, n.d.);

1. the foundation is locally oriented;
2. the foundation involves their supporters and partners in their work;
3. the foundation uses new management insights and innovations in their work;
4. the foundation sees it as their task to manage the areas as stewards;
5. the foundation sees themselves as experts and puts the knowledge they have to use in their work.

Utrechts Landschap participate in the Hart van de Heuvelrug nature program. In this program there has been a swap in forest areas, with part of the WA Hoeve being compensated by Kamp Zeist (Province of Utrecht, 2022b). This is further discussed under section ‘1.5.2.1 Kamp van Zeist’. For this reason, Utrechts Landschap has been very present in the conflict concerning the redevelopment in the WA Hoeve.

Utrechts Landschap is placed in the category ‘high power, high interest’ because the foundation has via the program ‘Hart van de Heuvelrug’ influence in the plans to redevelop in the WA Hoeve, and it has a lot of interest in the area because the area lays against the area of Utrechts Landschap. Thereby, it is also interested in the area due to the two Heathlands in the area.

3.2 Institutions & Funds

The plans to develop housing in the WA Hoeve involve healthcare institutions and a construction fund. Healthcare institutions are organizations that deals with healthcare in the Netherlands. The healthcare institutions that are involved in the WA Hoeve are Altrecht and Reinaerde. Both institutions have no profit motive. A fund is a gathering point for investors where all the investors' money ends up, also called the fund assets. With the construction fund, the fund assets are invested in real estate. The construction fund that is involved in the WA Hoeve is BPD. Both institutions and fund own land in the WA Hoeve and/or have been given a certain function in the process. This allows them to exert influence through their position, money, function and prestige. Additionally, this allows them to have a lot of influence in the development process.

3.2.1 Altrecht

Altrecht is a healthcare institution for specialized mental health care (Altrecht, s.d.). The institution owns on the WA Hoeve 27.2 ha land (Figure 2). However, because the healthcare is changing to more care at home and because of the incident regarding Anna Faber, Altrecht is going to leave the area in 2027 (RTV Utrecht, 2017; Altrecht, 2020). In doing so, Altrecht is looking to sell the area for 15 million (Rap, n.d.).

Altrecht is placed in the category ‘high power, low interest’ because it is the owner of a part of the WA Hoeve, and it can decide to whom it sells the area. Further, Altrecht is little involved in the redevelopment in the WA Hoeve, because they are going to leave the area. The thing they are mainly

interested in is getting 15 million or more for their land. This makes that Altrecht has little interest in the redevelopment plans.

3.2.2 Reinaerde

Reinaerde is a healthcare institution that provides care and support/guidance for people with disabilities (Reinaerde, n.d.). Like Altrecht, Reinaerde owns part of the land in the WA Hoeve (Figure 2). In 2007, agreements were made which stated that Reinaerde would leave the WA Hoeve and make room for nature and that Altrecht would stay. However, due to the change in the care market, Reinaerde will ultimately stay in the WA Hoeve and Altrecht will leave the area (Gemeente Zeist, 2017). Reinaerde is working with the municipality on its own destination plan (bestemmingsplan) in which nature will be redeveloped to its original social care function (Gemeente Zeist, 2017).

Reinaerde is placed in the category 'low power, low interest', because it has its own destination plan for their area, which makes that they are virtually absent from the conflict regarding the redevelopment in the WA Hoeve on Altrecht and BPD's area.

3.2.3 BPD

BPD | Bouwfonds Gebiedsontwikkeling is a corporation fund that realizes living environments as an area developer (BPD, n.d.). BPD originates from the semi-governmental organization Bouwfonds and has been a direct part of Rabobank since 2017 (BPD, n.d.). The fund has an integrated approach in which they want to focus on the affordability and sustainability of housing in every area of development (BPD, n.d.). It has already bought a part of the land from Altrecht (HMA) and is probably going to buy the rest of the land as well. In the process, they will build a new residential neighborhood on behalf of the municipality. In the redevelopment, the municipality of Zeist is officially responsible for the planning process. However, the municipality has delegated this role to BPD because they do not have experts and/or capacity for this themselves (Bram van der Ende, personal communication, November 3, 2022).

BPD is placed in the category 'high power, high interest' because BPD is owner of the HMA, it is responsible for the planning process, and through this project it hopes to make a large profit.

3.3 Government institutions

Government institutions are the bodies that govern the Netherlands. In the Dutch government there are three levels of government: national, provincial and municipal level. Furthermore, are the water boards (Waterschappen) also a different level of government that embraces the water management of a certain region. In the Netherlands, there has been decentralization in government since 2015. This means that government tasks have been transferred from the government to the province, municipalities and water boards (Ministry of the Interior and Kingdom Relations, 2019). This means that most of the management of nature and environment lie with the provinces, municipalities and water boards. The levels of government that are involved in the redevelopment of the WA Hoeve are the provincial and municipal level. Hereby, the government institutions that are involved are the province of Utrecht and the municipality of Zeist.

3.3.1 Provincie Utrecht

The provincial government consists of the deputies (executive committee) and the commissioner of the king. Tasks assumed by the province are (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2021a):

- Determine whether cities and villages can expand and where business parks and office parks can be built. This is stated in the 'Wet ruimtelijke ordening'.
- Realizes new nature and preserves current nature;
- Monitors compliance with environmental laws for air, soil and water. In addition, the province combats pollution, for example through soil remediation;
- Supervises the municipalities. Each year the municipalities have their budgets and financial statements approved by the Provincial Executive.
- Additional tasks of the province can be found at Rijksoverheid.nl

The goal of the nature policy of the province of Utrecht is to preserve, strengthen and connect nature. Their pillars are to create a robust network of nature, more attention to the experience/accessibility of nature, protection of plant and animal species and the sustainable use/financing of nature. In doing so, the province always makes a careful balance between conservation of nature and other interests (Province of Utrecht, n.d.). The province of Utrecht also has the task of protecting the NNN. Municipal destination plans and environmental permits (omgevingsvergunningen) cannot violate the NNN (Interim Omgevingsverordening, 2021). More about NNN can be found under section '1.3 NNN'. Besides, the province of Utrecht and the municipality of Zeist also participate in the program Hart van de Heuvelrug . This program was established in 2004 with the goal "to secure the future of the plants and animals central to the Utrechtse Heuvelrug" (Natuurontwikkeling Hart van de Heuvelrug: Hart van de Heuvelrug, n.d). Because there has been so much more emphasis in recent years on the conservation of nature, the question is whether this program is pursuing the goals for the future and whether this project is outdated?

Provincie Utrecht is placed in the category 'high power, high interest' because the province has the task to create and protect nature, can overrule the municipality, and participates in the program 'Hart van de Heuvelrug'. Hereby, the province has the task of protecting the NNN and making sure that there is a balance in the red and green area.

3.3.2 Gemeente Zeist

Municipal governments consist of a municipal council, mayor and a college of mayor and aldermen. Duties assumed by the municipality are (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2021b):

- Construction of destination plans. Which states the areas intended for houses, nature, and businesses.
- Supervision of construction and making agreements about the processes.
- Constructs of public streets, roads, footpaths and bicycle routes, and maintenance.
- Implementing the environmental management act (Wet Milieubeheer). This regulates, among other things, the separate collection of household waste.
- Accessibility to parks and nature.
- Additional tasks of the municipality can be found on Rijksoverheid.nl

In the environmental vision of Zeist ('Omgevingsvisie') 2022-2025 (Gemeente Zeist, 2021c), the municipality stated that Zeist is a network of nature, landscape and cultural history. In doing so, they emphasize that the greenery in the municipality is their gold/imago/DNA. In addition to recreation in green spaces, the Municipality of Zeist considers it important that nature and biodiversity remain

conserved. They want to maintain robust zones where nature is given priority. The municipality also wants to pay attention to weak links of NNN, one of these parts is located near Den Dolder. Because green is so important to the municipality of Zeist, for every development that takes place, green is their starting point and not their closing item (Gemeente Zeist, 2021c). The municipality of Zeist is also thinking about climate change and their 'Omgevingsvisie' states that by increasing the number of natural areas, they want to create a good sponge effect where more water is retained for the drier periods.

However, the municipality of Zeist also states that by 2040 there will be a demand for 104,000 new houses and that they want to build 2,500 new houses by 2030 (Gemeente Zeist, 2021c). They want diversity in housing supply and nature-inclusive building similar to what has already been done in Sterrenberg and Kerckebosch. The municipality of Zeist also wants to build houses in the WA Hoeve, aiming for 400 to 500 houses (van der Ende & van den Boer, 2022). In addition, the municipality also wants to place facilities in the area for recreation, work and catering (Gemeente Zeist, 2017). The communication of the municipality of Zeist to citizens is very poor. For example, 16 associations and foundations sent a joint letter to the municipality requesting more citizen involvement in the initiatives taking place in Zeist. Former member of the Project Guidance Group, J.M. Rap, also said that the municipality of Zeist communicates poorly and that the plans of Zeist can be perceived as an imposed idea. He advises the municipality to first inform the population about integral contours and build support (Rap, n.d.).

Gemeente Zeist is placed in the category 'high power, high interest' because the area falls under the municipality of Zeist, the area is a new place where the municipality can build houses to reduce the housing shortage, and the municipality of Zeist is officially responsible for the planning process. The municipality of Zeist is more powerful than BPD, because BPD is employed by the municipality. However, the municipality of Zeist is less powerful than the province of Utrecht because the provinces have the task to supervise the municipalities.

4. Effects of building plans

This chapter focuses on analysing the effects of construction work in the area of the WA Hoeve. First, in section ‘4.1 Approach to nature conservation’, we outline our general perspective on the protection of nature. In section ‘4.2 Requirements and ambitions of Zeist for sustainable construction’, there is an explanation of the requirements for building in the municipality of Zeist, based on their sustainable construction policy. In section ‘4.3 General effects and recommendations’, effects are described for different nature-related topics. This includes urban animal and plant species, the effects on trees and carbon storage, general effects on nature, and permanent effects of residential presence. Also, a recommendation will be done on using climate-adaptive trees. In section ‘4.4 Analysis per area’, these different effects will be analysed per building area of the concept plans. Section ‘

4.5 Scenarios' describes three different building scenarios, namely the current building plans, the alternative building plan, and an additional plan as our suggested alternative. This section also explains the opportunities and risks of the various scenarios.

4.1 Approach to nature conservation

Protected areas have been the predominant conservation strategy in the past century. However, the isolated character of protected areas, along with other issues, has made it difficult to integrate protected areas in the surrounding landscape. This has called for a revised look at the protected area concept, which has been illustrated by Palomo et al. (2014) in Figure 24. Here, the protected area first shifts from an island to a network approach, where there is a focus on connectivity. We think this network approach is represented by the Utrechtse Heuvelrug, as it is a network of forest patches like the WA Hoeve, between which connectivity is promoted as much as possible, for example in the 'Hart van de Heuvelrug' program. After the network approach comes the landscape approach, where it is acknowledged that also the area surrounding a protected site should be managed in order to guarantee conservation of the protected area. This is also represented by the WA Hoeve, as it is not solely a nature area, but rather a healthcare area where natural and cultural values meet.

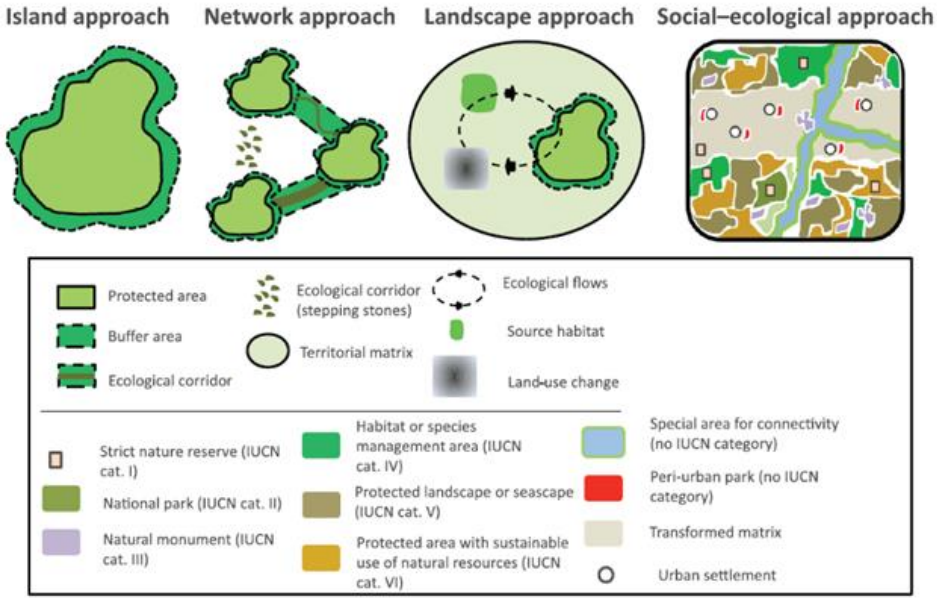

Figure 24: The evolution of the protected-area concept—from islands to networks to the landscape approach and the proposed social–ecological approach for protected areas. (Palomo et al., 2014)

To not allow houses to be built in nature, would be to stick to the approaches described above. However, in the contemporary situation this can be difficult, as anthropogenic forces have become so large that nature cannot be kept apart from humans. This calls for another approach to conservation: the social ecological approach. In this approach, ecosystem services take a central role: they may bring protected areas more in line with the needs of society by highlighting all of the benefits that we derive from those areas. Including social considerations in the understanding of the ecology of a region, can result in a more complete conservation approach (Palomo et al., 2014). This is why we will use the social-ecological approach as a starting point in this part of the report. We aim to link ecological and

societal factors, and look at opportunities rather than obstacles. Through this approach, it may be possible to meet the needs of nature and humans altogether.

4.2 Requirements and ambitions of Zeist for sustainable construction

The municipality of Zeist has developed a sustainable construction policy (Gemeente Zeist, 2022), containing their requirements and ambitions, which is an addition to the national and provincial legislations. This policy is developed to provide clarity to project developers about the requirements and ambitions of the following themes: energy, climate adaption, green and nature-inclusive construction, circular construction, and sustainability of construction sites.

4.2.1 Energy

Zeist demands that newly developed residential areas must be 'energy-producing', which means that on a yearly basis more sustainable energy is produced than consumed. In order to achieve this, they demand that solar panels have to be installed on every roof, wherever possible. Construction projects involving more than 15 buildings, or that exceed 1500 m^2 (considered large-scale constructions), need to be tested for their sustainability, energy, and environment impact. These sustainability performances of the buildings have to be tested with GPR software (Wolf, 2022), where an average score of an eight across all themes is required. Additionally, during the development of new residential areas it is required to minimise the installation of new or larger natural gas connections. However, objections can be made to deviate from these requirements. For example, by reasoning why it would not be technically or financially reasonable.

4.2.2 Climate adaptive construction

The changing climate should already be considered during the developing stage of new construction. Especially the predicted effects of floodings, heat, and drought should be mitigated wherever possible. To mitigate the consequences of desiccation and an overload of the sewer system, Zeist has the requirement that rainwater must be collected within each new plot, and collected rainwater cannot be disposed of through the sewer system. During construction, space must be created for groundwater storage, of at least 45 litres for every square meter of land that is built upon. Zeist also strives to design its environment to prevent a local increasing temperature. They have the ambition to design 40% of the urban environment with heat resistance or cooling functions, with their own preference for natural solutions such as trees.

4.2.3 Nature-inclusive construction and design

The real estate sector has major influences on the inclusion of nature in urban development. One method that project developers can use to preserve or enhance biodiversity within an area, is to integrate nature-inclusive constructions and designs in their development plans (Haaster-de Winter et al., 2022). This means that the natural values are integrated into the construction of property or are realised in the local surroundings. To conserve the biodiversity in developing areas, developers can adapt their construction methods, consciously select construction materials, and implement ecological designs to the buildings. The importance of nature-inclusive building is also acknowledged by BPD themselves, as can be read on their website (BPD, 2021). Nature-inclusive building is often reasonable to achieve, both financially and technically, therefore the municipality of Zeist developed some requirements that have to be met for newly constructed housing. At least two types of provisions should be realised for building-inhabitant species such as birds and bats. Proposed building plans must also contain a plan to conserve what is considered 'valuable' vegetation in the area. The ambition of the

municipality is to encourage vegetative diversity of local gardens, with predominantly native species that match the existing landscape. They also indicate that they would like to experiment with increasing the vegetation in neighbourhoods by adding more vertical vegetation on buildings.

4.2.4 Circular construction

Conscious handling of building materials is important to reduce resource depletions, CO_2 emission and production of waste. The municipality uses the strategy described by the Dutch 'Planbureau voor de leefomgeving' in the published R-ladder (RVO, 2020), which is based on the philosophy 'reduce, reuse, recycle'. They aspire to use sustainable concrete wherever possible, and use more than 40% of recycled or bio-based materials. Yet, their conditions only require that at least 5% of the materials used originate from secondary (recycled) or bio-based sources. For large-scale constructions, it is mandatory to arrange a material passport for each house. In which the future owner can examine all the products and materials used during construction.

4.2.5 Sustainable construction site

Large-scale projects can often consume a lot of time to complete. During this time it is essential to minimalize the nuisances, harmful emissions and disruption of nature that can be caused by the construction process. The municipality aspires to reduce the amount of waste as much as possible, by increasing the efficiency of the construction process. They also aim to minimise the amount of traffic at the construction site, and stimulate the usage of electric vehicles as much as possible. Although, similar to the requirements and ambitions of their energy policy, it is possible to make objections, if for example you can properly reason why it is not financially or technically feasible.

4.3 General effects and recommendations

4.3.1 Effects on NNN

Even with the new NNN borders that went into effect with the Omgevingsvisie (see section '1.3.2 Change in NNN'), the building plans still affect the NNN. The municipality of Zeist and BPD have therefore commissioned the ecological consultancy bureau Royal HaskoningDHV to find out whether the building plans can be performed in accordance with the legislation as explained above. The municipality of Zeist has published this analysis on their website (Royal HaskoningDHV, 2021b). In this document, Royal HaskoningDHV outlined their building plans per area, and whether the plans meet the requirements of the Interim Omgevingsverordening (see Figure 25).

For the HMA, they conclude that the proposed plans in this area do not affect the NNN because it mostly consists of existing buildings and hard surfaces. Furthermore, they argue that the NNN that is lost to the building plans is being compensated by the addition of other areas of high ecological value to the NNN. Therefore, they conclude that the NNN is not affected by the plans in the HMA, in accordance with article 6.3(2) of the Interim Omgevingsverordening .

For the NOV, they argue that this area does not fall within the boundaries of the NNN at all.

For the ZOV, they argue that the redevelopment of this already partly built-up area ensures a demonstrably increased value to the NNN, by adding more nature to the NNN than is being lost.

For the Zorgkern, no concrete plans are available yet, and Royal HaskoningDHV has therefore not extended their analysis to this area. Most of this area is already built-up by the psychiatric institutions of Altrecht and Fivoor.

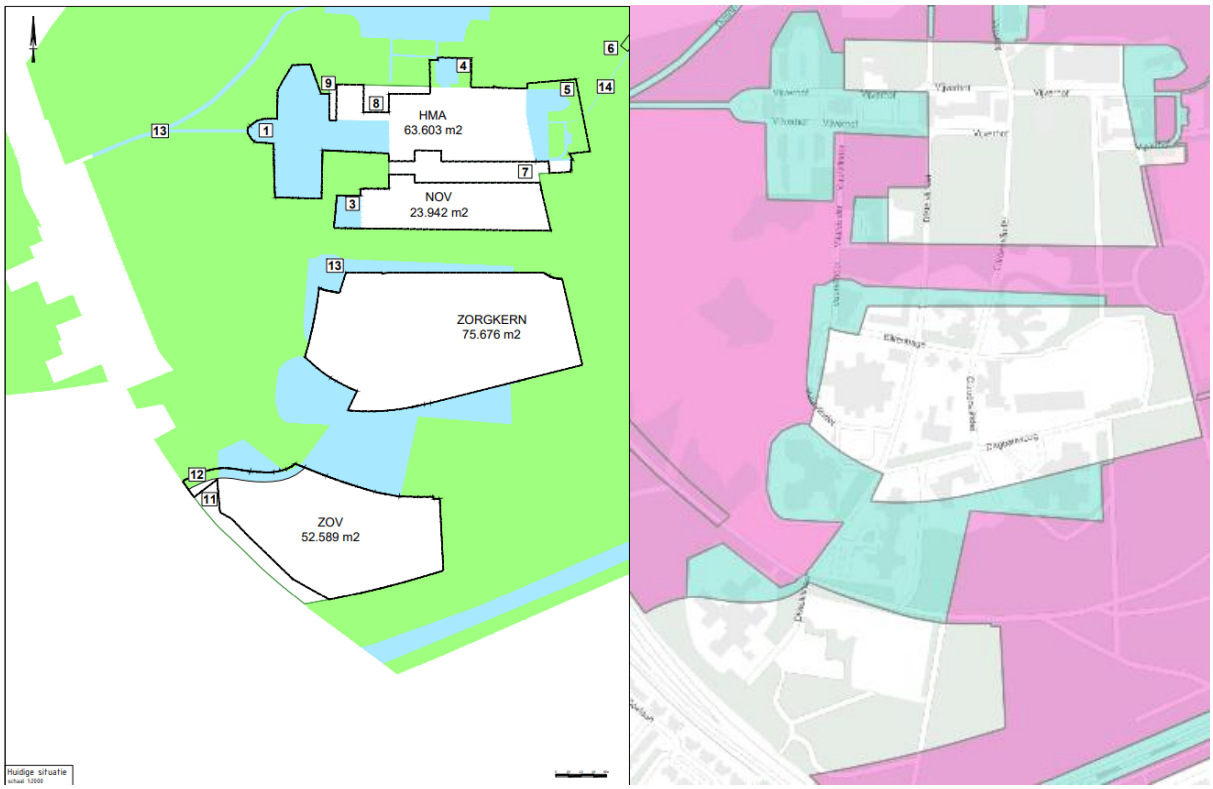

Figure 25. Left: a map of the development fields and NNN, taken from the Royal HaskoningDHV NNN document (2021). Right: the NNN areas as shown in Figure 4. The green (left) and purple (right) areas are NNN areas of natural value, the blue areas (left and right).

As explained, Royal HaskoningDHV have based their reasoning on the new NNN borders that have been changed as a "pre-sorting" for the benefit of the Omgevingsvisie. In their 2017 vision for the WA Hoeve, the municipality of Zeist claims that the province will change the borders of the NNN to ensure that the development of the area will be possible when the time comes (Gemeente Zeist, 2017). This is in accordance with what is written in the Provinciale Ruimtelijke Structuurvisie (see section '1.3.2 Change in NNN'). Correspondence with the province of Utrecht confirms that the areas have indeed been removed to make space for the development fields (Bert Geerdes, personal communication, November 29, 2022). Figure 25 shows that the areas that have been removed correspond to the four development fields.

Nevertheless, the removal of the NNN areas have not been substantiated by one of the lines of reasoning described in article 6.3 of the Interim Omgevingsverordening. Royal HaskoningDHV claims that in the current situation, the built-up surfaces at the WA Hoeve are all adjacent to one another in one continuous way, and that in the new situation, after the building has finished, there will be wider strips of nature between the built-up areas (Royal HaskoningDHV, 2021b).

On the basis of our visits to the area, we cannot but disagree with this assessment. There is a lot of green between the current built-up areas, and the strips of forest between the HMA and the area currently occupied by Altrecht and Fivoor (Zorgkern), will significantly decrease when the NOV will be built. It is true that parts of the areas that have been removed from the NNN since March 2021 are already built-up, which according to article 6.3(2) of the interim omgevingsverordening, means that they

would not have been a part of the NNN in the first place. But this is not the case for all areas that have been removed. As shown in Figure 26, there is a strip (red circle) that lies outside of the newer NNN area, but that is nevertheless indicated by the province of Utrecht as forest (Provincie Utrecht, 2022a). When visiting the area, we confirmed that this strip is indeed covered by diverse forest (Figure 27). This strip is exactly the part where the municipality of Zeist and BPD want to build the NOV, and of which Royal HaskoningDHV concludes that it is not part of the NNN and therefore does not need to be included in their NNN analysis (Figure 25).

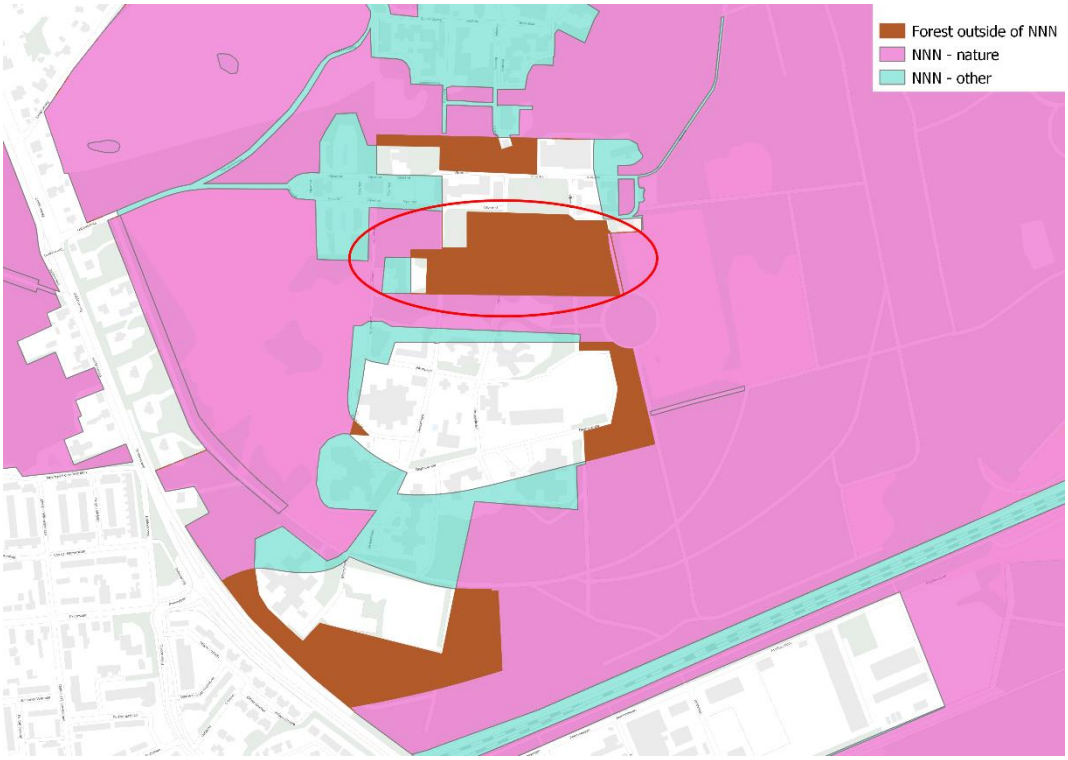

Figure 26. NNN areas since March 2021, including areas indicated by the province of Utrecht as forest, that lie outside of the NNN area. The part circled in red is the location of the NOV (Provincie Utrecht, 2022d).

Figure 27. Photo taken of the forest that is claimed to lie outside the NNN since March 2021, circled red in Figure 26..

In conclusion, the analysis of Royal HaskoningDHV has made it seem that the NNN will barely be affected and will in fact improve – as it should, if the rules of the Interim Omgevingsverordening and Omgevingswet are applied. This is only the case when considered from the perspective of the already changed NNN borders since March 2021. Although these changes to the NNN have been in applied in accordance with provincial legislation, there is nevertheless a slight negative impact to the overall network.

4.3.2 Urban species

Residential areas do not only create limitations for wildlife, but they also provide opportunities. Species are often more adaptable than people might think, and some species have even evolved to function well in an urban environment – for example, species that naturally nest on rocks are better adapted to a built-up area, because of the similarities between buildings in cities and rocks found in nature (Kark et al., 2007).

4.3.2.1 Birds

Birds often use cities for their permanent habitat, as a breeding area, or as a foraging area. Residential areas often have structural elements that create advantages for some species of birds. These advantages can become even larger if the breeding or foraging behaviour of birds is considered while building, by using non-structural elements like nest boxes and trees.

Since 2007, urban avian species are monitored by Sovon Vogelonderzoek Nederland and Vogelbescherming Nederland through the Meetnet Urbane Soorten – MUS (SOVON, n.d.). MUS uses a benchmark that can be used to compare the expected occurrence of urban avian species to the actual occurrence of these species – which often changes based on the use of non-structural elements.

MUS categorizes urban avian bird species into seven groups: residential breeders, pioneer species, water and wading birds, park and garden birds, tree birds, shrubbery birds, and cavity-nesting birds (SOVON, n.d.).

Residential breeders are species like the common swift (*Apus apus*; gierzwaluw), western jackdaw (*Corvus monedula*; kauw), common starling (*Sturnus vulgaris*; spreeuw), and house sparrow (*Passer domesticus*; huismus). They incubate their eggs in buildings, under roof tiles and in other inlets. A non-structural element that can help house sparrows is the so-called “bird mezzanine” (vogelvide), an eaves system that creates a protected nesting site under the lowest rooftiles (Figure 28). Other options include regular nest boxes, like ‘neststenen’ (bricks with holes in them), or a ‘huiszwaluwtil’, a big nest box used by colonies of common house martin (*Delichon urbicum*; huiszwaluw).

Figure 28. Bird-mezzanine (Monier B.V., 2022).

Pioneer species make use of newly created abiotic environments as a result of human activity. They either use these areas for breeding or for foraging. Examples are common pheasant (*Phasianus colchicus*; fazant), Eurasian oystercatcher scholekster (*Haematopus ostralegus*; Scholekster), and various species of gulls (*Laridae*; meeuwen). They often make use of more industrial areas, or temporary areas created as a result of construction. This makes it hard to carry out targeted management for these birds. One non-structural element that can help these pioneer species is roofs with gravel or shells, with some protection from the sun and from predation, on which they can nest undisturbed.

Water and wading species depend on water for breeding or protection. Examples are great crested grebe (*Podiceps cristatus*; fuut), common mallard (*Anas platyrhynchos*, wilde eend), Eurasian coot (*Fulica atra*; meerkoet) and common moorhen (*Gallinula chloropus*; waterhoen). Some other waterfowl are less likely to occur in a sandy, forestry area like the WA Hoeve. However, species like this can still be supported by planting reed at the banks of ponds and canals. By creating a less steep bank more reed can grow, in which these species can rest and breed in a sheltered environment.

Park and garden species can be found in city parks with groups of trees and shrubbery – they overlap a lot with species that are more specialized to trees and shrubbery. Examples are dunnock (*Prunella modularis*; heggenmus) and European robin (*Erithacus rubecula*; roodborst). These species need variation between trees and shrubbery for their nesting sites, and use lawns for foraging.

Tree species like Eurasian collared dove (*Streptopelia decaocto*; turkse tortel), Eurasian blackcap (*Sylvia atricapilla*; zwartkop), and European greenfinch (*Chloris chloris;* groenling) do well in areas with old trees. Old avenue trees ('laanbomen') often provide opportunities for birds in this category, and in general, the WA Hoeve's undisturbed forests are a great habitat for tree species.

Shrubbery species like dunnock, Eurasian wren (*Troglodytes troglodytes*; winterkoning) and common whitethroat (*Curruca communis*; grasmus) use shrubbery and thickets for breeding or protection from predators. In contrast with tree species, old trees are actually a disadvantage for these species, because they provide less cover.

Cavity-nesting species overlap a bit with the house breeders, but also include great tit (*Parus major*; koolmees), Eurasian blue tit (*Cyanistes caeruleus*; pimpelmees), short-toed treecreeper (*Certhia brachydactyla;* boomkruiper), and various species of woodpeckers (*Picidae*; spechten). Old trees can provide cavities for them to nest in, but houses and nest boxes can also be used.

4.3.2.2 Bats

Bats are small mammals that have adapted tremendously to the urbanization of humans. Especially the building inhabiting species such as the common pipistrelle, and the nathusius's can be considered true cultural followers, and can therefore be found in most urbanized areas. Most bat species descend from a long lineage that used to reside in caves, but urbanization of humans provided them with roost locations that simulate the cave climate, specifically stone buildings such as churches.

In the Netherlands, bats can be roughly divided into two groups: the building inhabiting and tree inhabiting species (although some species might reside in both types of habitat). The roosts of bats are well protected under European (habitat directive) and Dutch legislation (wet natuurbescherming), which aims to prevent the loss of the roosts due to construction or tree felling. It is important to note that most bat species utilize a variety of roost locations that are all connected in a larger network that is part

of their home range. Different roosts within this range often have different functions, and bats may use a specific roosts at different times of the year. In addition, bats regularly switch between roosts with the same function, which means that roosts may be temporarily unoccupied but could still be considered essential as part of their network.

The roosts can be divided into four main functions: (1) summer roosts, which are roosts that can be used by a single or multiple individuals, for one or more nights close to suitable foraging areas; (2) nursery roosts, which are used by larger groups of female individuals that come together to raise their young; (3) reproductive roosts, which are roosts that are used by males, often close to female groups, to advertise their availability for reproduction to females; and (4) winter roosts, which are roosts that are used to hibernate throughout the winter. It is possible that bats re-use their summer, nursery, or reproductive roosts for hibernation. But the roosts require a consistent climate, so bats are often found hibernating in larger estates, castles and bunkers from the second world war. In addition to the roosts, their essential foraging areas and flight paths within their network are also considered protected. Different bat species have different methods of relocation within their network and utilize a variety of prey searching strategies. Avenue-like structures are an example of key components that bats use to relocate between areas. These structures assist bats with their orientation, but can also act as a bridge between fragmented foraging areas.

Currently, there are many buildings that have to be renovated in the Netherlands. It is therefore essential to monitor the species and their use of the area, to prevent the loss of their conservation status. To guarantee the prevention of their loss, the network of green agencies (Netwerk Groene Bureaus; NGB), developed a bat research protocol (Netwerk Groene Bureaus, 2021), which is a mandatory research method for a development project to qualify for an exemption or dispensation. These surveys are used by ecologist to determine the species, quantities and usage of the area, which is then used to decide appropriate measures such as compensations to guarantee their conservation status. These measures can be considered ‘tailor-made’ and may be unique for each distinctive situation. Common measures that are used in practice are developed to compensate the loss of roosts, flight routes and foraging areas that are considered essential. Compensation of roosts in commonly done by providing alternative roosting boxes. These boxes are selected for their durability (choice of material), type of roosts that has to be compensated (boxes for a nursery colony or for single individuals), and which species was found (building or tree inhabiting). For new buildings, the creation and conservation of bat roosts can be taken into account during the developing period. By choosing an alternative architecture of new buildings, space can be made available for built-in boxes, which bats can use without being disturbed by future renovation projects. The compensation of foraging areas and flight routes require precise information about the expected impact of the developing project. But is mainly done by re-establishing enough similar vegetation, or for new construction projects carefully selecting vegetations best suited to the area. Additionally, bats can also be sensitive to light pollution. However, measures to mitigate the effects of light need to be considered individually for each species, and functions of the roost. The decision and implementation of measures should therefore always be guided by an ecological specialist and many mitigation possibilities are detailed in the official knowledge documents of various bat species (BIJ12, 2017). These documents are partly used by provinces when assessing the exemption or dispensation application.

4.3.2.3 Other mammals

Another mammal species that might be in danger of losing part of its habitat due to the building plans is the European badger (*Meles meles*; das). However, research has shown that the badgers are capable of adapting to residential areas, and that urban badgers are increasing in the United Kingdom (UK) (Bateman et al., 2012). Badgers generally prefer habitats consisting of broad-leaf woodlands and meadows in which they often forage for earthworms. While in urban environments they tend to avoid open grasslands like lawns, and extend their diet to include anthropogenic food sources. For example, in Bristol, UK, fruit makes up 48-61% of their diet, so orchards can play a big role. Their diet is also supplemented by food left behind by humans. In Brighton, UK, 29% of households left out food for small mammals like foxes and badgers. Still, badger distribution in residential areas is in part dependent on whether they are able to dig tunnels for their dens.

Deers like the roe deer occur almost everywhere in the Netherlands, including the WA Hoeve. Although they avoid busy city centres, but they can be found near and in villages and suburbs. A study by Ciach et al. (2019), found that areas that contain more open habitats, are more likely to have roe deer, but that artificial lighting has the opposite effect (2019). In its current state, the WA Hoeve forms a good habitat for the roe deer, because it has plenty of vegetation for shelter and open patches for food. Although it is likely that an increase in resident activities will harm the roe deer population at the WA Hoeve, two measures might mitigate this loss: decreasing the amount of artificial lighting at night, and leaving a continuous strip of trees as shelter in-between the residential plots. The terrain manager of Altrecht, Dick Schippers, argues that such a strip should have a 100-150 m width to be suitable as an ecological corridor for roe deer (personal communication, December 2, 2022).

4.3.2.4 Herbaceous plants

Ruderal plant communities arise in areas where high human activity has caused a disruption of the environment – examples are construction sites, sidewalks, and train tracks. Furthermore, there is often an excess of nutrients like nitrogen. Plant communities like this can be important for insects, especially in extensively built-up areas with few other plants. A lenient mowing policy, especially in the spring and summer months, can help these plants grow.

Two common ruderal plant communities that you can find in residential areas in the Netherlands are Erigeronto-Lactucetum and *Hordeetum murini (*Flora van Nederland, 2022b).

The plant community Erigeronto-Lactucetum consists of mostly annual or biennial plants that complete their lifecycle in one or two years: *e.g.* tall hedge mustard (*Sisymbrium altissimum* L.; hongaarse raket) and prickly lettuce (*Lactuca serriola*; kompassla). You will find it mostly at construction sites and along roads and train tracks. If the area it grows in is regularly disrupted, this plant community can keep existing indefinitely.

Hordeetum murini is dominated by wall barley (*Hordeum murinum*; kruipertje). It can be found along roads and on sidewalks, against walls and on parking spots. As can be seen in Figure 29**,** this plant community does not need a lot of space to grow, and can establish itself on a sidewalk.

Figure 29. Hordeetum murini (Flora van Nederland, 2022a).

Due to these and other plant communities, urban cities can have higher species richness than rural areas, but they are not always self-sustaining (Kowarik, 2011). For development in the WA Hoeve, it is therefore important to consider the urban ecosystem in conjunction with the surrounding areas. Communities within and outside of the residential area can then support each other.

Another thing to take into account is that seed dispersal is often the limiting factor for urban species (Fischer et al., 2013). Urban dispersal vectors like traffic (*e.g.* people bringing along seeds with their clothes) cannot fully compensate for the fragmentation that is often caused by buildings. As such, it is important to create ecological networks with stepping stones or corridors, like patches of forests and lawns (Kowarik et al., 2019). If plant communities are better connected their dispersal is less limited.

4.3.3 Trees and carbon storage

Some trees may be cut down on the WA Hoeve. However, it is essential to realise that this is not necessarily a bad thing. A lot of carbon is stored in trees, but this carbon is still stored in the wood if they are cut down. If the wood is used for construction or carpentry, the carbon remains in those products, and the negative effect on carbon storage is negligible. If the wood is used as fuel, the carbon is released into the air. However, this fuel is burned for a reason, such as heating or generation of electricity. Had this wood not been used as fuel, a different source would have been used, most likely a fossil one. It may take decades for a tree to grow, but it takes millions of years to form fossil fuels. Therefore, releasing carbon from wood is not as bad as burning fossil fuels, since it will only take a few decades for the carbon from the wood to be taken up into a tree again (provided the same amount of forest is allowed to regenerate as what has been cut down), while the alternative would remain in the atmosphere for millions of years.

Old trees have the capacity to store more CO_2 than young trees (Stephenson et al., 2014), but young trees have more potential to become big. Old forests also store more carbon than new forests, but new forests have the potential to become old forests. Eventually, old growth forests reach a point where the trees have reached their maximum height and the majority of trees are no longer growing. At that point, they only take up as much as or less carbon than they release (Nave et al., 2019). They still hold a lot of carbon within them, but they don't take up any more. A new forest however still has the potential to grow and take up as much carbon as required to grow into a tree of the same size.

Because of these two reasons, felling forests and compensating for them elsewhere is not necessarily a bad thing in terms of CO_2 storage. This is of course assuming that the same area of forest is allowed to

regenerate. It is however important to realize that it can take decades for a forest to grow. This means that on the short-term, not a lot of carbon will be stored in a new forest.

4.3.4 Climate-adaptive trees

In the Netherlands, one consequence of climate change is drier summers and wetter winters. Because of this, it is wise to think about how to make Dutch forests more adaptive to this changing climate. Beech trees, a cultural-historical staple in the Dutch landscape and often used as avenue trees, have a low tolerance to drought (Leuschner, 2020). Although old beech trees have value for birds and insects, it might be better to look towards the future and plant trees that are less drought-tolerant.

An effective strategy to mitigate drought stress is by planting individuals with a drought-tolerant genotype (Ismael et al., 2022). A tree species that is vital in the ecology of the area but is not very tolerant to droughts might also grow elsewhere in the world, where in isolation it has developed a distinct genotype that is better adapted to droughts. This reasoning can also be applied to closely related species like the common oak (*Quercus robur*; zomereik) and sessile oak. Because of its slightly more developed taproot, the sessile oak is less sensitive to drought than the common oak, especially on sandy soils like of the WA Hoeve (Eaton et al., 2016). Coincidentally, both species are already native to the Netherlands.

In general, soil type and hydraulic conditions are the most important factors in determining which tree grows best where (Boosten et al., 2020). Given what is known about the changing climate, predictions can be made about which trees will be able to be the most vital in our landscape in the near future. An example is the field maple (*Acer campestre*; veldesdoorn), which is relatively drought-tolerant and likely grows well on nutrient-poor sandy soils like the soils of the Utrechtse Heuvelrug (Kremers et al., 2022). A further advantage is that its leaf litter is relatively nutrient-rich and decomposes quickly compared to the litter of beeches and oaks. This allows for a more biodiverse undergrowth. In the case of the field maple, the tree itself also provides a great contribution to the biodiversity of an area. For example, they produce a lot of pollen and nectar for bees and other insects, the leaves and buds are popular among herbivores, and some species of butterfly use the tree as their host plant.

Given the low drought-tolerance of some native tree species, we recommend using more drought-resistant species. Depending on the quality of the wood, the felled trees can either be used to create e.g. playground equipment, or they can be left at the side of the road and form natural fences and habitats for insects. Measures such like this might seem to hurt the ecological value of the area in the short term, but will help it in the long term, especially taking climate change into account.

4.3.5 Permanent effect of residential presence

4.3.5.1 Roads

Roads can have a significant effect on animal mortality due to roadkill (Lodé, 2000). Even when the roads do not kill animals outright, they can act as barriers that contribute to fragmentation (Andrews, 1990). For the degree to which roads form a barrier mainly the width and traffic intensity are important, with road surface material only plays a minor factor (Forman & Alexander, 1998). Finally, even when the roads do not act as a barrier, they can disturb nearby animals (Andrews, 1990). This disturbance effect can partially be attributed to sound, especially for large mammals (Kaseloo & Tyson, 2004). Furthermore, cars emit nitrogen oxides (NOx) and small amounts of ammonia (NH3) which contribute to the fertilisation and acidification of the areas where this nitrogen is deposited.

Some mitigating measures are possible for all of these effects. The mortality effect of roads can be reduced by adding underpasses for wildlife to the roads (Lodé, 2000). Roads can be made narrower to try and minimise the barrier they form (Rico et al, 2007). Trees can be planted by the side of the road to mitigate noise pollution (Maleki & Hosseini, 2011). Finally, by keeping the length of the road to a minimum, nitrogen pollution can be minimised as people won't have to drive as far, lowering the distance they're emitting nitrogen for. Trying to keep the roads away from nitrogen sensitive habitats can also be advantageous.

4.3.5.2 Light

Streetlights may form another problem. With increased light pollution, species that use light to orient themselves may be disoriented, niche differentiation between species with preferences for different light levels may disappear which could result in biodiversity loss, predator-prey relationships may be disrupted and due to changes in behaviour, competition dynamics may be altered (Longcore & Rich, 2004).

Most of this is a result of the exact thing we are trying to accomplish by placing streetlights, namely the illumination of things we are trying to see. Without compromising on that function, we will not be able to do much to mitigate this effect. Different colours of street lights might be an option, but different colours affect different species. For example green light disturbs bats (Spoelstra et al., 2017), while red light disturbs migrating birds (Poot et al., 2008), though white light contains both of these colours. Gaston et al. (2012) suggest that higher wavelengths should affect less animals and narrower spectral composition in combination with these high wavelengths might help reduce their effect.

It is an option to not place street lights, which saves energy but makes it more difficult to see things on the road which might compromise safety. A few other options suggested by Gaston et al. (2012) include trying to focus the light more on the area intended to be lit, reducing the intensity of the light and limiting the amount of time the artificial lighting is on for. Another option might be to use traffic lights that turn off when the road is not currently being used (Yoshiura et al., 2013). Many of these measures also help to reduce electricity consumption.

4.3.5.3 Compost

Currently fallen leaves collected on the WA Hoeve are collected and dumped in a big pile which is allowed to compost. One important consequence of this is that the European rhinoceros beetle, has started using this as a food and heat source. (Dick Schippers, personal communication, December 2, 2022). In turn local badgers have started frequenting this compost heap and dig for the beetle larvae (Dick Schippers, personal communication, December 2, 2022). We have confirmed that something is digging a large amount of holes in the compost heap (Figure 30), but we cannot confidently determine the species that made these tracks. We therefore recommend a camera trap survey is carried out to determine what animal is digging these holes.

Figure 30. Compost heap located at the north-eastern part of the WA Hoeve, close to the HMA.

This compost heap will not necessarily have to go. But, with more people inhabiting the area there will be more people who want to clear their lawn of leaves. The municipality could arrange for these to be collected and moved to a compost heap which would serve its current purpose, this might be combined with an educational purpose (which could be as simple as adding a sign with an explanation of why the leaves are composting there, and why they should be left undisturbed).

4.3.5.4 Recreation

With the leaving of Altrecht and the realisation of houses on the WA Hoeve, the number of recreants will undoubtedly increase. One of the reasons for this is quite straightforward: with houses being built, the area will have more residents, who will use the surrounding nature for all sorts of recreational activities. This can be walking (with dogs), biking, playing, picnicking and much more. Another reason for increased recreational pressure is the fact that Altrecht will leave. Until now, the psychiatric facilities have withheld some local residents from going to the area, as they may not have felt comfortable there (Dick Schippers, personal communication, December 2, 2022).

An increase in recreational activities can have a number of negative effects on nature. This can contribute to a species or habitat type reaching a critical threshold, which means that the favourable conservation status is at stake. The effects can be divided into five categories (Henkens et al, 2012):

- disruption of fauna
- damaging of vegetation
- habitat loss and fragmentation
- pollution
- direct population change

Most of these effects are small and difficult to measure. The effects of disruption of birds and mammals is generally bigger, because these animals are more sensitive and interactions occur at a larger scale.

Disruption often takes place without the recreant taking notice. The effect of disruption is reinforced when area rules are violated (Henkens et al, 2012). Because of this, strict legislation and regulations on recreation are very important. Recreants should not litter, stay on the paths and not go into the forest after sundown.

Having paths go through the heather fields does not necessarily hurt the heather. Footpaths made of sand can help some indicative heather species like the sand lizard (*Lacerta agilis*; zandhagedis): as a management type, dry heather also consists of small patches of sand (BIJ12, 2022).

4.3.5.5 Pets and garden plants

If an area is inhabited by people, it is expected that they will bring their pets along. Especially dogs and cats can have a considerable effect on nature. These effects are mostly experienced by birds and mammal species. Dogs can frighten, hunt and possibly kill ground-bound birds and mammals. This effect is magnified when dogs are not kept on their leash (van Lunteren & Emond, 2021). A study by Length et al (2008) found that deer activity was significantly lower within 100 m of trails in areas that allowed dogs than in areas that prohibited dogs. Small mammals like squirrels and rabbits showed this reduction in activity within 50 m from trails. Apart from effects on wildlife, dogs also urinate and defecate near trails, which causes eutrophication, which can influence the local vegetation (van Lunteren & Emond, 2021).

The impact of cats on wildlife is presumably even larger. Free-ranging cats are well known to hunt birds, mammals, reptiles, and amphibians. It is estimated that annually around 90 million preys are being killed by housecats in the Netherlands (Knol, 2015). Measures can be taken to decrease this mortality, for example collars with bells, which can significantly reduce the number of preys being killed by cats (Ruxton et al, 2002). In order to minimize the effects of dogs and cats on the nature in the WA Hoeve, adapting legislation may be desirable. This could include that it will be obliged to keep dogs on a leash and that cats should wear a collar with a bell, or a kept inside.

Not only pets, but also garden plants can affect surrounding nature. Many garden plants are exotic species. These species can naturally spread from gardens into surrounding nature, where they can have negative effects on biodiversity. This can be for example because they outcompete native species. The amount of exotic plant species in Dutch nature has increased vastly over the past century, from 200 to over 1400 species (Pieters et al, 2018). It is important that residents think twice before planting exotic species with a high risk of spreading.

However, it should be noted that a lot of common exotic garden plants have existed in the Netherlands for ages, and form no problem for the biodiversity. As long as the plant is not invasive, it is not a problem. In fact, exotic species can actually be better adapted to the microclimate of a residential area, as the buildings, drainage and air quality can create abiotic factors that differ strongly from more “natural” areas (Hoffman, 2010). Furthermore, because pollen and nectar play a vital role in ecosystems by providing food for pollinators, any plant that can offer pollen and nectar for insects is going to contribute to the ecology of the area. Insects do not care where a plant originally came from, as long as they can eat its pollen and nectar.

4.4 Analysis per area

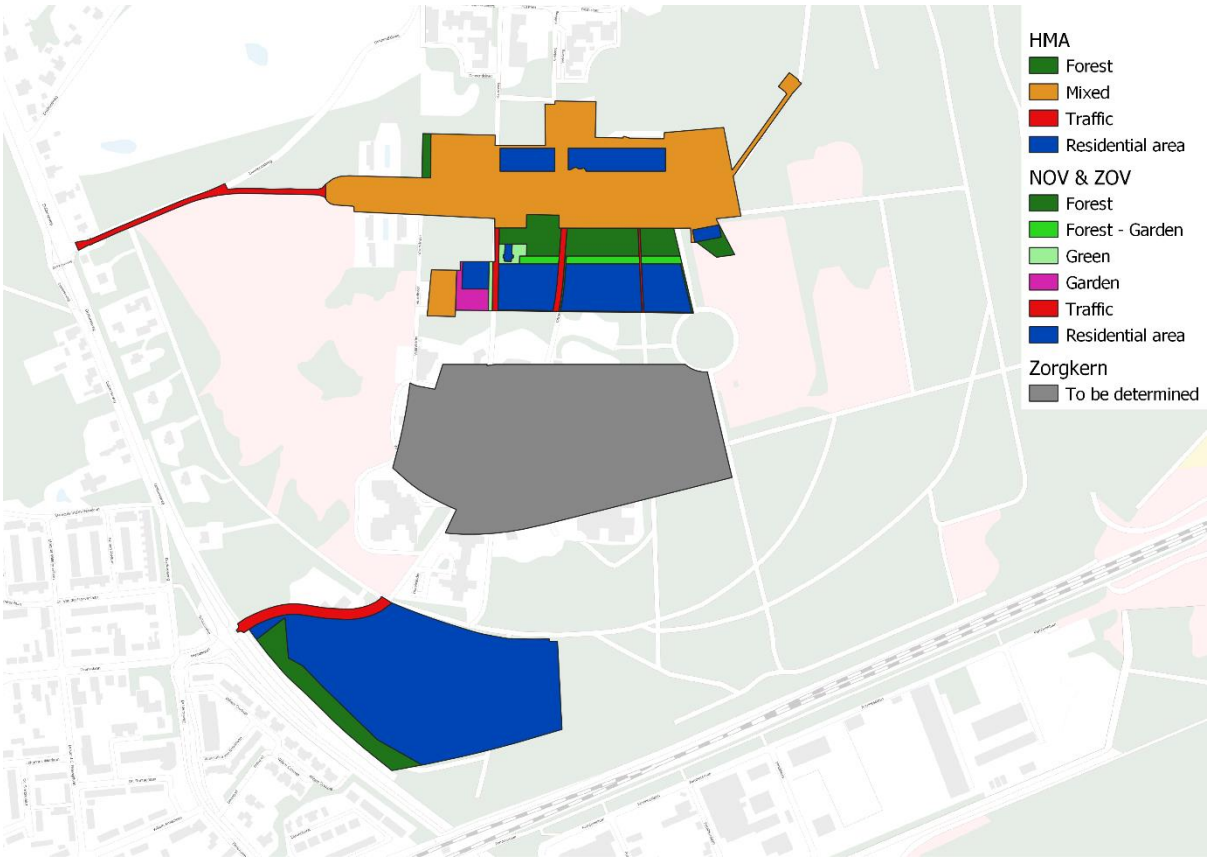

Figure 31. Distribution of building areas. 1: Historische middenas (HMA), 2: Noordelijk Ontwikkelingsveld (NOV), 3: Zorgkern, 4: Zuidelijk Ontwikkelingsveld (ZOV). Based on the 'Gebiedsvisie 2017' of Gemeente Zeist (2021).

In this section, we analyse the consequences of the effects for the different development fields from the current building plans. Figure 31 shows these development fields and their respective zoning plans, as far as they are known. For a more in-depth discussion of the building plans, we refer to section '2. Building plans'.

4.4.1 HMA

Only 12 extra houses will be built in the HMA. Other than that, the developing plans make use of the existing buildings, which will be repurposed into various functions like restaurants, hotels, etc. The impact will therefore be limited. As a general effect, extra traffic in the area will increase pressures on the surrounding nature – similar to the other areas.

4.4.2 NOV

The NOV will be built in a patch of forest in between two built-up areas, to the south of the HMA, and to the north of the Zorgkern. The projected surface area of forest to be cleared is 1.9 ha. The loss of biomass will be compensated for elsewhere (see section '1.5 Forest strategy'). Other than that, the potential damage here is twofold: (1) some of the trees to be felled might be relatively old and lose their function as a habitat for animals, and (2) the area might play a role as an ecological corridor between the eastern and the western heather.

As for the first point, note that – as explained in section '4.3.2 Urban species' – tree species and cavity-nesting species of birds often use old trees as their nesting place, and multiple species of plants, fungi, and insects use the microclimates that these trees provide to their advantage. During the development of the WA Hoeve, it would therefore be sensible to focus on the conservation of the older and more inhabited trees. To this end, the municipality of Zeist will focus on the conservation of the existing structure of avenues and their trees (Hendrik Visser, personal communication, December 7, 2022). These avenues can be found in estates throughout the Netherlands, and even have their own management plan ('L.01.07 Laan'). Like the municipality of Zeist, we recommend preserving the existing avenue structure of the WA Hoeve as much as possible, and not widen any of the existing avenues as to not unnecessarily remove any old avenue trees.

As for point (2), first it must be mentioned that the area of the NOV plays a limited role in the broader NNN. As can be seen in Figure 3 and Figure 4 in section '1.3 NNN', the western provincial road 'Dolderseweg' already forms an obstacle for wildlife to go west, and the general direction of the NNN lies more towards the north/northwest, along the Utrechtse Heuvelrug. Nevertheless, we disagree with the decision to remove this area from the NNN (see sections '1.3 NNN' and '4.3.1 Effects on NNN'). The current patch of forest does form a corridor for animals wanting to visit the western heather field. Currently, it is 75 m to 150 m wide, while the planned width of the corridors around the NOV is 50 m at minimum (Gemeente Zeist, 2017). Even now, the buildings 'Spinoza' and the 'zusterhuizen' are in the way (Figure 32). At the moment, the impact of these buildings is limited because of the general lack of activity in the area, especially at night. For a lot of animal species, quiet and darkness at night will allow them to move much closer to residential areas than they otherwise would. For some species of birds, and small mammals like badgers and foxes, residential areas can also provide new foraging opportunities. The effectiveness of the planned corridors to the north and to the south of the NOV therefore depend a lot on the specific design of the area. We recommend focusing on leaving continuous patches of forest and using animal-friendly artificial lighting (what kind of lighting is optimal depends on the species, see section '4.3.5.2 Light'). Placing these patches close to roads, along with shrubbery for smaller mammals, will help mitigate the negative effects of roads as obstacles. Furthermore, the usefulness of the corridors around the NOV can be mitigated by creating a stronger corridor between the ZOV and the Zorgkern.

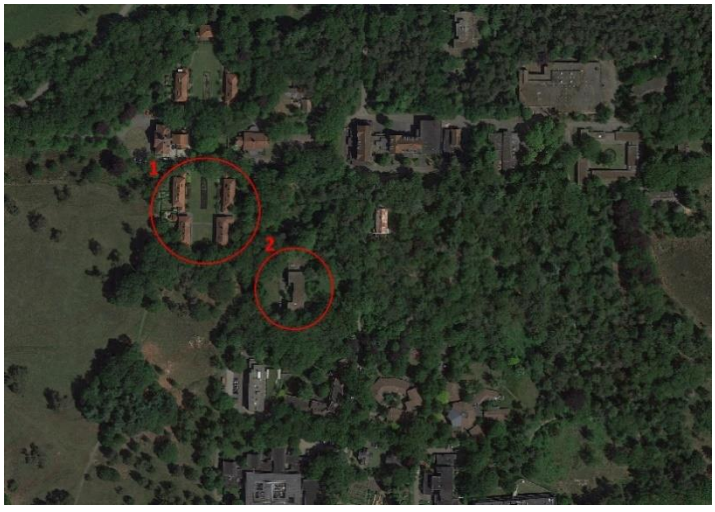

Figure 32. The buildings (1) the 'zusterhuizen' and (2) 'Spinoza' (Google Maps, 2022).

4.4.3 Zorgkern

The Zorgkern is the area that is currently occupied by Altrecht and Fivoor and lies between the NOV and the ZOV. Because the Zorgkern is occupied by Altrecht and Fivoor, there are already buildings in this area. Therefore, no forests have to be felled in this area. The Zorgkern is in the middle of two heathlands. There will be a different effect on nature if the area of the Zorgkern is entirely used or not. The idea of the project manager (Visser) is that a part of the Zorgkern is used as a residential area and that the other part is given back to nature so they can make a corridor between the two heathlands. With this idea, there is less pressure on nature in the Zorgkern because a smaller area is used for housing and the demolishing of houses creates a good piece of barren land that is well suited for heathland development. This would help with the corridor between the two heathlands in the south of the Zorgkern. The other idea is that the whole area of the Zorgkern will be used as a residential area. Then, no area of the Zorgkern can entirely be used for the corridor between the two heathlands and the corridor will be much smaller. The amount of land they will use in the Zorgkern depends on the number of houses they will eventually build. Currently, the plans amount to a maximum of 25 houses per hectare that are allowed to be built. With these plans, the maximum number of houses that can be expected is 160. This ensures that in the Zorgkern an open character where nature and housing may overlap can be established. With the plans to only build in the Zorgkern, the idea is that 400 houses are placed in the Zorgkern. This ensures that the Zorgkern has a less open character and that there is a greater distinction between housing and nature.

The effects of roads in the Zorgkern are limited. The municipality of Zeist wants to make use of the existing avenue structure as much as possible. The new two-way street that is being built to connect Den Dolder to the WA Hoeve from the south, will connect to the already existing street ‘Distelvlinder’. This street will be one-way. The street ‘Citroenvlinder’ will be extended from the Zorgkern towards the ZOV, also one-way (Figure 33). One-wat streets are narrow, making them a smaller barrier to wildlife that want to cross. The noise pollution of traffic on these roads is limited due to the tree lanes on both sides of the roads. However, as said, the Zorgkern is in the middle of two heathlands. This causes that the Zorgkern and the roads to the Zorgkern are in a place where wildlife wants to cross over. Mitigating measures for wildlife crossing can minimalize the negative effects for wildlife. The Zorgkern is in the middle of the area that is intended for residential areas. This makes light pollution a problem for wildlife. However, there are already streetlights present along the roads in the Zorgkern. Over the past years, there has been a lot of wildlife in and around the WA Hoeve despite these streetlights. This means that even if the Zorgkern is turned into a residential areas, the light pollution from street lights are not expected to change, unless the amount of street lights is increased.

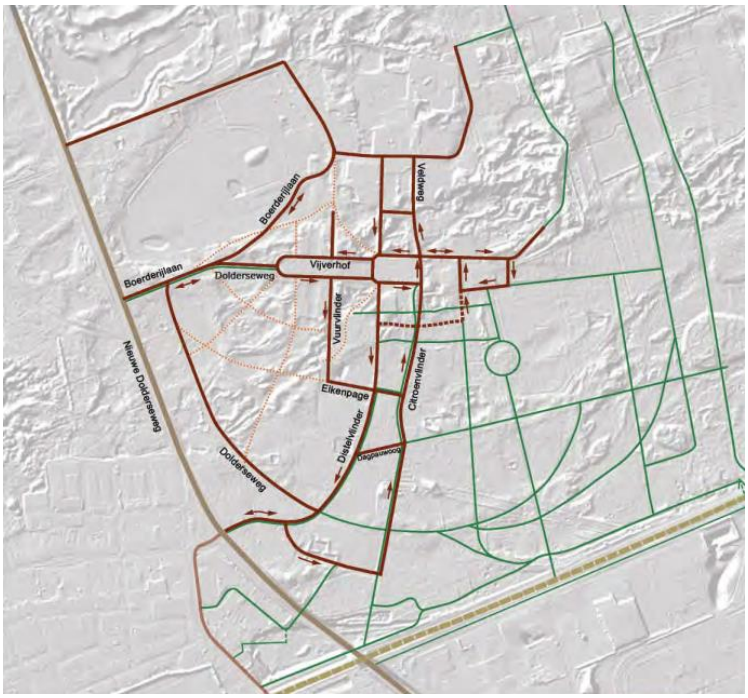

Figure 33. The new two-way street connecting Den Dolder to the ZOV, and the two streets one-way streets connecting the ZOV to the Zorgkern. Taken from 'Beeldkwaliteitsplan: Bosch & Hei' (Gemeente Zeist et al., 2021).

4.4.4 ZOV

The ZOV is located on the southern part of the area, bordering Den Dolder. The importance of the ZOV for the NNN is limited. It is already close to the town, and it does not form an important passageway to any area. Some habitat will be lost in the ZOV itself of course, but the loss of this habitat does not significantly endanger the local connectivity of the NNN. In terms of habitat loss the ZOV is pretty significant, as it is mostly consists of forest and natural areas, with the exception of the Delta building and a few sport fields.

For the ZOV, the effects of roads are limited. A new road will have to be build, but this road will only cross through built up area. This means that there will probably barely be any wildlife crossing the road. The ZOV would also be located very close to the existing roads and offer a convenient connection to the rest of Den Dolder, minimising nitrogen emissions. The road would also be reasonably far removed from both dry heather areas. The road would still border natural areas it might disturb, but the barrier and lethal effects are minimised. Light pollution can also easily be minimised due to the peripheral location of the ZOV relative to the natural areas surrounding it. By implementing the light pollution mitigating measures it could be minimised to a very minor factor applying almost exclusively to the ZOV. Transporting leaves from the ZOV to the current location of the compost heap would be difficult, so it might be worth to make another community compost heap for this development field.

4.5 Scenarios

4.5.1 Current building plans

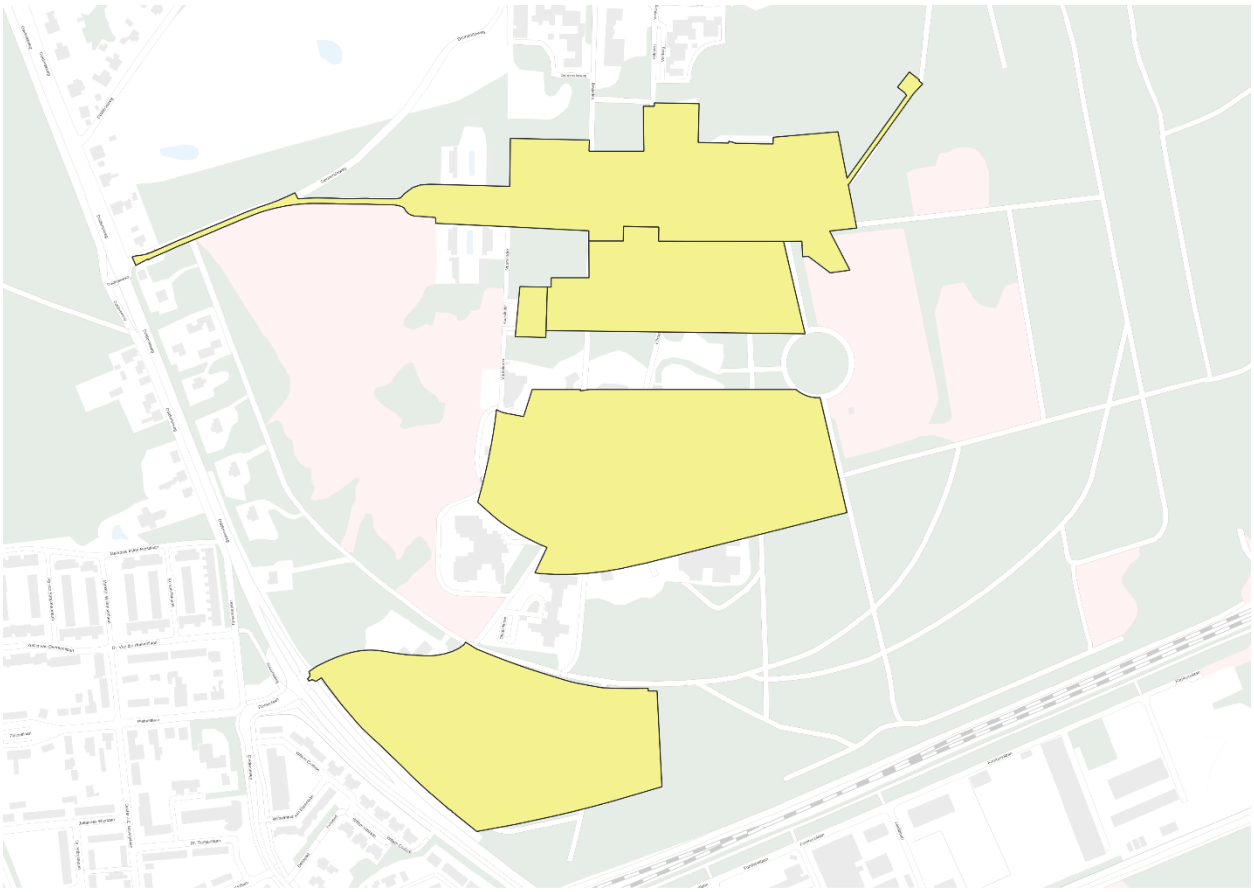

Figure 34. All the areas used in the current building plans. From top to bottom: HMA, NOV, Zorgkern, and ZOV.

The current building plans include building houses in all four areas. In this scenario, it is not yet known how the buildings on the Zorgkern will look like. For the other three areas, there are already general plans. In total, there are plans for a maximum of 400 houses divided over these areas. In addition, there will be infrastructure, gardens, restaurants, and shops. Between the Zorgkern and the ZOV, a corridor will be created between the heather fields. In this scenario, there is taken care of compensating nature that is removed on other places. The details of this plan can be read in section '2. Building plans'. This plan has a couple of benefits:

- The heather fields will be connected. This is not yet the case. Utrechts Landschap agrees with the current building plans because this connection creates possibilities.
- With the houses come more gardens. Gardens have the opportunity to increase biodiversity in the area, by using different (native) garden plants and trees, different structures, fruiting plants and high vegetation cover. For several animal and insect species, this could mitigate further fragmentation of their habitats in the area (Ossola et al., 2019).
- There will be enough houses for every segment of the population, which can contribute to solving the housing problem in the Netherlands (Provincie Utrecht, 2022f).

- A corridor will be created between the Zorgkern and the ZOV, which will be wider than before, that will act as an eco-passage.

Negative sides of the plan:

- There will be a maximum of 400 houses. This means that there will also be a large area of gardens, infrastructure, and lights. Also, there will be more recreational pressure. This will lead to habitat loss and fragmentation. Known habitats of for example the grass snake and slowworm will be destroyed and there is a risk of individuals dying during demolition and construction work (Royal Haskoning DHV, 2021a).
- The corridor between the Zorgkern and the ZOV is crossed by two one-way roads. This lowers the barrier for wildlife to cross, as the road is one-way. But that will cause more animals to cross the road which could potentially lead to more road kills (Bruinderink et al., 2010).
- There will be more nitrogen emissions because of more traffic, so more pressure on the heathland. Also, the houses that will be built next to the heather fields will impact the area in a negative way.
- Around 6 hectares of forest will be removed. Although this will be compensated on other places, forest removal does have a negative effect on the habitat of animals and general biodiversity. There is a replanting duty for every tree removed (Provincie Utrecht, n.d.).

4.5.2 Alternative building plans

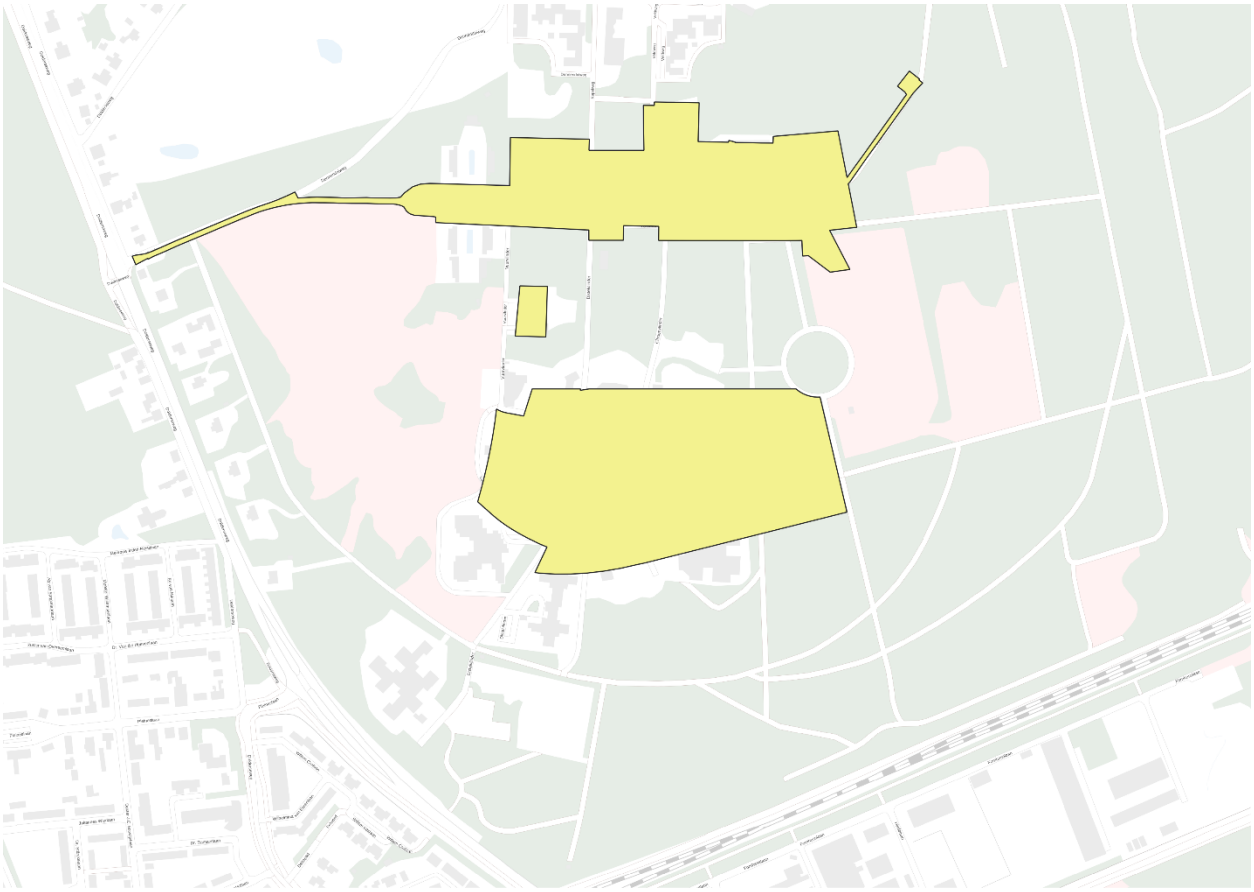

Figure 35. All the areas used in the alternative proposed by the Vrienden van de WA Hoeve: the HMA and Zorgkern.

In the scenario proposed by the Vrienden van de WA Hoeve (and since adjusted following communication with the municipality), the plan is to build only in the Zorgkern and the HMA, and to give the NOV and ZOV back to nature (van der Ende & van den Boer, 2022). The proposed maximum number of houses is 175-200. This roughly corresponds to the plan of the municipality of Zeist to realise 160 residences in the Zorgkern, and 65-75 residences in the HMA (of which only 12 will actually be newly built, rather than repurposed from existing buildings). Furthermore, the vrienden van de WA Hoeve recommend to leave a buffer of forest between the eastern heather field and the Zorgkern. In the current situation, this buffer is about 75 to 150 m wide.

Because the municipality must abide by the agreement to build no more than 25 residences per hectare, there is a limit to what can be built in the Zorgkern alone. The proposal to build all of the planned 400 residences in the Zorgkern is therefore not possible. The surface area of the HMA as shown in the zoning plans is roughly 5.8 hectares (Gemeente Zeist, 2021a). Abiding by the "25 residences per hectare" rule, theoretically a maximum of 145 residences is possible in the HMA. Together with the maximum number of houses at the Zorgkern – 160 – a total of 305 residences could be realised in this alternative plan. Depending on how wide the buffer between the residential area of the Zorgkern and the eastern heather has to be, this total would be further decreased. Given the plans to have restaurants in the HMA, a maximum of 65 residences is more likely. That would put the total at 225 residences.

However, such a scenario would disregard any plans to build public areas like shops and restaurants at the HMA. Only having residential areas at the WA Hoeve would decrease its role as a functional neighborhood: people would have to go to Den Dolder for their shopping. More generally, without the ZOV and the proposed two-way street connecting it to Den Dolder, the lack of connection to the rest of the village is a big downside.

The advantage of only building in the Zorgkern is that the area is already built-up in the current situation: there is not a lot of nature that has to make way for the building plans. However, removing existing forest is not necessarily a problem (see section '4.3.3 Trees and carbon storage'). Furthermore, the Zorgkern is located in the middle of the WA Hoeve. Roads will have to connect the HMA to the Zorgkern, and traffic will decrease the current functionality of the patch of forest as an ecological corridor from west to east. Alternatively, if you would build a road connecting Den Dolder to the Zorgkern from the south, the problem remains the same: the patch of forest south of the Zorgkern would lose part of its functionality. From an ecological perspective, it would be better to leave as much surface area in the middle of the WA Hoeve for nature as possible. This would also relieve pressures from the two heather fields to the west and east of the WA Hoeve.

To conclude, the benefits are as follows:

- Making use of the existing built-up areas as much as possible, and therefore removing as little forest as possible (see section '4.3.3 Trees and carbon storage' for why removing forest and replacing it elsewhere does not need to be negative for CO_2 balance).
- Compared to the current building plans, there will be less traffic in the southern part of the WA Hoeve because the ZOV will not be used.
- There will be a wide connection between the eastern and western heather because the ZOV will be fully given back to nature.

The negative sides are:

- The ecological corridor between the HMA and the Zorgkern would not be fully functional due to roads connecting the two areas.
- The Zorgkern is the area closest to the two heather fields.
- A theoretical maximum of 225 to 305 residences could be built – less than the agreed upon total of 400, and without any public buildings.
- The lack of connection to Den Dolder (unless the southern road is being built anyway, in which case the forest south of the Zorgkern would lose its full functionality as an ecological corridor).

4.5.3 Our suggested alternative

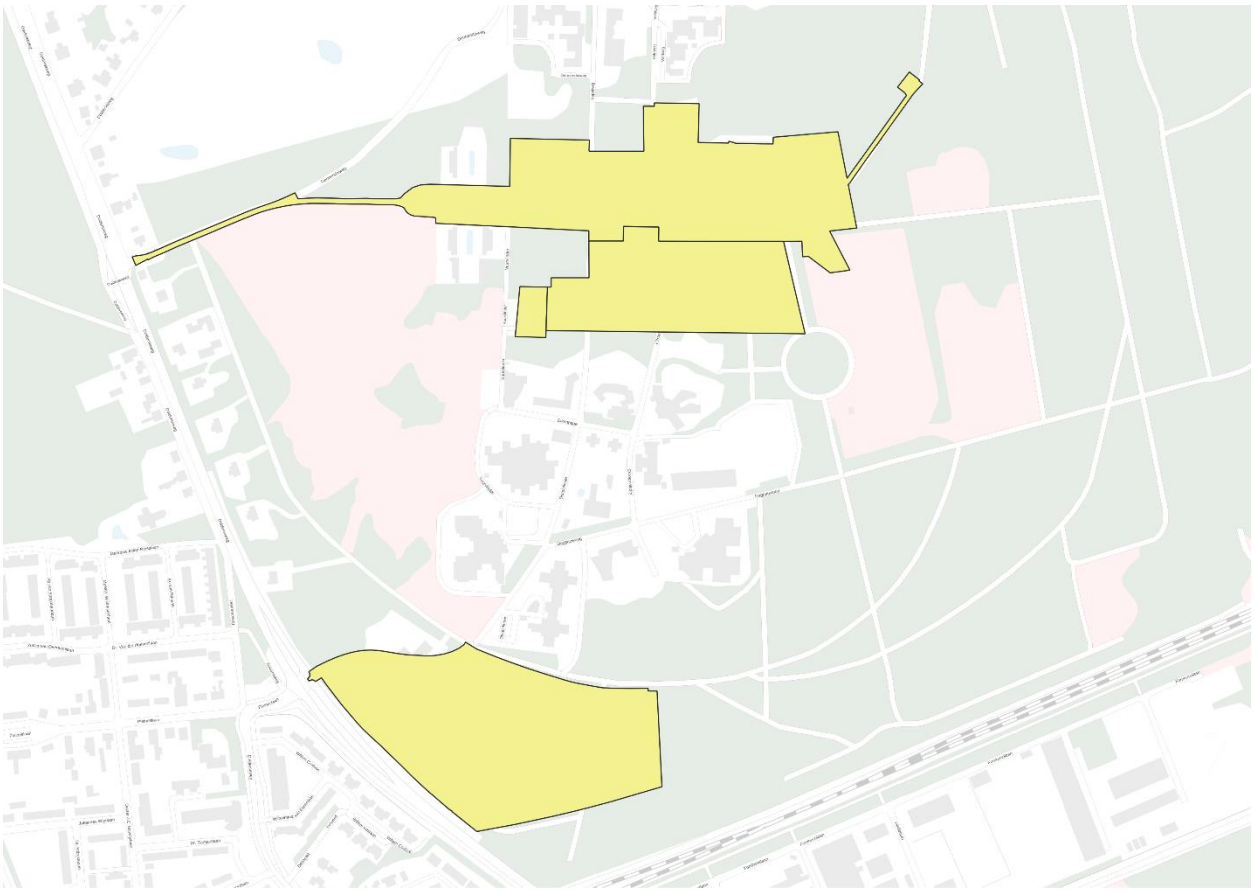

Figure 36. All the areas used in our suggested alternative: the HMA, NOV, and ZOV.

We propose an alternative scenario which we expect to have certain benefits, the main one being superior connectivity between the eastern and western areas of the WA Hoeve. This scenario happens to be the exact opposite of the alternative scenario mentioned above, namely one where residences are built in the ZOV + NOV + HMA. The compost heap would have to be split up into a northern and southern heap as there will not be an easy way to transport leaves from the ZOV to the NOV and HMA. This alternative plan would supply a maximum of 240 residences (HMA: 65, ZOV: 142, NOV: 33). If you would dedicate the HMA solely as a residential area, a maximum of 320 residences is possible.

This plan also has the following benefits:

- It offers great connectivity as the area around the Zorgkern is barely used and forms a wide corridor to the western heather.
- In the Zorgkern, a new forest area can be developed with a focus on climate change-resistant species with a high value for biodiversity.
- No roads have to cross through the area, further improving connectivity and reducing the risk of roadkill events.
- The buildings in the ZOV would be located in close proximity to Den Dolder, giving decent access to services.

The negative sides of the plans are:

- The forest in the area with the ZOV would have to be cut down to make room for housing, while not many trees are saved in the Zorgkern.
- Not building in the Zorgkern means you miss out on 160 possible residences.

5. Conclusion

The environmental surroundings of the WA Hoeve could create an appealing area in which people and nature can live in balance. High biodiversity in the environment can provide various services to its inhabitants, namely regulating, cultural, productive and supporting services. In addition, living in a natural environment can have positive influences on health of the residents. According to the vision of the province of Utrecht, which is based on the upcoming Omgevingswet, there should be room for development to solve the current housing crisis, but natural environments and cultural heritage should always be handled with care. The municipality of Zeist also has its own visions and ambitions on topics such as energy, climate-adaptivity, nature-inclusive building, circularity and sustainable construction, which should be taken into account in the planning by project developers. Therefore, the WA Hoeve cannot be simply further developed until several requirements to mitigate potential negative effects are met.

One of these requirements is to prevent any effects on existing NNN areas, and if they cannot be avoided they should be limited, or compensated. Several forest parts in the WA Hoeve are part of the NNN, some of these NNN parts were redesignated in 2021. Other parts were surveyed by Royal HaskoningDHV that claimed that after the building plans are implemented there would be wider strips of nature available, and that the forest on the NOV is not part of NNN and therefore not included in their analysis. However, according to our own analysis, there are various vegetation parts between the built-up areas, including strips of diverse forest, that could decrease significantly if the NOV will be build. We would therefore recommend that these strips of forest are included in the official effect analysis of the NNN. Attention must also be paid to increasing the forest area, which is according to the plans of the province of Utrecht. So far, it does not seem that this project will contribute to this increase, but rather that the forest area will decrease in a number of hectares. The nature compensation within the Hart van de Heuvelrug program should compensate for the lost forest area on the WA Hoeve in order to prevent a total loss of forest cover in the province. It would be even better to increase the forest surfaces in this program. We recommend focusing on good and valuable nature development in the Hart van de Heuvelrug programme, for example at Kamp van Zeist.

The flora and fauna of the area is protected by the visions and ambitions of the province and national legislations. It is a requirement to do as much as reasonably possible to defend the conservation status of species. As a result, project developers are obliged to monitor the species that make use of the area, estimate the impact of the development plans, and make working protocols with ecological experts to compensate or mitigate the estimated effects of the plans. This all needs to be done in order to qualify for an exemption or dispensation. The project developer, BPD, is adhering to these policies, and has hired Royal HaskoningDHV to perform a quickscan of the area. In the conclusion of this quickscan, they recommend several future species-specific investigations, of which they already performed a Natuurtoets for the HMA. The results of these investigations are expected to be used to take specific, tailor made measurements such as compensation or mitigation to prevent a population decrease of those species. We therefore recommend waiting for the outcome of these specific investigations, and to monitor the compliance with the agreed compensation and mitigating measurements.

With the current building plans, the idea is that four areas will be available for housing: HMA, NOV, ZOV and the Zorgkern. Thereby, no more than 25 houses per hectare can be build. The vision of housing is focused on housing for every segment of the population. Between the NOV and the Zorgkern, and the Zorgkern and the ZOV there will be eco corridors where wildlife can pass through. Furthermore, the historic road structure will be restored and the lane structure will remain. However, the most important to take away from the current building plans is that it is just a vision. This means that there are no concrete plans yet. Leaving room for change and potential new ideas, we recommend to utilise this space and engage with the municipality of Zeist regarding the natural and historical values of the area.

Stakeholders that have high power and high interest are the Province of Utrecht, the municipality of Zeist, BPD and Utrechts landschap. The stakeholder with high power and low interest is Altrecht. The stakeholders that has low power and high interest are Stichting Milieuzorg Zeist, Stichting Beter Zeist and Vrienden van de WA Hoeve. The stakeholders that have low power and low interest are Reinaerde and Belangenvereniging Den Dolder. To achieve the best result regarding the protection of the natural area in the WA Hoeve, we recommend to seek cooperation with various stakeholders and advice to:

- Unite the foundations/associations that are interested and together develop constructive plans and recommendations, so that there is a solid constituency for the alternative.
- Do not put all hope in the province of Utrecht, but also look for other ways to preserve the nature values in the area, for example by civic initiatives.
- Do not only focus on controversies and potential problems, but instead explore the potentials and possibilities for a better future of the WA Hoeve.
- Continue to attend the participation evenings and ask questions about ambiguities of the developing plans.
- Since the plans will not be implemented until after 2027, it is an idea to suggest to the municipality the schetsschuit instrument. This is a spatial planning tool with the objective of seeking new solutions, creating support and setting the process in motion (Dienst Landelijk Gebied, n.d.)

In addition to these requirements and advices we have some general points of guidance and a critical reflection that can be used in making the houses more nature-inclusive and climate-adapted. We believe that there are options to implement the building plans with the intended numbers of houses, while respecting nature. Therefore, we recommend to look for the opportunities that new housing can offers.

This includes increasing the connectivity of the heathland, increasing the biodiversity of the area through new trees and garden plants, and making nature more climate-resistant through the use of climate-adaptive tree species. Besides, ways to make housing construction greener should also be explored extensively.

Promotion of biodiversity

- Dead wood should be left in nature, instead of being cleaned up. Fallen or felled avenue trees can also be left in place, these can be used by insects and fungi, ultimately increasing the biodiversity of the area (Op Akkerhuis et al., 2006).
- To increase the quality of the heather, the western heathland and the corridor between them must be managed by sheep who intensively graze small areas of heathland and deposit their faeces elsewhere. Let Utrechts Landschap manage the heath, just as is done in Kerckebos.
- The local environment of the new houses should be designed to provide a suitable habitat for wildlife, for example by including enough shrubs, trees and plants that bloom at different times of the year so that the environment will be used throughout the year.
- Mixed wild plants can be sown in the verges along the roads. This has advantages for insects, birds and bats due to the food supply (Vogelbescherming Nederland, 2018).
- Set up a monitoring program to track any changes in biodiversity before and after the development. That way, adjustments can be made in time without hurting the biodiversity of the area.

Nature-inclusive construction

- To increase people's connection with nature and to maximize well-being, and to use biobased materials, it is an option to promote building in a biophilic way (ORGA architect, 2022). Biophilic construction creates a synergy between architecture, people, and nature, and minimizes the use of fossil materials.
- The new houses should be designed to be nature-inclusive. Space must be reserved for bird and bat boxes, especially for building inhabiting species that already use the WA Hoeve. Additionally, it could be considered to collaborate with organisations that specialise in nature-inclusive building, so that realistic and proven methods can be applied for this specific environment , e.g. ecological consultancy ‘NatuurInclusief’ (NatuurInclusief, n.d.).
- Harvested wood from the area needs to be reused in applications such as wooden benches and fences. This allows that a reasonable proportion of CO_2 from the felled trees remains stored in the area.
- Gardens can be part of nature in the WA Hoeve. These gardens can feature plants that increase biodiversity. These plants can be native or exotic as long as they are not invasive.

Climate adaptivity

- Planted trees must be drought-resistant, but must also have a deep root system. In that way, during dry summers, the trees can still reach groundwater on these sandy soils. That is why it is useful to purchase plant material from tree nurseries that grow trees on similar soils, for example from Brabant. These trees are pre-adapted to sandy soils. When planting, focus on

species that can provide pollen and nectar for insects and fruit for birds (Hoffman, 2010). Whether these plants are native or exotic is less important.

- Rainwater must be collected within the area around the residence itself. Excess rainwater can be collected in rain barrels made of sustainable material. This water can be used in drought periods for watering the garden. It would be even better if rainwater could be used indoors, for example to flush the toilet ('regenwaterrecuperatie'). Bioswales (*wadi's*) can also be used to store excess rainwater, so that it does not have to be drained into the sewer. Soil sealing has to be reduced to a minimum (Zwaagstra, 2014).
- Use sedum roofs, a high percentage of green in the garden, and plant many avenue and park trees to reduce heat stress in urban areas (Atelier GroenBlauw, n.d.).

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Appendix 1. People contacted

- Roel Sillevis Smitt: Werkgroepsecretaris for commissie voor de milieueffectrapportage (commission for environmental effect reporting).
- Dick Schippers: Groundskeeper for Altrecht.
- Hendrik Visser: Project manager WA Hoeve for the municipality of Zeist.
- Margriet Hartman: Has done research on mammals in the area.
- Bert Geerdes: Ecologist and advisor nature management for the province of Utrecht.

Appendix 2. Useful links

General information / tips

- Website with factsheets and research on integrating green areas in the city, and beneficial effects of greenery: https://degroenestad.nl/factsheets/
- Building climate-adaptive and nature-inclusive
    - https://www.bouwnatuurinclusief.nl/
    - https://klimaatadaptatienederland.nl/
    - https://bouwadaptief.nl/

Information about the project

- Bestemmingsplan Historische Middenas WA Hoeve – Gemeente Zeist (21 december 2021): https://www.ruimtelijkeplannen.nl/viewer/view?planidn=NL.IMRO.0355.BPWAHoeveHistMidAs-OW01.html
- Toelichtingsdocument bestemmingsplan Historische Middenas WA Hoeve – Gemeente Zeist (21 december 2021): https://www.ruimtelijkeplannen.nl/documents/NL.IMRO.0355.BPWAHoeveHistMidAs-OW01/t_NL.IMRO.0355.BPWAHoeveHistMidAs-OW01.html Toelichtingsdocument bestemmingsplan Historische Middenas WA Hoeve – Gemeente Zeist (21 december 2021): https://www.ruimtelijkeplannen.nl/documents/NL.IMRO.0355.BPWAHoeveHistMidAs-OW01/t_NL.IMRO.0355.BPWAHoeveHistMidAs-OW01.html
- Bestemmingsplan Noordelijk en Zuidelijk Ontwikkelingsveld WA Hoeve – Gemeente Zeist (21 december 2021): https://www.ruimtelijkeplannen.nl/viewer/view?planidn=NL.IMRO.0355.BPWAHoeveNRDZDOV-OW01.html
- Toelichtingsdocument bestemmingsplan Noordelijk en Zuidelijk Ontwikkelingsveld WA Hoeve – Gemeente Zeist (21 december 2021): https://www.ruimtelijkeplannen.nl/documents/NL.IMRO.0355.BPWAHoeveNRDZDOV-OW01/t_NL.IMRO.0355.BPWAHoeveNRDZDOV-OW01.html

Research on nature values in WA Hoeve

- Quickscan flora en fauna in het kader van de Wet natuurbescherming: Willem Arntsz Hoeve Den Dolder. https://www.ruimtelijkeplannen.nl/documents/NL.IMRO.0355.BPWAHoeveHistMidAs-OW01/b_NL.IMRO.0355.BPWAHoeveHistMidAs-OW01_tb9.pdf
- Natuurtoets flora en fauna in het kader van de Wet natuurbescherming, onderdeel Soortenbescherming: Historische Middenas (HMA): https://www.ruimtelijkeplannen.nl/documents/NL.IMRO.0355.BPWAHoeveHistMidAs-OW01/b_NL.IMRO.0355.BPWAHoeveHistMidAs-OW01_tb11.pdf

Appendix 3. List of WNB-protected and red-listed species occurrence in the WA Hoeve in the last 5 years according to NDFF data

Soortgroep	Soord Nederlands	Soort weten-schappelijk	Wet NB: vogel-richtlijn	Wet NB: habitat-richtlijn	Wet NB: andere	Rode Lijst
Amfibieën	Bruine kikker	Rana temporaria	NA	NA	Bescherming	NA
Amfibieën	Gewone pad	Bufo bufo	NA	NA	Bescherming	NA
Amfibieën	Groene kikker (Onb.)	Pelophylax esculentus synklepton	NA	NA	Bescherming	NA
Blad- en Levermossen	Gewoon trapmos	Lophozia ventricosa	NA	NA	NA	Rode Lijst: Kwetsbaar
Blad- en Levermossen	Grijze bisschopsmuts	Racomitrium canescens	NA	NA	NA	Rode Lijst: Bedreigd
Insecten - Dagvlinders	Bruin blauwtje	Aricia agestis	NA	NA	NA	Rode Lijst: Gevoelig
Insecten - Dagvlinders	Geelsprietdikkopje	Thymelicus sylvestris	NA	NA	NA	Rode Lijst: Bedreigd
Insecten - Dagvlinders	Heivlinder	Hipparchia semele	NA	NA	NA	Rode Lijst: Kwetsbaar
Insecten - Dagvlinders	Kleine parelmoervlinder	Issoria lathonia	NA	NA	NA	Rode Lijst: Kwetsbaar
Insecten - Dagvlinders	Kommavlinder	Hesperia comma	NA	NA	Bescherming (+Provincie Utrecht)	Rode Lijst: Bedreigd
Insecten - Wespen, Bijen en Mieren	Heidewespbij	Nomada rufipes	NA	NA	NA	Rode Lijst: Kwetsbaar
Korstmossen	Gemarmerd vingermos	Physcia aipolia	NA	NA	NA	Rode Lijst: Bedreigd
Korstmossen	Gewoon schorsmos	Hypogymnia physodes	NA	NA	NA	Rode Lijst: Gevoelig
Korstmossen	Groene schotelkorst	Lecanora conizaeoides	NA	NA	NA	Rode Lijst: Gevoelig
Korstmossen	Klein leermos	Peltigera rufescens	NA	NA	NA	Rode Lijst: Kwetsbaar
Korstmossen	Purper geweimos	Pseudevernia furfuracea	NA	NA	NA	Rode Lijst: Kwetsbaar
Korstmossen	Sierlijk rendiermos	Cladonia ciliata	NA	NA	NA	Rode Lijst: Bedreigd
Korstmossen	Varkenspootje	Cladonia uncialis	NA	NA	NA	Rode Lijst: Kwetsbaar
Reptielen	Hazelworm	Anguis fragilis	NA	NA	Bescherming (+Provincie Utrecht)	NA
Reptielen	Ringslang	Natrix helvetica	NA	NA	Bescherming (+Provincie Utrecht)	Rode Lijst: Kwetsbaar
Reptielen	Zandhagedis	Lacerta agilis	NA	Bescherming	NA	Rode Lijst: Kwetsbaar
Schimmels	Hanenkam	Cantharellus cibarius	NA	NA	NA	Rode Lijst: Gevoelig
Schimmels	Kammetjesstekelzwam	Hericium coralloides	NA	NA	NA	Rode Lijst: Gevoelig
Vaatplanten	Bevertjes	Briza media	NA	NA	NA	Rode Lijst: Kwetsbaar
Vaatplanten	Gele kornoelje	Cornus mas	NA	NA	NA	Rode Lijst: Gevoelig

Soortgroep	Soord Nederlands	Soort weten-schappelijk	Wet NB: vogel-richtlijn	Wet NB: habitat-richtlijn	Wet NB: andere	Rode Lijst
Vaatplanten	Gevlekte orchis	Dactylorhiza maculata	NA	NA	NA	Rode Lijst: Gevoelig
Vaatplanten	Jeneverbes	Juniperus communis	NA	NA	NA	Rode Lijst: Gevoelig
Vaatplanten	Korenbloem	Centaurea cyanus	NA	NA	NA	Rode Lijst: Gevoelig
Vaatplanten	Steenanjer	Dianthus deltoides	NA	NA	NA	Rode Lijst: Kwetsbaar
Vaatplanten	Waterdrieblad	Menyanthes trifoliata	NA	NA	NA	Rode Lijst: Gevoelig
Vaatplanten	Wilde kievitsbloem	Fritillaria meleagris	NA	NA	NA	Rode Lijst: Bedreigd
Vogels	Appelvink	Coccothraustes coccothraustes	Bescherming	NA	NA	NA
Vogels	Blauwe reiger	Ardea cinerea	Bescherming	NA	NA	NA
Vogels	Boerenzwaluw	Hirundo rustica	Bescherming	NA	NA	Rode Lijst: Gevoelig
Vogels	Bonte vliegenvanger	Ficedula hypoleuca	Bescherming	NA	NA	NA
Vogels	Boomklever	Sitta europaea	Bescherming	NA	NA	NA
Vogels	Boomkruiper	Certhia brachydactyla	Bescherming	NA	NA	NA
Vogels	Boomleeuwerik	Lullula arborea	Bescherming	NA	NA	NA
Vogels	Boompieper	Anthus trivialis	Bescherming	NA	NA	NA
Vogels	Boomvalk	Falco subbuteo	Bescherming	NA	NA	Rode Lijst: Kwetsbaar
Vogels	Bosuil	Strix aluco	Bescherming	NA	NA	NA
Vogels	Buizerd	Buteo buteo	Bescherming	NA	NA	NA
Vogels	Ekster	Pica pica	Bescherming	NA	NA	NA
Vogels	Fitis	Phylloscopus trochilus	Bescherming	NA	NA	NA
Vogels	Fluiter	Phylloscopus sibilatrix	Bescherming	NA	NA	NA
Vogels	Gaai	Garrulus glandarius	Bescherming	NA	NA	NA
Vogels	Gekraagde roodstaart	Phoenicurus phoenicurus	Bescherming	NA	NA	NA
Vogels	Gierzwaluw	Apus apus	Bescherming	NA	NA	NA
Vogels	Glanskop	Poecile palustris	Bescherming	NA	NA	NA
Vogels	Goudhaan	Regulus regulus	Bescherming	NA	NA	NA
Vogels	Goudvink	Pyrrhula pyrrhula	Bescherming	NA	NA	NA
Vogels	Grauwe gans	Anser anser	Bescherming	NA	NA	NA
Vogels	Grauwe vliegenvanger	Muscicapa striata	Bescherming	NA	NA	Rode Lijst: Gevoelig
Vogels	Groene specht	Picus viridis	Bescherming	NA	NA	NA
Vogels	Groenling	Chloris chloris	Bescherming	NA	NA	NA
Vogels	Grote bonte specht	Dendrocopos major	Bescherming	NA	NA	NA
Vogels	Grote lijster	Turdus viscivorus	Bescherming	NA	NA	Rode Lijst: Kwetsbaar
Vogels	Havik	Accipiter gentilis	Bescherming	NA	NA	NA
Vogels	Heggenmus	Prunella modularis	Bescherming	NA	NA	NA
Vogels	Holenduif	Columba oenas	Bescherming	NA	NA	NA
Vogels	Houtduif	Columba palumbus	Bescherming	NA	NA	NA

Soortgroep	Soord Nederlands	Soort weten-schappelijk	Wet NB: vogel-richtlijn	Wet NB: habitat-richtlijn	Wet NB: andere	Rode Lijst
Vogels	Houtsnip	Scolopax rusticola	Bescherming	NA	NA	NA
Vogels	Huismus	Passer domesticus	Bescherming	NA	NA	Rode Lijst: Gevoelig
Vogels	Kauw	Corvus monedula	Bescherming	NA	NA	NA
Vogels	Keep	Fringilla montifringilla	Bescherming	NA	NA	Rode Lijst: Gevoelig
Vogels	Kleine bonte specht	Dryobates minor	Bescherming	NA	NA	NA
Vogels	Kneu	Linaria cannabina	Bescherming	NA	NA	Rode Lijst: Gevoelig
Vogels	Koekoek	Cuculus canorus	Bescherming	NA	NA	Rode Lijst: Kwetsbaar
Vogels	Koolmees	Parus major	Bescherming	NA	NA	NA
Vogels	Koperwiek	Turdus iliacus	Bescherming	NA	NA	NA
Vogels	Kramsvogel	Turdus pilaris	Bescherming	NA	NA	Rode Lijst: Gevoelig
Vogels	Kruisbek	Loxia curvirostra	Bescherming	NA	NA	NA
Vogels	Kuifmees	Lophophanes cristatus	Bescherming	NA	NA	NA
Vogels	Merel	Turdus merula	Bescherming	NA	NA	NA
Vogels	Nachtzwaluw	Caprimulgus europaeus	Bescherming	NA	NA	NA
Vogels	Pimpelmees	Cyanistes caeruleus	Bescherming	NA	NA	NA
Vogels	Putter	Carduelis carduelis	Bescherming	NA	NA	NA
Vogels	Raaf	Corvus corax	Bescherming	NA	NA	Rode Lijst: Gevoelig
Vogels	Ransuil	Asio otus	Bescherming	NA	NA	Rode Lijst: Kwetsbaar
Vogels	Roodborst	Erithacus rubecula	Bescherming	NA	NA	NA
Vogels	Scholekster	Haematopus ostralegus	Bescherming	NA	NA	NA
Vogels	Sijs	Spinus spinus	Bescherming	NA	NA	NA
Vogels	Sperwer	Accipiter nisus	Bescherming	NA	NA	NA
Vogels	Spreeuw	Sturnus vulgaris	Bescherming	NA	NA	NA
Vogels	Staartmees	Aegithalos caudatus	Bescherming	NA	NA	NA
Vogels	Tjiftjaf	Phylloscopus collybita	Bescherming	NA	NA	NA
Vogels	Torenvalk	Falco tinnunculus	Bescherming	NA	NA	Rode Lijst: Kwetsbaar
Vogels	Turkse tortel	Streptopelia decaocto	Bescherming	NA	NA	NA
Vogels	Vink	Fringilla coelebs	Bescherming	NA	NA	NA
Vogels	Vuurgoudhaan	Regulus ignicapilla	Bescherming	NA	NA	NA
Vogels	Watersnip	Gallinago gallinago	Bescherming	NA	NA	Rode Lijst: Bedreigd
Vogels	Wespendief	Pernis apivorus	Bescherming	NA	NA	NA
Vogels	Wilde eend	Anas platyrhynchos	Bescherming	NA	NA	NA
Vogels	Winterkoning	Troglodytes troglodytes	Bescherming	NA	NA	NA
Vogels	Witte kwikstaart	Motacilla alba	Bescherming	NA	NA	NA
Vogels	Zanglijster	Turdus philomelos	Bescherming	NA	NA	NA
Vogels	Zilvermeeuw	Larus argentatus	Bescherming	NA	NA	NA

Soortgroep	Soord Nederlands	Soort weten-schappelijk	Wet NB: vogel-richtlijn	Wet NB: habitat-richtlijn	Wet NB: andere	Rode Lijst
Vogels	Zwarte kraai	Corvus corone	Bescherming	NA	NA	NA
Vogels	Zwarte mees	Periparus ater	Bescherming	NA	NA	Rode Lijst: Gevoelig
Vogels	Zwarte roodstaart	Phoenicurus ochruros	Bescherming	NA	NA	NA
Vogels	Zwarte specht	Dryocopus martius	Bescherming	NA	NA	NA
Vogels	Zwartkop	Sylvia atricapilla	Bescherming	NA	NA	NA
Zoogdieren, Grond-gebonden	Boommarter	Martes martes	NA	NA	Bescherming (+Provincie Utrecht)	NA
Zoogdieren, Grondgebonden	Bosmuis	Apodemus sylvaticus	NA	NA	Bescherming	NA
Zoogdieren, Grondgebonden	Das	Meles meles	NA	NA	Bescherming (+Provincie Utrecht)	NA
Zoogdieren, Grondgebonden	Dwergmuis	Micromys minutus	NA	NA	Bescherming	NA
Zoogdieren, Grondgebonden	Eekhoorn	Sciurus vulgaris	NA	NA	Bescherming (+Provincie Utrecht)	NA
Zoogdieren, Grondgebonden	Egel	Erinaceus europaeus	NA	NA	Bescherming	NA
Zoogdieren, Grondgebonden	Haas	Lepus europaeus	NA	NA	Bescherming	Rode Lijst: Gevoelig
Zoogdieren, Grondgebonden	Konijn	Oryctolagus cuniculus	NA	NA	Bescherming	Rode Lijst: Gevoelig
Zoogdieren, Grondgebonden	Ree	Capreolus capreolus	NA	NA	Bescherming	NA
Zoogdieren, Grondgebonden	Rosse woelmuis	Myodes glareolus	NA	NA	Bescherming	NA
Zoogdieren, Grondgebonden	Vos	Vulpes vulpes	NA	NA	Bescherming	NA
Zoogdieren, Grondgebonden	Wolf	Canis lupus	NA	Bescherming	NA	NA
Zoogdieren, Vleermuizen	Gewone dwergvleermuis	Pipistrellus pipistrellus	NA	Bescherming	NA	NA
Zoogdieren, Vleermuizen	Gewone grootoorvleermuis	Plecotus auritus	NA	Bescherming	NA	NA
Zoogdieren, Vleermuizen	Laatvlieger	Eptesicus serotinus	NA	Bescherming	NA	Rode Lijst: Kwetsbaar
Zoogdieren, Vleermuizen	Rosse vleermuis	Nyctalus noctula	NA	Bescherming	NA	NA